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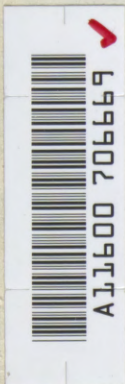
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HEARINGS BEFORE THE SUBCOMMITTEE ON IRRIGATION AND RECLAMATION OF THE COMMITTEE ON INTERIOR AND INSULAR AFFAIRS UNITED STATES SENATE

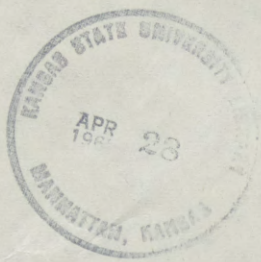
EIGHTY-NINTH CONGRESS
FIRST SESSION

ON
S. 22

A BILL TO PROMOTE A MORE ADEQUATE NATIONAL PROGRAM
OF WATER RESEARCH

MARCH 2 AND 3, 1965

Printed for the use of the
Committee on Interior and Insular Affairs



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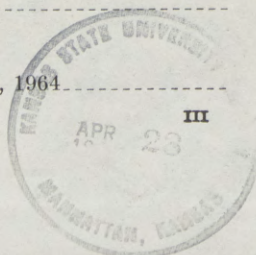
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WATER RESOURCES RESEARCH

TUESDAY, MARCH 2, 1965

U.S. SENATE,
SUBCOMMITTEE ON IRRIGATION AND RECLAMATION
OF THE COMMITTEE ON INTERIOR AND INSULAR AFFAIRS,
Washington, D.C.

The subcommittee met, pursuant to call, at 10 a.m. in room 3110, New Senate Office Building, Senator Clinton P. Anderson (chairman of the subcommittee) presiding.

Present: Senators Anderson, Moss, Burdick, Kuchel, Allott, and Jordan.

Also present: Jerry T. Verkler, staff director; Stewart French, chief counsel; and Richard N. Little, minority counsel.

Senator ANDERSON. This is an open, public hearing by the Irrigation and Reclamation Subcommittee of the Senate Interior Committee on S. 22, a bill to promote a more adequate national program of water research. Senators Bartlett, Bayh, Bible, Burdick, Carlson, Gruening, Hart, Jackson, Kuchel, Long of Missouri, Mansfield, McGee, McGovern, Metcalf, Morse, Moss, Tower, and Yarborough, joined with me in sponsoring this measure.

I will direct that the text of the bill and any reports the committee may receive on it prior to the time these hearings go to press be printed at this point in the record.

(The data referred to follows:)

[S. 22, 89th Cong., 1st sess.]

A BILL To promote a more adequate national program of water research

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That (a) section 200 of Public Law 88-379 of the Eighty-eighth Congress is repealed and

(b) That there is enacted in lieu thereof the following:

"Sec. 200. There is authorized to be appropriated to the Secretary of the Interior \$5,000,000 in fiscal year 1966, increasing \$1,000,000 annually for five years, and continuing at \$10,000,000 annually thereafter from which he may make grants, contracts, matching, or other arrangements with educational institutions, private foundations, or other institutions; with private firms and individuals; and with local, State, or Federal Government agencies, to undertake research into any aspects of water problems related to the mission of the Department of the Interior, which may be deemed desirable and are not otherwise being studied."

U.S. DEPARTMENT OF THE INTERIOR,
OFFICE OF THE SECRETARY,
Washington, D.C., March 1, 1965.

Hon. HENRY M. JACKSON,
Chairman, Committee on Interior and Insular Affairs,
U.S. Senate, Washington, D.C.

DEAR SENATOR JACKSON: This responds to your request for the views of the Department of the Interior on S. 22, a bill to promote a more adequate national program of water research.

We recommend that the bill be enacted.

S. 22 would amend title II of the Water Resources Research Act of 1964. Under title II of the Water Resources Research Act the Secretary of the Interior is authorized to support a program of research into aspects of water problems related to missions of the Department of the Interior. Appropriations of \$1 million per year for 10 fiscal years commencing with fiscal years 1965 are authorized for the program. Money appropriated pursuant to this authority may be used for grants, contracts, matching or other arrangements with educational institutions (except those at which a water resources research institute is maintained pursuant to title I of this act), private institutions, private firms, or individuals and Government agencies, local, State and Federal. The act provides that appropriations may be made to finance grants, contracts and other arrangements only if they are not disapproved by the Senate or House Committees on Interior and Insular Affairs.

S. 22 would not change the purpose of title II of the Water Resources Research Act, but it would enlarge the scope of the program and remove some limitations from it. The bill would make four important changes in title II.

First, appropriations would be authorized at the level of \$5 million for fiscal year 1966. The authorization would increase by \$1 million annually until the level of \$10 million was reached. The authorized ceiling would remain at \$10 million per year thereafter.

Second, the 10-year limit on the authorization for appropriations to carry out title II would be eliminated.

Third, the prohibition against support of research at educational institutions where there is a title I water resources research institute would be dropped.

Fourth, the provisions for legislative committee review of proposed grants, contracts, and other arrangements would be dropped.

We believe that all four of the changes that S. 22 would effect are justifiable and would benefit the program. We therefore support the bill.

As to the first change, in the short life of the Office of Water Resources Research (established in the Department to administer title II), we have received 36 proposals for research activity into water resource problems affecting the Department's missions. These proposals aggregate \$1,750,000 and come from responsible, qualified individuals and organizations. Many of them would be accepted if it were possible to do so within the limitations of the appropriations available. This outpouring of proposals is particularly striking in view of the fact that appropriations under title II have not yet been made. When the limit of authorized appropriations was established at \$1 million per year it could not be known with certainty what level of activity could be anticipated. In supporting the bill that became the Water Resources Research Act the Department was not in a position to predict what level of response would be stimulated by the act. Experience based on the number of proposals received to date demonstrates that \$1 million per year is inadequate, and suggests that an authorization of \$5 million to support the first year's research program is justified. As the program becomes better known, and as more talent and capacity is developed over the next few years, we expect promising proposals to increase, thus justifying a gradually rising appropriation ceiling to \$10 million per year by 1971.

As for establishing the authorization for appropriation without a definite time limit, at least two points should be made: (1) Much of the research that will be undertaken will be of a long-range nature and the prospect of long-term support for it must exist if it is to commence; and (2) water problems will persist and the capacity to analyze and deal with them will grow in the future; this Department's mission will become more important and complex as time goes on and it is reasonable that the program be authorized on a continuing basis.

The third objective of S. 22—dropping the prohibition against associating with institutions maintaining water resource research institutes—makes eminent sense. These institutes and the educational centers where they are located

are likely to be the loci of much of the water resources research capability in the Nation. The Secretary should have the authority to look to that capability to accomplish the purposes of title II. The provision in the bill that support may not be given to research projects otherwise being studied will insure that duplication will not result from dropping this provision of the act.

Fourth, S. 22 would eliminate the authority of the Committees on Interior and Insular Affairs of the House of Representatives and Senate to bar appropriations to fund research projects proposed to be undertaken pursuant to title II of the act.

The last sentence of section 200, title II, requires that each proposed grant or other arrangement be submitted to the Congress to lie before the Committee on Interior and Insular Affairs of the House of Representatives and Senate for 60 days. Appropriations to finance these grants or other arrangements are permitted under the act only if neither committee disapproves them within the 60-day review period.

In approving the Water Resources Research Act the President made reference to this requirement, stating:

"One provision of the bill, however, causes me serious concern, and I request its deletion. The Secretary of the Interior, in administering the program is required, in effect, to obtain the approval of the committees of the House and Senate for each water research grant or contract. Although this legislation is so phrased that it is not technically subject to constitutional objection, it violates the spirit of the constitutional requirement of separation of power between the executive and legislative branches. It is both inappropriate and inefficient for committees of the Congress to participate in the award of individual contracts or grants. Apart from the question of the relationship between the executive and legislative branches, the delays which would ensue from the suggested procedure would be detrimental to both scientific research and the timely achievement of the important mission of the legislation."

S. 22 would carry out the President's request.

The Bureau of the Budget has advised that there is no objection to the presentation of this report from the standpoint of the administration's program.

Sincerely yours,

STEWART L. UDALL,
Secretary of the Interior.

EXECUTIVE OFFICE OF THE PRESIDENT,
BUREAU OF THE BUDGET,
Washington, D.C., March 2, 1965.

HON. HENRY M. JACKSON,
*Chairman, Committee on Interior and Insular Affairs,
U.S. Senate, Washington, D.C.*

DEAR MR. CHAIRMAN: This is in response to your request for the views of the Bureau of the Budget on S. 22, to promote a more adequate national program of water research.

S. 22 would repeal section 200 of the Water Resources Research Act of 1964 (Public Law 88-379), and substitute therefor a provision which would authorize appropriations to the Secretary of the Interior of \$5 million in 1966, increasing \$1 million each year thereafter for 5 years, and \$10 million annually thereafter for grants, contracts, matching, or other arrangements for research on water problems related to the mission of the Department of the Interior.

Repeal of section 200 of Public Law 88-379 would eliminate, among others, a provision therein requiring that projects proposed to be initiated under the section must lie before the Committees on Interior and Insular Affairs of the Senate and the House of Representatives for 60 days, and that only if neither committee disapproves them within the review period could funds be appropriated to finance the projects. The President requested deletion of this provision when he approved the Water Resources Research Act on July 17, 1964. We would, therefore, strongly favor action which would remove this undesirable requirement.

S. 22 would change the existing provisions of section 200 by (1) raising the ceiling on and removing the 10-year duration limitation on appropriation authorizations, and (2) removing the prohibition against use of funds under title II by institutes established under title I of the act.

We believe it may be desirable to enable the Secretary of the Interior to make funds under title II available to the institutes established under title I of the act, and would not object to removal of the prohibition. In supporting water research related to the mission of the Department of the Interior, the Secretary should have the freedom to seek the most competent capability. Greatest qualification on a given subject may, in fact, reside with an institute.

As to the enlargement of appropriation authorizations for title II research, the complexity and number of water problems related to the mission of the Department of the Interior appear to be great enough to indicate clearly that \$1 million annually is insufficient to support good research leading to their solution. The bill, S. 2 as the administration supported it in the 88th Congress, provided for the same amounts as contained in S. 22.

Sincerely yours,

PHILLIP S. HUGHES,

Assistant Director for Legislative Reference.

Senator ANDERSON. S. 22 would accomplish the purpose stated in its title by amending Public Law 88-376, the Water Resources Research Act. This basic, forward-looking legislation developed from S. 2, a bill I sponsored with other Senators in the 88th Congress, which was the subject of comprehensive public hearings and widespread study and comment.

As introduced and passed by the Senate on April 23, 1963, title II of S. 2 provided grant, matching, and contract funds through which financial assistance would have been available to educational institutions in addition to State land-grant colleges, to private organizations, and to local, State, and Federal agencies to undertake special research in water resource problems.

Our point was that the State land-grant college is not necessarily the best, nor the only, institution in a State that is best qualified to carry out a particular line of research.

The House Interior Committee struck out this provision entirely in reporting the bill, and S. 2 passed the House without it. In conference, we were able to get only a modified, limited part of this program restored.

In addition, an amendment was added requiring that projects under title II must be submitted to the Senate and House Interior Committees prior to any actual appropriation of funds.

In signing S. 2 into law as it came from conference, President Johnson expressed "serious concern" over this provision for a congressional veto of an executive act and asked for its repeal.

Without objection, I will direct that the text of the President's statement of July 17, 1964, on the occasion of the signing of S. 2 into Public Law 88-379 be made a part of the record of these hearings.

(The statement referred to follows:)

[Excerpt from Congressional Record, July 22, 1964, p. 16099]

STATEMENT BY THE PRESIDENT, JULY 17, 1964

The Water Resources Research Act of 1964, which I have approved today, fills a vital need.

Abundant good water is essential to continued economic growth and progress. The Congress has found that we have entered a period in which acute water shortages are hampering our industries, our agriculture, our recreation, and our individual health and happiness.

Assuming a continuation of current practices, by the year 2000 there will not be enough usable water to meet the water requirements of parts of the States of Arizona, California, Colorado, Delaware, Idaho, Illinois, Indiana, Iowa, Kansas, Louisiana, Michigan, Minnesota, Montana, Nebraska, Nevada, New Jersey, New Mexico, New York, North Dakota, Ohio, Oklahoma, Oregon, Pennsylvania, South Dakota, Texas, Utah, Wisconsin, and Wyoming.

This legislation will help us solve this problem. It will create local centers of water research. It will enlist the intellectual power of universities and research institutes in a nationwide effort to conserve and utilize our water resources for the common benefit. The new centers will be concerned with municipal and regional, as well as with national water problems. Their ready accessibility to State and local officials will permit each problem to be attacked on an individual basis, the only way in which the complex characteristics of each water deficiency can be resolved. The bill contemplates a high degree of interstate cooperation, and I urge that this be encouraged.

In large measure, this legislation is a tribute to the vision and wisdom of Senator Clinton P. Anderson, of New Mexico. He has long recognized the problems. He developed the program. He guided it through Congress. He has been in the forefront of the effort to see that adequate supplies of water are available in all parts of the Nation.

One provision of the bill, however, causes me serious concern, and I request its deletion. The Secretary of the Interior, in administering the program is required, in effect, to obtain the approval of the committees of the House and Senate for each water research grant or contract. Although this legislation is so phrased that it is not technically subject to constitutional objection, it violates the spirit of the constitutional requirement of separation of power between the executive and legislative branches. It is both inappropriate and inefficient for committees of the Congress to participate in the award of individual contracts or grants. Apart from the question of the relationship between the executive and legislative branches, the delays which would ensue from the suggested procedure would be detrimental to both scientific research and the timely achievement of the important mission of the legislation.

