Career Opportunities in Water Resources

Seminar Conducted by
Oregon State University
WATER RESOURCES RESEARCH INSTITUTE
Spring Quarter 1966

Corvallis, Oregon

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JULY 1966
Preface

A seminar series to acquaint students with federal and state water resources planning agencies, and employment opportunities with these agencies, was conducted during Spring Quarter 1966. Designed principally for graduate students, the lectures also attracted undergraduates, faculty members, and the general public.

Speakers discussed the operations of their respective agencies, problems encountered in their work, and new activities envisioned for the future. They also indicated, in general, the type of person sought for employment, and the training considered essential or desirable.

The presentations emphasized the need for individuals who are not only competent in their technical fields but also conversant with related disciplines. More than this, there evidently is an absolute requirement for any ambitious young person to be able to communicate, both orally and in writing, in order to advance in the field of water resources. Top-level positions demand skilled "generalists" rather than narrowly trained specialists.

The limitations of time made it impossible to cover the areas of private industry and local governmental agencies. Their activities should not be overlooked in considering careers in the field of water resources planning, management, and research.

Malcolm H. Karr

Corvallis, Oregon
June 30, 1966
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I am proud to be able to return to my own school to represent an agency for which I have worked since my school days. It is pleasing to see the extent to which other Federal and State agencies are represented, both on the seminar program and here in this room today. It is even more pleasing to see so many individuals interested in learning of the career opportunities in water resources. I hope that some of you will be willing to fill some of the vacancies we now have in our organization, or that you will go to work for some of the other resource-oriented agencies. We are all partners on the same team. If you do go into water resource development, you should recognize that it calls for hard work. At the same time, it offers a reasonable pay check and an opportunity to start an interesting and productive career. Please note that I said "an opportunity." Just going to work for a resource-oriented agency will not guarantee that your career will be interesting or productive - or that your pay will increase with the years. To take full advantage of the opportunity, you will have to bring with you to the job some special assets. Some of those assets may be inherent in some of you and already acquired in others. Some can be obtained here on the campus. I plan to name the special assets which the Corps needs and finds hardest to get. I expect that you will note some of the same things being mentioned by subsequent speakers.

WATER RESOURCE DEVELOPMENT

Water resource development is work for the well-being of people. That definition can be confirmed by a study of Federal and State legislation having to do with water resources. The cumulative effect of Federal legislation to date is to provide for recognition of eight potential primary project purposes as being appropriate to Federal water resource projects.
Those purposes are:

- Flood control
- Navigation
- Irrigation
- Power generation
- Water supply
  - Municipal
  - Industrial
- Water quality control
- Fish and Wildlife enhancement
- Recreation

Those are the purposes for which water resource projects are planned and used. The extent to which each of those purposes can and should be served must be decided on the basis of the needs of the area involved and the resources available to meet those needs. This requires coordinated and cooperative planning, with primary emphasis on the nature and extent of the resources involved and the present and projected future needs for use of those resources.

I am going to reiterate this point from time to time - water resource planning now is, and must continue to be, resource oriented instead of project oriented. By that, I mean that water resource agency planning and water resource developments must be based on the resources available, the needs of people for the control and use of the resources, and the necessity to plan for ultimate development rather than to look for the biggest and best projects for today. When we talk of the well-being of people, we must consider the future, and the fact that the resources we have available to develop for today and the future are not limitless. We must consider all of the needs for those resources, and all of the ways - projects and programs - by which the resources can be controlled, conserved, and used.

THE CORPS OF ENGINEERS

The Corps of Engineers' physical organization in the United States consists of about 10 division offices having supervision over the work of more than 30 district offices. Here in the Northwest, the North Pacific Division covers Alaska, all of Columbia River Basin in the United States, coastal areas in Oregon and Washington, and some of the landlocked high desert area in Oregon. The Division includes Alaska, Seattle, Walla Walla, and Portland Districts. Portland District covers all of Columbia
River Basin downstream from John Day Dam, the coastal slope of Oregon, and the high desert area in eastern Oregon. The District organization consists of an Engineering Division, a Construction Division, and an Operations organization, all serviced by personnel, fiscal, and management people. Our district office is headed by an officer of the Corps of Engineers, currently Colonel William J. Talbott. Our working staff is civilian, under Civil Service appointments.

The U.S. Army Corps of Engineers is a Federal planning and construction agency. As such, it is one of a group of three. The other two, our partners and in a healthy sense our competitors, are the U.S. Soil Conservation Service of the Department of Agriculture and the U.S. Bureau of Reclamation of the Department of Interior. Each of the three partners has much of the same areas of responsibility and capability as do the other two. Each, however, has come into being by a different route and each generally, and somewhat incorrectly, is given public recognition as a special-interest agency.

The Corps of Engineers was made a part of the water resource development picture a long time ago. Initially, we were a single-purpose, project-oriented agency. As the needs of the Nation developed, and as the balance between total needs and the total of available resources changed, we became a multiple-purpose, or comprehensive, water resource planning agency. As the change took place, emphasis was placed on the relation between resources and needs. It became necessary to plan for orderly, continuing development which would serve today's needs and permit conservation and ultimate development of all of the water and related resources to best serve the needs and well-being of people.

The background and change of emphasis for the Corps can be summarized by reference to a relatively few significant Congressional actions.

In about 1824, the Congress authorized and directed the Corps of Engineers to do clearing and snagging on a tributary in the Mississippi River system to improve a channel for navigation. The purpose was to facilitate the movement of goods needed by the people of the area. That first Congressional action was based on a Supreme Court decision which held that navigation improvements were a national work, with a national consequence, and a proper subject for appropriation of Federal funds. The work was project-oriented; it was based on development and use, for the needs of the time, of a small segment of what appeared to be a limitlessly abundant resource. If that same reach of channel which was snagged and cleared more than 140 years ago still carries commerce, it must be coincidence; there was no overall plan of which that work was an element.

In 1902, the Congress made irrigation a part of Federal water
resource development. Mr. Mangan, of the Bureau of Reclamation, probably will cover that point in a subsequent session.

In 1927, more than 100 years after the initial step, Congress recognized the needs of the Nation for a higher degree of water resource planning. That recognition was based on a change in the balance between the needs of the people and the extent to which resources were readily available for exploitation by individuals and small groups. It consisted of a request for an estimate of the cost of surveys of all of the rivers of the United States; the surveys to cover the needs and potentials for navigation, flood control, irrigation, and power. That estimate, published by the Congress as House Document 308 of the 69th Congress, was the basis for a series of studies and reports, popularly known as "308" reports, on streams such as the Columbia River here in the Northwest.

In subsequent Acts, between 1936 and 1965, Congress expanded the field of Federal water resource planning to cover the eight potential primary project functions I mentioned earlier. Particularly significant is the 1936 Flood Control Act, which established Federal policy regarding flood control and the requirement for economic justification of flood control works, and which assigned flood control work on major streams to the Corps and work on the watersheds to the Department of Agriculture. By 1965, each of the Federal agencies, to the extent consistent with the type of project involved, was authorized by Congress to plan for all of those potential functions. Also, Senate Document 97 of the 87th Congress spelled out, in one complete and comprehensive publication, the concept of planning for the use and control of the resource rather than of planning for individual projects. You can find copies of Senate Document 97 in your library and in Mr. Karr's office. I recommend it to you as a complete exposition of the present concept of planning for ultimate water and related resource development on a planned, step-by-step basis.

WHAT THE CORPS DOES

As a Federal construction agency in the water resources field, the Corps of Engineers has four basic responsibilities. These responsibilities are discharged in successive steps:

1. **Preauthorization planning** - This is the responsibility to make the initial studies of water resource development potentials and the need for these developments. This is where the need for broad knowledge, and most of the things I will talk about, comes into the picture. This is the part of the job for which qualified people are lacking and which I hope you will be interested in, and train for. It involves the Corps, the people, and many other
agencies. Preauthorization studies result in recommendations to the Congress for adoption of plans and/or construction of projects. Originally, the emphasis was on construction of projects, but now we strive first to consider the resource and formulate an overall plan, then recommend any appropriate projects within that plan. Organizationally, this work is the responsibility of the Planning Branch, Engineering Division.

2. Detailed planning and design - Once a project has been recommended to and authorized by the Congress, the next step is preparation of detailed designs, and plans and specifications. This work is not done by the same people who make the preauthorization studies. It is done by a separate group of people who generally are more specialized in training and capabilities. Part of these people are in Planning Branch and part are in Design Branch, both in Engineering Division.

3. Project construction - When a project has been authorized by Congress, and when detailed planning and design are complete, a third segment of the Corps' organization takes over. Our Construction Division has the responsibility of supervising construction, usually by contract, of the projects which result from Step 1 and which are detailed in Step 2. As in Step 2, this is rather specialized work; it does not require a knowledge of water resource planning as such.

4. Project operation and maintenance - Except for local protection projects, the Corps of Engineers operates and maintains its completed projects. While this work requires a few trained engineers, it does not require the abilities and training that this seminar group represents. You are the people who should be developing a broad background, and the capabilities to become qualified resource planners.

**HOW THE CORPS WORKS**

In discharging its basic responsibilities, the Corps of Engineers acts as directed by Congress, and only when and to the extent that Congress appropriates funds. This pamphlet, copies of which will be available in Mr. Karr's office, enumerates the steps involved in the conception, authorization, and construction of plans and projects for water resource development. You may wish to look into the details, but the basic things to remember are that:
1. Water resource planning is done upon local request and Congressional authorization and appropriation. It is a cooperative and coordinated effort, involving many agencies, many people, and many skills. Each agency, and each person, must be ready, willing, and able to work with all the rest to prepare a balanced and proper plan for water resource control and development. This is why I said earlier that, even if you do not ever work for the Corps, you can make the job easier, and the results better, if you make the most of your training and bring increased capability to any phase of water resource activities.

2. The basic steps in water resource planning, in the preauthorization state, are four in number:

a. Determine the problems and needs of the people involved, both today and in the future, to the extent that those problems and needs involve water and related resources. This step must include consideration of all of the eight functional fields or project purposes mentioned earlier; that is, flood control, navigation, irrigation, power generation, municipal and industrial water supply, water quality control, fish and wildlife enhancement, and recreation. It may include consideration of a sub-basin, a complete stream basin, a region, or even more than a region, depending on the needs and problems involved.

b. Determine the potentials available to meet the needs or solve the problems. This includes consideration of both water and related resources, such as lands, fish and wildlife, etc.; and potential sites for water resource projects, such as dams, levees, channels, etc. It may be limited to a sub-basin or a basin, or it may require consideration of a region or more than one region.

c. Screen the potential sites, to eliminate those which do not warrant more consideration; then formulate, compare, and analyze plans and alternative plans for use of potentials to serve needs and solve problems. From the overall plan, select those projects which should be constructed in the near future, and make complete analyses as a basis for possible recommendation for construction. The first two steps were completely resource oriented. In this third step, we bring projects and programs into the picture, but still on the basis of the extent and nature of the resource and present and future needs for control and use of the resource.
d. Consummate the planning by obtaining a record of the views of those concerned as to the plans and alternatives, and the projects selected for possible recommendations, and by preparing a report and recommendation to the Congress. I want to emphasize that obtaining the views of those concerned is not a matter of coming out of an ivory tower when all the studies are completed and asking for an opinion on the end result. It is, rather, an essential process of continued public contact, from the start of a study, with the people concerned. It is a process of making them a part of the study team, to such an extent that they understand what is being done and why, and feel capable of agreeing with the findings. It is not a process of being swayed by local desires and abdicating the responsibility for good engineering, but of inspiring understanding and confidence on the part of the people for whom the engineering is being done. If the water resource planner does not earn that understanding and confidence, his plans probably will not materialize, or his goals will be only partially achieved. To put it another way, water resource development planning probably is no better than the majority of the public believes it to be!

Although the Corps and the other planning and construction agencies always have worked toward comprehensive planning, I am not aware that any of the agencies now have in operation projects which embody provisions for serving, as authorized primary project purposes, all of the eight functions I have named, or even as many of those functions as now would be found to be physically and economically feasible. Thus, the full implementation of the four basic steps I have outlined is a new activity, and one which will continue to be developed as time goes on. For example, a current review of Willamette River Basin involves the coordinated work of more than 30 Federal and State agencies, and the techniques and procedures used still are being developed. I do not expect to see the final answer as to the best way to plan until the final planning is complete - and that day is far away!

**PROBLEMS IN WATER RESOURCE PLANNING**

Among the most severe problems you will face, if you become water resource planners - and I include all phases, not just the Corps of Engineers - will be those of physical, financial, and social constraints and limitations. I am not talking about specific water resource control and use problems, but about the problems of the engineer, scientist, and technician in accomplishing water resource planning.
Physical problems will include lack of potentials, such as limited annual water supply; and lack of adequate project sites for control and use of a resource. Also, there will probably be less potentials for serving needs for fish and wildlife, recreation, and possibly even the production of foodstuffs, than would be desirable to meet projected needs.

Financial problems run the full gamut from local to national and from the availability of enough funds to the justification for using Federal funds - your money and mine - to provide for the well-being of people. If we had unlimited funds available, and could operate on the basis of needs alone, our planning problems would be much reduced. It is relatively easy to establish a reasonable summation of needs and desires. It usually is possible, within physical limitations, to find ways and means to satisfy a reasonable part of those needs and desires. On the other hand, the benefits to be realized may not warrant spending the money, or the costs may be beyond the financial capability of the people concerned (locally, nationally, or both). One test of the appropriateness of project construction, as expressed by Congress in the declaration of policy contained in the 1936 Flood Control Act, is that "... benefits, to whomsoever they may accrue, exceed the cost..." Another is the availability of enough money, when it is needed, to do the job. Your plans must meet both tests if you are to be successful.

Finally, from day to day in water resource planning, you will face social problems. It is true that water resource planning is done by technically trained and competent people. It is equally true that all such planning is done because of the needs and desires of the majority of the people involved. Thus, no matter how technically correct and adequate the planning may be, it usually will prove to be no better than it is believed to be by the majority of the people concerned. This is not an argument for the application of high-pressure sales techniques by engineers and planners. That is probably the last thing we need. It is, at least in my estimation, a compelling consideration in deciding what kind of people we need for some of the most important jobs in water resource planning and development.

**TYPE OF PERSON NEEDED**

Obviously, in looking for people to work in water resources, we look for people with adequate technical training. Most of the people the Corps of Engineers hires are engineers - either civil, or mechanical, or electrical. From that standpoint, any graduate of any recognized engineering school is qualified, and we have many of them. Similarly, any graduate in any discipline pertaining to water or water-related resources is qualified to work in his phase of water resource development.
At the same time - and I expect that you will be told the same by other lecturers - a high percentage of those who come to us with a bachelor's degree are lacking in one or more qualifications essential to effective water resource planning.

What then do we want, in addition to the completion of work adequate to earn a degree - what do we require in water resources planning that is not essential to doing a good job in detailed design or construction, or project operation?

We want, and cannot find enough of, the following things as a package of catalysts necessary to make the technical training effective:

1. The personal characteristics which will make a good impression on others, such as sincerity; willingness to cooperate; and ability to take abuse, or what may seem to be abuse, with a smile and then come back for more. We have no important place in water resource planning for the man with a chip on his shoulder, or a dislike for people, or toes that are tender when trod upon.

2. A broad training and interest in all phases of water and related resource development. Our top positions in water resource planning are held by people who are not specialists in any of the functional fields I have named and are not specialists in design, hydrology, or any specific phase of engineering. Rather, they have an understanding of the basics of most of those things, a willingness and desire to look at the overall picture - to see the size of the forest as well as a few of the trees - and an ability to guide the work for others.

3. The ability to communicate orally and in writing. This ability is the essential element of the package of catalysts. I have repeated that planning, in the long run, probably is no better than the people concerned believe it to be. If our top people cannot tell their subordinates what is to be done, and how, and why and when, the technical work of planning within our office may be inadequate and incomplete. If those same people cannot tell the representatives of cooperating agencies what we are doing and why, and explain what kind of information we need and how we plan to use it, we will not be able to achieve coordinated, cooperative planning that takes proper account of needs and potential for use and conservation of resources. Finally, if those top people in our organization cannot tell the public what we are doing, and cannot write a clear-cut, concise, and complete report and recommendation to summarize a study, most of the value of their work and that of their cooperators will be
wasted. I cannot emphasize enough the fact that a successful water resource planning engineer must be able to communicate, or the fact that we cannot find enough engineers who have the other qualifications and also are willing and able to talk and write. Public speaking courses, and a little journalism, can help to solve communication problems.

SLIDES

I have some slides which show the results, to date, of Corps of Engineers' water resource activities. These include single and multiple-purpose projects, some completed and some in the construction and detailed planning stages. Some of these have resulted from project-oriented planning, and some from planning that was more nearly resource-oriented. All of the projects completed or under construction were authorized on the basis of studies made when Congress recognized only four potential primary project functions - flood control, navigation, irrigation, and power generation. Many of them have incidental beneficial effects or potentials so far as water supply, water quality control, fish and wildlife, and recreation are concerned, but none of them now can be operated specifically for those purposes. One of the goals of the Willamette review study and report, scheduled to be completed in 1969, will be to review those projects on both a needs-oriented and resource-oriented basis and to recommend any justifiable physical or operational modifications to permit additional functions to be better served as primary project purposes.

The following slides were presented and discussed by Mr. Stewart:

1. THE DALLES PROJECT on Columbia River: Navigation lock, spillway, powerhouse, and non-overflow section totaling 8,700 feet in length. Project completed 1957. Cost $250,000,000. Installed power capacity 1,119,000 Kilowatts.

2. BONNEVILLE PROJECT on Columbia River: Navigation lock, spillway, powerhouse, and non-overflow section. Project completed in 1942. Cost $87,000,000. Installed power capacity 518,400 Kilowatts.

3. WILLAMETTE BASIN MAP: 8 multiple-purpose dams completed, 3 under construction, 3 authorized.

4. DETROIT AND BIG CLIFF DAMS on North Santiam River: Detroit - concrete gravity dam. Big Cliff - re-regulating unit and operated by remote control from Detroit. Total generating capacity of Detroit and Big Cliff is 118,000 Kilowatts.
5. DETROIT PROJECT: Dam, spillway, and powerhouse. Dam is 454 feet high. It is the highest concrete dam designed, built, and operated by the Corps of Engineers.

6. HILLS CREEK PROJECT on Middle Fork Willamette: Spillway, regulating outlet, powerhouse, and non-overflow section. Dam is earth and gravel-fill structure 304 feet above the foundation. Completed in 1962.

7. COUGAR PROJECT on South Fork McKenzie: Completed in 1963. It is a $54,700,000 rock shell, impervious core dam, about 1,500 feet across the crest, 1,500 feet wide at the base, and rises 519 feet above the foundation. It is the highest dam in the State of Oregon, the highest rockfill structure in the United States, and the highest dam ever designed and constructed by the Corps of Engineers.

