

NEW HORIZONS IN WATER RESEARCH

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This is my initial attendance at your Annual New Mexico Water Conference and I am very pleased to be present. A keynote speech is an exacting assignment, and I consider it a distinct honor that Dr. Corbett invited me here for this purpose. Together we are to explore the theme, "Research--Key to the Future in Water Management." In my own topic, "New Horizons in Water Research," I hope to contribute a new idea or two and help set the stage for the very timely discussions to follow.

I detect here a sharp professional awareness of the water needs of New Mexico--for industry, agriculture and your whole economy. Your key concept is growth. Much of your state is generally deficient in rainfall. Within its borders are vivid contrasts in climate and topography. It is an area increasingly attractive to tourists and utilized extensively by the military for some of its unique installations. New Mexico nevertheless is still a land of wide open spaces, whose waters fortunately have not suffered the intense pollution experienced by some of her more heavily populated and industrialized sister states. Thus, I am not surprised that much of your concerns at this Annual Conference have been oriented to water quantity--to capturing, conserving and putting to maximum beneficial use as much water as can be made available.

My business happens to be water quality--more specifically, water pollution control. I represent the federal government's program of water pollution control in the Public Health Service and its parent agency, the U.S. Department of Health, Education, and Welfare. I should like to keynote this Conference on the premise that quantity and quality are rather closely related in water resource development. They are inescapably linked in reservoir construction; in evaporation control; in irrigation projects; in programs of ground-water recharge. Certainly, quantity and quality also go hand in hand in our water research programs.

Your own Dr. Viessman of the Civil Engineering Department here at New Mexico State University made some poignant statements bearing on this at your Conference last year. That Conference, you recall, centered around the saline water conversion plant at Roswell where the Department of Interior is test-piloting its interesting findings of the past decade. It is a program full of promise for New Mexico and the whole Southwest.

Dr. Viessman warned of the enormous quantities of wastes which accrue from desalted water--residues which will constitute a major

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pollution and cost headache unless researchers can find some safe and inexpensive method of disposal. In delivering one million gallons of pure water daily, Dr. Viessman said, the Roswell plant will also produce about one-third this quantity of waste effluent. He estimates that a community of 40,000 getting 15 percent of its average daily water supply from saline water conversion will also get an unwanted bonus of solid waste 16 times greater than the volume from its entire sewage treatment operation.

Please note that Dr. Viessman emphasized that research must find some additional answers in the saline water program which up to a point has been so successfully launched.

Very often success in one area calls for further investigation in another. In this age of rapid technological advance, growing populations and production, nothing in research or research needs remains static. This is borne out in the accelerated research and development we have witnessed across the board since World War II.

President Johnson's first budget allocated \$15.3 billion for research and development for the coming fiscal year. It is nearly five times what the Government spent for these items just 12 years ago.

Let me say, however, that until very recently, those of us long involved in the water business were rather keenly aware of needs and deficiencies in water research. Thus, when Congress some two years ago became intensely concerned over the rapid rise in government research, we had misgivings. There were inquiries and reviews by Congressional committees, the Executive Department and others, and these, we felt, might well lead to retrenchment in water research.

But reports now coming out of the special inquiries are heartening. To quote a report issued in Washington only last month by the House Select Committee on Government Research:

"Additional funds requested for research and development in the coming fiscal year are less than \$1 billion, the lowest annual increase in recent years...The Federal Government's marriage to research and development has been marked by an amazingly long and luxurious honeymoon. This is due mainly to the exhilarating nuclear age atmosphere in which the union was finally fused and unsparingly nurtured. Noting the recently slackening annual increase of Federal funds for research and development activities, some say the honeymoon is over. Be that as it may, it is certain the marriage will endure. And while it is not so certain what precise course this permanent venture will take, what must be made certain is that some plans are now provided to help avoid the diversions and obstacles and problems of all sorts that inevitably lie in the road ahead. At the same time it is the task of this committee to

insure that the incentives for engaging in research and development are strengthened and safeguarded rather than strangled by excessive controls and red-tape."