Senator ANDERSON. By way of background and in further explanation of the President's position. I will point out that in the 84th Congress we passed the legislation that has become so important to reclamation, popularly known as the Small Reclamation Projects Act, or Public Law 984, 84th Congress.

It so happens that I, along with Senator Russell Long, who then was a member of this committee, and Senator Alan Bible, and the late Frank Barrett, sponsored the bill, the text of which became the law. In the measure as passed the Congress reserved to the Interior Committees of the Senate and House an outright veto over any contract into which the Secretary proposed to enter.

President Eisenhower signed the bill with "great reluctance," and said it would not be implemented until the section impinging upon the jurisdiction of the executive branch was repealed.

Accordingly, early in the next Congress, the 85th, we modified the outright veto provision to provide that no appropriations for a project should be made until the Interior Committees had had a chance to look it over. This provision is found in Public Law 85-47.

President Johnson took the position that a similar provision written into S. 2 of the 88th Congress is a rather thinly disguised interference with the constitutional responsibilities of the Executive and called for its repeal.

S. 22, in rewriting title II of the Water Resources Research Act, would drop the back-door veto.

Those of us who sponsored S. 2 hoped to enlist as many scientists as possible in the effort to solve urgent water problems and to begin to attract graduate students to the water resources field. Five great water regions in the United States are going to be using all water available to them by 1980.

Others are going to have water quality problems which must be solved in the next few years or their economic development will come to a stop.

Trained hydroscintists and water resources research are urgently needed. The limitations on the title II program consequently seem to many of us unrealistic when judged against the Nation's needs.

It is my understanding that the executive branch has adopted regulations for the administration of the S. 2 program which, while allowing applications to be filed under title II, make no provision for the submission of projects to Congress for appropriations.

I regret that, for I would like to see promising water resources research projects, for which competent manpower can be enlisted, move ahead. I hope that witnesses today will indicate any projects which have been proposed to the Office of Water Resources Research under title II, and something of their nature.

My hope that we can amend the act, and bring the program as it was originally conceived into full operation, has increased as a result of the fine leadership we have in the new Office of Water Resources Research.

Dr. Roland Renne, the Director, is a man whose capabilities came to my attention quite a few years ago when I served as Secretary of Agriculture. He was working in the Department of Agriculture at that time. He has since been president of Montana State University at Bozeman. He was called from his post there to serve on a Missouri Basin Survey Commission and on a National Water Policy Commission appointed by President Truman and chaired by the late Morris L. Cooke. He has served on international missions. I know that he recently declined a splendid private foundation offer to remain in public service.

I have every confidence that under Dr. Renne's leadership we will develop an excellent land-grant school system of water research centers. I am equally sure that he could also develop a program, beyond the land-grant college centers, of great worth in meeting pressing water research needs.

The hearing this morning will have Dr. Renne as its first witness, appearing for the Department of the Interior. Dr. Renne, you are a very welcome participant here. But first, I will ask if any other member of the committee wishes to make a statement at this time.

However, at this point I wish to say I have a statement from Senator Birch Bayh which will be put in the record, if there is no objection.

If there are other Senators who wish to submit statements later, they will be included in the record at this point.

(The statements follow:)

STATEMENT OF HON. BIRCH BAYH, A U.S. SENATOR FROM THE STATE OF INDIANA

Mr. Chairman, members of the committee, prior commitments prevent me from personally testifying before you today. However, my absence in no way expresses a lack of interest in these proceedings. On the contrary, I consider the Water Resource Research Act and S. 22 to be of crucial importance in our efforts to insure an adequate water supply for future generations.

In January 1961, the Senate Select Committee on National Water Resources, under the chairmanship of the late Senator Robert Kerr, of Oklahoma, sent to the Senate its notable report on the Nation's water needs and problems. This farsighted statement listed five major areas in which our water program must be upgraded if we are to meet the needs of society.

The passage of the Water Resource Research Act of 1964 marked the enactment of one of these recommendations. The remaining four proposals are incorporated in S. 21, legislation which was unanimously approved by the Senate last week.

The adoption last year of the Water Resource Research Act, under the skillful leadership of our distinguished colleagues from New Mexico, Senator Clinton Anderson, was a landmark in the area of water resource development. This law firmly committed the Federal Government to long-range planning as a necessary prerequisite to the development of a comprehensive water conservation program. However, a series of unfortunate occurrences combined to curtail the effectiveness of the Water Resources Research Act.

I refer, of course, to certain House amendments to title II of the law. Senator Anderson has wisely submitted S. 22, a bill designed to unshackle the program and enable it to fulfill its originally intended purpose. I am happy to cosponsor this piece of legislation.

S. 22, in eliminating the existing section 200 of Public Law 88-379 and substituting new language in its place, will have two important effects. First, the passage of Senator Anderson's proposal will eliminate congressional review of all consultative awards made by the Secretary of Interior. This provision of the existing statute is unnecessarily time consuming. It is an usurpation of executive authority by means of a legislative veto over programs sustained by previously appropriated funds. This is in complete disregard of our concept of separation of powers and should be eliminated from this program.

Second, the passage of S. 22 would increase the amount of funds available for use in obtaining the services of individuals and groups not employed by the recipient of a water resource research grant.

The Kerr committee found that our Nation will have an adequate supply of water only if we invest billions of dollars in pollution control, recycling and storage reservoirs. Authoritative sources tell us that we will have water shortages in 28 States by the year 2000 unless we plan today for the future.

Advancements in industrial technology, the extension of water systems, increased irrigation, population explosion, and our booming affluence have resulted in a great increase in water usage.

Today Americans use three times as much water as they did in 1900. These figures are staggering, but understandable, when we realize that it takes 65,000 gallons of water to produce 1 ton of steel, 7,000 gallons to process 100 cases of tomatoes, 50,000 to 100,000 gallons to test an airplane engine, and 550,000 gallons to air condition a department store.

There is little doubt that a sound, well-coordinated nationwide water policy must be developed. Expert research and scientific study can provide us with the tools to create such programs. The establishment of a water research center in each State, as provided by Public Law 88-379, can greatly aid these efforts. But more is required.

Title II of this act enables the Secretary of Interior to employ the talents of individuals and groups to supplement the work done by water resources research centers. This is an extremely important provision, because not every qualified scientist, foundation, engineer, or institution will be directly employed by the established research center. These consultative funds are necessary to insure participation by all qualified personnel.

The present program authorizes only \$1 million per year for 10 years for these purposes, averaging \$20,000 per year per State.

Inadequate funding and stringent time limitations will not solve a problem of this magnitude.

S. 22 would amend title II so as to authorize \$5 million in fiscal 1966 and an additional \$1 million annually until the sum reached \$10 million per year. This \$10 million yearly authorization would continue until no longer needed.

In my opinion, an authorization of this size is the minimum required to meet this challenge. Certainly, a nation that spends millions of dollars a year on such items as chewing gum, cosmetics, and movies can afford \$10 million a year to insure an unlimited supply of clean, clear, fresh water for future generations.

Water sustains all life and permits all growth and development. No natural resource is more precious. For these reasons, I heartily support S. 22 and hope that it will receive the enthusiastic support of this committee.

U.S. SENATE,
Washington, D.C., March 3, 1965.

HON. CLINTON P. ANDERSON,
Chairman, Subcommittee on Irrigation and Reclamation, Committee on Interior and Insular Affairs, U.S. Senate, Washington, D.C.

DEAR MR. CHAIRMAN: This is to express my support of S. 22, a bill to promote a more adequate national program of water research.

The proposed legislation would enhance the usefulness of the Water Resources Research Act of 1964 (Public Law 88-379), of which I was a cosponsor. It would authorize substantially larger appropriations for the Secretary of the Interior to carry out the purposes of title II of the act, as proposed under S. 22; namely, to "make grants, contracts, matching, or other arrangements with educational institutions, private foundations, or other institutions; with private firms and individuals; and with local, State, or Federal Government agencies, to undertake research into any aspects of water problems related to the mission of the Department of the Interior, which may be deemed desirable and are not otherwise being studied."

S. 22 would also enable land-grant universities eligible for water research support under title I to qualify under title II. Under the present act such universities are specifically excluded under title II.

As a land grant institution, the University of Hawaii has applied for research funds under title I. Should S. 22 become law, the University of Hawaii would also be able to seek title II funds.

As an island State located in the middle of the Pacific, Hawaii has water problems different from those found on the mainland United States but not unique among some Pacific islands. Therefore, the results of water resources research conducted in Hawaii may be applicable to places like American Samoa, Guam, and the trust territory—all of which are under the administrative jurisdiction of the Department of the Interior. Just as research specialists in Hawaii now assist other Pacific islands in such fields as agriculture, education, and public health, so can our research specialists in water resources assist peoples on other Pacific islands. Through cooperative arrangements with the Department of the Interior, Hawaii can serve the national interests in advancing the well-being of the Pacific areas under American jurisdiction.

Not only the University of Hawaii, but also the State government of Hawaii, local water agencies, and qualified institutions, private individuals, and firms would be able to participate in water research as contemplated under title II.

I strongly urge the passage of S. 22.

Sincerely yours,

HIRAM L. FONG.

Senator ANDERSON. Now, Dr. Renne, please go ahead with your presentation.

STATEMENT OF DR. ROLAND R. RENNE, DIRECTOR, OFFICE OF WATER RESOURCES RESEARCH; ACCOMPANIED BY EUGENE D. EATON, ASSOCIATE DIRECTOR, DEPARTMENT OF THE INTERIOR

Mr. RENNE. Thank you, Mr. Chairman, members of the committee. We have prepared a statement for the record which I would like to have printed in the hearing report.

Senator ANDERSON. Without objection it is so ordered.

(The statement referred to follows:)

STATEMENT BY DR. ROLAND R. RENNE, DIRECTOR, OFFICE OF WATER RESOURCES RESEARCH, DEPARTMENT OF THE INTERIOR

Mr. Chairman, consistently with the legislative report of the Department of the Interior, my testimony is in support of enactment of S. 22, "to promote a more adequate national program of water research." It is a privilege to support this very worthwhile bill sponsored by the chairman of this subcommittee, Senator Anderson, and cosponsored by 18 other Senators with distinguished records in natural resources affairs.

The bill being considered today complements the provisions of the Water Resources Research Act of 1964 (Public Law 88-379), and provides for engaging in urgently needed water research the full range of scientific and engineering competence that is the purpose of the 1964 act. In fact, amendment of the 1964 act as proposed by S. 22 will restore the act to substantially the form in which it passed the Senate in 1963. The Department of the Interior supports S. 22 now just as it did similar provisions in hearings before this committee in 1963.

The Congress enacted the Water Resources Research Act of 1964, to use words

of the statute itself: "In order to assist in assuring the Nation at all times of a supply of water sufficient in quantity and quality to meet the requirements of its expanding population." This congressional purpose stems from recognition of critical present and prospective nationwide problems of water supply in relation to water requirements.

Senate Report No. 29 of the 87th Congress, the report of the Select Committee on National Water Resources, in January 1961 summarized the findings and recommendations derived from 18 months of studies and public hearings. The committee found that in every section of the United States serious water problems exist that will become increasingly serious in the years ahead. The problems are of many different kinds—insufficient quantities of water, unacceptable quality of water, inadequate development of storage and conveyance systems, unresolved competition among various classes of water uses, and inefficient and wasteful water-use practices are among the principal elements of the problems—but the consequence is widening gaps between rapidly mounting water-use requirements and the supplies of water available for use. Water problems, the select committee found, in many sections of the country may constitute a serious hazard to development of the Nation's economy and to the welfare of its people.

A principal means of dealing with these problems is to increase our knowledge of water resources, and thereby to improve our ability to utilize them efficiently and conservatively. The select committee recommended a substantially strengthened and coordinated program of research into ways to increase available supplies, and ways to increase efficiency in the use of water required to produce manufactured goods and services. The committee recommended that, in addition to the in-house research of the Federal agencies, the research competence of universities and others should also be fully utilized, and it recommended provisions to authorize support of such extramural research.

I have very briefly summarized the pertinent background that led to enactment of the Water Resources Research Act of 1964. Some members of this subcommittee were also members of the subcommittee which in the 88th Congress considered the initial authorization legislation, S. 2. A number of the members of the present subcommittee were also members of the Select Committee on National Water Resources in the 86th Congress. It hardly seems necessary, therefore, to take your time to detail the background of the research act. It is, however, pertinent to summarize very briefly the progress that has been made since President Johnson signed the act into law on July 17, 1964.

The program now is in operation. Secretary Udall established the Office of Water Resources Research, reporting directly to the Secretary, to administer the responsibilities assigned to the Department of the Interior. The next step was provision of rules and regulations for administration of the program. These specify who is eligible to participate, how applications are to be made and the information to be supplied therewith, allowable uses of funds granted under the act, and the procedural matters of concern to research administrators. Concurrently, an initial appropriation of funds to implement the program was requested and was provided in the supplemental appropriation act of October 7, 1964.

That initial appropriation provided for a partial funding. The act makes each of the States and Puerto Rico eligible to receive an annual allotment toward the support of a water research center, and, in addition, authorizes appropriation for matching grants for specific water research projects beginning in fiscal year 1965 at \$1 million, and increasing at the rate of \$1 million annually to the \$5 million level at which it continues thereafter. Last October's partial funding provided for allotments to 14 States, plus \$260,000 for matching grants.