8. TRIPP LOCATION, South Santiam: Levee and drift barrier.


10. View of Marion Forks Fish Hatchery.

11. Chart depicting recreation use of Willamette Valley projects.

12. GREEN PETER PROJECT on Middle Santiam: Under construction - concrete gravity structure, a gate-controlled spillway, and will require more than 1,200,000 cubic yards of concrete.


15. WILLAMETTE RIVER AT SALEM: Natural and regulated summer hydrograph. A comparison of natural flow and regulated flow. Increased summer flows result of storage projects.

16. ROGUE RIVER BASIN MAP: Authorized projects - Lost Creek, Elk Creek, and Applegate Reservoirs.
17. LOST CREEK DAM AND RESERVOIR: Artist's conception. Spillway, regulating outlet, powerhouse, and non-overflow section.

18. LOST CREEK DAMSITE: Position of project.

19. CHANNEL ENTRANCE, COOS BAY: Dredge Pacific entering channel and Charleston boat basin in background.

20. CHARLESTON BOAT BASIN (Coos Bay).

PAMPHLET

This pamphlet, copies of which are in Mr. Karr's office, summarizes the status of the Corps of Engineers' work in Oregon, as of January 1965. It contains a map which shows the location and status of multiple-purpose and navigation projects; and the locations where studies are being made, and the 1965 status of those studies. (Mr. Karr has pointed out to me one error, or omission, on the map. From the symbol used, it is not clear which Corps of Engineer Districts are in which Division. If you want to pick up a copy of the pamphlet, please note that Portland and Walla Walla Districts are in North Pacific Division, and San Francisco and Sacramento Districts are in South Pacific Division.) Text material in the pamphlet provides a description of each of the projects and studies shown on the map.

SUMMARY

The Corps of Engineers is a Federal planning and construction agency, with a broad field of responsibility for water resource development. We see a need for more and better qualified people, both in our own agency and in other water-resource-oriented agencies. We believe that proper qualification includes more than the normal elements provided by technical training leading to a degree in one of the water-oriented disciplines. We believe that a catalyst is necessary if those elements are to combine to provide solutions, which are technically adequate and also practical of realization, to the pressing problems of water resource control, conservation, and use. That catalyst is the package of characteristics, training and skills I have mentioned, and the essential skill is communication.

We are willing to back up these statements of need for qualified people. We now have unfilled requisitions for several water resource planning engineers. The grades offered range from GS-9 to GS-12. The salaries in those grades range from entrance levels of about $7,500 and $10,600 annually to maximums of about $9,800 and $13,900, respectively.
Normally, we hire graduate engineers and put them on a 20-month training program. If they are well-qualified, they can start at GS-7 level at about $6,300 per year. At the end of their training period, in which they will have served in all engineering elements of the district organization, they usually can qualify for GS-9. After that, their progress will depend to a large degree on how well they can do the job.

To come back to the jobs we now have unfilled, and to the theme of this talk, the highest salary offered, and the position hardest to fill, is for a man to communicate - to write reports of comprehensive water resource studies and prepare correspondence in connection with those studies. For the right man, the job will be interesting, demanding, and satisfying. Also, for the right man, it can be the door to continued growth and advancement - probably more rapid advancement than is available through any other job we have. It is not a job a graduate engineer can expect to get without serving his time in the lower grades. Neither is it a job he can expect to get if he does not have the special assets I have mentioned.

I have attempted to challenge you to go beyond technical competency and specialization. I hope that some of you will accept the challenge. If you do, water resource planning will be easier, the results will be greater, and your pay checks will be bigger than if you do not.
The Federal Water Pollution Control Administration

ADMINISTRATIVE AUTHORITY

Career opportunities in the Federal Water Pollution Control Administration are as varied as are the responsibilities relating to the many aspects of a comprehensive water pollution control program such as set forth in the Water Pollution Control Act.

The first Federal water pollution control legislation was enacted in 1948. The act of that date was temporary in nature and had a five-year period in which to demonstrate the need for Federal participation in the control of water pollution which heretofore had been considered a State responsibility only. In 1956 Congressional amendments to the Act gave it permanent status. Since that time, other amendments have extended further the role of Federal government in the field of water pollution control and have changed very materially the type of administration.

The 1948 Act placed the Federal responsibility for pollution control in the U.S. Public Health Service, an agency of the Federal Security Administration. When the Department of Health, Education, and Welfare was created the Public Health Service became an arm of that Department.

The amendments of 1956 and 1961 transferred the administrative responsibility from the Surgeon General of the Public Health Service to the Secretary of the Department. The Public Health Service, however, continued to supply the professional and technical personnel necessary to carry out the responsibilities set forth in the Act. The most recent amendment, the Water Quality Act of 1965, established an independent agency within the Department and gave the Secretary of Health, Education, and Welfare the direct authority to administer the Act through a Federal Water Pollution Control Administration under the supervision of an Assistant Secretary.
The head of the new Administration is known as the Commissioner. Just recently, the President designated Mr. James M. Quigley as the first Commissioner of the Federal Water Pollution Control Administration.

This change has resulted in considerable alterations in personnel policy. Under PHS both commissioned officers of the Service and Civil Service personnel were engaged in water pollution control activities. Under the new Administration, PHS officers are not permitted to continue indefinitely as officers, but are given an opportunity, if they so desire, to transfer to Civil Service status. A certain number of key commissioned officers will no doubt be detailed to the Administration for a limited period in order that the functions and activities may continue without serious interruption during this period of reorganization.

Still another change has occurred as a result of the President's Reorganization Plan #2 which was submitted to Congress and which is now in effect, namely the transfer of the Federal Water Pollution Control Administration activities from the Department of Health, Education, and Welfare to the Department of the Interior. This transfer became effective May 10, 1966. While this will mean that the Administration is reporting to a different Department of the President's Cabinet, it does not change the basic legislation. It is expected that business will continue as usual.

RESPONSIBILITIES

As indicated in my opening comments, the Federal Water Pollution Control Act established a comprehensive program for the prevention and control of pollution. It provides for planning for water pollution control; research and training; financial grants to State water pollution control programs; financial grants for research and for the construction of waste treatment works; the abatement of pollution through Federal enforcement actions; the establishment of water quality standards; and the control of pollution from Federal installations and miscellaneous supporting activities.

A brief description of some of these responsibilities will give an indication of the variety of job opportunities which are available within this particular activity of the Federal government.

**Water Quality Control**

It should be noted that Section 1 of the Act establishes a national policy to enhance the quality and value of water resources and also establishes a national policy for the prevention, control, and abatement of pollution.
The Congress, however, specifically states that it shall be the policy to "recognize, preserve, and protect the primary responsibilities and rights of States in preventing and controlling water pollution."

Section 3 of the Act calls for the development of comprehensive programs for eliminating and reducing pollution of inter-state waters and their tributaries. In so doing, the Administration is charged to develop such programs in cooperation with Federal agencies, State water pollution control agencies, inter-state agencies, municipalities and industries involved. Furthermore, these programs are to consider the measures necessary to conserve water for all beneficial water uses.

One of the important 1961 amendments authorized the Federal construction agencies such as the Corps of Engineers and Bureau of Reclamation to consider the provision of storage in Federal reservoirs for release for water quality control and specified that the Secretary advise these agencies concerning the need for and value of such storage. This facet of water resource development is, of course, an integral part of any comprehensive plan for water quality control. It should also be noted, however, that this storage is not a substitute for treatment but rather is a supplement to regulate streamflows where they are inadequate to receive the treated waste effluents without causing undue deterioration in stream quality.

Comprehensive Planning

The development of comprehensive plans for the major river basins of the Nation is now well under way.

Such a project was initiated for the Columbia River Basin in 1961; the study is to be completed by July 1, 1967. To develop such a plan, it is necessary to collect and analyze a wide range of economic and scientific data. This involves obtaining information on the physical, chemical, and biological quality of surface and ground waters of the nation, determining existing and potential water uses, making inventories of sources of pollution, determining present and future needs for waste treatment facilities, and examining the need for and value of storage to improve water quality. It is equally important to consider the effects of water quality resulting from faulty land management practices such as forest roads and highway construction, mining operations, gravel washing, irrigation practices, and the proper application and use of agricultural chemicals.

The use of computers is assuming an increasingly important role in analyzing and evaluating the data and interrelationships between the physical, chemical, and biological phenomena involved in water quality management.
It is also necessary to make projections of population growth and rates of water and land resource development and to estimate their impact on water supplies and water quality. It is likewise essential to identify possible conflicts between water uses and to point out the areas where research is needed in order to develop better tools for decision-making. The project staff to carry out this study totals approximately forty people. This includes economists; sanitary, civil, and hydraulic engineers; chemists; biologists; bacteriologists, land management experts; resource planners; and supporting clerical and administrative personnel.

Research and Training

The Act also provides for the carrying out of research, training, and special demonstrations. The 1961 amendments authorize the construction of seven regional research laboratories, one of which is now nearing completion on the Oregon State University campus.

These laboratories will be engaged both in intramural and extramural research. Likewise, they will require all of the technical and professional disciplines associated with the complex problem of water and how to keep it clean and usable. Besides their research function, the laboratories will provide training opportunities for the many special facets of water pollution control. These will not replace academic training, but normally will consist of short, specialized training periods of one to two weeks' duration.

Construction

Another phase of the program requiring professional personnel is that authorized by Section 7 which provides for Federal grants to State and inter-state agencies and municipalities for the construction of treatment works. This phase of the program is carried out in close cooperation with the State water pollution control agencies, but requires engineering personnel to review plans, to inspect construction for compliance with the provisions of the grant, and to perform other related engineering evaluations.

Enforcement

Still another large user of professional personnel is that required to carry out the enforcement activities under the Act. Section 10 of the Act grants to the Federal government certain enforcement authority to abate pollution. This authority, however, except under special situations, is limited to the control of pollution on inter-state waters; that is, where the
pollution from one state adversely affects the quality of water in another state.

Several such actions have been taken by the Federal government on certain inter-state waters throughout the nation during the past ten years. As the first phase of Federal participation in an enforcement action, the Administration calls a conference of the state and inter-state agencies concerned with the specific case. Normally, it is necessary to carry out a comprehensive and detailed survey of the area in question before such a conference is called in order that the Administration may have an authoritative and current picture of the problem. This frequently involves extensive field studies, supported by laboratory investigations, data analysis, and industrial waste surveys. All of these activities likewise require the services of many scientific personnel as well as people from the legal profession.

Water Quality Standards

The 1965 amendments also specified that water quality standards applicable to inter-state waters should be developed. The Act provides that the States may develop these standards subject to the approval of the Secretary of the Interior. The States have been directed to adopt by July 1, 1967, these criteria and develop a plan for implementation and enforcement of the same.

If the State does not choose to do so or does not meet the time schedule, then the Secretary is charged with this responsibility. In any event, the field offices of the Federal Water Pollution Control Administration and the State water pollution control agencies undoubtedly will be working together very closely within the next many months to develop such water quality criteria that can serve as a guide in enforcing inter-state pollution actions in the future. This activity will also require the services of engineers, fisheries biologists, chemists, and others in developing sound and reasonable criteria.

Section 11 of the Act requires that Federal departments having jurisdiction over Federal property or facilities cooperate with Federal and State water pollution control agencies in preventing or controlling pollution from these sources. The President recently has given this section further impetus through Executive Order #11258 which spells out in considerable detail and in unmistakable language how and the extent to which Federal agencies shall participate in being a leader and setting an example in the control of pollution.
SHORTAGE OF QUALIFIED PEOPLE

I trust that the previous statements have served to illustrate the types of activity involved in this particular branch of the Federal government and the wide variety of scientific, legal, and related disciplines required in this broad field of managing the water and related land resources of the nation so that they may continue to serve the ever-increasing needs of a water-hungry nation.

The Portland office of the Federal Water Pollution Control Administration has approximately seventy people at the present time. With the increased responsibilities resulting from the recent legislation, it is anticipated that the program will expand further thereby requiring additional professional personnel to adequately carry out our functions.

This is only one of ten or so regional offices throughout the country, all of which are in the same critical situation and all of which are short of qualified personnel necessary to do the job which Congress has directed shall be done. We only hope that we can gather a fair share of the essential scientific disciplines coming from the nation's universities.
The Oregon State Sanitary Authority

The Oregon State Sanitary Authority is the state agency in Oregon which has primary responsibility and authority for maintaining the quality of Oregon's water resources. It is the only agency, state or federal, which presently has the authority to deal with pollution of water where it can be dealt with most directly and most effectively -- at the source of pollution. Thus, it is the only agency legally equipped to conduct a truly effective state-wide water pollution control program.

The Oregon State Sanitary Authority was created in 1938 by initiative of the people. It is entrusted with the duty of carrying out public policy of the state of Oregon relative to pollution of the state's waters. Public policy calls for maintaining a reasonable degree of purity of its waters consistent with the protection and conservation of public health, the recreational enjoyment of the people, the economic and industrial development of the state, the protection of property, and conservation of human, plant, aquatic and animal life. Thus, the broad objective of the Sanitary Authority is to maintain reasonable water quality while allowing for and providing for reasonable uses of our water resources.

The statutes under which the Sanitary Authority operates also stress the voluntary cooperative approach to pollution abatement and provides for administrative hearings and court action only if and when the cooperative approach has clearly failed. The working staff of the Sanitary Authority has not in the past felt seriously handicapped by a lack of authority to act. Experience has shown that the most effective and lasting progress can be achieved by working with, not against, an individual, company or city in getting a pollution problem solved. Since 1945, when it became possible following the end of World War II to initiate and sustain a reasonably adequate water quality control program, Oregon has made excellent progress in reducing its imposing backlog of water pollution problems. The general water quality situation in Oregon today is good
and is improving not deteriorating. Given sufficient men, materials and a strong public mandate, any reasonable level of water quality can be attained with the present cooperative approach.

The primary point I wish to make here, however, is that our people spend a great deal of their time working with people. We might be considered the door to door salesmen of good water quality. We cover the state, find the problems, hopefully sell the pollutor on a reasonable solution, and usually leave a satisfied customer.

Occasionally we run into a situation where a solution cannot be attained within a reasonable time via the voluntary approach. Usually these are special cases where the pollutor plainly cannot afford to do what must be done to solve his problem, or where a practical technological solution has not yet been found. In such cases the matter is brought before the members of the Sanitary Authority for a formal hearing, findings of fact, and order. If the offender still does not comply, a court action is instituted. With the possibility that any pollution problem might eventually end up in an enforcement action, we try to carry out all of our investigations and abatement efforts so that violation of the statutes can be proven, and it can be shown that the cooperative approach had been tried and had failed if the matter does in fact go to court. Thus far, the Sanitary Authority has held formal public hearings involving 41 municipalities, 40 industries, and 15 miscellaneous entities. It has been necessary to file complaints in Circuit Court in only 15 cases. One of these reached the State Supreme Court where the decision was in support of the Sanitary Authority.

**ADMINISTRATION AND ACTIVITIES**

The Sanitary Authority is a separate board organized for administrative purposes as a division of the State Board of Health, but it operates independently in carrying out its air and water quality control responsibilities. It is composed of seven members which include the State Health Officer, the State Engineer, a member of the State Fish Commission, a member of the State Game Commission, and three lay members. All except the State Health Officer who is appointed by the State Board of Health are appointed by the Governor for four-year terms.

The Sanitary Authority board establishes policy and directs the state's air and water quality control programs. The Sanitary Authority staff accumulates data, makes recommendations, and carries out the policy directives of the Sanitary Authority.

While the Sanitary Authority acts as an independent body, its tech-
The Division of Sanitation and Engineering is sub-divided into four sections; namely, the Air Quality Control Section, Water Quality Control Section, Environmental Sanitation Section, and a Laboratory Services Section. (Refer to Figure 1.)

The Air Quality Control Section has the responsibility for conducting a state-wide comprehensive Air Quality Control program including the promulgation of standards and regulations, the review and approval of plans and specifications for new air quality control facilities, the collection of air quality data, and the abatement of air pollution problems which affect the public health or welfare or interfere with the use and enjoyment of one's property.

The Environmental Sanitation Section embraces nine major program activities including Furniture and Bedding Sanitation, Massage Licensing, Plumbing, Private Water Systems and Sewage Disposal, Food Services Sanitation, School Sanitation, Tourist and Travelers Sanitation, Shellfish Sanitation, and Vector Control - which includes solid waste disposal.

The Water Quality Control Section consists of three main programs including Water Pollution Control, Public Water Supplies and Public Swimming Pool Construction and Sanitation.

The Laboratory Services Section provides supportive laboratory services for all program activities and supervises special project and research activities for the entire division. We are presently in the process of bringing all of our laboratory functions together under one roof and one supervisor in a newly developed 6,000 sq. ft. laboratory facility.

Since the State Board of Health-Sanitary Authority responsibilities extend state-wide, we have found that better, more efficient coverage of the state can be provided by establishing district offices in Bend, Eugene, Medford, Pendleton and Portland. The field office personnel operate all programs within their areas and capabilities, and request assistance from the division headquarters staff when and as needed. Our District Engineers are all experienced, registered professionals, but the assistant district engineer positions offer a unique opportunity for young engineers to gain broad, fundamental experience in the field of sanitary engineering.
ORGANIZATIONAL CHART
DIVISION OF SANITATION & ENGINEERING
OREGON STATE BOARD OF HEALTH
10/26/65

Governor

State Board of Health

State Sanitary Authority

State Health Officer

Division of Sanitation & Engineering

State Sanitary Engineer

Environmental Sanitation

Laboratory Services

Air Quality Control

Water Quality Control

- Furniture & Bedding
- Massage Licensing
- Plumbing
- Private Water & Sewerage
- Food Services
- School Sanitation
- Tourists & Travelers
- Shellfish
- Vector Control

Water Pollution Control

Water Supply Sanitation

Air Quality Control

Environmental Radiation Surveillance

Water Pollution Control

Water Supply Sanitation

Swimming Pool Sanitation

FIGURE 1
Members of the headquarters staff of the Water Pollution Control program operate somewhat as specialists but coordinate their activities with the rest of the staff. We have two sanitary engineers who work exclusively with municipal sewage treatment problems and personnel. Their objectives are to ensure that municipal sewage programs and facilities for the entire state are kept currently adequate and are operated and maintained in an effective, efficient manner. They maintain close contact with municipal officials, receive and analyze sewage treatment plant operational reports, conduct sewage treatment plant efficiency studies, provide bases for sewage treatment plant design criteria and standards, assist cities with special waste treatment and plant operation problems, and conduct a strong sewage treatment plant operators' training program. They are assisted in these efforts by temporary summer employees and district office personnel.