Here indeed is new opportunity to overtake the horizons in water research--horizons which for a long time were receding, even as our water problems pressed alarmingly closer.

This year's water research and development activities costing some \$65 million are carried out by eight Federal agencies. The term "research and development" includes activities in which the primary aim is either to develop new knowledge or to apply existing knowledge to new uses. These activities may be carried out in government installations, in colleges and universities, or in other state, local or private facilities using Federal funds. Involved are the multiple uses of water--for agriculture, industry, hydro-power, recreation, fish and wildlife, public water supplies, and a wide variety of activities.

They range from investigations in weather modification to increase precipitation and how to reduce reservoir evaporation so studies in the control of seepage in water distribution systems and developing water application rates for the many crop and soil types of various regions. Some of the research, as I have already indicated, relates to demineralization of saline and brackish waters; and some to the control of phreatophytes, the deep-rooted, water-consuming trees and shrubs of the semi-arid lands. These are but a few of the many studies under way in the Government's \$65 million-a-year water research effort. You will hear more about these programs in the discussions today and tomorrow.

In my own field of water pollution control, research has outgrown the traditional concerns of bacterial contamination arising from domestic sewage and the older types of organic industrial wastes. The growing demands for clean water have forced us to re-examine our methods for controlling water quality.

Today we are seeking answers to the complex chemicals finding their way into our waters--including such troublesome substances as foaming detergents, agricultural pesticides, and the taste-and-odor causing phenols. We are concerned, too, about such problems as acid mine drainage; about sediments which fill stream channels and reservoirs, cause corrosion, affect the fishery, and increase the cost of water treatment. Radioactive pollution is being kept under constant surveillance. Temperature increases which result from industry's use of water for cooling purposes, may have harmful effects on fish and aquatic life and reduce the capacity of the receiving water to assimilate wastes. Too little study has been made of ground-water contamination in our growing "septic tank suburbias." The build-up of salt in return-flow irrigation waters is increasingly troublesome. These are but a few of today's water pollution problems

to which we do not have the full answers--to which we must find the answers through research and development.

For more than three years the Public Health Service has been engaged in an intriguing research project in the field of waste water renovation. This program, which has come to be known as our "Advanced Waste Treatment Project," has two ultimate objectives. One is to help abate our nation's growing water pollution problems, and the other, more startling in concept, is to renovate waste water--sewage, if you please--for direct and deliberate reuse for all legitimate purposes.

Waste waters are this country's most immediately available water source. They do not have to be pumped over mountains or from deep underground sources. If we can learn how to remove the contaminants from these waters efficiently and economically, then these waters can be used again and again. In a single step such a new technology would alleviate both our water pollution and our water supply problems.

Technically, advanced waste treatment may be looked upon as a two-step process: (1) separating concentrated contaminants from the purified water "product" and (2) disposing of these contaminants in a way that will render them forever innocuous. The need for developing this two-step treatment process is more than economic, even though its success will be measured by economics. Many of the inorganic and organic contaminants now entering our water resist every phase of present day treatment--sewage treatment, natural purification in streams, and water treatment.

We have explored half a dozen principles of physical-chemical separation--some of them similar to the salt water conversion processes--and we have others under study. We are exploring these both in our own laboratories and by contract with industrial and university laboratories. We are ready to go into large scale testing of two methods--carbon adsorption and electro dialysis.

We can speculate that the future water renovation plant will encompass a number of processes, in series and perhaps in parallel. Some of these processes may be those we use today in municipal water and waste treatment, while others--for example, foaming or freezing--will probably be new to sanitary engineering. Disposal processes will be a part of the entire system and may include land-fill, digestion, incineration, and injection.

We can expect, within this framework, that a variety of degrees of renovation will exist, depending upon the intended water use. For irrigation and for recreational, and some industrial uses, partial renovation may be adequate; but plants designed to produce water of potable quality must be capable of rather complete renovation.