By December 5, 1964, the closing date of the competitive period for the initial 14 allotments, requests had been received from institutes established in 43 States and it was necessary to select from them the 14 that could be funded from the supplemental appropriation. With the aid of expert consultants, the selection has been made. However, it was determined also that, consistently with the standards for evaluation that are provided in the act itself, all 43 applicants were qualified to receive an allotment. Subsequently, water resources research institutes have been established in all 50 States and Puerto Rico, and all of them have requested allotments as authorized by the act.

In recognition of the importance of water resources research problems and of the readiness of the institutes in each of the States to move ahead on the research program, the President has requested a supplemental fiscal year 1965 appropriation to fund allotments to all 51 water resources research centers, along with a regular fiscal year 1966 appropriation to continue that support next year.

The Water Resources Research Act of 1964 provided for three forms of assistance to research. The first two of these which I have just discussed are:

(1) The annual allotment to one research center in each State and Puerto Rico, the allotment beginning in fiscal year 1965 at the \$75,000 per State level and increasing by steps to the level of \$100,000 per State by the fourth year, and continuing at that rate thereafter.

(2) Matching grants toward the cost of specific water research projects, beginning in 1965 at the \$1 million level and increasing by \$1 million steps to the \$5 million level at which it continues thereafter.

(3) The third form of assistance is authorized in title II of the act. This is for contracts, matching or other grants, or other arrangements for research by universities other than those at which the research centers are established, research foundations, private firms or individuals, State or Federal agencies, or others competent. This is for water resources research related to the mission of the Department of the Interior. Title II as enacted requires that before title II research projects may be funded, they must lie before the Senate and House Interior and Insular Affairs Committees for 60 days, and not be disapproved by either committee during that period.

At the time that President Johnson approved the act he stated his objection to this procedure for congressional clearance of specific research projects proposed under the title II program, and he requested that Congress delete that requirement. Because of the President's objections, no funding has been requested for title II projects. Enactment of the bill that is now being considered by this subcommittee would remove the feature to which the President has objected, and thus clear the way for proceeding with the title II program.

The full implementation of title II as would be authorized by S. 22 is in the national interest because it would provide for bringing into productive action a wide range of research competence additional to that which is provided through the title I support of State water resources research centers. I have already summarized briefly the findings of the Select Committee on National Water Resources relative to the importance and nationwide occurrence of critical problems whose effective solution depends on additional research.

In 1963, this subcommittee took extensive testimony from a considerable number of authoritative governmental and nongovernmental experts supporting in detail the need for additional water resources research and the potential effectiveness for getting such research performed by utilizing university and other non-Federal research entities to complement the work of the Federal agencies. Although I do not wish to burden the committee with repetition of information with which it is already familiar, it is appropriate to note that 1964 was marked by dramatic demonstrations of the nationwide significance of water resource problems.

From the State of Washington, to California, the West Coast States suffered devastating floods with widespread loss of life, severe property damage, and disruption of transportation and communications. The 1964 floods caused damage comparable to that which might be inflicted on this country by a foreign enemy. Research that will provide means for mitigating future damages of this kind and magnitude unquestionably is needed and justified.

In the same year, in the eastern and midwestern sections of the country, the 1964 drought was equally dramatic evidence of the Nation's water problems. We may perhaps be accustomed to water scarcity in the semiarid Western States, although even there the 1964 drought established new records. As reported by the Interior Department Water Resources Review of December 1, 1964, in New Mexico the combined contents of Elephant Butte and Caballo Reservoirs (which supply the water for the intensively developed Mesilla and El Paso Valley) were 11 percent of the average and 40 percent less than a year ago, ground water levels in the Roswell Basin declined to the lowest level in the 24 years of record, and in Lea County the ground water levels were the lowest in 30 years of record.

But the 1964 drought was not a problem of the Western States alone. The same Interior Department review reported "drought conditions intensified during November in the Upper Delaware River Basin * * * ground water levels continued to decline in Rhode Island, Massachusetts, and southwestern New Hampshire * * * for the fourth consecutive month streamflow of the Susquehanna River at Conklin, N.Y., was the lowest for that month since the records began in 1913 * * * ground water levels in upstate New York continued to decline through November, and in many wells levels were lowest for any month since records began * * * in New Jersey the drought continued through

its 43d month * * *." Equally alarming records were established in a number of other States also.

Implementation of title II will substantially strengthen the research program. This is evidenced by the considerable number of high-quality research projects that have been discussed with us by a wide range of academic and nonacademic people. In fact, even though the title II authorization is not being implemented, 24 research projects have been proposed by 7 different non-land-grant universities from New York and Pennsylvania across the country to Texas and New Mexico. In addition, 12 research projects have been proposed by nonacademic research institutions that likewise are located across the Nation from Pennsylvania to California. This latter group represents a very high order of established research performance. For a considerable period of time, these research institutes have been servicing industry by providing the scientific and engineering basis for new and more efficient industrial production. This kind of research competence won recognition when industry had to meet the demands for nuclear age weapons systems and for space-age exploration. The same competence that rose to those challenges can be applied to provide scientific and engineering know-how for solving the no less important water resources problems. Enactment of S. 22 would permit utilization of that competence.

In addition, the land-grant universities that are eligible for water research support under title I could under S. 22 also qualify under title II. This is highly desirable because in many cases the land-grant universities are especially well equipped to work on problems related to the mission of the Department of the Interior. Enactment of S. 22 would enable this Department to utilize such research competence in developing the scientific basis for new and improved methods of natural resources conservation and development.

The committee may be interested in a few examples of potential title II research projects that have been submitted to us already. The New Mexico Institute of Mining and Technology, a non-land-grant institution of higher education in that State, has outlined research in systems analyses that could provide greatly improved techniques for ground water basin management. The Mellon Institute is interested in research to improve methods for identifying inorganic chemicals in water. New York University at Buffalo, N.Y., has proposed the development of computer methods for studying Lake Erie pollution. The University of Indiana, which, like New York University at Buffalo, is a non-land-grant institution of higher education, has proposed hydrogeologic research to improve understanding of the scientific principles of ground water movement and accumulation. Another example that may be of particular interest to this committee because of its concern with river basin planning is a University of Texas—also a non-land-grant university—proposal for developing analog computer methods for handling water quality data in river basin planning.

I note that the schedule of witnesses provides for testimony by representatives of a number of other research groups that could qualify under title II whenever it is amended along the lines of S. 22. Because those other witnesses will no doubt be furnishing information to the committee I will not cover the discussions that we have had with them about possible research that they might perform. Let me just say in summary that on the basis of a considerable number of discussions and meetings, as well as correspondence, we are confident that there is a very substantial amount of high-quality research which could be performed under the title II program, and that there is every reason to expect that it would produce results valuable in water resources conservation and development.

I appreciate the opportunity of appearing before the subcommittee in support of enactment of S. 22.

Mr. RENNE. I would like very briefly to summarize some of the progress we have made to date, as an entry into the title II discussion. You recall that the appropriations for the water research program were provided for the current year in the October 7, 1964, Supplemental Appropriation Act.

This amounted to enough to fund 14 centers or State institutes. A deadline of December 5 was set for getting in the applications from the States for the first competitive group. By that date 43 States had submitted detailed requests for the organization of their institutes and for funding the allotment under section 100 of the act.

Fourteen out of these forty-three were selected. They were notified of their selection in January, and in the meantime we went over in detail with them specific projects which they plan to undertake under this program.

Mr. Chairman, I have a set of tables which summarizes by 9 major categories the types of projects which have been submitted both for the 14 initial allotments and for the other 37 State research centers, since all 51 have made formal application or request for allotments. I would like to submit those tables to be included in the record.

I think it would be helpful to see the kinds of projects that are being proposed for study.

(The tables referred to follow:)

CATEGORIES OF WATER RESOURCES RESEARCH

1. Nature of water.
2. Water cycle—including precipitation; snow, ice, and permafrost; evaporation and transpiration; streams and lakes; ground water and hydrogeology; oceanic influences; and forecasting.
3. Water and land management—including water movement in soils; water and plants; watershed protection; water-yield improvement; erosion and sedimentation; upstream flood abatement; irrigation; and drainage.
4. Development and control—including water supply; flood control (downstream); hydropower; navigation; urban and industrial water-use problems; recreation; fish and wildlife; estuarine oceanography; coastal engineering.
5. Qualitative aspects—including characterization of wastes; effects of pollution on water uses; interactions of wastes; disposal of waste effluents; surface interactions; effects of development on quality; quality characteristics; and aqueous solutions.
6. Reuse and separation—including saline-water conversion; advanced waste treatment; improved treatment of wastes; treatment of water; and use of water of impaired quality.
7. Economic and institutional aspects—including role of water in growth, economics of development and management; economic analysis of institutions; area appraisals.
8. Engineering systems—including design; materials; and construction, operation, and maintenance.
9. Manpower and research facilities—including education and training; and research facilities.

Preliminary breakdown of research projects proposed by 14 State water resources research centers

Location of center by State	Number of projects proposed by research categories:									
	I	II	III	IV	V	VI	VII	VIII	IX	Total projects
Arkansas.....			1	2						3
Colorado.....		2		2	1					5
Georgia.....	3	6	2	1	4	1	1	2		20
Idaho.....			1				1			2
Illinois.....		1			3			2		6
Michigan.....		2	2	3	1			1		9
Missouri.....		1	1					1		3
Montana.....		1		1						2
New Hampshire.....		1	1		1					3
New Mexico.....			4	2	1					7
New York.....				2		1			1	4
Ohio.....				1	3					4
Utah.....		1			1		1	1	1	5
Washington.....		2	2	2	1		1		1	9
Total.....	3	17	14	16	16	2	4	7	3	82
Percentage.....	3.7	20.7	17.1	19.5	19.5	2.4	4.9	8.5	3.7	100

NOTE.—Broad subject matter headings are those developed and used by the Committee on Water Resources Research of the Federal Council for Science and Technology, Office of Science and Technology.

Preliminary breakdown of research projects proposed by State water resources research centers which did not receive an initial Federal allotment

Location of center by State	Number of projects proposed by research categories									Total projects
	I	II	III	IV	V	VI	VII	VIII	IX	
Alabama.....					4	1		1		6
Alaska ¹										
Arizona ¹										
California ¹										
Connecticut.....		3	2	1	3		1	2		12
Delaware.....		1	2	3	2	1				11
Florida ¹										
Hawaii.....		3	3	1				1	1	9
Indiana.....		1	2	1	2					6
Iowa ¹										
Kansas.....		2	2		2					6
Kentucky.....		1	1	1	1		1	1		6
Louisiana.....			2	3	3		6	2		16
Maine.....			1	1	4					6
Maryland ¹										
Massachusetts ¹										
Minnesota.....		4	5		2			2		13
Mississippi.....			2				2			4
Nebraska.....		2	7				4	1		14
Nevada ¹										
New Jersey.....		1		1	1		1	1		5
North Carolina ²		2	8	10	11	1	3	2		37
North Dakota ²	1	1	16	5	8	1	3	4	2	41
Oklahoma.....	1		2	2	4				1	10
Oregon ¹										
Pennsylvania.....		1	1		5		1			8
Puerto Rico ¹										
Rhode Island.....					3		1		1	5
South Carolina.....		4			2		1	1		8
South Dakota ¹										
Tennessee.....			2		2			2	1	7
Texas.....		1	1		3		1			6
Vermont.....		1	1		3					5
Virginia.....		2		2	3			1		8
West Virginia.....		1	1		5			1		8
Wisconsin.....					1		1			2
Wyoming.....									1	1
Total.....	2	31	61	31	74	4	28	22	7	260
Percentage.....	1	12	23	12	28	2	11	8	3	100

¹ List of specific projects to be supported by Federal allotment not available.

² Projects to be initiated first are not specified.

NOTE.—Board subject matter headings are those developed and used by the Committee on Water Resources Research of the Federal Council for Science and Technology, Office of Science and Technology.

Mr. RENNE. The set of three sheets shows the nature of each category and what kind of research is included in that particular category of study. Then the two sheets show the 14 institutes which have been funded and the 37 yet to be funded.

In the supplemental appropriation there were funds provided for matching grants under section 101 of the act, but only \$260,000. We are in the process now of going over the matching grant requests and in the process of selecting those which will utilize the \$260,000.

The other item in the appropriation was for administration, \$155,000. No appropriation, of course, was requested for title II.

In the President's budget was submitted a request for a second fiscal year 1965 supplemental which would fund the remaining 37 State water research centers. As I have said, all of those have submitted their requests. We have gone over their programs carefully and feel that all 37 are worthy and ready for support to undertake the research suggested.

Senator ANDERSON. Doctor, on or off the record, would you care to comment on the fact that Georgia has 20 projects, and no other State has more than 9?

Mr. RENNE. Yes, the projects from Georgia were 20, 16 at Georgia Tech and 4 at the University of Georgia. I think the record is for one of our good Western States which submitted 41, Mr. Chairman, but on an average they range from 5 to 7.

This not only shows a lot of interest—

Senator ANDERSON. Would you like to state which one?

Mr. RENNE. North Dakota.

Senator ANDERSON. I was wondering whether they had an unusually active group or had a man at the school who had a particular interest in water resources research?

Mr. RENNE. In many of the States where the land-grant university is separate from the State university they have, through a memorandum of understanding or agreement, or through a setting up of a joint council or executive committee for the center, worked together in the preparation of the program.

For example, in the State of Washington, the Washington State University at Pullman, where the center is located, and the University of Washington at Seattle, drew up a memorandum of understanding, it was approved by the board of regents, and the research program includes both the University of Washington and Washington State University. They are one of the 14 of the original allotments and they are underway.

So we feel this procedure brings in considerable water research competence of the State.

In the State of Montana, the council or board for the center is made up of seven members, three from the State university, three from the land-grant university and one from the school of mines.