We currently have one sanitary engineer, and an additional presently unfilled engineering position, assigned to work with industrial waste problems. Their objectives are to maintain a complete, accurate and detailed state-wide registry of industrial waste sources and loads, to define and evaluate the pollution problems caused by industrial waste discharges and to work with the industries toward obtaining and maintaining adequate pollution control facilities and programs. They also are assisted by and work closely with district office personnel. Pulp and paper manufacture and food processing are the two largest producers of industrial wastes in Oregon; however, the metals and chemical industries and many other individual problems offer an almost endless variety of interesting challenges in this special program area.

**WATER SURVEYS AND STUDIES**

One of the most important activities of the Sanitary Authority is the Water Quality surveys which are carried out year round over the entire state. These surveys fall into one of two categories; either basic data gathering surveys which are conducted on a monthly or quarterly basis to provide routine surveillance or monitoring of water quality, or special surveys conducted on a more frequent basis in special problem or special study areas. An example of the latter is the daily sampling of the lower Willamette River during the low flow seasons which resulted in the present Sanitary Authority policy requiring secondary treatment, or better, of sewage and industrial wastes which are to be discharged into any waters of the Willamette River Basin.

Surveys of streams, lakes, bays and estuaries are conducted by teams of sanitary engineers and biologists in the field working closely with chemists and bacteriologists in the laboratory.
In the past we have had to apply our efforts principally in areas where the most pressing crisis happened to occur. To a certain extent we still must operate this way but in 1965 as part of the study to determine "Oregon's Ultimate Water Needs" the Sanitary Authority contracted with the State Water Resources Board to conduct comprehensive water quality studies and prepare reports for all of the major river basins in the state by the end of 1969. This special project provided some additional staff and incentives which has permitted and encouraged the Sanitary Authority to adopt a more systematic approach in carrying out its water quality studies.

Another important function of the Water Quality Control Section is to review and approve plans for all public swimming pools, public water supply facilities, public sewers and sewage treatment plants, and industrial waste treatment facilities before such facilities are constructed and placed in operation. This program activity is presently performed by two registered sanitary engineers assisted by the Water Quality Control Section Chief. A limited amount of field inspection is made of projects under construction with the assistance of district office personnel.

The present staff of the Division of Sanitation and Engineering of the State Board of Health includes 19 engineers, 3 biologists, 8 chemists, 12 sanitarians, 4 plumbing inspectors and 15 secretaries. Counting the positions provided by the State Water Resources Board contract work, and legal and administrative positions shared with other programs of the State Board of Health, the total time spent on water quality control work and related activities by the State Board of Health-Sanitary Authority is equivalent to approximately 25 full time positions.

MORE PERSONNEL NEEDED

In order to catch up and keep ahead of the increasing problems and rapid developments in Water Pollution Control, the present Water Quality Control staff should be increased by at least 23 positions in the next biennium. These additional staff needs as presently envisioned include:

1 engineer to assist with PL 660 construction grant program and plan review.

1 engineer to provide limited field supervision of new construction.

1 technician or engineering aide and two part-time trainees to assist with plant supervision.
1 engineer to assist with industrial waste disposal.

1 biologist and 3 technicians or engineering aides to assist with stream monitoring programs.

1 chemist to assist with laboratory work.

1 draftsman and 1 data analyst to assist with office work.

1 full time legal advisor to assist with law enforcement and legislation.

3 engineers and 2 sanitarians to assist with complaint investigations and district work.

1 public information representative to assist in keeping the public informed of state-wide water quality control progress and needs.

3 office secretaries.

We have already advised the Legislative Interim Committee on Public Health and seemingly most of the Sportsmen's groups and service clubs in the state of these needs and it appears at this time that we have considerable legislative sympathy and public support.

Undoubtedly we will be greatly expanding our staff and water quality control activities in the future. The federal administration has given great emphasis to the need for controlling pollution of our rivers and streams and effectively managing and conserving our limited water resources. This program has had great appeal to the public and the people are demanding and will continue to demand that our water resources be cleaned up and kept clean.

With the anticipated expansion of the state's water quality control activities the Sanitary Authority will have a definite need for several well qualified sanitary engineers, aquatic biologists, and sanitary chemists with BS or MS degrees. We have no complaints about the present levels of academic training. Recent graduates in sanitary engineering, aquatic biology and chemistry, in general, are well prepared to perform effectively in any of our programs. Within our well diversified staff we have so far been able to find any specialized skill that has been needed.

Experience, we are willing to provide in abundance. There are tricks to every trade which can only be learned on the job. This is especially true of our work.
We are particularly looking for men who like to work with people and who can motivate and help them to solve their water pollution problems. We need men who can after a reasonable breaking in period take on a project and with limited supervision see it through to a satisfactory conclusion. We are more interested in the basic qualities of integrity, reliability and potential for learning than we are in any specialized training or experience. The most desirable character trait of all is a strong desire to do the very best job possible. Pride of accomplishment - we look for this in past academic records, inquiries to references, and in personnel interviews.

If you have a BS or MS degree in sanitary, civil or chemical engineering, aquatic biology or chemistry and are interested in working directly to improve the quality of Oregon's water resources by helping to solve actual pollution problems, or if you would like the opportunity to gain broad experience in the field of sanitary engineering or environmental health, please come to see us.
Presented April 13, 1966 by JOHN F. MANGAN, Area Engineer, Lower Columbia Development Office, Bureau of Reclamation, Salem, Oregon.

The U.S. Bureau of Reclamation

It is a real pleasure for me to participate in your Water Resources Seminar. Mal Karr and I have exchanged views on education in Water Resources from time to time, but I didn't expect him to arrange for such a fine "soap box" for me to talk from. I do appreciate the opportunity to talk to you. We, in the Bureau of Reclamation, are vitally interested in you from two standpoints: (1) to interest you in working for the Bureau, and (2) the type of education you are receiving in the field of water resources.

I would like to introduce the Bureau of Reclamation and then talk about the interrelationship of disciplines within the Bureau and within the broad field of Water Resources. I will also comment briefly on the training that I think people in the Water Resource field should have. I have a few slides to illustrate the type of work we do.

The Bureau of Reclamation is an agency within the Department of the Interior, responsible for the development of water and related land resources. Reclamation develops multi-purpose projects involving some or all of the functions of irrigation, hydro-electric power, municipal, industrial and domestic water, flood control, navigation, fish and wildlife, recreation, water quality or pollution control, and at times salinity control. Also, incidental to the construction of reservoirs, silt control becomes important in some sections of the West. Our activities cover all phases of project development from initial planning through authorization, designs, specifications and construction, to operation and maintenance of the completed project. These phases are supported by a well-rounded program of research and testing.

The Bureau of Reclamation came into being with the Act of July 17, 1902, commonly referred to as the Reclamation Act, so consequently we now have over 60 years of experience in the field of water resources.
BUREAU OF RECLAMATION OFFICES
AND REGIONAL BOUNDARIES

Figure 1
development. By law, Reclamation's activities are confined to the 17 Western States, Hawaii, and Alaska. (Figure 1)

**ORGANIZATION AND FUNCTIONS**

Reclamation projects vary all the way from relatively simple, low-cost, small irrigation developments to large, complex, multi-million dollar, multiple-purpose projects, such as the Columbia Basin in Washington, the Central Valley in California, or the Missouri Basin in the several states covering most of the area of the drainage of the Missouri River. In addition, we carry on various phases of research, testing, and development on our own or in cooperation with others, including the colleges. We also have a sizable foreign activities program under way which is carried on in cooperation with the State Department. Actually, some of our overseas assignments, such as in Ethiopia, Afghanistan, and Philippine Islands, are under the direct supervision of the Bureau of Reclamation and are manned by personnel on Bureau payrolls. This is in contrast to some of our people who have gone on foreign assignments and who are now under the direct supervision of the State Department and are no longer employees of the Bureau of Reclamation.

Our overall organization is under the direction of the Commissioner's office in Washington D.C. This is a policy making staff and the "front office" for contacts with the Congress and the other heads of Federal agencies.

The 17 Western States are divided into the seven regions shown on the chart. Each Region has an independent Regional organization with District, operating offices and planning offices.

The Chief Engineer's Office in Denver is the focal point of our Design and Research Center. The Chief Engineer provides the service of highly skilled specialists to the seven Regional Directors.

From a career standpoint, an individual can start in any of the field, or Regional Offices, or the Chief Engineer's Office and transfer throughout the organization as he advances in his career. Career opportunities are not limited by the individual office in which he starts.

The functions of the Bureau of Reclamation might be divided into several general categories: (1) planning and authorization, (2) design, (3) construction, (4) operation and maintenance, (5) research, and (6) administration. (Figure 2)
CAREER OPPORTUNITIES

RECLAMATION

Planning
Design
Construction
Operation
Research
Administration

Figure 2
Planning and authorization concerns itself with that phase - from the original concept of a project in the field to the official transmittal of a report on a project to the Congress and the subsequent authorization of the project. Planning involves all the ramifications of engineering and economics, and the integration and cooperation of the many individuals and agencies - local, state, and Federal - interested in the development of water resources. Authorization is very closely allied with the planning process, and it involves the machinery for liaison with the President through the Bureau of the Budget and Congressional hearings.

Design and construction is self-explanatory. This phase concerns itself with the preparation of designs and specifications, advertisement for bids, award of contracts, and the actual field supervision of construction. Although the Bureau of Reclamation does practically all its own engineering work, the field construction, except for a very minor percentage, is accomplished by private contractors following the customary bidding process.

After a project is constructed, it is our policy to have the local water user agency, generally an irrigation district, take over the irrigation facilities at the earliest opportunity and to operate and maintain them. Such operation and maintenance is done under the general observation and direction of the Bureau of Reclamation to assure that the Federal investment is adequately protected. On the other hand, power facilities and the larger multiple-purpose reservoirs are normally operated and maintained by the Bureau of Reclamation with people from appropriate disciplines. The Grand Coulee Dam is an example of this.

In our Chief Engineer's Office in Denver, we have our principal design office and a research and testing branch that employs a wide variety of disciplines; engineers, chemists, physicists and others.

Spread throughout the Bureau is the administrative staff. Many of these people come up through the ranks from their respective disciplines. Some, of course, come directly from the Civil Service Federal Service Entrance Exams. These people are in personnel, procurement and property management, budgetary and organization methods.

CHANGING PERSPECTIVES AND REQUIREMENTS

As I mentioned earlier, we started in 1902. At that time we were concerned primarily with the settlement of the "arid West." We were bringing irrigation water to dry lands throughout the sparsely populated West. We were "engineer oriented" and "single-purpose minded."
FUNCTIONS OF MULTIPURPOSE STORAGE PROJECTS

1 FLOOD CONTROL
2 NAVIGATION
3 WATER QUALITY
4 M.and I. WATER
5 RECREATION
6 IRRIGATION
7 FISH and WILDLIFE
8 POWER

Figure 3
As time passed and the need developed, power was added as a project function, first to provide construction power, then to provide financial assistance. Flood control came next. Working with the Corps of Engineers, we provided space for flood control in our reservoirs on an operating schedule to facilitate flood control.

Fish and Wildlife enhancement was also added as a function of the project. Here we turned to the Fish and Wildlife Service for recommendations.

In addition, more recently, we are concerned with Recreation, Municipal and Industrial Water, and Water Quality Control.

No longer are we "single-purpose minded." In the projects we work with now, we study all of the eight functions involved in water resources. (Figure 3) The details on these functions are developed either by us or by other agencies in their respective fields and incorporated into our plans. Over the years we have moved from being strictly an engineering organization to one of many disciplines. Indications are that our top administrative people of the future will be selected on the basis of the broadest background, regardless of their academic training. This is a change from the earlier concept that the administrators generally came from the engineering field.

Figure 4 illustrates the staffing of the Planning office. This is the field I know the most about and can talk about more easily. Planning is basic to all the rest of the Bureau's operations. It is here that the ideas for developing the land and water resources originate, are studied and tested for economic and engineering feasibility, and where alternatives are considered in order to arrive at the most suitable plan. To accomplish this, we must consider local, State and national needs, topography, geology, climate, soils, transportation facilities, and markets, to name just some of the factors involved.

As you can see, we employ many types of people and their efforts are all essential to the development of a project plan. No plan is similar to another and we in planning need people with the ability to think in broad terms. Water resources today involve significant problems of water supply and its distribution, the best use of our water resources for the good of mankind and the ever-increasing population of the nation, and the many conflicts of interest, including social and political. It is a challenging future for those of you who are so inclined.
CAREER FIELDS IN PLANNING

CIVIL and AGRICULTURAL ENGINEERS

SOIL SCIENTISTS - SOILS OR AGRONOMY MAJORS

AGRICULTURAL ECONOMISTS - OR GENERAL ECONOMISTS WITH AGRICULTURAL BACKGROUNDS

GEOLOGISTS - OR ENGINEERING GEOLOGISTS

REPORT WRITERS - GEOGRAPHY MAJORS, RESOURCE ECONOMISTS OR RELATED FIELDS

Figure 4
ABILITY TO COMMUNICATE

In the planning field we perhaps get the broadest exposure to these conflicts of interest and purposes. But beyond that, we have to translate our plans into reports and letters to convey our point of view to many readers. We start with people of our own staff, the soil scientists, geologists, economists, hydrologists, and civil engineers. We need to communicate orally and in writing continuously. The best plan in the world won't get off the ground if we cannot present it in a clear and concise manner, either orally or in writing to our superiors, our cooperators, to the average citizen and to members of Congress. This is one of our most difficult areas.

Our experience has been that generally this area of your educational background has been neglected. Your courses are oriented to your technical excellence, but sometimes, fellows, I think some of you couldn't write a clear and concise letter home for money!

I don't think we in our office or in the Bureau of Reclamation are the only people with this idea. Others have told me the same thing, and it isn't a problem just in government. The water resource field is based on communication and a thorough-going exchange of ideas. We must communicate with each other at all levels and with the public. There is no way to escape it if we are to accomplish the objectives that are being set up for us by the Congress.

MORE BACKGROUND NEEDED

To carry this idea a little further, we think some of you come to us with astonishingly little knowledge of government organization and processes involved. Water resource development is related to the governmental processes from the simplest village sewer problem to the huge multipurpose Federally planned and built water supply project. Whether you work in or out of government in this field, you are affected by water legislation at all levels of government.

There is a need for you as engineers to understand economics to a greater degree than most of you do. Those of you in other disciplines should be broadening your outlook into areas other than your own.

It is my personal view that "personal relationships" should be emphasized to a greater degree than is now the case, particularly for those who plan to enter the planning phase of water resource development. By this, I mean that all disciplines need to be able to meet others, dis-
cuss conflicting views and get the men of other views to work harmoniously for a common goal.

There have been a large number of conferences on the importance of water resource development. One of the larger ones was held right here on your campus. All of these point up the broad economic, social and political aspects of the water resource problem. Those of you in the teaching field should take your cue from them and give your students the opportunity and the incentive to get an introduction through college level courses that will point out the problems and the need for the students to inform themselves beyond their immediate technical discipline.

PERSONNEL NEEDS

Now, what does the Bureau have to offer?

Of course, most of our immediate opportunities are for engineers in the civil, mechanical, and electrical fields. In the 1965-66 fiscal year, we had openings for 135 people in the seven regions with 50 of those earmarked for the Chief Engineer's Office in Denver. These are generally at the GS 5-7 level. A few start higher.

We also have a continuing need for soil scientists or others with a background in soils, agronomy, or in farm crops. We need some civil engineers versed in hydrology. We need a few capable economists; there is opportunity for both general economists and agricultural economists, and we need geologists grounded in engineering and ground water.

People able to do creative writing in the technical field are indispensable to us. They are few and far between.

Figure 5 shows the prevailing salary schedule for Federal employees. You are probably familiar with it.

The GS-3 and 4 rates are generally those assigned for undergraduate summer work. Graduates generally start as GS-5 or 7 level and progress in more or less of a training capacity to the GS-11 level. We in Reclamation generally consider GS-11 to be the general professional level. The GS-12 is a supervisory or highly skilled technical person. This thinking probably agrees with most of the other Federal agencies.
# FEDERAL SALARY SCHEDULES
*(STARTING SALARIES)*

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*Figure 5*
SLIDES

The following listing is of slides shown at the seminar to give a view of water resources development from the Bureau of Reclamation's frame of reference.

1. Aerial view of Grand Coulee Dam showing dam pumping plant and Equalizing Reservoir - Bureau of Reclamation Photo

2. Stream gaging station in rugged terrain in eastern Washington - J. F. Mangan Photo

3. View of irrigation diversion structures on Deschutes River near Bend, Oregon - Bureau of Reclamation Photo C-112-119-18

4. Land levelling operation Farm Unit No. 70, Block 83, Columbia Basin Project Photo 43251

5. First crop on Farm Unit No. 70, Block 83, Columbia Basin Project Photo USBR 43418

6. Pea crop on Farm Unit No. 70, Block 83, Columbia Basin Project USBR Photo

7. Farm Unit 96, Block 40, Columbia Basin Project showing settlers first housing USBR Photo

8. Farm Unit 96, Block 40, Columbia Basin Project after 10 years development USBR Photo

9. Crops on Farm Unit 96, Block 40, Columbia Basin Project showing farm crops after development USBR Photo

10. View of apple crop in Central Washington - J. F. Mangan Photo

11. Sailboating on Lake Roosevelt - J. F. Mangan Photo

12. Picture of a problem. Deschutes River near Benham Falls, Bend, Oregon - Stream is controlled by irrigation releases in conflict with desired fishery on recreation flows. USBR Photo C-112-119-3A

13. Aerial view of Flaming Gorge Dam, Colorado River - USBR Photo 591-421-1006
14. Aerial view of Glen Canyon Dam on Colorado River - USBR Photo CX 400-525

15. View of Glen Canyon Bridge looking downstream into Colorado Canyon - USBR Photo C 557-420-1047

16. View of Glen Canyon Bridge steelwork - USBR Photo 557-420-1247

17. Green Springs power plant, Talent Irrigation District near Ashland, Oregon - USBR Photo CX 119-149

18. View of Grand Coulee Dam from local view point showing dam and spillway and townsit - J. F. Mangan Photo

19. Night view of Grand Coulee Dam - USBR Photo

Federal and State Planning for Outdoor Recreation

I appreciate the opportunity to discuss career opportunities in Water Resources as they relate to the Bureau of Outdoor Recreation, National Park Service, and State Parks. In order to cover these subjects in 50 minutes, I will mention only the broad responsibilities of each. I have a few slides which depict the Oregon Parks organization and a number of others which will give some idea of the scope of one Bureau of Outdoor Recreation study.

The Bureau of Outdoor Recreation was created as an outgrowth of the Outdoor Recreation Resources Review Commission Report. The Commission's report from 1958 to 1961 provides a comprehensive look at U.S. outdoor recreation. It recommends a number of steps to improve our national situation with reference to outdoor recreation. The report establishes that:

1. Outdoor recreation is a public good for which the Nation, its States, and its local governments and the private sector share responsibility.