Waste water reclamation is already contributing significantly to solution of some of southern California's complex water problems. The Public Health Service is supporting a project which, for almost two years, has been using reclaimed waste water to replenish ground-water supplies on which the Los Angeles Metropolitan Area depends. The Whittier Narrows Water Reclamation Plant, built by the County of Los Angeles and operated by the Sanitation District, reclaims 12 million gallons of water daily from a nearby trunk sewer. The water is sold at \$12.75 per acre-foot--the same as is paid for Colorado River water imported for the same purpose--to recharge ground-water supplies used by the City of Los Angeles. The Sanitation District is currently considering expansion of the program at a cost of \$20 million for eight additional plants to reclaim 100 million gallons daily--approximately one-third of the District's sewerage waste waters.

Similar use of ground-water recharge is being made along the southern California coast to correct the serious intrusion of salt water where the fresh-water aquifer has been overmined.

Perhaps the most interesting use of reclaimed waste water is occurring at what we call the Santee Project, inland from San Diego about 17 miles. Here the Public Health Service is cooperating in an experimental use of reclaimed waste waters for recreational purposes. Initiated in 1959, the project which comprises four recreational lakes, has been well accepted by the public for boating, fishing, and as a picnic and golfing area. Santee, let me say, has completely exploded the myth that the public will not accept reclaimed sewage waters for purposes other than irrigation. The count of visitors in a single day has been as high as 10,000. We are presently investigating the health aspects of this recreational use of reclaimed waste water, before permitting swimming, water-skiing and eating of the fish that are caught.

Reclaimed waste water figures prominently in the Southwest Water Plan in which your own State of New Mexico is involved. Interestingly, the plan makes the point that water management is as important to this five-state area as is the development of new supplies. Six management procedures are named, and the amount of water that can be expected to accrue from each is delineated.

Five of these procedures--lining or sealing of irrigation canals, channelization, control of phreatophytes, ground-water recovery, and evaporation suppression--would provide the Southwest some 655 billion gallons of water per year. The sixth procedure--urban return flows, which is the waste water reclamation technique I have been talking about--would provide more than all the others combined, 880 billion gallons per year.

Now, gentlemen, I want to talk for a moment about cooperation as a part of the "New Horizons in Water Research." Three weeks ago in New York City I told an industry group that the first requisite of any cooperative effort is good communication. If we are to help

regions, states, cities or people solve problems, or if they seek our help in solving problems, we must know who they are, where they are, what is needed--and they must know the same about us.

We know that water problems requiring research are growing, both in number and complexity. I have mentioned that some eight Government agencies are involved in water research. And here let me stress that every effort is made to avoid overlap and duplication of effort to derive maximum benefit from research dollars. We in Government recognize our great responsibility in research. We are equally aware that we must cooperate with others in seeking solutions to problems. But to be truly effective, you and we must do an effective job of communicating with each other. Conferences such as this are most helpful.

I have also said that the Government's \$15 billion a year investment in research and development is being spent in part in the colleges and universities, as well as in state, local and private facilities. In this connection, I want to tell you of one of the greatest opportunities for cooperative research that has ever presented itself in my own field of water pollution control.

Seven regional water pollution control laboratories have been authorized by the Congress in various parts of the country, and they will have a profound impact on maintaining and improving the purity of our waters. For the first time, our research program will have its resources deployed in the heart of the areas where water pollution problems occur.

Supporters of the laboratories and the Congress itself realized that water pollution problems vary greatly from one part of the country to another; they were aware also that the laboratories should be located in sections of the country which have special problems due to natural causes, climate, geographical features, or man's habits. These points are reflected in the legislation, which also makes a third and, I feel, very wise provision. It specifies that, insofar as practicable, each such facility is to be located near an institution of higher learning--in which graduate training in water pollution research might be carried out.

The laboratory which will serve New Mexico is to be located at Eastern State College, Ada, Oklahoma. It will open in about one year, but already we are assembling a nucleus staff there. When complete, it will be staffed by about 100 scientist and technical personnel, plus 50 supporting workers.