Of course, in many States there are other major institutions that have considerable research competence and that have not as yet been brought into the program. I think this is evidence of not only very real interest but a desire to bring into full play the total research competence in a given State and I think that is one of the very real advantages of having a center in every State, Mr. Chairman.

Senator ANDERSON. I was just trying to find out whether the large number submitted for some States is an indication of greater need or greater enthusiasm?

Mr. RENNE. It is more an indication of their enthusiasm, although in the States with many projects they had not been able to go into many aspects which they would like to go into under our program.

Considerable work has been done with plants and their use of water in growing, but not nearly as much has been done in the management and economics of water use, competitive uses, and further east, in related aspects like acid mine wastes and pollution, flood damage, and that sort of thing.

I think this is evidence not only of interest but also of a desire to work on these problems, which are very troublesome.

Of course, 41 really in a sense shows the scope of interest, but we could not undertake that many all at once in this case.

The budget for fiscal year 1966 provides for funding all of the 51 institutes; that is, the 50 States and Puerto Rico, provided for in the act, with the \$87,500 allotment authorized in the act; and under section 101 for the matching grants it provides for \$1 million rather than the \$2 million authorized in the act.

The administrative expense is listed as \$427,000 for fiscal year 1966. Of course, no funds are requested for title II.

Under the title II of the act we have had a great deal of interest evidenced already. There are witnesses who will testify today who are involved in water research areas which have indicated their interest. They have submitted projects to us. In the prepared statement we break those down, those submitted by non-land-grant universities, those submitted by research firms, foundations, corporations, and the kinds of projects which are being proposed.

Other witnesses will say more about that in their testimony, I am sure.

I would like, Mr. Chairman, to have included in the record, and I have copies here of the President's statement of July 17 in which he explained not only his objection to certain wording of the Water Resources Research Act, Public Law 88-379, but also pointed out some of the very real possibilities of the program under the act.

Senator ANDERSON. I inserted the President's statement in my introductory remarks, Dr. Renne.

Mr. RENNE. Very good, thank you.

Then I would like to put in the record a statement from the Secretary of Interior to the Director of Water Resources Research which explains how he feels the Office of Water Resources Research should be administered if an effective job is to be done.

It especially emphasizes imaginative leadership and along with the President's statement deals with the problem of duplication and coordination.

Along that line we have, Mr. Chairman, worked closely with the Office of Science and Technology, and I would like to include in the record the President's October 24, 1964, memorandum which in accordance with the provisions of the act, named the Office of Science and Technology as the coordinating agency. Our instructions are to work closely with the Science Information Exchange and the Office of Science and Technology in connection with working out a catalog of current research projects. This will assist research workers in seeing what kinds of research are already underway, and the catalog will help us, when projects are submitted, to eliminate duplication and to provide for the most effective program with the funds available.

I have copies of the memorandum of the President to departments. These are brief statements, of course, but I think these documents make the record complete to show the responsibility which has been placed on our office.

Senator ANDERSON. Without objection they will be included at this point.

(The memorandums referred to follow :)

THE WHITE HOUSE,
Washington, October 24, 1964.

Memorandum for :

The Secretary of Defense.
The Secretary of the Interior.
The Secretary of Agriculture.
The Secretary of Commerce.
The Secretary of Health, Education, and Welfare.
The Chairman of the Atomic Energy Commission.
The Director of the National Science Foundation.
The Secretary of the Smithsonian Institution.
The Chairman of the Tennessee Valley Authority.
The Director of the Bureau of the Budget.
The Director of the Office of Science and Technology.

Public Law 88-379, the Water Resources Research Act of 1964, provides that the President clarify agency responsibilities for Federal water resources research and make arrangements for interagency coordination of such research.

In view of the continuing nature of this function, I am asking the Director of the Office of Science and Technology to assist me in this responsibility in close cooperation with the Bureau of the Budget and the departments and independent agencies which are concerned.

The area of water resources research is a particularly difficult one to coordinate because of overlapping statutory missions of numerous agencies. Fortunately, this has been recognized for some time, and substantial progress has already been made. The Office of Science and Technology and the Federal Council for Science and Technology have given special attention to water research for 3 years, and in December 1962 established a Committee on Water Resources Research. The report of that Committee, "Federal Water Resources Research Program for Fiscal Year 1965," which I transmitted to the Congress in March of this year, is evidence of the value of such cooperation.

I shall therefore continue to look to the Director of the Office of Science and Technology for leadership in these matters, and request that he keep me informed, in order that the objectives of these coordination responsibilities are fully realized.

Public Law 88-379 also states that there shall be established, in such agency and location as the President determines to be desirable, a center for cataloging current and projected scientific research in all fields of water resources.

The Science Information Exchange has been making good progress in cataloging such research and shall be the general purpose facility for such cataloging. As required by the act, each Federal agency doing water resources research shall cooperate by providing the cataloging center with information on work under way or scheduled by it. Beyond this, it is expected that the Federal agencies will, in turn, make full use of such cataloging center in addition to internal information systems and other means which may be required for good management.

It is recognized that in the enactment of Public Law 88-379 a particularly difficult responsibility falls upon the Secretary of the Interior to so administer the act that it contributes to a comprehensive and coordinated nationwide program of water resources research. He will be required to obtain the continuing advice of all agencies concerned. I expect all those agencies concerned to extend their full cooperation to the Secretary in achieving this objective.

LYNDON B. JOHNSON.

U.S. DEPARTMENT OF THE INTERIOR,
OFFICE OF THE SECRETARY,
Washington, D.C., October 20, 1964.

Memorandum to: Director, Office of Water Resources Research.

From: Secretary of the Interior.

Subject: Administration of the Water Resources Research Act.

In authorizing publication of the proposed rules and regulations that you have recommended, note also must be taken of the policies guiding program administration.

The Water Resources Research Act of 1964 is a major forward step in natural resources conservation and development. It makes possible full engagement of

the Nation's intellectual capabilities in meeting the Nation's water problems. New and improved means of dealing with water problems of local, State, regional, and national levels will result from enlisting the competence of the universities and other research entities. Administration of the program should ensure that these results are achieved.

This new program enlarges the tradition of Federal support for non-Federal agency research that provided for cooperative Federal-State agricultural research. We have the opportunity and the responsibility for an even wider extension of water resources research cooperatively with all who have competence.

There will have to be creative leadership to stimulate research in areas where new knowledge is most needed and to assure high quality in the research undertaken. Building on the experience of other programs of research support, counseling with the technical experts of this Department and of other agencies, and continuing interchange of views with the academic and research communities will assure knowledgeable program administration.

Perceptive administration also should be alert to imaginative new approaches that develop among the research workers themselves. As has been the experience of the cooperative agricultural research program, much of the success of this new program will flow from freedom of research workers to attack problems on their own initiative. Provision of that freedom consonant with the requirements of the act is an important objective of program administration.

Our growing population and our expanding economy require greatly increased water use. The quantity and quality of available water are important not only for utilitarian purposes but also for outdoor recreation, for fish and wildlife, and other deeply valued elements of life.

Resources research can do much in enabling this Nation—and other nations also—to meet use requirements without arresting our growth or sacrificing the natural and social values of our environment.

Basically, this new program joins with long-established programs to meet this purpose.

STEWART L. UDALL.

Mr. RENNE. We have now on the press our first catalog, which covers all of the projects currently active which are being financed in part or in whole by the Federal Government. There are more than 1,500 projects included in this catalog, cross referenced different ways for effective use by the Science Information Exchange of the Smithsonian Institution, which has had a great deal of experience in this area. We feel this will be a very valuable catalog.

We expect it to be available within a month. We will see that you receive copies, of course.

A second part of the catalog will be other water resources research not financed in whole or in part by the Federal Government.

We have had a request from some of the river basin agency staffs asking that that we publish a catalog of significant water research being carried on in other countries that might be useful to our own Nation.

These catalogs could be very helpful, not only in preventing unnecessary and unproductive duplication, but also in helping us to see areas which are not being covered, and also, of course, work with others who are working on some of the more significant problems.

Mr. Chairman, that brings us, I think, to title II, which is the purpose of your hearing today on S. 22, which I am sure you all know restores the original wording of the Senate bill which was largely the basis for our present act.

We feel that this proposed amendment would be very valuable in broadening the areas of research competence upon which we can draw. As I have indicated before, a considerable number of projects have been discussed with us by organizations that do not qualify for inclusion in the water research centers, that is, they are not land-grant

universities. Many of them are not State universities. This amendment would broaden the provisions of title II to cover a much larger area of research competence.

The amendment includes the land-grant universities as well as the non-land-grant universities, private research firms and other groups.

We feel that this is highly desirable because if we are to do the most effective possible job of water research we should be in a position to utilize water research competence wherever it may exist.

We cannot do that under the present circumstances.

Some 36 potential title II projects have been submitted to us, 24 of those are from non-land-grant universities. Other projects submitted are from firms such as those that are represented by individuals here today and they will discuss them in some detail with you.

Even though title II has not been implemented, and there have been no funds appropriated for it, we have received these project requests, we have gone over them, evaluated them, but, of course, can do nothing further in funding them.

The 24 research projects that came from non-land-grant universities represent the States of New York and Pennsylvania, across the country to Texas and New Mexico. We have received a proposal from the School of Mines in New Mexico at Socorro, presenting a project for research which we feel has very real interest and merit.

In addition, we have received 12 research projects from nonacademic research institutions that are likewise located across the Nation from Pennsylvania to California.

We feel this group has a great deal of research competence. For example, one of these is the Mellon Institute, which is interested in means of improving the identification of inorganic chemicals in water. We have also received projects from the Illinois Institute of Technology in Chicago, the North Star Research & Development Institute at Minneapolis, and others. Some of these and other projects have been explained in more detail in our prepared statement, Mr. Chairman. We feel they have very real merit.

SENATOR ANDERSON. Of course, you recognize that the reason many of these projects have not been able to get underway is the result of the present limitations in the law. What is your feeling on those limitations?

MR. RENNE. Well, consistent with the position of the Department of the Interior and the President, of course, our office favors the amendment to remove the wording on the grounds that it would enable us to operate more efficiently and we would favor that amendment.

SENATOR ANDERSON. The point is that when a somewhat more drastic form of this same type of amendment was written into the Small Projects Act, President Eisenhower declined to permit the legislation to become effective until this limitation was removed. President Johnson has taken that same position, basically. So the executive branch has maintained a consistent position with respect to such restrictions.

MR. RENNE. Well, Mr. Chairman, this completes my verbal statement. I would be very happy to answer questions. I have our Associate Director, Mr. E. D. Eaton, with me today and most of you have

known him for a good many years and know of his interest and competence in the field of water research and development.

Senator ANDERSON. What about weather modification? Increasing precipitation is a most fundamental method of increasing water supplies. Do you want to comment on that aspect? The Commerce Committee has not scheduled any hearings on the weather modification bill, S. 23, which I sponsored. Do you feel that weather modification has any part in this program?

Mr. EATON. Mr. Chairman, as this committee is well informed, weather modification is a very promising research area. It is recognized by the Department of the Interior as a very promising opportunity for increasing the usable runoff through a modification of precipitation so that snow will be deposited at high elevations and thereby contribute effectively to usable runoff in the semiarid areas.

This committee has had a major impact on that program by encouraging the Department to undertake research and it has assisted in securing funds for that research. As a consequence of this there is now quite an active program of weather modification being supported largely through the appropriations to the Bureau of Reclamation supplementing the programs of the National Science Foundation and the Weather Bureau.

This has utilized a good deal of the available competence in that field at this time. We feel that the Research Act would enable us also to participate in supporting that sort of research should that become desirable.

At the present time, it appears that weather modification research proposals are submitted to the National Science Foundation, the Weather Bureau, and the Bureau of Reclamation, rather than to the Office of Water Resources Research. A number of good research men are interested in this work, according to our information.

Does that answer your question, sir?

Senator ANDERSON. Yes. With the exception that the Committee on Commerce has not taken any action on Senate bill 23, which deals with this very problem. Of course, there was a newspaper story, the authenticity of which I do not guarantee, to the effect that certain areas might be retaining for themselves certain water supplies through weather modification. It is a story that has interested us for many years.

You can increase the number and density of rain clouds, and also take action which will affect where the moisture might fall. Weather modification is very important in any consideration of water supplies in many areas.

It is my hope that it might be possible for this agency, in its consideration of water resources, to look into the development of additional water supplies through weather modification.

Mr. EATON. The terms of the water research legislation would authorize our support of that sort of project. Should meritorious projects be submitted to us and if the Bureau of Reclamation or the National Science Foundation's established programs were not able to support such research, we would be able to consider it.

I certainly agree with you, sir, that this is one of the very promising and very important fields that requires additional research emphasis. Senate bill 23, of course, would establish that on a long-term basis.

Senator ANDERSON. If the flow of the Colorado River reaches 13 million acre-feet somebody might become very interested.

Mr. EATON. Facetiously, Mr. Chairman, I have heard it said there are really many problems of the Colorado River drainage basin that would be solved by an additional 5 million acre-feet of runoff per year.

Senator ANDERSON. I think that might be true; I think also it is one of the problems we might be able to solve.

Senator Moss?

Senator Moss. Thank you. I just have one question.

You mentioned in your remarks, Dr. Renne, that research is being done on acid mine wastes, or waste water. Can you tell me where particularly that is being done? Is it being done only in the East or out West also?

Mr. RENNE. Yes, sir; the three States in which this problem is serious are Ohio, West Virginia, and Pennsylvania. All three of these States, through their water research centers, submitted projects that dealt with some aspect of acid mine wastes. Ohio is one of the initial 14 for allotment. They emphasized in their proposals the study of means by which acid mine waste problems in polluting water could be solved. It sounded so much like a project that is already underway by the U.S. Geological Survey that we had them check very closely.