2. The tasks are so large and complex that coordinated action at the national level is essential and opportunity to participate in a variety of outdoor recreation activities is, for various reasons, unequally distributed among our people.

3. The forces affecting the situation are often beyond the control of local governments. In many instances they have exceeded the financial resources of the States.

During the last decade or two, outdoor recreation has assumed significant proportions in the social and economic life of our country. It constitutes a major use of our land and water resources and is now considered to
be on an equal basis with other functional demands upon these resources. In many instances, it has become a priority use.

One of the recommendations of the Commission was that a Bureau of Outdoor Recreation be created in the Department of the Interior.

President Kennedy promptly endorsed this recommendation in his conservation message of March 1, 1962. With equally quick action, after consultation with legislative leaders, Secretary of the Interior, Stewart L. Udall, by administrative order, established the Bureau of Outdoor Recreation on April 2, 1962. The Bureau's overall purpose is to provide a focal point and leadership in a nationwide effort by coordinating the various Federal programs and assisting other levels of government to meet the demands for outdoor recreation.

With a total Bureau history of only four years, we are still feeling our way but are gaining experience, knowledge, and strength.

**FUNCTION AND ORGANIZATION OF THE BUREAU**

The Bureau's functions are authorized principally by three statutes and an executive order, Public Law 88-29, which we refer to as our Organic Act; Public Law 88-578, the Land and Water Conservation Fund Act of 1965; Public Law 89-72, the Water Projects Recreation Act; and Executive Order 11017 of April 27, 1962, as amended.

Authorities in these basic documents assigned to the Secretary of the Interior have, with but one exception, been delegated to the Bureau of Outdoor Recreation.

As spelled out in these documents, the Bureau's functions are many. For our discussion, they may be broadly summarized as:

1. Planning - River Basin Comprehensive Water Projects - State-wide, Nationwide
2. Recreation Research
3. Technical Assistance -- BIA, GSA, BLM, Military
4. Federal Program Coordination
5. Grants-in-Aid to states and local government
6. Staff to Recreation Advisory Council
Shortly after the Bureau was established, the President, by Executive Order, implemented another ORRRC Recommendation when he established a Recreation Advisory Council. This council is composed of the Secretaries of Interior; Agriculture; Defense; Commerce; Health, Education, and Welfare; and Housing and Urban Development. The purpose of this body is to provide broad policy advice to Federal agency heads on all important matters affecting outdoor recreation resources and to facilitate coordinated efforts among the various Federal agencies.

It is important to note that when the Bureau is working on assignments from the Recreation Advisory Council, it functions independently of the Department in which it is housed.

The Bureau does not manage any lands or other outdoor recreation resources. It has six small regional offices located in Philadelphia, Pennsylvania; Ann Arbor, Michigan; Atlanta, Georgia; Denver, Colorado; Seattle, Washington; and San Francisco, California. The Pacific Northwest Region covers the States of Alaska, Idaho, Montana, Oregon, and Washington.

At the present time, the Bureau has 394 employees total. These are mostly professional people and have an average grade of 9.6 with an average salary of $9,500. Their professional backgrounds are perhaps as diverse as will be found in any governmental organization of this size.

**CURRENT PROGRAMS OF THE BUREAU**

Let me mention our major programs and give you an idea of the professional disciplines involved.

**The Nationwide Outdoor Recreation Plan**

One of the basic responsibilities of the Bureau is to formulate an outdoor recreation plan for the Nation by 1968 and to update the plan every five years thereafter. Projections of needs will be made initially to the years 1980, 2000, 2020. This work is done in our office by a staff including statisticians, geographers, and landscape architects - - (several with master degrees).

The Nationwide Plan will be a guide to sound public policy in outdoor recreation to insure that the variety of recreation opportunities desired by our people will be available in the general locations they desire, in sufficient quantity to serve them adequately. It will be an appraisal of the supply of outdoor recreation lands and waters available in the United States, the demand of the American people for outdoor recreation opportunities, and the resulting needs for additional areas and facilities to meet the public demand.
The Plan will be concerned with all kinds of outdoor recreation, with the preservation of natural beauty and environment, the timely acquisition of the lands and waters of highest value for outdoor recreation, and the development of adequate facilities. It will encompass urban and rural aspects and public and private programs.

Recreation Planning for Water Resources Projects

The Bureau cooperates with the Federal construction agencies in recreation planning at water and related land resource development projects. It makes recommendations for recreation development and use in both river basin studies and individual project studies.

Federal water development reports are submitted by the Corps of Engineers, the Bureau of Reclamation, the Soil Conservation Service, and others to the Bureau for review and comment. Non-Federal public and private reservoir development proposals subject to Federal license by the Federal Power Commission are likewise submitted to us for appraisal.

The Bureau's participation in water resources is of particular significance for several reasons: (1) water-based recreation constitutes a very substantial portion of all outdoor recreation; (2) many Federal water resource developments provide extensive recreation opportunities and become important segments of the Nationwide Plan as well as of the statewide plans of the States concerned; (3) the amount of Federal investment in recreation at water development projects is large and growing each year; and (4) the Land and Water Conservation Fund provides that a portion of the Fund may be transferred to Miscellaneous Receipts, as a partial offset for capital costs of future Federal water development projects which are allocated to public recreation and to the enhancement of fish and wildlife values. The staff performing these functions includes foresters, geographers, biologists, and business administrators.

LAND AND WATER CONSERVATION FUND ACT

The Land and Water Conservation Fund Act of 1965, approved September 3, 1964, undoubtedly is one of the most important recent Conservation measures. This pay-as-you-go program is designed to stimulate, encourage, and assist local and State governmental agencies in creating new and expanded high-quality public outdoor recreation areas and facilities by providing (1) for statewide planning and, (2) for financial assistance. It is financed by revenues from the $7 Federal Recreation Permit and other Federal recreation fees, sales of surplus Federal real property, and the Federal motorboat fuels tax.
In addition to Grants-in-Aid aspects of the Land and Water Fund Act, provision is also made for the acquisition of recreation lands by the Federal Forest Service, National Park Service, U.S. Fish and Wildlife Service. Approximately 40 per cent of the money collected into the fund is available for Federal acquisition purposes. With this connection, it is the responsibility of our Bureau to review the acquisition proposals and concur in a position favoring acquisition if this is borne out by our analysis.

These three agencies acquire lands under their normal authorities. The Land and Water Conservation Fund simply is a source of funds, and this Bureau has the added responsibility placed on it by Congress to review and recommend those acquisitions in which it concurs. In our office, this review process is carried out by a forester with extensive experience in acquisition of recreation lands.

SPECIAL AREA STUDIES

The Bureau also deals with studies of special areas to determine recreation values and makes recommendations regarding their recreation use, development, and administration.

Not all special area studies are carried out independently by the Bureau. Some are undertaken in cooperation with other Federal agencies, non-Federal public agencies, and private agencies.

Among the major National or Regional studies are the Wild Rivers Study, which was completed last year; the National System of Trails Study, on which a report is now being prepared; the Lewis and Clark Trail proposal, which was reported to the Lewis and Clark Trail Commission last fall in St. Louis; and the Conservation Inventory of Military Lands, which President Johnson has requested. In addition, the staff contributed to the North Cascades Study. All these studies are conducted by inter-disciplinary teams including geologists, biologists, engineers, economists, and foresters.

OREGON STATE PARKS

I have been asked to mention Oregon State Parks Organization to you. Let me begin by saying that each of the states is organized differently. Oregon's organization is described not necessarily as an optimum one but if you will judge by the Oregon Parks system, you will recognize that this is one of the best systems in the U.S.

The Oregon State Highway Department is organized as the chart shows. This is a common arrangement with a Commission for policy de-
termination and Executive line organization. The Park Division reports to the State Highway Engineer through an Assistant Highway Engineer.

The Parks Organization provides both line and staff function. Staff function is carried out through the State Recreation Director. He provides counsel to local and County Government and is responsible for the Oregon State Plan, for liaison with the Bureau of Outdoor Recreation, and for Oregon's participation in recreation aspects of comprehensive river basin plans.

The Line Organization deals with Park Management through four divisions. These are:

- Office Management
- Field Operations
- Engineering
- Planning

State Park Supervisors are practical men with extensive experience in actual management of the land and water resources.

State Parks Organization employs:

- Historians
- Landscape Architects
- Civil Engineers
- Park and Recreation Managers
- Geographers

Salary ranges are:

- Planners $6,000 -7,500
- Park Supervisors 7,500 - 9,300
- Landscape Architects 6,900 - 8,550

The State Park Superintendent currently receives an annual salary of $12,000 and his assistant's salary is $10,000.

**NATIONAL PARK SERVICE**

With advent of the Bureau of Outdoor Recreation, some of the project review and water planning responsibilities of National Park Service were transferred to the Bureau. National Park Service continues to be responsible for historical and archaeological aspects, comprehensive river basin plans and project studies. It provides detailed planning for
The Bureau of Outdoor Recreation analyzes needs—supply and demand—data (the broad planning)—the National Park Service does the detailed planning. This means that only a small staff is required for this function.

I am not prepared to discuss the overall needs and demands for people on National Park Administration, which is a large employer in itself.

PERSONNEL REQUIREMENTS

To summarize for you, let me mention several of our needs in addition to those technical skills which university graduates are expected to have.

1. Communication ability—Most of our work is carried out either through written materials, instructions, reports, letters, etc., or orally by telephone, television, public appearances, etc. On rare occasions, we get a new employee who writes well. Even more rarely, we get one who is an effective spokesman.

2. Abstract quality—Frequently, we get people who think in clichés or do not use their thought processes. We sometimes hire the other extreme—the completely impractical person, too abstract. In planning, a person capable of abstract thought who yet can relate his abstractions to reality is rare but much sought after.

3. Imagination—We frequently have employed planners who extrapolate from the past quite well. We rarely get people who can imagine, can create, can improvise, can think in bold terms. Perhaps government employment tends to stultify the creative instincts? In any case, we need imaginative, creative people.

4. Completeness—We get people who can’t complete a project. They either become bored with it or just don’t know how to wrap up a piece of work. It seems obvious that a professional person should be capable of completed staff work but frequently he or she is not. Technical expertise is most often the long suit, and we must have these people, too; but in planning, the qualities I have mentioned are invaluable.

5. College material—I am not well qualified to comment on how contemporary college teaching may be. It would be my observation that those we hire who are well grounded in fundamentals and are also broadly informed in political, economic and social though ultimately become our most capable administrators.
It seems relatively easier to learn how to do a thing from a foundation of fundamentals rather than why to do a thing from a foundation of technical expertise.

We would rather have a liberally educated man with a foundation of fundamentals in his technical field than a technically expert person lacking broad knowledge. Nothing seems to go out of style quicker than technical expertise.

Finally--What about you? What are you looking for? If it's money, public service is often a poor provider. If it's security, and I think this is a false goal--the government has some places for such people, but they are to be pitied. If it is an opportunity for stimulating, exciting work wherein money becomes relatively unimportant and your goal is public service, then government service can be most rewarding.

This undoubtedly seems more than a little naive to you as it did to me when I was in your chair. I can only recount that from my own experience this is a true statement. The successful government people of my acquaintance have generally been so immersed in what they are doing, and so convinced that it is necessary, that how much they are rewarded monetarily has not been the prime consideration.
The Soil Conservation Service

The Soil Conservation Service is happy to participate in this seminar on careers in water resources. Many of our best people are Oregon State University graduates, and we frequently have positions open for others who are well-qualified and interested in the conservation of natural resources. These natural resources, land and water, provide us with food, fiber, and wood products and will continue to do so. Thus, the wise use and conservation of our land and water resources is important to everyone.

From a career standpoint, an interest in water resources naturally leads to a desire to know more about the participating organizations. You want to know who they are, what they do, and how they carry out their work. And, you are probably most interested in job possibilities - the various professions employed, the work, problems and future opportunities. The following brief review will answer these questions in regard to the Soil Conservation Service - its overall assignment, the scope and nature of its activities, and the principal careers involved in its work.

NATIONAL PROGRAM

The Soil Conservation Service is a part of the United States Department of Agriculture. It is the Department's technical agency for soil and water conservation on private lands and is the first organization of its kind and size to be set up in the world. The Service is responsible for developing and carrying out a national program of conservation for land and water resources. This program has been authorized by several Acts of Congress during the past thirty years. Activities under these acts are carried on with the cooperation of other Federal agencies and State and local agencies and organizations.
Except for a staff of 300 in the Washington, D.C. office, the Service's 17,000 employees are located in 3,400 offices throughout the 50 states, Puerto Rico, and the Virgin Islands. The work is directed by Administrator D. A. Williams and his staff in Washington. The State Conservationists and a Director of the Caribbean Area are responsible for field operations, with help from four Regional Technical Service Centers. These centers are located at Upper Darby, Pennsylvania; Fort Worth, Texas; Lincoln, Nebraska; and Portland, Oregon.

The Service administers those USDA activities that provide technical assistance to private landowners and operators in their efforts to conserve soil and water. It also provides technical and financial assistance for planning and executing programs to protect and improve water and land resources in small watersheds. And, it provides technical information and services to other agencies cooperating in related programs.

The objectives of our national program are to:

1. Achieve land use adjustments and treatments that will conserve land and water resources,
2. Reduce hazards of floods and sedimentation,
3. Assure the most efficient long-term use of soil and water,
4. Establish a more permanent and stable agriculture, and
5. Otherwise help to insure the orderly development and prosperity of rural areas.

As I have mentioned before, our principal activity is to help plan and apply conservation measures on privately-owned land. Our primary means of furnishing this help is through local Soil and Water Conservation Districts that have been organized under state laws. There are now 3,000 of these districts in the United States, working with nearly 2 million landowners and operators. Here in Oregon, over 95 percent of our total population lives within the boundaries of one of our 62 districts.

To do its part in the conservation job, the Service has drawn together a staff skilled in a wide range of technologies - engineering, agronomy, biology, forestry, range management, soil science, geology, hydrology, economics, administration, and others.

To best explain the work of the various specialists and to illustrate some of the teamwork involved, our activities will be discussed under a few major headings - Soils, Conservation Planning, Hydrology, Economics, and Engineering.
SOILS

The Soil Scientist is a key man in the Service. He studies soils in the field and in the laboratory to determine their physical and chemical properties, their classifications, their capabilities, and to explain their uses and management requirements. This information is collected very carefully through an acre-by-acre examination.

The soils are then classified and correlated within a national system so that similar soils will have the same names and descriptions. This facilitates the development and exchange of knowledge about particular soils. The Soil Scientist works with other specialists in preparing interpretations for a wide variety of uses, including agriculture, forestry, range, engineering, recreation, and land zoning.

In most states, soil scientists are grouped into teams, each of which surveys in a designated soil survey area. Upon completion of all field, laboratory, and interpretative work, detailed reports with maps are prepared and published.

The Soil Scientist’s major problems are the maintenance of production and quality. One cannot be raised or lowered at the expense of the other. The most successful soil scientists are versatile; they are good in the field, are excellent writers and are adept at explaining soils information to other people.

CONSERVATION PLANNING

The planning for needed soil and water conservation measures on farms, watersheds, and river basins is a major activity and occupies much of our staff. Since this work involves private lands, the ultimate selection and installation of one or more alternative measures rests with the owner. We give the technical help that explains the problems and the opportunities for land and water and then help plan and install the conservation measures.

This work is done or supervised by a person known as a "Soil Conservationist." His background and training can vary, depending upon the requirements of a specific job assignment. Generally, he has a background in agronomy, but it might also be range or forestry, economics, biology, or even engineering.

Those conservationists with an agronomic background generally work in areas where cropland predominates. Their work with cooperators of the district is focused on the protection and improvement of farm lands.
They help the owner prepare a basic plan, which considers the capabilities of the land, and alternative uses that are compatible with the owner's operations. Such measures as terraces, diversions, contour farming, grassed waterways, farm ponds, irrigation systems and tile drainage are common and are planned and installed in large numbers.

In those areas where the predominant land use is for grazing, the Soil Conservationist has a background in range work. Much of the West consists of range land and its use has many impacts upon water resources. The practices and measures needed to facilitate good use of range land include protection by proper grazing; stock water developments by ponds, springs and wells; and water-spreading for increased forage.

In many areas, farm woodland is important. Here, the planner will need a background in forestry. With this training, he can help landowners determine which parts of their farms have soils best-suited to the growing of tree crops. Some land, perhaps, could be cleared; but, other land needs to be converted to trees. Windbreaks for protection are considered, and sometimes woody plantings are just right to prevent or stop erosion on croplands.

Since we also work with groups of farmers and ranchers in overall watershed development, the basic principles of good land use and treatment may be prescribed along with larger structural measures.

In recent years, there has been increased emphasis and activity on mass-planting whole river basins. Here again, the conservation of land and water are considered. In our part of this work, we employ all sorts of specialists, commonly under the direction of an engineer since structural measures assume an increasing importance.

**HYDROLOGY**

How big a reservoir do I need to irrigate half my farm?

If I build it that big, will it fill up each year?

What size should the spillway be?

These and similar questions concerning little and big problems must be answered as daily routine.

Our field people need simple procedures for quick, reliable answers on small jobs. Our specialists in hydrology develop these guidelines and
test them. They also make special studies and analyses of larger jobs. They utilize stream flow, climatic and soils data and land use data in getting peak flows and volumes of water yield. They synthesize floods and theoretically route them through structures to determine different effects. As in most agencies, our men use the latest methods and equipment. Widespread use is made of electronic computers, and many special programs for our work have been developed.

Much of the best water used in the West, on farms and ranches and in cities and towns, comes from the summer melt of winter snowpacks. We look each year to the mountains for clues to our current water wealth. Water supply forecasters have the responsibility of relating hydrological-meteorological events on important watersheds to the expected spring and summer runoffs.

Data on accumulated snow is obtained from on-the-site manual measurements and by telemetered measurements from pressure pillows. Other valuable data comes from soil moisture blocks, precipitation, temperature and wind velocities. Information is analyzed and correlated with past streamflows to develop forecasts that are promptly given to all water users to guide their decisions on best use of the expected supply.

**ECONOMICS**

Like any other resource development, conservation must pay off if much of it is to be done. Many decisions on alternative land use, treatment and structural measures hinge upon their costs and benefits.

Our economists need a background in agriculture, must be skilled in techniques, must be able to work well on a team, and must be at least mildly optimistic.

Their work includes preparation of crop budget curves to show the expected benefits of various conservation measures, the assembly of information on flood and erosion damages, and analyses of cost-benefit relationships for structural project measures.

**ENGINEERING**

The Service employs many engineers whose work is vital to the planning and construction of the structural measures necessary for soil and water conservation. Usually, our engineers have been trained in
either agricultural, civil or general engineering.