We believe our relationships with the schools will be the key to our cooperative research in the future. We interpret the provisions of the legislation authorizing these facilities to mean that we are to work with these institutions in every feasible manner. We further believe that the Congress intended us to work with several institutions and not merely those on whose campus the facility may be

located. Consequently, we are developing plans with many schools which we hope will ultimately include all of the eligible institutions in the general area to be served by each laboratory.

Helping us to interpret the Congressional Act is this paragraph from a recent report presented to the President by the Federal Council for Science and Technology:

"Where possible, cooperative arrangements between Federal research establishments and the universities should be strengthened and extended in order to permit the outstanding scientific competence that exists in Government agencies to contribute to the training of new scientists. These include authorization and arrangements for Government scientists to teach and engage in research at educational institutions, locations of some Government research activities at educational institutions, and increased opportunity for graduate-thesis work at Government laboratories under arrangements with the universities."

In 1962, the Congress provided for two additional water pollution research centers, to serve as national water quality standards laboratories. One facility will focus on fresh water at the University of Minnesota's Duluth campus and the salt water laboratory will be at the University of Rhode Island.

For the past year we have been meeting with state, university, and industrial people to map out research projects in different parts of the country. We are moving toward a partnership which will bring together the scientific competencies of industry, Government and our great institutions of learning. Let me assure you, however, that we are not going to duplicate any of the fine work that is already being performed or can better be done at the universities.

The Public Health Service also maintains a program of grant-supported research in the universities, now numbering close to 300 projects. They include a number of fellowships, training projects and field demonstrations, in addition to basic research by individuals. Here at New Mexico State University, for example, one of the grants is supporting a study in "Aerobic Treatment and the Biochemical Oxygen Demand Test."

We feel strongly that the degree of success attained by these grant-supported projects will be directly measured by the freedom with which we permit them to operate in the universities. Nevertheless, the persons involved welcome and need assistance and leadership. Most of all, they need encouragement and recognition in some tangible form. Also, it is evident that if the gap in knowledge in the water pollution field is to be filled, some organization and coordination must be supplied through administrative circles.

As I see it, one of the functions of our scientists at the regional laboratories would be to encourage departments in the various schools--schools not heretofore concerned with water pollution control--to apply for research grants, demonstration grants, and training grants, or to assist students in applying for research fellowships. In this way, we can gradually bring new brain power and skills to our many unsolved, and emerging new, problems.

So, the new regional centers will be more than laboratories and research facilities, per se. They will serve much as does the Public Health Service's Sanitary Engineering Center at Cincinnati--as focal points for training, for demonstrations and pilot plant studies, and for technical and scientific assistance. We will certainly expect the individual states to make known to us the types of technical training and other assistance they would like to have from the seven regional water research centers.

When he had been some 18 months in office, our late President Kennedy expressed to the Congress his belief in "concentrated and coordinated research programs...directed to such specific problems as desalinization of water, improving water quality...and preventing water evaporation." He said that "just as our investment of scientific talent, money, and time is better utilized in well-coordinated and complementary programs within the Federal Government and by the closest working relationships with state and local governments, the academic community and industry, so our efforts should be meshed with those of the other countries of the world."

It is on this note that I should like to close my remarks. The growing needs for water have created interests and pressures that have brought this resource into the highest councils. It is evident that the sweep of research and development having to do with the water resource is more than nationwide--is now worldwide in scope. We find ourselves, for example, involved in such developments as UNESCO's International Hydrological Decade and the establishment of a Scientific Committee on Water for the International Council of Scientific Unions. My own program two years ago helped organize an International Conference on Water Pollution Research, the second session of which will meet in Tokyo in August of this year.

We live amid nuclear power and jet propulsion which have shrunk our planet to very small proportions indeed. In managing its resources we can no longer proceed on a narrow nation-by-nation basis. Rather, we must share--we are sharing--our knowledge and findings nation-to-nation. Whatever the research undertakings--whatever the useful information and technological applications developed by any nation--they must be shared to advance the cause of all mankind.