And the U.S. Geological Survey advised that the proposal of Ohio is along different lines, particularly the ecological and the biological aspects of the effects of this waste on the growth of certain plantlife in streams which, in turn, of course, affect not only the fish but the quality of the water itself.

The Public Health Service is very much interested in this type of project. They indicated also that this project was not a duplication of theirs and so Ohio is going forward with that particular project. Pennsylvania submitted projects along this line and so did West Virginia. There are other States that are concerned with it, but I think these three are most concerned with it.

Senator Moss. Coal mines primarily are the subject of such studies?

Mr. RENNE. Yes. In the process of mining the coal you release certain other minerals so that the problem becomes quite complex.

Senator Moss. The same problem would apply, perhaps, to other metal mines and therefore we might expect to find interest and concern in the Rocky Mountain area, too.

Mr. RENNE. Very definitely, the Rocky Mountain Range. Yes, sir.

Senator Moss. Thank you.

Senator ANDERSON. Senator Kuchel?

Senator KUCHEL. Only this. I am a coauthor of this legislation and I shall support it, because I very much believe that out of scientific research and study, the national interest will be served presumably by making more feasible proposals to assist all parts of this Nation in solving specific problems in the field of water which face them—too much, too little, and so forth—in your categories of water resources research which you have enumerated.

I take it we are all agreed the purpose of the law which would not be affected by this bill is for research with respect to any problem that touches that subject?

Mr. RENNE. That touches either the quantity or quality, Senator.

Senator KUCHEL. For example, were the benefits of nuclear power to be involved in any study, that would not preclude your authority from granting the type of research contracts you contemplate herein, would it? It is wide open?

Mr. RENNE. I think anything which affects the quantity of water or the quality of water is a pretty broad range.

Senator KUCHEL. Or the movement of water from one area to another, for example, Doctor?

Mr. RENNE. Yes.

Senator KUCHEL. Because we are also interested in the problem of cost.

Mr. RENNE. Yes.

Senator KUCHEL. And if by utilization of this new-found source or power, water could be transported from one area to another more economically and thus more feasibly, and studies were available to you in which the use of nuclear power would be a part, that would be within the purview of this law; would it not?

Mr. RENNE. Yes, sir; and we have. I recall one proposed research which involves a study of the cost factors of lifting water to get it on to certain lands that are not now reachable because of the cost of lifting the water for irrigation. A lower cost of power, which might be developed through nuclear processes, would, of course, bring that project into very definite range of feasibility.

Senator KUCHEL. I have no more questions, Mr. Chairman.

Senator ANDERSON. Senator Burdick.

Senator BURDICK. No questions.

Senator ANDERSON. Senator Allott.

Senator ALLOTT. I have just one question, Doctor.

My only concern about this entire program has been one of duplicated effort. I understand you come from Montana—

Mr. RENNE. Yes, sir.

Senator ALLOTT. As you know, there is a great deal of water research that has gone on in the West, mostly in our higher educational institutions.

Mr. RENNE. That is correct.

Senator ALLOTT. The matter of water research is not one that has just recently been given attention in the West, it has been going on for a period of, in some instances, 75 years or more.

In looking over your breakdown, I see that you have research going on in the same categories at as many as 7, 8, 9, 10 different places.

Now, my only thought is this, that a great deal of care has to be exercised to keep this from becoming a duplicative process. We cannot afford wasteful duplication—we have been doing too much of it.

You mentioned that the Office of Science and Technology was going to supervise this matter. Who has charge of that office now?

Mr. RENNE. Dr. Donald Hornig is the Director of the Office of Science and Technology.

Senator ALLOTT. I have not had a chance to meet him. He has not come before our appropriations meeting yet, and, of course, he is inexperienced at appearing before congressional committees. How many people in the Office of Science and Technology—which has a comparatively small staff—are devoted to the active supervision of the research programs?

Mr. RENNE. I am going to ask Mr. Eaton to answer that, because OST has a Committee on Water Resources Research. Mr. Eaton represents our Department of Interior along with Mr. Hendricks, the alternate on that Committee. It is made up of representatives from all the major departments of the Government that have any interest and activity in water research. We feel this is a medium through which a great deal of information necessary to keep duplication to a minimum, Mr. Senator, is provided, and I would like Mr. Eaton, since he represents our Department on that overall coordinating committee of water research, to answer that.

Senator ALLOTT. Let us hear from him. I would like an answer to my question, if I can get it.

Mr. EATON. Senator Allott, the Office of Science and Technology, which is a unit of the Executive Office of the President, under the directorship of Dr. Donald Hornig, has one full-time professional staff man who devotes substantially all of his time to water research in the Office of Science and Technology. He functions as a staff man, assisting the Director of the Office of Science and Technology, and also as chairman of the interdepartmental committee on water resources research, which is composed of representatives of all of the executive departments and independent agencies.

Senator ALLOTT. Who is the man?

Mr. EATON. This is Mr. Ray Linslay, Prof. Ray Linslay, who is on leave from the College of Engineering at Stanford University.

Senator ALLOTT. What is his background in water?

Mr. EATON. He is a civil engineer of very high professional standing as an engineering hydrologist, and author of one of the most widely used text on engineering hydrology. He has many distinguished positions in professional societies. If you would like, I could supply for the committee a brief statement of—

Senator ALLOTT. I will get that from the Director.

Out of a total staff of 133, then, in the Office of Science and Technology, I am not sure I understand your figures—do you know how many there are there?

Mr. EATON. I do not know the number.

Senator ALLOTT. There is, however, one man who is assigned to the area of water. I am asking this question because I am sure that it ties directly into the limitation that Congress put in title II last year, which indicated a concern we would move so fast in this area that the research grants and assistance would be excessive and, therefore, duplicative.

To what extent are these actually reviewed in the water research office, to be sure that there is not a duplication? It would seem that in some of these categories Dr. Renne has put in his tabulation there is duplication—this is not in the record, is it, Mr. Chairman?

Senator ANDERSON. Yes; it is.

Senator ALLOTT. That there is such a wealth of knowledge that to rework and turn over again and again a lot of these areas is an unjustifiable duplication. This is what I personally am concerned with. I am not concerned with the need for the solution to these problems, because I am convinced of the need. Since we in the West, particularly the 11 Western States, have worked on many of these problems, there is already a wealth of research information.

I do not want to keep on turning over the same ground, and I want to be sure that we are not turning over the same ground.

Mr. RENNE. I agree with you thoroughly, Senator. I will explain just very briefly that these nine categories have been developed by the Office of Science and Technology. They include within each category many subsections so that grouping them into these nine general categories would not necessarily indicate that because several research projects are in category 4 or category 5 that it is necessarily duplication. But I will explain briefly how we try to review these projects.

We have a very small staff. There are six of us on the professional staff in the Office at the present time. Each of us goes over the project carefully, the proposal for research, and then we determine which agencies of the Government, which are in a closely related field, would be best able to give us an appraisal of whether this duplicates any on-going research.

Senator ALLOTT. Does the member of the Office of Science and Technology exercise an effective veto power over the actions of your Department under this water resources program?

Mr. RENNE. No. I think it is more the providing of information upon which scientists can appraise whether they are duplicating and the kind of duplication.

Now, of course, some projects sound very similar, and yet different emphases are being undertaken, and this is not actually unproductive duplication.

Senator ALLOTT. I simply wanted to express for the record my only real concern about this whole area in which we are just getting started. I believe the chairman has some more questions he wants to ask, so I will yield at this point.

Mr. RENNE. May I add one point, Senator?

Senator ALLOTT. Yes.

Mr. RENNE. We do rely heavily on panels of consultants made up of individuals who are pretty well known, and expert in their particular fields. We rely upon them when projects are referred to them to tell us whether in their knowledge there are other projects being undertaken which would be duplicative.

We feel that these individuals are the most likely to know whether there are other projects that are on-going that would be duplicative, because we have a small staff, and we are especially anxious in consulting with other members of the Federal Government, of departments as well as these experts and consultants, to keep duplication to an absolute minimum.

We feel that is one of the major objectives of this Office, Mr. Chairman, to coordinate work in water resources research and to keep duplication to an absolute minimum.

Senator ANDERSON. Dr. Renne, I am very much interested in the questions which Senator Allott asked. There comes to mind my own experience with the Agricultural Act in 1947, in which the Government was spending huge sums of money for agricultural research without knowing what was going on in agricultural research. It took us, as you may recall, weeks and months to even make a catalog of all these and put them on punchcards and check them to find out the number of places where absolute duplication was taking place.

I will cite one example. Many schools in the West were interested in the question of how the irrigated cotton took dye compared to how Rain Belt cotton took dye. States side by side were doing the same work in the same fashion at somewhat duplicative costs.

I think that is what Senator Allott is trying to avoid. You may recall that in the initial version of the bill that became the law, we had a provision for a catalog of projects; it was stricken out because officials who would administer the act testified that such catalogs would be prepared in any event. I am glad to see that you are doing it.

I would like to have you clarify what you are finding out in these catalogs. Do they show the duplication? Can we assume that, all over the United States, all water research work is done without duplication of somebody else's work, or are the same things happening frequently?

For example, in flood control, diking is often necessary. Some people found out that, strangely, atomic energy programs might have some part in such programs. Isotopes were placed on the banks. As a result the places of origin of the silt were able to be ascertained. Therefore, by placing dams in certain places it is possible to stop reservoirs from silting up so rapidly.

A development such as this is potentially of very great value. But we must have some means of channeling dollars so the work they do will not be duplicated. The situation outlined by Senator Allott could get out of hand. I do not know who the man is in the Science and Technology Division, but he has his work cut out for him if he is going to keep track of all the water resources research projects in the United States. I think perhaps we ought to have more than one man on it.

But I interrupted you, Senator Allott; I am sorry.

Senator ALLOTT. I appreciate the chairman's remarks. I have concluded my questions. Thank you, Mr. Chairman, very much.

Senator ANDERSON. Senator Jordan.

Senator JORDAN. Mr. Chairman, I think we all recognize the need for a strong program of water research. I want to identify myself with the remarks of Senator Allott and the chairman here. My great concern over the possibility of just endless duplications of the many research projects—I am not going to belabor the point, because Senator Allott covered it very well.

I would only ask to make this request, Mr. Chairman, that Dr. Renne or the staff provide for the record a list of the projects that have been turned down because they duplicate other projects.

Mr. RENNE. Do you mean our office, Mr. Senator?

Senator JORDAN. Yes; whoever does the screening of these research projects.

Senator ANDERSON. I don't believe he cares whether your office did it or the Office of Science and Technology did it, as long as somebody has turned down something because of duplication.

Senator JORDAN. And the list of projects turned down by someone because they duplicate other research projects.

Mr. RENNE. Yes. We have already begun going over submissions by the States and have found some duplication which we have eliminated.

Senator JORDAN. I want a list of those projects turned down by someone because they are duplicative.

Mr. RENNE. We will get that for you, Senator, and have it for the record.

Senator ANDERSON. One of the reasons that caused President Johnson to hesitate a long time before signing the water resources bill was the provision requiring these projects to be submitted to the Senate and the House of Representatives. If you do not want us to have such a requirement in the law, you should make it possible for us to be satisfied that these dollars are being used effectively. I am sure if you are going to expect additional appropriations in future years, it has to be done on the basis that Congress is satisfied this work is fulfilling a need.

Mr. RENNE. With your permission, Mr. Chairman, we will prepare a brief statement for the record.

Senator ANDERSON. Yes.

Senator JORDAN. That is all, Mr. Chairman.

Senator ANDERSON. Thank you very much, Dr. Renne.

Mr. Eaton, we are also glad to have you back with us.

(The information requested is as follows:)

ACTION ON SPECIFIC RESEARCH PROJECTS WHICH THE OFFICE OF WATER RESOURCES HAS QUESTIONED FOR POSSIBLE DUPLICATION

1. New Hampshire Water Resources Research Center: The proposed project, "Water Production as a Forest Land Use," was questioned. The Office of Water Resources Research recommended consultation with the U.S. Forest Service, the Geological Survey, and other agencies. As yet no reply has been received, hence approval has been withheld.

2. University of Ohio Water Resources Center: With respect to three proposed acid mine water research projects, the Office of Water Resources Research requested further information as to their relation to other current research on the subject, especially the activities of the U.S. Bureau of Mines, the Geological Survey, the Bureau of Sport Fisheries and Wildlife, and the Public Health Service. This information was requested with particular regard to provision for coordination and avoidance of unproductive duplication. The center has responded that further searches have revealed no duplication of effort previously reported or currently underway and has provided detailed information on these searches. Proposals have been approved.

3. Utah State University Center for Water Resources Research: The Office of Water Resources pointed out that the project, "Water Quality Factors," might be closely related to research of the Public Health Service and of the U.S. Geological Survey. The Office of Water Resources Research requested that the Utah center confirm that their project has taken that into consideration so as to avoid undesirable duplication. The center responded stating that this project had been discussed in detail and does not duplicate work underway or planned by others. This project has been approved by the Office of Water Resources Research.

4. Kentucky Water Resources Institute: The Office of Water Resources Research pointed out that the proposal, "Collection and Evaluation of Basic Geologic, Hydrologic, and Climatologic Data," appears to be partially duplicative of activities of the U.S. Geological Survey. The institute was asked to reexamine it and advise of steps taken to eliminate any duplication that may be involved. No reply has been received as yet, and approval is being withheld accordingly.