Principally, their work involves irrigation and drainage systems, diversion dams, multi-purpose reservoirs, floodways, stream channel protection, floodgates, and pump stations. These structures all involve extensive use of earth, concrete and pipe. Small structures are built in large quantities, using standard plans and specifications developed by our engineers.

Some of our engineers are in positions where they are involved in many types of moderate-sized jobs. Other engineers may be involved on small watershed planning and operations and may specialize in such fields as hydrology, soil mechanics, design, or construction.

We utilize a number of engineering geologists for foundation investigations, channel stability determinations, and sedimentation surveys. Our engineers do not need a farm background; however, they do need to be interested in agriculture and be well-grounded in one of the branches of engineering. They must like working with people and must have a desire for professional advancement.

**SUMMARY**

Employees of the Soil Conservation Service work with people - all kinds of people - in the national program of soil and water conservation. The activities are broad and complex. But, the goal is simple - to assist in getting needed conservation on the land. To date, one and one-half (1.5) million basic plans have been completed to guide soil and water conservation on 500 million acres of private lands.

The staff is trained and experienced in many different technical fields. They work as a team in getting the job done. Since they work on private lands, they need to have, besides good technical training, the ability to sell sound conservation and to motivate others.

New professional employees usually enter the Service at grades GS-5 and GS-7. First, they are assigned for about a year to training locations where they receive intensive on-the-job training. During this period, they also attend a short formal course at one of four training centers to receive general instruction in the Service's operations.

Besides the usual Civil Service rights and fringe benefits, we have a Career Development and Promotion Plan developed and kept current with assistance from employees. Among other things, it provides a promotion-
from-within policy for filling higher-grade positions.

Further information about our work and employment opportunities may be obtained by writing or calling: Mr. A. J. Webber, State Conservationist, Soil Conservation Service, 1218 SW Washington Street, Portland, Oregon 97205.

SLIDES

Soils

1. Soil Scientist at work.
2. Biscuit scabland showing hummocks and rock lacing with cropland.
3. Field examination of soil sample.
4. In-place soil profile showing A, B and C horizons.

Conservation Planning

5. Land operator and technician plan conservation.
6. Hillside cropland erosion and sediment.
7. Gully erosion in field waterway.
8. Streambank erosion and emergency repair along Trout Creek.
9. Aerial view of contour strip cropping.
10. Large farmable diversion.
11. Mixed agricultural land use.
12. Grassed waterway through orchard.
13. Windmill, tank and trough for stockwater.
15. Small stockwater dam filled from spring runoff.
17. Farm windbreak in summer.
18. Snow drifts controlled by windbreak.

**Hydrology**
19. Measuring streamflow with current meter.
20. Snow surveyors on their way to work.
21. Weighing snow tube to determine water in sample.

**Economics**
22. Strawberry harvest.
23. Flood damage to onion harvest.

**Engineering**
24. Wet foundation investigation
25. Wood irrigation flume.
26. Enlarged channel in peat soil.
27. Floodwater pump station and protective dike.
28. Transition from earth floodway to box culvert.
29. Concrete lined floodway.
30. Floodway outlet via drop to river.
32. Trickle tube inlet.
33. Trickle tube during construction.
34. Water powered traveling siphon.
It is my pleasure to appear before you today to discuss career opportunities in water resources as reflected in the activities of the Oregon State Water Resources Board. Considering the background of Mal Karr, Executive Secretary to your own Water Resources Research Institute, you already may have been exposed to much of what I propose to say - Mal previously having served as Chief Engineer for the board.

To appreciate, fully, the scope of board activities, let us examine the board's origin, responsibilities, and authority.

Eleven years ago the Forty-eighth Legislative Assembly of Oregon established some farsighted objectives. The following declaration of policy, now contained in ORS 536.220, was made at that time:

"(1) The Legislative Assembly recognizes and declares that:

"(a) The maintenance of the present level of the economic and general welfare of the people of this state and the future growth and development of this state for the increased economic and general welfare of the people thereof are in large part dependent upon a proper utilization and control of the water resources of this state, and such use and control is therefore a matter of greatest concern and highest priority.

"(b) A proper utilization and control of the water resources of this state can be achieved only through a coordinated, integrated state water resources policy, through plans and programs for the development of such water resources and through other activities designed to encourage, promote and secure the maximum beneficial use and con-
control of such water resources, all carried out by a single state agency.

"(c) The economic and general welfare of the people of this state have been seriously impaired and are in danger of further impairment by the exercise of some single-purpose power or influence over the water resources of this state or portions thereof by each of a large number of public authorities, and by an equally large number of legislative declarations by statute of single-purpose policies with regard to such water resources, resulting in friction and duplication of activity among such public authorities, in confusion as to what is primary and what is secondary beneficial use or control of such water resources and in a consequent failure to utilize and control such water resources for multiple purposes for the maximum beneficial use and control possible and necessary.

"(2) The Legislative Assembly, therefore, finds that it is in the interest of the public welfare that a coordinated, integrated state water resources policy be formulated and means provided for its enforcement, that plans and programs for the development and enlargement of the water resources of this state be devised and promoted and that other activities designed to encourage, promote and secure this maximum beneficial use and control of such water resources and the development of additional water supplies be carried out by a single state agency which, in carrying out its functions, shall give proper and adequate consideration to the multiple aspects of the beneficial use and control of such water resources with an impartiality of interest except that designed to best protect and promote the public welfare generally."

To this end the Legislature created the State Water Resources Board, a board consisting of seven members appointed by the Governor subject to approval by the Senate. The board members receive no compensation for their services, but, subject to certain regulations, do receive actual and necessary traveling and other expenses incurred in the performance of their official functions.

A number of specific responsibilities were assigned to the board. Under the provisions of ORS 536.300 the Legislature provided that:

"(1) The board shall proceed as rapidly as possible to study: existing water resources of this state; means and methods of conserving and augmenting such water resources; existing
and contemplated needs and uses of water for domestic, municipal, irrigation, power development, industrial, mining, recreation, wildlife, and fish life uses and for pollution abatement, all of which are declared to be beneficial uses, and all other related subjects, including drainage and reclamation.

"(2) Based upon said studies and after an opportunity to be heard has been given to all other state agencies which may be concerned, the board shall progressively formulate an integrated, coordinated program for the use and control of all the water resources of this state and issue statements thereof."

Certain authorities were assigned to the board as well, such as those to classify and reclassify the waters of the state, subject to existing rights and priorities, to withdraw unappropriated waters from further appropriation, to attend conferences and meetings in or out of state considering water resource problems, to represent the state in preparing, entering into and carrying out compacts and agreements with other states or the Federal Government concerning water resources, and others.

To facilitate the progressive development of an integrated, coordinated program for the use and control of the state's water resources, the board divided the state into 18 basins. Although a technical staff was employed near the outset and has been continuously employed since then, the board early had to decide whether to develop a large staff with specialists in all disciplines or a limited staff with reliance being placed in specialists available either on a consulting basis or through federal or other state agencies. I am pleased to report that the board chose the latter procedure. This has enabled the staff to operate at a fairly uniform rate, changes in work load being reflected to some extent by greater or lesser amounts of non-board professional services.

The board also had to decide whether to try and augment basic data collection or to place emphasis on the analysis of existing data. Again, the latter procedure was chosen. This does not negate the necessity of running down files and extracting data, however.

**BASIN INVESTIGATIONS**

Let us follow briefly the activities of a typical basin investigation. The investigation will be under the direct supervision of a basin engineer at a State Civil Service classification of CE 3. Assisting the basin engineer will be either an assistant at the CE 2 or CE 1 level with, possibly, an Engineering Technician 1 also assigned to the basin. This crew is backed up by assistance provided through engineering services, such as data storage and retrieval, geology, graphics, and hydrology. In engineering services
employment classes range from ET 1 through 3 and up to CE 2.

Before the basin crew starts work in the basin, preparations are made by the board's field representative. The field representative works closely with the county court of each county in which a portion of the basin falls setting up County Water Resource Committees the members of which are appointed by the county court. The local water resource committees provide valuable liaison between the board and local interests in water use and control, private as well as public. Through subcommittees much valuable data is retrieved from local files such as from the power companies or from utility district files. Frequently valuable data results from personal knowledge, at the local level, of special recreational potentials or reservoir sites.

The data obtained from the county committees are presented to the board, formally, at a public hearing to which local interests, federal and other state agencies are invited to testify with reference to their knowledge or desires concerning the use and control of the basin's water resources.

Prior to the public hearing the field representative and the basin crew contact federal and other state agencies seeking data concerning the basin's water resources. Thus water right records from the State Engineer's files are tabulated to facilitate analysis. We are quite impressed with the advantages that we have found recently of data storage and retrieval utilizing punch cards, not only of water rights, but also of certain hydrological data. Hydrological data are obtained from the U. S. Geological Survey and from the U. S. Weather Bureau.

The basin engineer and his assistants make an exhaustive review of all available publications and data pertinent to the basin's water resources. This data is tabulated and analyzed to identify problems and potentials for development.

After the initial public hearing the basin crew carefully reviews the data provided by the county water resource committee and correlates that with data procured from other sources. The board has entered into a cooperative agreement with the U. S. Department of Agriculture for procurement of data relative to agriculture, particularly reservoir sites, as involved in potential Public Law 566 projects, cropping patterns and trends, and the general economy of agriculture. Under the same agreement, the USDA also provides data on forests and forest industries. Soil Conservation Service's River Basin Survey Crew under the guidance of the Field Advisory Committee prepares the special report.

Having utilized all available sources of data, local, state, and federal as well as private, the staff prepares a report and lists its findings.
as to problems and potential development of the water resources. Insofar as practicable, the findings are coordinated with the activities of other state and federal agencies. The report and conclusions are then presented to the board at a public meeting where, again, private as well as federal and other state agencies may comment on the report.

This is followed by the development of the board's program for the use and control of the basin's water resources which also is circulated for agency comment and reviewed at a public hearing prior to final draft. Once adopted by the board the program becomes binding on state agencies and public corporations.

Ten years ago, when the board was just getting started with its procedure, involving the analysis of the ten beneficial uses of water listed under ORS 536.300 which I have already quoted, the Federal Government still was recognizing only four beneficial uses of water as authorized functions of multipurpose projects; power, navigation, flood control, and irrigation. Today those four have been expanded to include municipal and industrial use, water pollution control, recreation, and fish and wildlife enhancement. The Oregon State Water Resources Board procedure of comprehensive review and coordination now is accepted practice in water resource planning.

DIFFERENT LEVELS OF PLANNING

So far I have discussed with you, primarily, water resource planning at the staff level. This is the level where there is a great need for technicians, hydrologists, geologists, draftsmen, and do not overlook report writers, preferably all having engineering backgrounds if not degrees. As one gets away from the comprehensive basin type 1 reports and approaches specific plans and specifications for projects, greater specialization is required such as soils mechanics, land classifiers, experienced designers, who in general are registered professional engineers. This is still relatively low level insofar as water resource planning and development is concerned, however.

One might consider the State Water Resources Board as the intermediate level of water resource planning, planning that gets beyond the individual basin or project level to encompass the overall needs of a state with limited integration of state with regional needs.

Let us look, momentarily, now, at the State Water Resources Board. Sitting on the board, today, are Mrs. Ruth Hagenstein, Chairman of the Board. Mrs. Hagenstein, who lives in Portland, has a background of
active participation in civic affairs and in the League of Women Voters. The League has long been keenly interested in water resource development. Mr. John Davis, who has served continuously on the board since its inception, is from Stayton where he runs an insurance business. General Louis H. Foote, Corps of Engineers, U.S. Army, retired, resides in Forest Grove. Mr. Karl W. Onthank, formerly Dean of Personnel Administration and Director of Graduate Placement at the University of Oregon, Eugene, is in semi-retirement, still works part-time at the University. Mr. La-Selle Coles, Manager of the Ochoco Irrigation District and past president of the National Reclamation Association lives in Prineville. Mr. William Jess, rancher, lives in Eagle Point, and Dr. Emery Castle, Dean of Faculty at Oregon State University resides in Corvallis.

These are individualists, having varied interests, located in various parts of the state. They are irrigators, economists, civil engineers, naturalists, businessmen, and at times in the past they have been attorneys and publishers. They must have an ability to appear in public, to speak extemporaneously. They must know or learn state water laws and have a working knowledge of Federal Programs and pending legislation. They must be politically wise yet free from political pressure.

In general, they have the same attributes as the high level planners, the basic difference being that the high level planning involves regions and the nation, or extremely complex planning at the state level, such as the California Water Plan. Incidentally, it might interest some of you to know that Harvey Banks, author of the California Water Plan, the most comprehensive water resource development plan undertaken to date, is a sanitary engineer.

It might also interest some of you to know that some of our best report writers are geographers.

TRAINING REQUIREMENTS

The ability to communicate, whether orally or in writing, is a requirement regardless of the level of planning activity. Technical background, in one or more of the engineering fields is desirable, civil, agricultural, chemical, etc. Some place along the line someone must apply some hydrologic calculations, determination of streamflows from, usually, woefully inadequate records.

As of this time, it appears that those seeking a career in the field of water resources, particularly that area involving policy decision as to the use and control of water resources, should have some engineering
fundamentals, some grasp of economics, quite possibly some background as a fish and wildlife biologist and some understanding of water law. Foremost, however, he must be able to communicate.

I mentioned earlier that the board relies strongly on the use of specialists available through other agencies and that the use of such professional services tends to stabilize the board's staff. As many of you are aware the board is undertaking a study to identify the ultimate water needs of the state in order to determine whether or not there will be any water surplus to our own needs, this in connection with the demands from the Southwest for diversion of water from the Northwest. Two major portions of that study currently are being done through service agreements with other agencies. The State Sanitary Authority is evaluating the water quality of major streams throughout the state and the Soils Department, Oregon State University, working in cooperation with the Soil Conservation Service is classifying major areas of the state, where soils previously had not been classified, to identify potentially irrigable land.

Completion of the Ultimate Needs Study, scheduled for 1969 will coincide with completion of the investigation of the state's basins.

That some shift in the type of personnel required thereafter may occur is a strong possibility. It is anticipated that reviewing and updating will be necessary to insure that the board's programs for use and control of the state's water will continue to serve the state's best interest. Indications are that more detailed studies will be made; detailed investigations of specific problems possibly with alternative solutions.

The board is actively participating in the CBIAC Task Force review of the Willamette River Basin, which study is due for completion in 1969.

The board also is participating, more at the observer level in the CBIAC Columbia North Pacific Study.

Mr. Lane, Executive Secretary to the board, as you may have noticed in a recent news release from the Governor's office, is being sent to Washington on a temporary basis, as a special consultant to our Congressional Delegation. It takes a person of particular skills to keep up with the rapidly changing views, local and national, in the field of water resource planning and development, particularly insofar as policy is concerned.

I foresee opportunities, for many years to come, in the field of water resource planning and development.
I have not had the opportunity to hear the earlier talks given in this seminar, but I assume you have heard comments on water philosophy by some very competent people. They may have quoted some interesting facts such as the world's total supply equals 326,003,100 cubic miles in the form of ice fields, lakes, rivers, ground water and water vapor in the atmosphere; or if this supply was dumped on to the 50 United States, that it would submerge the land surface to a depth of 90 miles. You may have also been told that the total potential earth-moving power of all the water in the United States equals that of five million D-8's. You have undoubtedly heard or read about reports of the United States or the world running out of water in the next 20 years, or the next 100 years, or some other period of time that suited the harbinger of doom. If you read the news at all, I know you have read about plans for diverting northwest water to the southwest or the granddaddy of all, the NAWAPA proposal (North American Water and Power Alliance).

We know it is true that water is our most important resource. It is the one substance that man is most sensitive to and cannot do without except for very short periods. Since most of the earth's original supply is still in use in the hydrologic cycle, man has neither learned to destroy it nor to synthesize it.

What do these simple facts and all the publicity presently being given mean? It does mean that a lot of manpower and effort will be spent in the next few years planning, building, and managing water projects. I hesitate to define it as the greatest task of the century, but it is unquestionably large enough to provide room for all segments of government and the private economy to play significant parts. There is room for all.

I believe also that the hue and cry of publicity and pseudo-scientific reports indicate some awareness of the problems by the general public, and a desire of the public for proper use of the water we have. It is in this light
that state agencies, such as the one I represent, the State Engineer, are most active. To fulfill my role here today, I should point out that, while it may not be under the same name, there is a counterpart agency in each of the 17 western states. All have been in business for nearly the 61 years that the Oregon State Engineer has, with similar duties and authorities. The State Water Resources Board representative, who is also here today, is from a relatively young agency created by the 1955 legislature, with the prime function of planning for future water policy.

FUNCTIONS OF THE STATE ENGINEER

The State Engineer's prime function is the administration of the state's water laws. To carry out these functions, the office is divided up into 6 divisions employing 35 engineers in the CE I to CE IV classifications, with annual salaries ranging from $7200 to $14,280. In addition, I have two geohydrologists in ground water investigation. Competent engineers in the water resources field have been difficult to find in recent years and, at present, positions are vacant in both the CE III and CE IV categories.

Salaries will vary from state to state with California leading and, in general, a state of flux exists due to competition between areas. Salaries are only part of the question. Job satisfaction and a realization that you are making a worthwhile contribution to a need are significant. We have a down-to-earth, realistic, practical purpose which fully meets this criteria.

Our work and philosophy is geared to the practical approach and spearheaded by collection of basic data as the prime requisite of any program.

My simple statement of the basic function of the State Engineer, "administration of the water laws," would indicate a leaning toward the administrative field that engineers reportedly have to enter, in private corporations, in order to obtain the higher paying, greater responsibility positions. Two of the divisions, that of water rights and adjudication, do provide this emphasis and room for promotion for engineers with that bent. The hydrographic, dams and hydraulic structures, hydroelectric power and watershed planning are geared more closely to the technical engineering field. The ground water division, as I mentioned earlier, requires a sort of a cross between a geologist and a hydraulic engineer, with no school providing specific training.

Employers of this class today rely on in-service training or proselyting from a companion agency. While these divisions are set up for organizational structure, the talents and knowledge of each are required throughout all sections in order to complete the job.
Hydrographic Division

We are the prime state agency in the field of basic data collection: stream flow records, ground water investigations, climatological data, topographic mapping, and snow surveys. In all of these fields we cooperate with the respective federal agency which ordinarily publishes reports covering the data collected by both. A fairly good record has been built on the major stream system, but much remains to be developed on the smaller tributaries. This data is essential for reasonable planning, acceptable water management, effective flood forecasting, and a host of other reasons. Most of the work is in the hydrographic division where we have 111 water measuring stations on streams, lakes, and reservoirs, in addition to the 89 stations in the U. S. Geological Survey - State Engineer cooperative program that are operated by state personnel. In the next 10 years, we should double the number of stations in each of these categories as well as adding facilities for monitoring water quality and temperatures.

For the young engineer with an outdoor bent, stream gaging and hydrologic studies provide an almost idyllic life. A pleasant amount of field work in some of the remote stream sections of the state, and practically all during good weather. The hydrographic section also regulates the use of water among those entitled to it in accordance with their priorities. To do this, a man must know the quantities available from the various sources of supply. The gaging serves an immediate need as well as for the future studies of watershed yield, peak discharge and other parameters in the stream regimen. Some surveys are carried out in cooperation with the Soil Conservation Service to provide basic data for watershed yield forecasts.

Dams and Hydraulic Structures

The dams and hydraulic structures division is primarily concerned with the safety of dams. With certain exceptions, primarily that of dams less than 10 feet in height or storing less than 9.2 acre feet of water, all plans and specifications for structures and the site thereof must be approved by the State Engineer. This also involves periodic inspection of existing structures and ordering any modifications that are necessary to provide a safe structure. No direct designing is done, but a broader knowledge than the ordinary designer has is required in order to be able to evaluate the different types and designs that are submitted. Economic superiority is not a determining factor, but safety is. Within this framework, new features and designs are encouraged as long as they can be supported by sound principles.

The ability to accept and support new designs in the face of static acceptance of the tried and true is a challenge not accepted by all, parti-
cularly when the desire must be tempered by the responsibility of protecting many. One of the prime reasons of dam failures in the past has been inadequate spillway capacities, yet most of the dams in the world have been designed on inadequate hydrologic knowledge. Practical field research is being done and more is needed to better define peak discharges from small watersheds for spillway designs, culvert designs, flood routing and other uses.

One aspect that has frequently been overlooked is the correlation between precipitation, evaporation, and runoff. In cooperation with the U. S. Weather Bureau, we have installed, and in operation, 8 evaporation stations and 35 storage precipitation stations, with 28 more to be installed this summer. We should have three times as many in the decade to provide part of the tests required by engineers in this field. Work in this division is of a highly specialized technical nature and provides the opportunity for association with the best engineers in the nation when checking their work for approval. Designers and consultants on some of our dam jobs come from New York, Seattle, San Francisco and all parts of the United States.

Oregon is extremely fortunate in its record of dam failures. We had none of any consequence in the 1964 Christmas flood and only one in our state's history that approached disaster proportions. Some of this credit must go to luck, but a substantial part lies with the long standing policy of insisting on adequate spillways even though funds were not sufficient for adequate construction inspection or investigation of existing structures. We do recognize fully the problem of excess costs if they are larger than necessary, as well as the hazard of being too small.

Hydroelectric Power

In our hydroelectric power division, all applications for development of hydro-projects are investigated for both engineering and economic feasibility prior to issuance of licenses. The policy question of whether or not fish and recreational interests will bar the construction of power projects on a particular stream is under the Water Board. Facilities installed to offset objections from these interests may run to 20 per cent of the project cost and, consequently, they do have an important bearing on the economic feasibility.

Another function involves Peoples' Utility Districts. Oregon had tremendous activity in this field in the thirties, quieting down during World War II and the subsequent years, and is now showing signs of resurgence. Detailed investigations of the advisability of creating a district or of annexing territory are required to be prepared by the State Engineer as part of the proceedings and prior to any final action.
Watershed Planning

The state having vacated the project planning field came back into the picture with our watershed planning set up to work on small projects. In general, these are assisted by the federal government under PL 566 and cover the field too large for the individual, but too small to come under the regular water resource projects of the Corps of Engineers, or the Bureau of Reclamation. Inherent in each is the element of flood prevention, but total watershed development is the goal. They are planned as community projects with the office serving as a consulting engineer to the local group. The blending of irrigation, municipal and industrial, recreation, fishery enhancement, and flood control requirements into a feasible project within the physical limits of the watershed to make the projects truly multipurpose is a real challenge.

In almost all cases, reservoirs, pipelines, channel work, fish facilities, recreational developments, and land treatment programs for the upper watershed are included in the design. We may be accused by the South of being water-rich and we are at some times during the year; yet no project can be built on natural stream flow alone. It is estimated that there are approximately 300 such projects in Oregon that would be feasible. In view of the present situation wherein the summer flow of our streams is either appropriated or set aside for fishery and esthetic purposes, storage projects are mandatory if there is to be any for the development. This provides almost unlimited opportunity for the engineer engaged in water development.

Groundwater

The last division, ground water, presents to me the greatest challenge because it is a subject that even the experts know the least about. Ground water's occurrence, capabilities, limitations and the methodology used in its evaluation are probably the least understood part of the rarely understood water resources field. Many times even those persons working in the discipline have no concept of ground water potential. We even have some people with Doctorate degrees in one of the sciences following theories no better than the forked willow stick, or black magic and the Ouija board. Until it is brought to the surface by usually expensive exploration and production facilities, we cannot see it, feel it, taste it, swim in it, or any of the standard means that the average person uses as a measure of water. In the technical sense, we cannot measure it with a gaging station to the same understandable, precise accuracy, but must infer its existence by correlating a geological study with results from tested wells. While the end result can be just as accurate and reliable, the time and expense is greater than with surface water.
To date, we haven't found any fish swimming in the interstitial openings in the aquifer or other functions of public interest to prevent its development. In many areas, this lack of public opposition will make it the most practical source of water for development. In others, it will simply be the most practical source of water for development. In others, it will simply be the most economical or only source available. Regardless of the reason, the existence of some two million cubic miles of ground water makes it a source which must be considered. We have not begun to tap it, or to utilize the methods which might be feasible for increasing the supply. Underground storage reservoirs are not subject to the tremendous evaporation losses of the surface, nor ordinarily to the contaminating effects of man.

Changes to the ground water regimen such as introduction of polluting materials must be viewed with considerably greater alarm than surface streams. Ground water bodies once polluted are not corrected by stopping the source since it may take many years or centuries to eliminate its effect. We have an excellent ground water law in Oregon. Within my ground water division lies the authority for its full control, the prevention of pollution, the investigation of supply, and the regulation of its use.

I hope you have gathered a feeling of the basic, practical approach to this segment of the Water Resources field. I assure you that there is unlimited room for career development for the sincere dedicated engineer.
Today I will describe in general terms the over-all functions and responsibilities of the U. S. Department of the Interior, but delve rather specifically into career opportunities in hydrology within the Geological Survey, the principal agency in the Department responsible for investigations and research of the water resources of the United States.

On February 23, 1966, President Johnson sent a message to Congress outlining a number of proposals for the "Preservation of America's Natural Heritage." Several points stressed by the President are of interest to us here. The message emphasizes that we must establish a course to maintain tall forests, clean air and clean rivers. It follows that we must first develop an understanding of what has already happened to our waters. President Johnson goes on to propose a Clean Rivers Demonstration Program to preserve entire river basins from present and potential pollution from their sources to their mouths.

President Johnson proposes that this responsibility be assigned to the Department of the Interior to better mesh water-conservation and water-use programs. The Federal Water Pollution Control Administration became a part of the Department of the Interior in the past few days which strengthens the over-all Department's water-management programs ranging from saline water research to pollution abatement and irrigation to fish and wildlife preservation. The Secretary of the Interior also serves as Chairman of the recently formed Water Resources Council in Washington, with eventual establishment of Federal-State River Basin Commissions in the field to undertake water and related land resource planning. Also, the Office of Water Resources Research was established under Secretary Udall in 1965. Thus, Interior has been assigned broadened responsibilities and becomes the lead Department in the Federal establishment in water-resources investigations and research, in planning of water development, and in the clean rivers program.
The world is facing an increasing complexity of water problems. In the western United States, gains in population and increased demands by industry and agriculture far outdistance available supplies in many sections. The Department of the Interior, as the major Federal resource agency, along with other Federal Departments, is deeply concerned about our present inability to keep pace with solutions or suggested corrections to these water problems. State and local organizations as well as citizens in almost every community are likewise troubled. The feeling prevails that extensive, costly and far-reaching efforts will be required in the not too distant future.

Harold E. Thomas and Luna B. Leopold of the Geological Survey vividly described the situation in their recent article in Science, when they wrote:

"Water habitually does not subscribe to our efforts at compartmentalization according to special interests in irrigation, industrial use, recreational use, municipal use; or to the allocations of fields for the chemist, for the geologist, for the sanitary engineer, for the physicist, for this or that Government agency, any more than it does to separation into areas bounded by property lines, country lines, State lines, or even some river-basin boundaries. As the areas of heavy demand expand toward each other and the necessity for water management increases, these artificial boundaries and classifications will have to yield more and more to the realities of the hydrologic cycle."

The Senate Select Committee on National Water Resources identified 18 major subjects on which additional research is urgently needed to improve conservation, utilization, and development of our water resources. Thus, there is a spreading awareness that hydrologic investigations and basic water research need to be greatly expanded to ensure that we are indeed anticipating all of the uses and matching them with available supply. Time is short, for already it is estimated that by 1980 the available water supply may be a limiting factor in growth and development of major portions of this Nation.

THE WATER RESOURCES DIVISION

Within the over-all framework of the Department of the Interior's responsibilities, the mission of the Geological Survey in water resources investigations and research occupies a strong and definitive position. The Conservation Division does investigate the water-use possibilities of the public lands and classifies them according to their value for water power.
and water storage. However, as the major part of water-resources investigations and research is conducted by the Water Resources Division, I will delve more specifically into the mission of that Division now to give you some insight as to the career possibilities within our agency.

Two pamphlets are available to you here today that provide additional details. The brochure, "Careers in Hydrology," presents complete information on opportunities for career professional positions in hydrology in the Federal Government. The second booklet is entitled "Professional Challenges in Water Resources," which illustrates the range of job opportunities available to candidates interested in a career with the Water Resources Division.

I am sure you will be interested in the fact that the first work of the Geological Survey was undertaken in 1867—almost 100 years ago—when Hayden conducted a survey in Nebraska. The Powell survey of the Green and Colorado Rivers in 1868 could be considered the beginning of water-resources investigations by this organization. In 1879, Congress officially established the Geological Survey with Clarence King as Director. In 1890, Frederick H. Newell headed the first official water resources investigations on the Rio Grande at Embudo, New Mexico. The Water Resources Division was formally constituted as an organizational unit in the Survey in July 1906. The work today of the Water Resources Division is conducted by more than 3,000 scientists and engineers from several hundred field locations in the United States, its possessions, and at over-sea posts.

In addition to the more than 60 years of active hydrologic investigations, the Water Resources Division of the U. S. Geological Survey has other characteristics unique among water agencies. The Geological Survey has no water development projects to promote, no dams to build, no irrigation projects to operate. It is not responsible for controlling floods or maintaining navigation channels. It does not buy or sell water, nor does it market or produce hydro-electric power. Its purpose, rather, is to determine and evaluate the quantity, quality, and distribution of the water resources of the United States, its territories, and possessions. To phrase it slightly differently, our mission is to (1) serve as an observer and recorder of the hydrologic data and events, (2) describe the hydrologic system through which the water moves in its environment, and (3) assess the effects of man's activities on the hydrologic systems.

As a Federal agency, the Water Resources Division also is unique in the extent to which it shares with State and local water agencies the responsibilities for planning and financing investigational programs directed toward achievement of its objectives.
This unique character of an organization confined solely to investigations of the hydrologic facts and associated research provides a creative atmosphere and a stimulus to an imaginative mind. I would emphasize that much of the work is accomplished through projects assigned to individuals or to small groups of employees, with the objective of a publishable product. Being an agency responsible for programs on a national scale—indeed even world-wide in scope as one of the leaders in the International Hydrological Decade—a diverse range of hydrologic problems are awaiting attack. Furthermore, the Water Resources Division activities span many scientific and engineering fields from glaciology to geochemistry, hydraulics to radiochemistry, ground-water to geomorphology and a host of other disciplines essential to measuring, observing, and understanding the hydrologic system. Thus, the Water Resources Division needs to enlarge and strengthen the range of competence and various skills to deal with varied aspects of the land phase of the hydrologic cycle.

MAINTAINING PROFESSIONAL EXCELLENCE

The reputation of the Water Resources Division of the Geological Survey as a scientific agency depends largely on the production and publication of sound scientific reports, atlases, maps and brochures because they are the chief tangible end product of the Division's efforts. As our reports basically are the result of the work of the individual, it follows that high standards must be applied to the selection of these individuals; and the maintenance of professional excellence and integrity of work require constant attention to the development and use of the full potential of our employees.

We employ a number of means to improve the capability of the individual. Interesting and varied work going on in different units within a given office or in different parts of the country provides wide opportunity for varied work assignments to broaden the individual's capabilities. The Division holds seminars and training schools, both in-house and collaboratively with universities and other outside institutions. There is opportunity for advance educational training through Survey-supported graduate studies, either on a part-or full-time basis.

The hydrologic inventories, appraisal, and research conducted by the Water Resources Division encompasses the range and variety of work performed by hydrologists, hydraulic engineers, chemists, geologists, soil scientists, geochemists, physicists, mathematicians, ecologists, botanists, and technicians. Field or laboratory work alternates with office work in investigative and research activities which include the behavior of radio-nuclides in water and soil, biological make-up in reservoirs and rivers, the dynamics of streams and the measurement of streamflow, monitoring for pesticides, salts and other quality parameters, the geology of
aquifers and the hydraulics of underground water, the hydrology of glaciers and lakes, estuarine hydraulics, and problems of infiltration, evapotranspiration and sedimentation, to name but a few.

I would emphasize that there is a wide range of career possibilities in the Water Resources Division, depending upon your individual ambitions and interests. If you prefer purely scientific or engineering work, there is place for your talents. There are opportunities in our research endeavors as well as in our investigative and appraisal programs. Some individuals may have a strong leaning toward administration of technical programs. After a proper grounding, I can assure you of the opportunities along this career ladder. Not infrequently men in our organization are "rotated" between the purely technical sector of our programs and management side. The range of opportunities in the Survey is indeed large and diverse and a challenge awaits the candidates from almost every scientific and engineering field.

The Geological Survey welcomes your inquiry into career opportunities in the Water Resources Division. The Portland Division office, 830 N. E. Holladay Street, Portland, Oregon, Area Code 503-234-3361, Ext. 1995, would be most pleased to have a visit by you, at which time there will be opportunity to see first hand some work activities and to talk with our men who have found challenging and rewarding work in the Geological Survey.
The Federal Service

The Federal employment system cannot be discussed in detail in the time allotted, but the following brief resume will be pertinent to our subject.

1. Civil Service Act of 1883:
   Took the "spoils" out of Federal Employment,

2. The System:
   Based on each applicant competing with all applicants for the position - hence the term "competitive" appointments.

   The examinations are either assembled (written test) or non-assembled (no written test). The majority of engineering and scientific positions are filled through non-assembled (no written test) examinations.

   Most full-time continuing positions are filled in this manner. They are referred to in many places as "permanent".

THE EXCEPTED SERVICE

The excepted service means excepted from civil service rules and regulations governing appointments. Most excepted positions are filled under what is called Schedule A. These positions are normally for a limited period (less than a year), although a few types of positions such as attorneys are filled for an indefinite period. The individual Federal agency can do this only if authority has been granted to them by the Civil Service Commission.
Schedule C positions, which are limited in number, serve at the pleasure of the appointing authority and are generally considered "political" appointments. Students, college professors, and consultants generally receive Schedule A appointments for temporary periods of employment.

**CONTRACTS OR GRANTS**

Many Federal agencies enter into contracts with consulting firms or universities for the performance of duties, particularly of a research nature or for new type programs. The individual is employed by the organization with the contract. The contract employee generally works very closely with the Federal agency. Examples of this are the contract BPA has with Oregon State University covering the "Detection of Decay in Wood Poles" and with Stanford University covering "Water Utilization".

**THE GOVERNMENT TREND TOWARD HIGHER DEGREES**

From a realistic standpoint, the Federal Service is becoming more interested in engineers and scientists with higher degrees. This stems from the increased number of students receiving graduate degrees and the complexity of the problems the engineer or scientist is called upon to solve.

Within the Interior the organizations that are more research oriented have the larger number of higher degree employees such as the Bureau of Commercial Fisheries. Organizations more operational in nature (design, construction, operation, maintenance) have a smaller proportion of advanced degree employees.

**THE GRADE STRUCTURE**

All Federal positions have grades that are under what is called the position classification system.

The duties and responsibilities are tied to the grade along with the qualifications. The following table covers the grade and general entrance qualifications for engineers and scientists.
NO EXPERIENCE - EDUCATION ONLY

GS-5 - BS Degree

GS-7 - BS Degree - top 25% of class
   MS Degree

GS-9 - MS Degree - top 25% of class

GS-11 - PhD

GS-12 - Superior PhD

Superior PhD is described as being in the upper half of his group.

Note:
1 year's experience generally qualifies a person for the next higher
grade, i.e., one year as GS-5 for GS-7, one year as GS-7 for GS-9, etc.
Grade promotion is the prerogative of the agency, and not a right of the
employee.

RECRUITMENT EFFORT

Although a student may file an application for a specific examina-
tion such as engineer, the practice that is being followed is for more per-
sonal contact between the agency and the individual. This comes about in
several ways such as:

1. Recruiting visits by the Federal agency;

2. Through personal contact of an agency representative and this
   student, particularly as a result of a research contract with a
   college;

3. Through contacts enjoyed by the faculty;

4. Upon the initiative of the student to work in a specific program
   or for a specific agency.

It takes effort on the part of an individual to keep abreast of what the Federal
government is doing in a specific field. There are 26 different government
organizations interested in oceanography. It is more than a little task to
find out about each of these organizations. A good source is the "Appendix-
The Federal agency is receptive to inquiries through letter, telephone calls, or personal visits. You, as a student, should not hesitate to contact the agency or agencies you are interested in. Remember, before you become a regular employee you will be looked at rather carefully. You owe it to yourself to look at the agencies rather carefully.

When considering employment you should consider such things as geographic location; benefits such as vacation time, insurance; graduate study and similar items, including your wife or fiancee's feelings. This is your responsibility.

POSITIONS IN THE FIELD OF WATER RESOURCES

(Not complete)

Engineer

Civil
Hydraulic
Sanitary
Electrical, Chemical, Mechanical

Biological Scientist

Fisheries Biologist
Wildlife Biologist
Micro Biologist
Forestry
Range Conservation
Soil Scientist
Soil Conservationist

Physical Scientist

Chemist
Physicist
Mathematician
Oceanographer
Geologist
Meteorologist
Hydrologist

The Civil Service Commission has established qualification standards for each competitive position. These are printed in the examination announcement. The Federal agency also has Handbook X118 that lists the qualification standards. All personnel offices of government should be able to
furnish you with this information.

It is necessary to be sure you are obtaining the correct amount of course work for the position you desire. For example, the standard for Biologist GS-5 is:

"A full 4 year course, in an accredited college or university, leading to a bachelor's degree including 30 semester hours in biological science."