5. Virginia Water Resources Research Institute: With respect to the project proposal, "Geomorphology of Beach Processes," the Office of Water Resources Research requested a statement as to whether the institute has consulted the Corps of Engineers about the research they are conducting on beach erosion and similar problems. We stated that this project is peripheral to the primary emphasis placed by the Water Resources Research Act on water supply and quality and asked that the institute consider substituting another project for this one. No reply has been received as yet and approval is being withheld accordingly.

6. Virginia Water Resources Research Institute: The project, "Mass Transport in Ionic Systems," was questioned as apparent duplication with Federal agencies' programs, in this case Office of Saline Water. No reply has been received as yet, and approval of this project is being withheld accordingly.

7. Virginia Water Resources Research Institute: The project, "Treatment of Industrial Wastes," was questioned as being apparent duplication of the Federal agencies' program, in this case the Public Health Service. The Virginia institute was asked to advise the steps taken to assure avoidance of duplicative research. No reply has been received as yet, and approval is being withheld accordingly.

8. Arkansas Water Resources Research Center: In the case of proposed project entitled "Quantitative Analysis of Streamflow-Rate Extremes" the question was raised by the Office of Water Resources Research as to whether the type of information developed cannot be readily secured through existing and evaluation of this proposal was requested of the center by the Office of Water Resources Research. The center made a further evaluation of this proposal and consulted with several people of the U.S. Geological Survey and the State of Arkansas. They concluded that the proposed statistical analysis of the streamflow data will provide much useful information that would not otherwise be available. The project was expanded to provide more information than was originally planned. The Office of Water Resources Research has accepted the explanation provided by the center and has approved this proposal.

9. Arkansas Water Resources Research Center: In the case of the proposed project, "Environmental Changes Produced by Cold-Water Outlets From Three Arkansas Reservoirs," confirmation was requested that this project had been coordinated with related activities of the Bureau of Sport Fisheries and Wildlife. Evidence has been received that this coordination has been effected and the proposal has been approved.

10. Auburn University Water Resources Research Institute: With respect to the project, "Oxidation of Organic Pesticides," further information was requested of the measures the institute will employ to avoid unproductive duplication of research by others including such Federal agencies as the Agricultural Research Service, the Public Health Service, and the Bureau of Sport Fisheries and Wildlife. No reply has as yet been received, and approval of this project is being withheld accordingly.

Twenty-three additional proposals from institutes for initial grants under Public Law 88-379 are now being evaluated by the Office of Water Resources Research. Other proposals where suspected duplication is involved may be uncovered and be called to the attention of the institutes for clarification prior to being approved. The Office of Water Resources Research assures avoidance of undesirable duplication by research supported under the Water Resources Research Act of 1964 by the following procedures:

(a) The regulations for administration of the program require that recipients of research support funds must make inquiry of the Science Information Exchange to determine what research is planned or in progress in the particular field of study to be undertaken, and that the projects proposed for support under the act do not duplicate established water research programs.

(b) Applicants must submit descriptions of their proposed research projects on the format of the Science Information Exchange to facilitate the appraisal made by the Office of Water Resources Research as further assurance of nonduplication.

(c) Requests for supporting funds and specific research projects proposals are reviewed by competent specialists from Federal and State agencies and from university staffs. Their review will specifically cover the question of duplication in addition to other questions.

The Office of Water Resources Research is taking an additional important action to assure avoidance of undesirable duplication of research supported under the act. Section 304 of the act states that there shall be established in such agency and location as the President determines to be desirable, a center for cataloging current and projected scientific research in all fields of water resources. The President has designated the Science Information Exchange of the Smithsonian Institution as the general purpose faculty for such cataloging.

The Science Information Exchange serves as a clearinghouse for information on current scientific research actually in progress. Government agencies and many non-Government agencies with major research programs actively cooperate by furnishing the exchange with timely information on their current research programs and projects. Non-Government agencies include private foundations

and fund-raising agencies, universities, industry, and individual investigators who wish to register their research.

As recognized by the act substantial improvement in water resources research activities can result from the general availability to research workers of current information on projected and on-going projects.

Accordingly a water resources research catalog, now in the hand of the printer, has been prepared listing all water research projects now being performed under U.S. Government sponsorship. This catalog is needed by the Office of Water Resources Research as one of the tools for administration of the program so as to avoid undesirable duplication of research. It also enables applicants for support under the program to avoid such undesirable duplication by being knowledgeable about what water resources research is being done, by whom, how, and where it is being done. Probably of equal value, the catalog enables the entire research community to be knowledgeable of the entire range of current scientific and engineering research related to water resources, their conservation, development, and utilization.

Senator ANDERSON. Without objection, we will put in the record a statement by William E. Welsh, executive director of the National Reclamation Association.

(The statement referred to follows:)

STATEMENT OF WILLIAM E. WELSH, EXECUTIVE DIRECTOR NATIONAL RECLAMATION ASSOCIATION

My name is William E. Welsh. I am executive director of the National Reclamation Association.

The National Reclamation Association over a long period of years has been intensely interested in all problems relating to soil and water research. We have had a special committee of our association working on this problem year after year since 1951.

We are fully aware of the increasing demand upon our available water supply and recognize, therefore, the need for accelerating our research program. We wish to congratulate those who have introduced and sponsored the bill, S. 22, which is now before you and are happy indeed to join in supporting this legislation.

In 1961 the National Reclamation Association joined with the National Association of Soil and Water Conservation Districts in sponsoring a national water research symposium which was held in Washington, D.C. Speakers at this symposium included some of our nationally known and best informed men on this subject. We believe this symposium aided materially in bringing to the attention of the country as a whole the necessity for accelerating our water research program. The program of this symposium, including all of the excellent speeches delivered at the symposium, was published as Senate Document 35 in June 1961.

Our soil and water research committee, in its report submitted at the Palm Springs convention last November, took a strong position in endorsing the accelerated program which the bill now before this committee, S. 22, would authorize. The following is a quote from our committee report:

"Title II, as originally contained in the bill S. 2, more realistically covered the research needs and provided for the fulfillment through modest, but adequate, appropriations, but had been completely removed by the House committee. Steps should be taken to either modify the present legislation or to reinstate the original concepts of title II of Senate bill 2."

Also, our resolution on soil and water research, which was adopted at the Palm Springs convention, strongly endorsed and urged strengthening of our water research program in the manner which S. 22 would provide. The following is our NRA Resolution No. 17 as adopted at the Palm Springs convention in November 1964:

"Whereas this association has for many years urged an acceleration in programs of soil and water research; and

"Whereas the amount of Federal funds spent on soil and water research of value to the reclamation States is inadequate to meet their increasing demands and should be materially increased: Now, therefore, be it

"Resolved by the National Reclamation Association, That those provisions of Senate Document 59 relating to the needs of the reclamation States be implemented and the program be accelerated so that important major research pro-

grams of value to the reclamation States be accomplished at an early date; and be it further

Resolved, That Public Law 88-379 (Senate bill 2) be amended by including in title II thereof the original provisions of said title contained in S. 2 as introduced; and be it further

Resolved, That research relating to the control of noxious weeds, to reduce injury to agricultural crops, be materially increased; and be it further

Resolved, That copies of this resolution be forwarded to the Appropriations Committees of the Congress, the Budget Bureau, and the Secretaries of Agriculture and the Interior."

We do, therefore, strongly support the bill, S. 22, which is now before your committee.

We appreciate very much not only the opportunity of presenting this statement but also the forward-looking progressive attitude which this committee has taken with respect to the important problem of water research.

Senator ANDERSON. Because Senator Allott is compelled to return to his work on another committee, I am going to ask Dr. W. E. Morgan, of Colorado State University, and chairman of the Water Resources Committee of the National Association of State Universities and Land-Grant Colleges, to testify at this time.

Senator ALLOTT. Mr. Chairman, I am very happy to present to the committee a man who I am sure has appeared before this committee on other occasions, and before other committees of Congress. He is the distinguished president of our Colorado State University, and we are very proud of him. We are particularly proud of the growth and advancement that the university has made under Dr. Morgan.

We are very happy to have you with us, Doctor.

Senator ANDERSON. Dr. Morgan, is Dr. Frey here with you?

Dr. MORGAN. Yes, sir.

Senator ANDERSON. As long as Senator Allott said what he did say, I want to add that you can hardly imagine how reassuring it has been during the progress on this water research legislation and other bills, Dr. Morgan, to have your constant help and support, and your very good judgment. It has been a tremendously wonderful experience for many of us. We have had to rely on long-distance telephoning to you, but your comments have been very helpful. Your presentations have likewise been very fine and useful to us. We are glad you handled this matter for the association of the land-grant schools.

STATEMENT OF DR. WILLIAM E. MORGAN, PRESIDENT, COLORADO STATE UNIVERSITY; CHAIRMAN, WATER RESOURCES COMMITTEE, AMERICAN ASSOCIATION OF STATE UNIVERSITIES AND LAND-GRANT COLLEGES; ACCOMPANIED BY DR. JOHN FREY, OF PENNSYLVANIA STATE UNIVERSITY

Dr. MORGAN. Senator, I thank you very much for those nice words. I appreciate the nice words of my Senator from Colorado also.

I have a statement for presentation to you. I thought I was coming on at 3 o'clock this afternoon, so I am busy rearranging things here, Senator.

My formal statement is only two and a half pages long. It was designed in expectation that questions would be asked to amplify it, and, therefore, I propose to read the entire statement. It will take less than 5 minutes.

My name is William E. Morgan. I am president of Colorado State University and am here in my capacity as chairman of the Water Re-

sources Committee of the National Association of State Universities and Land-Grant Colleges. I appreciate the opportunity to appear before this committee to express the association's interest in S. 22.

The National Association of State Universities and Land-Grant Colleges, in whose behalf this testimony is presented, consists of 97 State and land-grant universities and colleges located in each of the States and Puerto Rico. Member institutions grant more than one-fourth of all baccalaureate degrees and substantially more than half of all doctoral degrees in the United States. My appearance here today for this specific purpose is authorized by the association in a resolution adopted at its annual meeting November 10, 1964.

Last year when S. 2 was before you, I appeared as head of a panel of five witnesses from member institutions of our association for detailed discussion of the reasons for our support of that bill. Since the purpose of S. 22 is to return to the original concept of S. 2, I shall not burden you with repetition of the testimony presented a year ago, although I would like to state for the record that the testimony presented at that time is equally applicable today.

Instead of a panel of five witnesses today, we have present one other person from our association, Dr. John P. Frey, of Pennsylvania State University, whom you are asked to hear, and I should like to file with you a statement from another association member, Cornell University, of New York, signed by Dean Charles E. Palm, of the College of Agriculture, and Dr. Leonard B. Dworsky, Director of the Water Resources Center at Cornell University.

Senator ANDERSON. Without objection, that statement will be added to the record.

(The statement referred to follows:)

STATEMENT OF CORNELL UNIVERSITY, ITHACA, N.Y.

Cornell University's current centennial celebration has offered the university an opportunity to review its basic purpose and to rededicate itself to the future well-being of man and society. Cornell's original goals of offering any intellectually qualified person instruction in any subject and ignoring distinctions based on religion, sex, and color; of liberalization of the arts curriculum, promotion of research and advanced training in agriculture and engineering have been met.

Today, the rededication to these goals and their extension is not merely the task of the university. In the field of research, for example, it is a task also of government. That this view, too, is held by the Congress is clear in the research support to universities that it has provided. The Water Resources Research Act of 1964 is an outstanding example.

As we view the future, few things are certain. There are, however, a number of facts that seem reasonably clear. The Nation's population will double in a little more than three decades; more than 90 percent of our people will be living in urban centers within two decades; industry will double its productivity in about the same time; agriculture will have to maintain and improve its high rate of efficient production; and leisure time and opportunities for a better life will demand more recreational activities.

It is also clear that we will achieve these results effectively, at reasonable cost and without damaging limitations only if we develop the knowledge needed to control and manage our water resources.

The importance and value of S. 22 rests in the flexibility it provides the Nation in meeting a wide range of water issues and in the complementary nature of its provisions with other parts of the Water Resources Research Act of 1964 (Public Law 88-379).

Modern American universities, such as Cornell, provide the basic facilities for the production of qualified manpower to plan, develop, and manage the Nation's water resources, and can contribute greatly to the development of needed new knowledge through research.

In this national endeavor we must not—we cannot afford to—overlook any part of our society that can make a contribution to this important problem. Thus, the funds and the variety of methods as grants, contracts, matching, or other arrangements should be viewed as parts of an expanded armament to attack water problems. The ability to use this armament in connection with any part of our national composition—education institutions, private foundations, or other institutions; with private firms and individuals; and with local, State, or Federal Government agencies—provides the best assurance that we will be able to use our best talents wherever they may be found.

We are pleased to report to this committee that the Water Resources Research Act is helping Cornell to step up significantly its contribution to water resources research and the related training of scientists and engineers. As one of the universities selected to receive early support from the supplemental appropriation made available during the last session of Congress, we look forward to a continuation of the excellent cooperation we have received from the Office of Water Resources Research in the Department of the Interior and to the development of new and practical information to help us meet both our State and the Nation's needs.

Cornell University is pleased to join with the universities represented on this panel, under the outstanding leadership of President William Morgan, of Colorado State University, in urging favorable action on S. 22.

CHARLES E. PALM,
Dean, College of Agriculture.

LEONARD B. DWORSKY,
Director, Water Resources Center.

STATEMENT OF DR. WILLIAM E. MORGAN—Resumed

DR. MORGAN. Further, I wish to emphasize our association's support of the position taken with respect to this bill by witnesses representing other educational institutions and research organizations which are not members of the association I represent. We work closely with these other organizations in fruitful cooperation in the laboratory, in research planning, and in the classroom.

And now, I shall limit my remarks to a brief discussion of S. 2 as conceived in its original text.