For a Fisheries Biologist the 30 semester hours in a biological science must include:

"At least 6 semester hours in aquatic subjects such as limnology, ichthyology, fishery biology, aquatic botany, aquatic fauna, oceanography, fish culture or similar course work of equivalent basic values in the field of fishery biology; and,

"At least 12 semester hours in the animal sciences in such subjects as general zoology, vertebrate zoology, comparative anatomy, physiology, entomology, parasitology, ecology, cellular biology, genetics or research in these fields. Excess course work in aquatic subjects may be used to meet this requirement when appropriate."

For a Wildlife Biologist the 30 semester hours in a biological science must include:

"At least 9 semester hours in such wildlife subjects as mammalogy, ornithology, animal ecology, wildlife management, or research courses in the field of wildlife biology; and,

"At least 12 semester hours in zoology in such subjects as general zoology, invertebrate zoology, vertebrate zoology, comparative anatomy, physiology, genetics, ecology, cellular biology, parasitology, entomology, or research courses in such subjects; and,

"At least 9 semester hours in botany or the related plant sciences. (Excess courses in wildlife biology may be used to meet the zoology requirements where appropriate.)"

For your information the qualification standards for Hydrologist are:

A. A full course of study leading to a bachelor's or higher degree in an accredited college or university, with a major in hydrology,
science or engineering that has included 1 year (normally at least 6 semester hours) each in physics and in chemistry, mathematics through differential and integral calculus, and 12 semester hours in a combination of at least three out of the four following courses: geology, hydraulics or fluid mechanics, botany, and climatology--meteorology.

B.
Four years of experience, or a combination of education and experience that demonstrates possession of knowledge and skills comparable to those that would normally be acquired through the education described in the above.

In addition to meeting Basic Requirements, candidates must present education as follows to qualify for grades above GS-5:

1. Persons who possess, or are candidates for, a bachelor's degree and who are in the top 25% of their class (GS-7).

2. Graduate study in hydrology, science or engineering, that contributes significantly to the candidate's ability to perform professional work in hydrology, is qualifying for grades GS-7, and above, on the following basis:

   GS-7: One full year of graduate study.

   GS-9: Two full years of graduate study; or, for research positions, completion of requirements for a master's degree where the student's graduate record is in the upper quarter.

   GS-11: Successful completion of all the requirements for the Ph.D degree; or, for research positions, completion of requirements for a degree for which the minimum requirement is 2 full years of graduate study, where the student's graduate record is in the upper quarter.

   GS-12: For research positions, successful completion of all requirements for the Ph.D degree, where the student's graduate record is that of a "superior" student.
I have been asked to talk to you this afternoon about some of the water resource oriented activities in the Bonneville Power Administration, and to give you some insight as to the type of employee engaged in these activities as well as the kind of person we seek when recruiting new employees.

First, let’s briefly review the functions of the Bonneville Power Administration. BPA was established in 1937 under terms of the Bonneville Project Act. This Act charged the Administrator of BPA with the responsibility to market the power generated at Bonneville Dam, to construct the necessary transmission facilities, and to enter into contracts to encourage the widest possible use of the electric energy.

Over the years since the Bonneville Project Act was established, the Administrator's responsibility has been extended to include the marketing of power from 29 Federal dams that are now in operation or under construction. Projects are located in the States of Washington, Oregon, Idaho and Montana.

In virtually every instance, a Federal project has multi-purpose functions. For instance, the Grand Coulee Project was developed by the Bureau of Reclamation and permitted the reclamation of thousands of acres of land in Central Washington. The Federal projects in Southern Idaho are basically reclamation projects. The development of the Lower Columbia and Lower Snake Dams, each of which are equipped with navigation locks, will permit slack water navigation up to Lewiston, Idaho. Dams, such as those in the Willamette Basin, and Hungry Horse in the Flathead Basin, carry large flood control functions. Since power is the primary source of revenue from the projects, the timing of construction usually hinges on the ability to market the project’s power. The Federal power facilities -- dams, reservoirs, power plants and transmission facilities -- are referred to as the "U.S. Columbia River Power System."
THE U. S. COLUMBIA RIVER POWER SYSTEM

When the 29 Federal dams now existing or under construction are completed, the system will have an installed capacity of over 10,000,000 kilowatts. Reservoirs will have over 16,000,000 acre-feet of seasonal storage capacity in five major reservoirs, with additional minor amounts of storage capacity in several smaller reservoirs. In addition, under terms of the U. S. - Canadian Treaty for the Cooperative Development of the Columbia River, 15,500,000 acre-feet of storage capacity is under construction in Canada in three projects. These reservoirs, then, will have a total storage capacity of over 30,000,000 acre-feet and will catch and store the high summer runoff and control the release of this stored water to meet power demands during the winter months when flows are normally low.

I could go on with these statistics, but I won't, since I have available here, two brochures:

(1) BPA - History and Progress, and,
(2) Columbia River Power - Source to User,

which describe the system better than I possibly can. I invite you all to take a copy and read it at your leisure.

WATER RESOURCE ORIENTED ACTIVITIES

Planning, design, and construction of the Federal projects is the responsibility of the Corps of Engineers or the Bureau of Reclamation, depending upon the primary multi-purpose function. The Bonneville Power Administration is involved in the planning phase insofar as power marketing is concerned—and in an advisory way in determining the project timing and the initial and future installation of generating units. In addition, the power operating plans are prepared by BPA with due consideration of the constraints imposed by other multi-purpose functions.

As a power transmission and marketing agency, BPA has a large staff of employees—including many engineers—engaged in the study and design of the physical facilities for the transmission system, the acquisition of right-of-way, etc. I will limit my remarks, however, to those activities relating to the planning and operation of the hydroelectric projects.

The Columbia Basin Inter-Agency Committee now provides coordination among the various planning organizations in the Federal and State Governments. BPA is active in many of the subcommittees of the CBIAC such as Power Planning, Water Management, Hydrology, Pollution Control,
BPA is also active in many coordinating groups which cooperatively study long and short range operational and planning problems. The Pacific Northwest Utilities Conference Committee and the Northwest Utilities Conference Committee and the Northwest Power Pool Coordinating Committee are representative of this sort of activity.

One of the important long-range planning problems of hydroelectric system operation—and the one with which I am the most familiar—is the determination of the firm and secondary load carrying capability of the system. These computations involve developing operating strategies for the seasonal management of the storage water which will provide optimum firm and secondary load-carrying capability. Since the reservoirs and generating plants are widely located throughout the region, the hydraulic network becomes very complex. The problem of seasonal management of storage water will become more challenging during the next 10 years as the system grows and more river control is possible as a result of the new reservoirs mentioned earlier.

The completion of several high voltage interconnections with the Southwest will change the operational picture of the power system in the near future. These interconnections will provide a substantial market for secondary energy which is now spilled each year. In addition, as economics permit, it is anticipated to exchange surplus capacity available in the Northwest for surplus energy available in the Southwest, thereby increasing the firm energy supply for Northwest power loads.

Another interesting planning activity involves short-range power scheduling and operation. In this area, it is necessary not only to plan for the seasonal management of the water, but to schedule the generation at each plant for each hour in the day in a manner that meets the total power demand most efficiently and, at the same time, protects the future load-carrying capability against the probability of variations in forecast streamflow and power demand. This is a very specialized and complex problem. The system has now grown in size to the extent that it taxes the ability of the scheduling staff to complete the scheduling on a timely basis, and it is becoming imperative that many of the functions be automated. In order to facilitate our scheduling decision processes, we are planning an automatic data gathering and logging system to be installed in the very near future. This will be expanded on a step-by-step basis to provide fairly comprehensive automatic system control.

The planning and operational activities I’ve just briefly described are generally performed by engineers or engineering technicians. The natural tendency in the power industry is to look for employees with electrical engineering background. This is not essential, however, and we are more than satisfied with the performance of those with backgrounds from the other engineering disciplines. Our scheduling and operating staff is augmented by
meteorologists and hydrologists who perform the specific streamflow and weather forecasting services required in the operation of the hydro system.

During the past few years, we have added several mathematicians to our staff whose work is generally computer oriented. Because of the increasing trend in the use of automatic data processing equipment, we can probably expect a considerable increase in staff related to this work. In general, the professional engineers and mathematicians have Bachelor degrees. There is a definite trend, however, towards employing personnel with advanced degrees.

In summary, I believe it is accurate to say that problems relating to water resource activities are becoming more complex and challenging. We will need to apply all of the modern problem solving techniques at our command if we are to maintain an efficient operating system.
In considering career opportunities with the Forest Service, one should first look at the work, organization, and policies of this agency. Picture an organization that controls forest lands larger in area than Italy and Japan combined, or in terms of land units, 186 million acres. National Forest lands comprise 1/5 of the land area in the Western states, yet supply more than 1/2 the total flow of water. About 2/3 of the irrigated farm land and 600 or so major power developments use this water.

Over 1800 Western communities are entirely dependent on these public forests for their water supplies and many more are partly dependent. Enough lumber to construct nearly 1 1/4 million five-room houses each year comes from National Forest timber harvesting programs. More than 6 million livestock are grazed under permit annually. Roughly 1/3 of our country's big game animals live at least part of the year on these lands, and there are over 80,000 miles of trout streams. The National Forests have become America's favorite playgrounds. The statistics on recreation visits are staggering: Ten years ago recreation visits were on the order of 40 million; but by 1964 this had risen to 135 million.

ORGANIZATION AND RESPONSIBILITIES

The above is briefly what our work is about. Now for the organization to handle it. The Forest Service was established in 1905 as an agency of the Department of Agriculture. Major responsibilities now include administration of 154 National Forests and 19 National Grasslands; direction of cooperative forestry programs in 50 States, Puerto Rico, and the Virgin Islands; operation of 12 regional experiment stations and about 100 research project offices, laboratories, and smaller installations. Thus, the basic responsibilities may be visualized as a triangle with the points representing (1) the National Forest system, (2) research, and (3) the cooperative
State and private landowner programs. Of particular interest to this semi-
nar are the first two. I'll try to confine my part of the discussion to National
Forest activities and let Bob Harris tell you about research.

National Forest administration is the largest of the three major
fields and it employs the most people. General administration of all three
fields is exercised by the Chief Forester and his staff located in Washington,
D. C. This central office is made up of a number of functional and operating
divisions. Under the Chief, and to provide field administration, are
10 Regional Foresters -- each in direct charge of one of the 10 Forest
Service regions.

In each region there are several National Forests. Regional offices
are staffed much like the Chief's Office, with such staff and technical assis-
tants as are necessary for the conduct of the work. A Forest Supervisor is
in charge of each National Forest, and his staff also includes a number of
technicians. Forests are divided into administrative work units, each in
the charge of a district ranger who is responsible for the protection of this
unit (ranger district) and for the conduct of its business.

The ranger of today is a college-trained executive, but still carri-
es the imprint of the outdoorsman. He carries out work plans and oversees a
hundred activities, such as timber harvesting, recreation, fire protection,
construction, grazing, and maintains a business organization. The new
ranger is typical of the whole organization. Computers, airplanes, slide
rules, and anti-biotic sprays are some of its work tools. Along with the
ranger are men trained in dozens of professions, including business admini-
stration, all carrying on the vital and varied work of the Forest Service.

The basic management policy of the Forest Service embraces the
multiple-use concept. This concept was recognized by Congress when it
passed the "Multiple Use Act of 1960" which directs the Forest Service with
managing National Forests so as to provide best use of all the resources.
This is not a new direction of management for the Forest Service. In 1905
Secretary of Agriculture, James Wilson wrote Chief Forester, Gifford Pin-
chot, a now-famous letter containing this charge:

"In the administration of the forest reserves it must be
clearly borne in mind that all land is to be devoted to the
most productive use for the permanent good of the whole
people and not for the temporary benefit of individuals or
companies . . .

" . . . You will see to it that the water, wood, and forage
of the reserves are conserved and wisely used . . ."
Where conflicting interests must be reconciled, the question will always be decided from the standpoint of the greatest good of the greatest number in the long run.

In the years ahead there will be many conflicting interests, and many will no doubt involve our water resources. A few short years ago there was exactly 1 acre of National Forest land per person in the United States. By the year 2000, when our population is expected to reach some 330 million people, the average will shrink to little more than 1/2 acre per person. Also, by that time our water needs will be 2 1/2 times that which we use today. Demands for timber, livestock, and big game will double. Recreation use is expected to increase four-fold.

All of these and the many other needs will create pressures, the likes of which we can scarcely imagine today. Even now we are faced with too few acres to provide all the needs of all interests. For example, how much wilderness can be set aside to the exclusion of wood production? To what extent, if any, should recreationists be barred from public watershed lands which serve as a source of municipal water? Should certain rivers be retained in a free-flowing, damless condition at the risk of continued flooding problems and loss of potential power generation? Answers to these questions are not easy when considering the social, economic, and political implications, but they will have to be resolved so that wisest use of our resources can be had.

PERSONNEL NEEDS

Now to the people we need to carry on this work. We presently have around 18,000 on our permanent force. About 5,000 are professional foresters and 2,500 are in other professions. The remainder are administrative, custodial, protection and construction personnel. About 2/3 of our people are assigned to National Forests. The rest are in the Regional and Washington headquarters, the Forest Products Laboratory, Research work and other programs. In addition, we employ around 10,000 temporary employees during the field season for fire protection and other seasonal work activities.

It takes many types of professions to properly manage the many resources found on forest lands. We employ engineers, hydrologists, soil scientists, pathologists, entomologists, ecologists, range conservationists, wildlife and fishery biologists, geologists, architects, and meteorologists, to name a few. Many of these people function in more than one professional specialty.

With the increasing emphasis on water resource management and development, we expect in future years to employ more people having
academic training or a background of experience in water-related fields. In this respect, we are, and will be for some time to come, in competition with many other land management and water resource development agencies as well as the colleges and universities. I consider water and watershed management a real "growth" stock in so far as career opportunities for those entering these fields.

In previous seminars Federal pay scales and employment procedures have been described to you so I will touch only lightly on them. Most of our young professionals with Bachelor degrees are recruited at the GS-5 grade, and most advance to the GS-7 grade in about a year. Depending on the professional series, recruitment at the GS-7, GS-9 and GS-11 grades is sometimes possible for those possessing Masters and Ph. D degrees. Current salary ranges are as follows:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Range</th>
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<tbody>
<tr>
<td>GS-5</td>
<td>$5,181 - 6,720</td>
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<tr>
<td>GS-7</td>
<td>$6,269 - 8,132</td>
</tr>
<tr>
<td>GS-9</td>
<td>$7,479 - 9,765</td>
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<tr>
<td>GS-11</td>
<td>$8,961 - 11,715</td>
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<tr>
<td>GS-12</td>
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<td>GS-13</td>
<td>$12,510 - 16,425</td>
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<tr>
<td>GS-14</td>
<td>$14,680 - 19,252</td>
</tr>
<tr>
<td>GS-15</td>
<td>$17,055 - 22,365</td>
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</tbody>
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As of the end of October 1965, in our Pacific Northwest Region, about 3% of our professionals were in the GS-5 grade, 30% in GS-7, 29% in GS-9, 21% in GS-11, 12% in GS-12, and 5% in GS-13 and above. This will give you some indication of grade structures within our organization. In all Civil Service positions, grades are determined by the duties actually required to be performed by the employee.

The qualities we seek in recruitment, besides technical or professional competence, are those you have heard in other seminars this semester. In National Forest administration, we need people with strong managerial capabilities, interest and dedication to their work, and the ability to communicate effectively - both orally and written.

In closing, I realize I have strayed a little from the topic "Forest Service Career Opportunities in Water Resources." I have tried to give
you a broad picture of the work we do in the Forest Service, the people we employ, and how we are organized. One of the points you should now realize is that the field of water resource management is tied very closely to all the other natural resource fields.

Decisions regarding uses of our water cannot be made independently of other resource considerations. Thus, careers in water resources require not only specialized training but the ability and training to relate water resources to the other land and resource needs. Only in this manner can we be assured that our resources will be managed from the standpoint of "the greatest good of the greatest number in the long run." This is multiple use.
All of the major rivers of the United States have headwaters in forests, associated rangelands, or alpine regions. To derive the greatest benefits and protection from these headwater areas, improved knowledge of the management of watersheds and streams is needed. More than half the waterflow of the country originates in such areas. Whether this waterflow is beneficial or harmful, is well-regulated, sustained flow of good quality or erratic and silt-laden, is contingent to a major degree upon how the headwater lands are managed. Generally accepted estimates of water use indicate a doubling in demand by 1980.

The most logical place to look for additional supplies of high-quality water, or to improve timing of streamflow, is in the headwaters. At the same time, there are constantly increasing pressures to use watershed lands for a variety of other products and services. Research is needed to determine how best to adjust these several uses to give the necessary protection and development to soil and water resources.

The Forest Service program of forest soil and watershed research is carried out through 34 individual research projects at 26 locations throughout the country. At present, these projects are staffed by a total of about 100 scientists and their support personnel. Three of these projects are located in the Northwest. The research projects are problem oriented. That is, they are carrying on studies aimed at solution of problems concerning the management of forest, alpine, and related rangelands—problems having to do with water supply or problems of watershed protection, restoration, and stabilization.

Although our research is problem oriented, about 30 percent is basic in nature. This includes studies of hydrologic processes and relationships of soils, water, and plants, to better understand the hydrology of such lands and the mechanics of watershed behavior.
Our research may be grouped into four general categories: (1) water yield, (2) watershed protection, (3) watershed rehabilitation and stabilization, and (4) forest soil development and improvement.

Research in watershed management problems of the Pacific Northwest is done by a team of scientists with specialized training in hydrology, soils, meteorology, plant physiology, ecology, geology, engineering, microbiology and chemistry. One scientist is often trained in more than one field.

The scientists work together on soil-plant-water relations problems. It is more common for several scientists trained in different fields to be studying various aspects of the same problem than for one scientist to be working on all aspects of a given problem.

The Forest Hydrologist - is primarily concerned with watershed and associated studies relating streamflow to physical factors of the forest environment. This includes studies of quantity and distribution of streamflow from forested watersheds and the changes that result from forest management practices. He is also concerned with water quality as it is influenced by changes in cover.

The Soil Scientist - is concerned with studies of the genesis and morphology of upland soils and works toward a better understanding of these soils so that they can be classified and mapped in a more meaningful manner for watershed management. This involves an understanding of the hydrologic properties of soils and an attempt to improve methods of characterization. He also studies accelerated soil movement problems and attempts to develop ways and means of achieving stability in critical soil areas. Productive capacity of soils may be studied where re-vegetation problems are involved. The soil scientist may also make ecological studies to aid in the interpretation of the suitability of land for a given use or management practice.