Title I funds provided a base of fiscal support which, while relatively modern in size, had the value of continuity without threat of diminution. Thus the research administrator could not only plan with confidence for an on-going program of minimal size but could recruit his personnel with honest assurance that the job was not subject to the hazard of early termination. One must understand the workings of the typical academic mind to appreciate the enormous value of this factor of assured funding.

Title I also provided for selective funding of additional "peaks" of work on special or limited-term projects that would be superimposed on the base just discussed.

Title II funding, on the other hand, permitted what the military theorists would call "concentration of force" at the same time it promoted the development of a balanced research effort under the condition that exists in our country, a condition of wide diversity and broad dispersion of our national research talent.

The term "center of excellence" has been used, and doubtless abused, in free wheeling discussion of the broad subject of water resources research, but it serves my purpose well at this point, since title II funding would encourage the development of such centers. In its broadest context, the water problem in North America deserves the attention

of research talent wherever it exists, and the mechanism of title II enables the research administrator to seek it out and induce it to work.

Passage of S. 22 would facilitate and promote this end. On behalf of our association, I urge you to give favorable consideration to the bill.

Senator ANDERSON. Thank you, Doctor. Your suggestion to us is that there are private foundations and private institutions and things of that nature that ought to be utilized occasionally.

Dr. MORGAN. Yes, sir, the capabilities of these organizations, the personnel in these organizations, are available for the effort in water resources research. The need is for a means of triggering the effort, and title II funding as originally conceived provided that mechanism.

Senator ANDERSON. I do not quite know how it is lawyers go about qualifying a man as an expert witness, but if you are not an expert witness in this field, I do not know one who would be.

Do you feel there are problems in connection with water resources research that can be profitably handled by institutions, agencies, and individuals in addition to the land-grant colleges for which provision is made in the existing law?

Dr. MORGAN. I do, sir, for the reason that, as proud as I am of the institutions I represent, the public universities do not have a corner on all the talent in the many, many disciplines that can contribute to a broad program of water research.

Senator ANDERSON. I think that is a fine statement, and I appreciate it very much. You have been before us a great many times, and have given this a lot of thought.

Senator Allott?

Senator ALLOTT. Doctor, you mentioned one thing, and I note that the act still contains a clause which states: "deemed desirable and not otherwise being studied."

I am sure you agree with the point we had under discussion, which is to make every effort to see that we are not duplicating our research efforts and draining off available talent into duplicative work.

Dr. MORGAN. Senator Allott, I agree with this position completely. As one responsible for research administration, although a step or two removed on the the campus, I would like to assure you that we who have that responsibility are equally concerned to see that we do not have unwarranted duplication inside our own organization's efforts.

Duplication is a difficult thing to defend, and it becomes more difficult to defend when the pressure for use of our limited supply of research talent becomes greater as these problems crowd in on us.

I would, however, like to comment a little further on the subject of duplication, having been concerned with the problem of avoiding it for so many years in my job.

There are some things that appear to be duplicative on the surface, which, after further study and examination, are not nearly so duplicative.

Let me see if I can put it in these terms, although I am oversimplifying the problem in doing so. The more basic or fundamental the research project, the less justification there is for duplication of the effort at some other place for the reason that findings that come from so-called basic research are rather universal in their application, and once this answer has been derived in Pennsylvania or at the

University of Wisconsin, it is equally applicable in New Mexico or California, and so on.

So, this is what I mean by the statement that the more basic the inquiry, the less reason there is for duplication some place else.

A great deal of our research is applied in nature, and so I would say the converse of the previous statement is that the more the research project is one of application to a particular problem in a particular area, the less reason there may be to criticize it as being duplicative of something else.

Let me see if I can give you an example. We are very interested in the mountain area of Colorado in means of land treatment—mechanical and otherwise—to increase the water yield of the snow and other precipitation that falls on that area.

Now, the Great Smokies, are another mountain watershed, and I am sure there is interest in increasing the water yield from the precipitation there. Projects to discover how one may treat mountain land to increase water yield in these two areas might appear duplicative in that they are aimed at the same objective. But the results obtained in one area may be entirely different in another. The object of the exercise, however, is to increase the water yield at both places.

Ground-water management in the high plains and mountain regions or in the closed basin regions of the State where I live, I am sure, present different problems to the researcher than ground-water management in Missouri or in one of the Mississippi Valley States.

You could go on and on. What I am trying to say is that when research clearly is applied research—and bear in mind that one of the objectives of S. 2 was to permit States with all their wide diversity of conditions to work on some problems that are close to home and bothering them—there undoubtedly will be a lot of apparent duplication, and after further examination it may, of course, be real duplication. But I urge the review agency to look underneath each of these projects very carefully before assessing the degree of duplication.

Senator ALLOTT. I think I might even supply you with another good example. In Colorado, we have been struggling for many years—as you know, this goes back 30 years—in attempting to write a ground-water law. Actually, in my own mind a great many of the reasons for failing to do so lie in the lack of knowledge, as much as anything else—knowledge about our water, its direction, its scope, all of the other technical factors which make it impossible to write, or have made it impossible to write an intelligible bill up to this time. What would be secured from research in this area of Colorado, of course, may not be applicable to Montana, or Wyoming, or any other place.

There is another aspect of this that I would like to mention, since no one has mentioned it here this morning, Mr. Chairman. I look at the chairman's adjoining State of New Mexico and I see the fantastic growth of the Albuquerque area and the Santa Fe area, and I am sure that he can envision in a few years a megalopolis extending all the way from Santa Fe to Albuquerque. We in Colorado, who are looking ahead, can envision a megalopolis, from the Fort Collins-Greeley area south to Pueblo. This kind of development poses a problem which, I believe, is going to be the greatest problem of all.

It comes to a matter of not just recognizing and conserving water. It goes far beyond merely planning for the huge concentrations of population which are going to occur in the next 15 or 20 years. How we provide water for them, how we conserve it, how we reuse it, and a hundred other questions that you could bring up. I hope our friend Dr. Renne is still in the room and will keep in mind some projects in basic research, hard constructive thinking, as to how we in this country are going to deal with these problems 15 to 20 years from now. In some instances they are not that far away, they are here now.

Dr. MORGAN. Senator, you as a lawyer would be interested, I am sure, in one of the projects that has already been initiated in the Institute in Colorado. It deals with this very thing you are discussing, except it starts at the bottom with one small facet of it.

If I may put in general terms what you have just said, you are concerned with the overall problem of water management, and water management requires manmade institutions such as commissions, and the like, to develop plans and to carry them out.

Basically, these institutions must operate within the framework of water law and, of course, all of the law, but specifically water law. So one of the projects now under way in cooperation between Colorado State University and the University of Colorado Law School under, I believe, a professor you may know—Professor Sax—is to make a very detailed inquiry into one part of the foundations of water law in our State of Colorado.

This has led him, I understand, into the labyrinth of reclamation law, because much of our water in that State is derived from reclamation projects.

Now, this is illustrative also of how a project that is designed to be applicable to one small area; namely, the State of Colorado, may lap over into the area of basic findings that might or might not be applicable some place else.

We feel that in the next dozen or so years in our State the pressures you have described in terms of the development and concentration of population along the east face of the mountains will require possibly some drastic action, and certainly some very searching effort in the total overall management of water, and we are bound to need the most reliable advice with respect to the basic law of water when we get to that point.

So this really is the objective of starting this project now with the University of Colorado Law School.

Senator ALLOTT. Thank you very much, Dr. Morgan. I appreciate your statement. It was very helpful, but more than that, I appreciate your remarks, which have been more helpful even than your statement.

Thank you very much.

Senator ANDERSON. Senator Moss.

Senator MOSS. I have no questions. I do appreciate Dr. Morgan's appearance, and the fine work that he has done in this field as a leader of the land-grant college group. We are very proud of the work done in our land-grant college in Utah.

Dr. MORGAN. You should be.

Senator MOSS. We do appreciate the fine work you are doing.

Dr. MORGAN. At the risk of being impertinent, may I say that I know the work being done in Utah to be exceedingly good, because you

hired away from our campus the dean of engineering on the Utah State campus, who is responsible for the water program over there, and we would like to have him back.

Senator MOSS. We will not give him up.

Senator ANDERSON. No further questions?

Thank you very much, Dr. Morgan, and please feel free to write us and tell us your opinions, because they have always been extremely valuable and always welcome. Thank you very much.

Dr. MORGAN. Thank you, sir.

Now, Dr. Frey, who represents another member of our association, the Pennsylvania State University, has a statement to file with you and with your permission, may he comment on it?

Senator ANDERSON. Go ahead, Dr. Frey.

STATEMENT OF DR. JOHN FREY, OF PENNSYLVANIA STATE UNIVERSITY

Dr. FREY. I, too, have a prepared statement which I would like to read, if that is satisfactory with the committee.

My name is John C. Frey. I am director of the institute for research on land and water resources at the Pennsylvania State University, and I appear as a representative of the National Association of State Universities & Land-Grant Colleges.

S. 22 represents a desirable modification of the present act. It makes possible supplemental funding for educational institutions that are establishing institutes under title I, and it authorizes much more adequate funding for other institutions that wish to participate in the research and training program.

Educational institutions that are establishing institutes under title I will be in need of supplemental funding to properly carry out their many prescribed duties. Modern research technology permits exploration of extremely complex resource problems, but the costs of undertaking these investigations generally are quite high.

Special purpose projects in the \$75,000 to \$100,000 class have become quite commonplace in many of our leading colleges and universities. Relatively speaking, the authorized appropriation for a State water resources research institute is very modest, indeed. With limited assistance, institutes are responsible for the conduct of research in many fields of water, together with the responsibility of providing training for our future hydroscintists.

Moreover, it becomes the duty of each institute to arrange for cooperative research and training programs with other institutes and with such agencies and individuals of the State as may contribute effectively to the solution of water problems.

Even with matching funds as provided for under section 101 of the act, institutes may not be able to participate effectively for lack of counterpart funds.

Institutions of higher education, other than those that are establishing institutes under title I, often have outstanding scientists on their staffs, and further, may be extremely well qualified to undertake a program of water resources research because of location and special facilities or because of their academic services capability. Seldom does

each institution in a State have strong programs in all disciplines of knowledge. There is a tendency toward specialization with each institution making its contribution in only a few fields.

It is almost an insurmountable task to bring the services of all qualified scientists of a State into the water resources research program of a single institute. Coordination of efforts is possible, but joint participation in research operations often is impractical. Independent financing appears to be the most feasible approach if the services of scientists in several different institutions are to be employed. Title II funds are appropriate for this purpose, but must necessarily be increased if more institutions are to participate.

In broad context, organization for an effective program of water research should insure that the researcher, the policymaker, and society in general are all striving toward the attainment of a common set of objectives. These objectives might be identified as follows:

One, to develop a broad-based interdisciplinary program of research which will aid in the making of resource policy decisions.

Two, to facilitate under long-range public commitments the earliest possible attainment of research findings.

Three, to establish a process of carrying out research programs which will insure maximum returns on research dollars invested.

Attainment of these objectives—breadth, speed, and efficiency—quite logically requires an operational framework with orderly procedures for program planning, expeditious procedures for program implementation, and objective procedures for program appraisal. To the extent that these conditions are met, the purposes really of the Water Resources Research Act will be achieved.

From the standpoint of a research administrator, it seems clear that the provisions of S. 22 would enable the Secretary of the Interior to establish project priorities within a coordinated framework of research, provide for rapid review of research requests, maintain continuity in the funding of research programs, and channel flows of research findings to resource policymakers. These matters are of vital concern to research personnel at the State level who wish to participate in this very important water resources program.

Senator ANDERSON. Thank you, Doctor. I am glad to see that you agree that the kind of financing provided by S. 2 appears to be a feasible approach to get scientists in all parts of the country to serve and cooperate with different institutions.

One of the purposes of title II of S. 2 of the last Congress was to make available the services of persons needed, no matter whether they are in your State or some other State, wherever they are, whether they are in a private or public institution.

Do you have any questions, Senator Allott?

Senator ALLOTT. I have no questions.

Senator MOSS. I have no questions.

Senator ANDERSON. Thank you very much.

We have an old friend here, Sam Thompson, who is representing the Interstate Conference on Water Problems of the Council on State Governments.

Sam, we are always glad to have you here. We appreciate your coming.

STATEMENT OF SAM THOMPSON, INTERSTATE CONFERENCE ON WATER PROBLEMS OF THE COUNCIL ON STATE GOVERNMENTS

Mr. THOMPSON. Thank you, Mr. Chairman. I have with me Sam Swan, who is a colleague in the Washington office.

My name is Sam Thompson. I am chairman of the Mississippi Board of Water Commissioners, but today I am appearing on behalf of the Interstate Conference on Water Problems.

Two years ago I had the honor of presenting to this committee a statement by the interstate conference on the then pending S. 2, now Public Law 88-379. At that time we supported the pending legislation, including what was title II of that bill. We continue that support as is indicated by a resolution adopted at our 1964 annual meeting, a copy of which is appended to this statement.

Mr. Chairman, we wish to congratulate this committee and the Congress for its wisdom and foresight in enacting recently such far-reaching laws as the Water Resources Research Act, the wilderness bill, and the land and water conservation fund bill, and, in this Congress, in having moved so rapidly toward enactment of the water resources planning bill. Together with S. 22, these measures represent a recognition of the vital significance of water as a natural resource and a commitment on the part of Congress that the resource shall be conserved, used, and developed in a manner that will afford the greatest benefit to all our people today and in the future.

It is, of course, with respect to the future that S. 22 deals. We know of the ever-increasing demands on our water supplies. We cannot hope to meet such demands without a continued evolution in basic data collection; improvements in techniques in using and reusing water; enhancement of our ability to store and distribute water; and ever-increasing the supply of water.