The Soil Physicist - is concerned with the physical properties of soil, especially water relations. In our area he might work closely with a hydrologist trained in geology and engineering to study the relationships of soil, topography, geology, vegetation to soil instability. His knowledge of soil morphology and the movement of water through soils may lead to a better understanding of the causes of mass soil movement. The soil physicist attempts to gain a better understanding of how factors such as soil aggregation, slope, and rainfall interact to cause accelerated soil erosion. He studies these complex factors, both individually and collectively, in order to suggest ways in which management practices may be modified to minimize soil movement. He also studies the fate of eroded soil particles to pinpoint sources of stream sedimentation.
The Soil Chemist and Soil Microbiologist - are interested in the productive capacity of the soil and how this is modified by watershed practices. They are also interested in the disposition and movement of nutrient elements in the soil profile and how these characteristics are modified by management practices. This interest extends to studies of water quality, from the standpoint of both chemical and biological characteristics. In addition, these people participate in studies of soil stability--studies such as the influence of soil chemical properties on soil erodibility and the effects of certain micro-organisms on the formation of water-stable aggregates.

The Plant Physiologist - studies the moisture requirements of trees and other vegetation. In the Pacific Northwest, the greatest need is for basic studies of movement of moisture through root, stem, and leaf tissue. We also need to determine how species differ in transpiration rate under varying conditions of moisture stress, and to learn more about seasonal trends in water use. Basic and applied research of the plant physiologist can make a major contribution to determining the relative watershed management advantages of the various species--how vegetation can best be managed for increased water yield, or how vegetation can be successfully reestablished on depleted sites.

The Forest Meteorologist - studies the effects of meteorological factors upon evaporation from leaf, snow, and ground surfaces, and upon transpiration from plants in a forest environment. Other studies may include the effects of these same meteorological elements upon growth and development of protective vegetation. There is also a need for studies of the influence of major topographic features on local climate, and of the influence of local climate on precipitation distribution and streamflow characteristics.

Forest climatology, or the energy budget concept for determining evapotranspiration bases, is one of the most important concepts to enter the field of forest hydrology in recent years. The physical interdependence between energy requirement and vaporization of water is leading to an extensive search for a direct method of determining evapotranspiration loss.

This covers the most important skills used in our research program on forest soils and watersheds. I have touched here and there and only hit the high spots. In general, we are trying to use all disciplines to develop principles and understand hydrologic processes so we can understand watershed behavior, write prescriptions for watersheds to attain desired objectives, and reliably predict the results of various patterns and techniques of management.
Research careers in Forest Service research usually start after completion of training at the Master and Ph.D. levels. Recruitment levels are usually Grade 9, 11, or 12, depending upon education and experience. Scientists have opportunities for advancement wholly dependent upon their ability. Transfers and assumption of supervisory responsibilities are not required for promotion.

Support personnel are provided based upon need. As a general rule of thumb, it requires about $30 to $35 thousand to maintain a scientist and his supporting technical and administrative services. Opportunities for new training and retraining are provided. Each scientist has a training plan which is prepared annually.

Each scientist has considerable responsibility for planning research in areas related to his special skills. Project leaders and scientists analyze research problems and select priorities for studies to answer specific questions. The scientist prepares plans for each approved study and is allocated facilities, equipment, and support personnel to execute the work.

Upon conclusion of studies, the scientist is responsible for reporting his results. He has wide latitude in adapting standard techniques or developing new ones. In addition, each scientist has many opportunities to serve as a consultant in the application of research findings to management action programs.
Presented June 1, 1966 by JACK WOOLSTENHULME, Assistant Regional Supervisor, Division of River Basin Studies, U.S. Bureau of Sport Fisheries and Wildlife, Portland, Oregon.

The U.S. Fish and Wildlife Service

I think it most appropriate that representatives of both a state and federal agency share a program on fish and wildlife careers in water resources. In spite of their somewhat different responsibilities and authorities, they cooperate in a number of programs. Some of these programs are animal control, law enforcement, waterfowl management, fishery management, wildlife and fishery research, and the field of water development.

The staffs of both state and federal fish and wildlife agencies are similar in composition. Most have a few engineers, chemists, and statisticians, as well as specialists in fields such as realty, marketing, and information and education. However, the greatest number of those who are engaged in the principal business of these agencies—research or management of animal populations—are biologists. These people received their formal training in fish or game management or allied fields such as ecology, zoology, botany, forestry, and range management.

As an example, the Bureau of Sport Fisheries and Wildlife, which is one of the two Bureaus making up the Fish and Wildlife Service—the other is the Bureau of Commercial Fisheries—has a little more than 1,200 "technical" positions. About 90 percent of these are biologists or administrators whose background is biology or an allied field.

The Bureau of Commercial Fisheries is a smaller organization in numbers of personnel, roughly one-half the size of the Bureau of Sport Fisheries and Wildlife. Here the ratio of biologists to other specialties is about the same. The principal difference between them is that most of the biologists in this Bureau were trained in fisheries, not wildlife.

Most of the activities of the Fish and Wildlife Service which can be said to be water-resource-connected fall into three rather broad categories: fisheries, water resource development, and waterfowl management. The
first two, fisheries and water resource development, are important activities of both Bureaus. Waterfowl management is the responsibility of the Bureau of Sport Fisheries and Wildlife.

Generally, the people engaged in all these activities have at least one thing in common: their formal training, whether in fisheries, game management, or some related natural science or science-based technology, was one in which they had a deep, personal interest. These are all disciplines that have the capacity—perhaps more so than many others—to attract the kind of interest that can result in an exceedingly well-trained and single-minded scientist.

In many of our universities, even the undergraduate who wishes to concentrate on his major course of study to this extent is usually permitted—oftentimes encouraged—to do so.

There are a few jobs in the Fish and Wildlife Service in which there is no responsibility for convincing the public of the need for a given program or a certain way of doing it. If the well-trained biologist finds himself in one of these jobs, he's home free. Most of our work, though, is management for people. Some are fisherman, hunters, and nature lovers—and some are not. He works for all of them.

It can be quite a shock to go to work, fully equipped with all the latest biological knowledge, and find that most of the problems you're expected to solve are either social, economic, or political. That's when education begins. It's all very well to have a packsack full of carefully gathered data that says the management of a certain deer herd requires the harvest of a portion of its does, or that a certain fish run must be protected from harvest by certain individuals or for a certain period of time; but, somehow, that mass of data begins to shrink when it's measured against a mass of emotion.

I don't have a single, unequivocal, answer for a situation such as this. If you know enough of the non-biological background, however, there usually is one. Occasionally, I'll have to admit, it is time. I'll admit also that this is considered to be no answer at all by the person in a hurry.

**WATER RESOURCES DEVELOPMENT**

I'd like to tell you a bit more about one of our activities, water project development. It cuts across those of most other agencies who have talked to you in this seminar series. -- - - - - Now, there is an example of my emotion—or biological bias. I should have said it meshes with the activities of those other agencies.
In many respects, water resource development is one of the most important of the cooperative activities of the state and federal fish and wildlife agencies. No one of the others has in it more potential for destruction of fish and wildlife, and certainly no one of them can approach it in potential for doing good. Both sides of this coin can be seen fairly close at hand.

The Pacific Northwest has many streams in which runs of anadromous fish have been destroyed. At the time of project construction no one thought of the needs of these fish for unobstructed passage to spawning grounds, sufficient quantities of water in the streambeds at certain times of the year, or proper water quality. In many cases, these needs could have been assured with little or no cost.

Less than a day's drive from many of these "horrible examples" is the Columbia Basin Irrigation Project in north-central Washington. At one time, the area this project now covers was semi-arid land which provided fishing and hunting for only a few individuals. Now it teems with waterfowl and other forms of wildlife, as well as reservoirs and seep lakes which provide fishing for thousands.

You have to see the opening day of the fishing or hunting season there in order to believe it.

Fish and Wildlife Coordination Act

The many, many losses to fish and wildlife in the early days of water project development, and the comparatively few gains, led to passage in 1946 of the Fish and Wildlife Coordination Act. As Lincoln Steffens has pointed out for another field of human relations, excess is the predecessor of reform movements. I won't carry his observations further than this except to say that we try to use such "powers" as we have in a reasonable manner so as not to generate a reform movement away from fish and wildlife conservation.

The Coordination Act--this is what put the state and federal fish and wildlife agencies into the field of water resource development--states:

"...whenever the waters of any stream or other body of water are proposed or authorized to be impounded, diverted, the channel deepened, or the stream or other body of water otherwise controlled or modified for any purpose whatever, including navigation and drainage, by any department or agency of the United States, or by any public or private agency under Federal permit or license, such department or agency shall first consult with the United States Fish and Wildlife Service,
Department of the Interior, and with the head of the agency exercising administration over the wildlife resources of the particular state wherein the impoundment diversion, or other control facility is to be constructed, with a view to the conservation of wildlife resources by preventing losses of and damage to such resources as well as providing for the development and improvement thereof in connection with such water resource development."

The Coordination Act has been amended several times since 1946, principally for clarification. As it now stands, it gives fish and wildlife equal status with other project purposes; provides for withdrawal and purchase of lands for fish and wildlife; permits enhancement (a later Act, P.L. 89-72, the Federal Water Project Recreation Act, established some new ground rules for enhancement of fish and wildlife); and authorizes modification of projects and project operations on behalf of fish and wildlife.

The Act also provides for transfer of lands to state fish and game agencies for fish and wildlife management. The Coordination Act does not give the Fish and Wildlife Service or the state fish and game agencies any veto power over projects, nor does it require that our suggestions be adopted by construction agencies. It only requires that they be considered, and it gives authority for their adoption if they are found to be warranted.

**FEDERAL - STATE RESPONSIBILITIES**

We've been in this business for about 20 years, roughly about one-third to two-thirds of the time that conservation and management of fish and wildlife has been recognized as a profession.

In that 20 years, we've progressed from a "a voice, crying in the wilderness" to our present status as representatives of a recognized, valuable, natural resource. During that developmental period, there has grown up a system of shared federal-state effort on water development projects. It has never to my knowledge been the subject of a formal memorandum of understanding, as in most of our other shared programs, but it's fairly well defined now, and it seems to be working.

The state fish and game agencies have basic responsibilities for management of most species within the boundaries of their states. Consequently, they have in their files much of the information necessary to analysis of the effects of a project. Over the years, the collection of such data has come to be one of their most important responsibilities in water development work.
The Fish and Wildlife Service has the principal responsibility for report preparation, coordination with other federal agencies, and liaison with the Congress. In order to avoid duplication of effort, the state agencies usually do not prepare a separate report. They indicate with a formal letter their concurrence in the report of the Fish and Wildlife Service. I've made this sound simple, I think. Of course, it is not. Before agreement is reached on a report containing recommendations to conserve and develop fish and wildlife resources, there is usually a great deal of discussion.

DESI RABLE PERSONNEL QUALIFICATIONS

Fish and Wildlife biologists are not noted for their calm, dispassionate views of actions affecting fish and wildlife. I think this is because their vocation is quite often coincident with their avocation—and I think it's good that this is so. The person who is incapable of becoming personally involved in his job is not likely to do it well. This is not to say that a biologist in this field must think only of fish and wildlife.

Certainly, this is his first responsibility, but he must be prepared to fit it into a program which best serves the needs of everyone: those who care nothing for fish and wildlife, those who care so much they can see no good in a project which changes these resources at all, and all the people whose ideas fall somewhere in between these extremes.

The fish or game biologists in the field of water resource development must be prepared to accept the best possible compromise for fish and wildlife when it's offered, and he must be wise enough to recognize it. He must be prepared also to be satisfied with the "middle ground," since he's usually one of the few who will be. This is a field full of emotion—on both sides.

Another quality necessary to a good biologist in this field is imagination. Not all opportunities for fish or wildlife enhancement in connection with water development projects are obvious. For example, some I've seen have involved some extremely complicated water exchanges. To bring such ideas as these to fulfillment takes another quality—perseverance. You can't have too much of it. As I've implied, there will be resistance from both sides to proposals involving compromise on both sides. The person who is easily discouraged usually won't get there.

In the earlier days of our work in water development, it was enough that a biologist knew biology. If the accumulation of biological data is his only responsibility now, it may still be enough. But even success sometimes causes problems. In the earlier days, when we made recommendations that weren't accepted, they needed no justification.
Recently, we have found ourselves with the equal status in planning that we have been asking for and working for all these years. We've also found, however, that this opportunity brings with it some additional responsibilities. In order to justify our proposals, we've had to become at least semi-skilled in water resource economics, writing, engineering, hydraulics, legislative processes—even public relations, which some scientists believe is something someone else should do.

Most of the individuals in this field today, then, started their careers as wildlife or fishery biologists. In school they specialized in research or management, with a background of as much biology as they could cram into their curriculum. Their knowledge of these other facets was gained the hard way—in the school of hard knocks. Those who have been successful have become "human ecologists" in spite of their rather specialized training.

For the individual who wants to work in this field. I'd suggest—to go with the biology—some courses in economics, writing, public speaking, and government. You should take enough of these courses to become thoroughly familiar with the principles involved.

Another subject which I think is helpful to anyone, regardless of his major field of study, is mathematics. It's good discipline for the mind, and teaches logical thought processes in problem solving—something that's difficult to get from zoology and botany.

Last, and perhaps most important, is ecology in either its biological or social form. Its teaching, that no action we can take is without its implications elsewhere, is one none of us can afford to be without.

I haven't been able to attend the others in this seminar series, but I suspect that what I've said has already been said many times. In order to do a good job in any field which requires the accommodation of more than one interest—and this takes in a lot of territory—you must have a good understanding of the needs and desires of other people. You must know the part your particular specialty plays. You must condition yourself to be objective. This last is easy enough, ordinarily, but when the interest of someone else is involved, it becomes difficult.

If you can get the foundations for these attitudes from your schooling, you'll be that much ahead when you start work. You'll be well on your way, too, to being a good and useful citizen. This is even more important.
Fish and Game Management in Oregon

The career opportunities in water resources in the two state agencies--Fish Commission of Oregon and the Oregon State Game Commission--are many. In fact, with the possible exception of the positions related to the fiscal aspects of the organizations, nearly all the positions are water-resources oriented in some degree.

Both state organizations employ aquatic biologists whose relationship with the water resources of the state is obvious. Less well known is the relationship of the water resources of this state to game biology. From marsh areas for waterfowl and certain furbearers to simple watering devices for upland birds, water is of extreme importance to the game management program in the State of Oregon.

I do not believe it would be too much of an exaggeration to say that to a great degree both organizations are water-resource dependent and, therefore, that the positions in the organizations should be considered as careers in water resources whether the Civil Service classifications be that of an engineer, a supervisor, or an aquatic biologist. Both the Fish Commission of Oregon and the Oregon State Game Commission use the Civil Service classification series of aquatic biologists extensively. Pay range in this series runs from $480 to $810 a month. More specialized positions, as well as division heads and supervisory positions, run somewhat higher. Although it is not the highest paid field in the world, there are many desirable features to this type of work.

In fishery management the work falls mainly in three fields--propagation, management, and research. In each of these three major fields, there are many subfields. For example, in propagation there is nutrition, disease control, etc.

Information on training requirements, general duties, etc., is readily
available from the two agencies, the Civil Service Commission, and the American Fisheries Society. For this reason, rather than going into a great deal of detail, I would prefer to deal with a special career problem that not only exists with our two agencies but probably with all water-resources careers. I might even go further and say that this problem exists in all government and industry today. I would like to spend what little time I have left in just a brief statement of this problem to give you something to think about in preparing yourself for a career.

**LEADERSHIP TRAINING**

I believe this is best stated simply as leadership training and it certainly is sorely needed. I would hope that some in this room would aspire toward leadership and would be thinking something of training that would augment specialized training with this in mind. The basic problem might be stated as follows:

In this day of high specialization, which is certainly needed, there is increasing difficulty in the task of making the transition from particularized excellence (specialization) to the more general and complex problems of leadership. Specialization, unfortunately, leads to fragmentation of leadership and we all realize that in today's water resources as well as other programs and occupations, specialization is more and more necessary.

The former President of The Carnegie Foundation who is now Secretary of Health, Education, and Welfare, the Honorable John W. Gardner, in a speech on this subject last year made the following statement, and I quote: "It isn't anybody's business to think about the big questions that cross specialties, the largest questions facing our society." Secretary Gardner then continues, saying this about training of leaders: "The best students are carefully schooled to avoid leadership responsibilities. The academic world appears to be approaching a point at which everyone will want to educate the technical expert who advises the leader or the intellectual who stands off and criticizes the leader, but no one will want to educate the leader himself."

These are strong words and I am happy that I found authority of the stature of Mr. Gardner to express the feelings that many people in lower administrative positions have felt for some time.

Unfortunately, due to the type of specialized education today, the leaders who are developing lack the essential element of confidence so necessary for reaching and following through on difficult decisions. In fact, Secretary Gardner refers to what he calls the latest modern art as "how to reach a decision without really deciding."
How serious is this problem? Well, it is serious enough not only to concern people in state organizations managing fish and wildlife resources, but it is serious enough to concern top administrators in industry and government throughout our country. Really, we are on the horns of a dilemma and are forced to cope with two contradictory forces that are at work today. On the one hand, increasing specialization in all professions makes technical expertise an essential prerequisite for anyone who seeks the position of influence within his profession.

On the other hand, in this age of large-scale organization and increasing specialization, we face a more urgent need than ever before for people who are capable of practical action in complicated areas requiring deep knowledge of several related disciplines. The person who has equipped himself as a specialized technician and has succeeded in climbing the ladder of progression within his chosen profession may be, and quite possibly is, incapable later in life of thinking in broad terms about the largest questions that are facing his particular profession and activities. In the present instance it is the long-range use and management of our water resources.

**HUMANITIES AND SOCIAL SCIENCES**

How do we cope with this problem? I wish I knew the answer. Certainly the institutions of higher education, in general, during the past ten years have been pulling away from the idea of educating the generalist and have moved toward the teaching of specialized disciplines and doing their own research. This probably means that the individual himself will have to go it alone without too much assistance and guidance from his own academic institution.

I will recognize that it is taking a good many years out of a student's life now to become adequately trained in his own specialized discipline. To say that he should also have a little grounding in economics, law, political science, mathematics, engineering, history, and philosophy would be almost ludicrous. I do believe, however, that some of the humanities and some of the social sciences certainly are necessary in the basic educational training for a man who is to develop in to the type of person who is to make the decisions that will be needed in the next few decades.

Quite possibly, all we can say is that it would seem essential that training and education should assist the ability for creative thinking in the student. Also, the ability for the individual to relate his ideas to complicated problems bearing on sociology, economics, and other factors as well as his specialized scientific discipline must be considered.
In the final analysis, however, leadership is essentially an attitude of mind. No matter what educational programs, specialized training, or generalized experience are devised, there must be a willingness by some individuals to accept the risks which are the inevitable companions of leadership. The men who can achieve expertise but retain flexibility, who can find alternatives, and still put their efforts to the task of implementation--these will be the leaders of the future and these are the men who are direly needed.