Obviously, many of these needs are being met, at least in part. For many years basic data collection has been carried on cooperatively by the U.S. Geological Survey and the States. Efforts to control and abate pollution have been stepped up in recent years, and pending Federal legislation provides for further acceleration.

Under a number of programs storage of water and its distribution are furthered. Research in and development of methods to desalt saline and brackish water offer great promise.

S. 2, or, as it was passed, Public Law 88-379, in time will add substantially to our capacity to supply our expanding population with water adequate in quantity and quality. It will strengthen the contribution that universities, particularly land-grant and State universities, can make to water resources research, and it will stimulate education of scientists in water and related fields of inquiry.

However, with all due deference to the Congress, Mr. Chairman, we believe the bill reported by your committee last Congress was stronger in one important respect than the legislation adopted finally. The present bill, S. 22, would correct that deficiency.

We support S. 22 because we believe it will lend an added measure of flexibility to the water resources research program already authorized by Public Law 88-379. We recognize and we respect the capabilities of land-grant colleges and State universities. We point out,

however, as we have done consistently, that the location of research capacity follows no pattern.

It may exist, in fact it does exist, in existing public and nonprofit water research agencies and in engineering consultants.

Among such research institutes and engineering consultants is a substantial competence not ordinarily found on land-grant and State university campuses—a competence in which we, as State water resources administrators, have a vital interest. Many of these institutes and engineering firms have devoted much time and talent to municipal and industrial water problems.

To illustrate, we understand that a State water commission has proposed to the Department of the Interior a study of the comparative effectiveness of various types of State law and regulatory mechanisms. In the results of such a study our membership would be most interested.

Mr. Chairman, under the terms of title II of Public Law 88-379, State water research institutes may not undertake research to further the mission of the Department of the Interior. This prohibition—which would be lifted by S. 22—we regard as unwise. A number of such State institutes are well qualified to do such research. Indeed, we understand that the Department has received project proposals from some of them.

To sum up, Mr. Chairman, the Interstate Conference on Water Problems believes it important to utilize research capability wherever it may exist—in public and private colleges or in other public agencies or private organizations. We believe that S. 22 will further that end.

We support the bill.

Senator ANDERSON. The resolution adopted at the conference will be included in the record at this point.

(The resolution referred to follows:)

RESOLUTION ADOPTED AT THE SEVENTH ANNUAL MEETING OF THE INTERSTATE CONFERENCE ON WATER PROBLEMS, DECEMBER 7-8, 1964

III. WATER RESOURCES RESEARCH

Whereas the Interstate Conference on Water Problems by resolution in 1962 urged that then pending Federal legislation provide for using as nuclei for water research institutes existing public and nonprofit water research agencies attached to State or private universities or to nonuniversity connected State agencies; and

Whereas, as approved by the Senate, this legislation also would have provided in title II for an additional \$5 million program to support research into any aspects of water problems which may be deemed desirable and are not otherwise being studied, a provision amended substantially in the legislation as passed; and

Whereas Public Law 88-379 provides that such institutes be attached to land-grant colleges unless another college or university is designated by the State: Now, therefore, be it

Resolved by the Interstate Conference on Water Problems, That it support legislation similar to title II as included in the Senate version of the water research legislation considered by the 88th Congress so as to achieve a greater degree of flexibility in administration.

Senator ANDERSON. Thank you, Mr. Thompson. We appreciate your statement very much. I am glad you point out the location of research capacity follows no pattern. You want to find it no matter where it is. We appreciate that. It is a fine thing.

Mr. THOMPSON. We think the problems are varied enough, legal and physical, Mr. Chairman, that it is going to take the total com-

petence that we have in all fields in order to meet them for our expanding population in the future.

Senator ANDERSON. Last year's bill, as enacted, did not do what the present measure would do. You realize that I tried my best. We are glad to have support from you today for those things we had to leave out in the Water Research Act.

Mr. THOMPSON. We appreciate the effort that you made last year, and we hope that this year you will be successful.

Senator ANDERSON. Thank you.

Senator MOSS?

Senator MOSS. Thank you, Mr. Thompson. It is a very good statement, and I compliment you on it. I am very pleased, indeed, to have your support of the bill.

Senator ANDERSON. We are glad you could come again.

Mr. THOMPSON. Thank you, sir.

Senator ANDERSON. Dr. MacArthur, we are glad to have you here.

STATEMENT OF DR. DONALD M. MacARTHUR, MANAGER, CHEMISTRY AND LIFE SCIENCES RESEARCH CENTER, MELPAR, INC.

Dr. MACARTHUR. Mr. Chairman, Senator Moss, I am manager of the chemistry and life sciences research center at Melpar in Falls Church, Va., and also a member of the Water Research Council. I appreciate the opportunity to appear before you today.

The importance of controlling and providing quality water for our increasing population and industrial needs has been recognized for some time. Progress in this area has been slow primarily due to the lack of sufficient resources to develop the necessary technology.

The bill under consideration, S. 22, is long overdue. It will allocate resources more in line with the magnitude of the problem and will insure that the wealth of talent and technology in colleges, universities, and industries across the country is brought to bear on the problem.

The most effective approach to fulfilling the short-range needs is through the application of currently available technology. The purpose of this testimony is to demonstrate, using four or five typical examples, that defense and space technology, which has been developed on programs not directly concerned with water resources, has immediate application to water quality measurement, water purification, and water conservation.

Water quality measurement: Regulation of water quality for domestic, industrial, agricultural, and recreational use is difficult without proper chemical monitoring systems.

Incidents such as outbreaks of epidemics in metropolitan cities served with modern water treatment facilities, bacterial food poisoning traced to Great Lakes smoked whitefish, and infectious hepatitis traced to oysters all point to the necessity of continuous biological monitoring of water supplies.

Government research and development efforts over the last 15 years have included work on special devices to detect and monitor trace quantities of toxic chemicals and pathogenic biological material. In response to these requirements industry has developed a steadily improving array of sensors.

Equally advanced instrumentation technology has been developed under the space program. By way of example, I would like to cite the development of a miniaturized gas chromatograph that will continuously monitor extremely low concentrations of 75 organic compounds of widely differing composition in the Apollo spacecraft environment. This unit could easily be modified to detect pesticides and other organic pollutants. In addition, studies on the detection of extraterrestrial life have led to the development of instrumentation capable of automatically and reliably detecting bacteria and viruses at very low concentrations.

Turning now to water purification, water purification methods may be classified into: one, physical removal of foreign substances; and two, detoxification without removal. Physical techniques include filtration and distillation. Methods which reduce toxicity include sterilization and chemical transformation.

Recent research on the purification of water contaminated with highly toxic materials has led to new techniques.

This work showed that conventional filtration techniques would not remove suspended materials in colloidal sizes. Extended studies showed that passing water through a sand bed covered with a thin layer of diatomaceous earth effectively removed colloidal suspensions.

Activated charcoal absorption systems are not only expensive but cannot be economically regenerated. But current work indicates that low-cost materials like coal, china clay, and silica gel can be upgraded to possess adsorption capacities similar to activated charcoal by suitable pretreatment methods.

One final example: the stringent requirements of long-term manned space flight are leading to the development of improved adsorption and filtration methods capable of providing potable water from fuel cell effluent and human waste materials.

Turning now to water conservation: Good water management practices require that sources of water loss be controlled. One of the most obvious areas of attack is the water loss from reservoirs.

Methods involving the spreading of monomolecular layers of organic materials have been shown to decrease the rate of evaporation of water. The transfer of this process from laboratory to reservoir operations has not been successful.

One of the most important aspects of evaluating the relationship between the evaporation rate and the retardation efficiency is the method of water loss measurement. The current method of recording changes in water levels does not establish a direct cause-effect relationship between the presence of evaporation retardant and water loss.

Recently developed infrared sensor systems can, however, measure the critical property of water reservoir covered with evaporation retardant. The amount of water vapor in the air over a reservoir can be monitored continuously. This means that the rate of evaporation can be measured directly over very short time periods, which then permits direct correlation of evaporation rate with the presence of retardant on the water surface.

This does not solve the problem of water loss. It does represent, however, an applied research tool now available which can be used to completely evaluate a variety of retardants in a variety of field situations. In this way the feasibility of this often-proposed approach can be definitely determined.

These few examples help to illustrate that a sound research program on effective water resources utilization can be based upon currently available technology from the national research and development complex.

Organizations in the defense and aerospace industry, such as the one I represent, cannot afford to speculate by establishing facilities and initiating company-sponsored programs unless there is a clearly defined demand for services. It is sometimes said that defense contractors will not or cannot "diversify," but you will find that these contractors are aggressive enterprises, and will move quickly and apply all their technological resources once they see an effective demand. Most industrial groups, along with their associations with nonprofit and university organizations, are capable of meeting any product specifications if there really is a demand for the product. This has been illustrated time and time again in our military and space programs. Therefore, to exclude from the attack on water resources this industrial capability, or to limit artificially its involvement, is to overlook much of the history of this country's technical progress.

That is the end of my statement.

Senator ANDERSON. Thank you, Dr. MacArthur. I am very much interested in one paragraph here where you say "one of the most important aspects of evaluating the relationship between the evaporation rate and the retardation efficiency is the method of water loss measurement."

You refer to these attempts to control the rate of evaporation of water and you say the transfer of this process from laboratory to reservoir operations has not been successful.

Do you think the process is promising or do you think it is going to be difficult to establish? I have seen a number of articles on spreading oil on top of reservoirs; what would it do to retard evaporation? Of course, retarding evaporation is important. There are two large reservoirs in Arizona which involve substantial losses as a result of water evaporation.

Mr. MACARTHUR. Mr. Chairman, I quite agree; water loss from reservoirs is one of the biggest problems we have: 71 percent of the total average rainfall in the United States, or 3,000 billion gallons a day, is lost through evaporation and transpiration processes. These techniques I refer to, of spreading monomolecular layers of organic materials on water, work very well in the laboratory but when you transfer it to the field situation, for example, a reservoir situation, you have problems of film breakage and pile up due to wind-and-wave action. There are other techniques that could be applied, one of which involves the utilization of reflective or emissive films or coatings. Again a lot of work has been done here under R. & D. sponsorship for other applications. One area I know of is that of countermeasures at sea utilizing reflective films. I think this approach also has potential. More effort has to be put into this total area but one of the drawbacks right now, as I tried to point out, is the fact there is no good way of evaluating how good evaporation retardants are. An example is that an individual looks at the water level one day and comes back the next day and looks at it again. In such a case the difference in water level might be due to evaporation, seepage, drainage, or transpiration from plants at the side. This system I talked about today that has been

developed for other applications actually looks out over the water surface and measures the rate of evaporation as it is actually occurring. In this way you have a very simple technique for comparing one film with another and determining the retardation efficiency of each. It could be an extremely useful research tool.

I think this area of water evaporation retardants has to be continued, but more concentrated effort has to be put into it if its full potential is to be realized.

Senator ANDERSON. Thank you very much. If you have any material in your files that illustrates why you believe evaporation control has not been too successful so far, I would appreciate it if you could give us a little summary. That is, why it has not been successful, where it has not been successful.

Dr. MACARTHUR. It has not been as successful in field situations as it has been in the laboratory. In the laboratory one can reduce the evaporation from water surfaces dramatically by putting monomolecular things on the surface. When you go to the reservoir, the films break and pile up due to wind and wave action and you do not see the same reduction as you do in the laboratory. There are many operational problems and I think a lot of these have to be looked at more thoroughly. Laboratory and field studies have been carried out in this area over the last 20 years. Field examples that readily come to mind are Lake Hefner, a 2,500-acre lake in the State of Oklahoma, and Elephant Butte in the Rio Grande in New Mexico. In summation it has been found that wind is a major factor and that the most severe problems are application and maintenance of the films.

Senator ANDERSON. Dr. MacArthur, you have not testified before this committee very much, and I would appreciate it some time if you would, for my own information, if nothing else, supply me with a résumé of where you have been and studied, because, obviously, you are a scientist and we would like to keep up with you.

Dr. MACARTHUR. Thank you, sir.

(The information requested is as follows:)

MacArthur, Dr. Donald M., 5313 Albemarle Street NW., Washington, D.C. B. Sc. (Hons.) Chemistry, St. Andrews University (Scotland), 1954. Ph. D. Physical Chemistry, Edinburgh University (Scotland), 1957. 1957-58—University of Connecticut, instructor, Department of Chemistry. 1958 present—Melpar, Inc., Falls Church, Va., manager, chemistry and life sciences research center.

Responsible for the management and technical direction of a group of over 200 scientists representing a broad spectrum of disciplines from instrumentation engineering to biology, including instrument design and development, physical chemistry of solutions, materials research, toxicology, biophysics, and medical virology.

Presently responsible for the management of research and development programs in the following general areas:

1. Detection instrumentation: This involves research on concepts for sophisticated physico-chemico analyses, which have been incorporated in to variety of detection systems for monitoring trace concentrations of toxic biological and chemical substances.

2. Life sciences: This includes research on mechanisms of induction of cancer by viruses, development of therapeutic agents, and the utilization of biological systems for the production of energy.

3. Atmospheric sciences: Research on the development of experimental methods which will permit detailed study of the movement of particulates suspended in the atmosphere under various meteorological conditions.

4. Natural resources: Research here includes membrane processes for desalination of water, conversion of coal to economically useful synthetic intermediates,

and the development of techniques for the reclamation of soil contaminated by pesticides.

5. Space sciences: Research on the physical and chemical processes occurring in cometary tails, design and construction of instrumentation for the detection of extraterrestrial life, and research on the effects of remote sampling procedures on the viability of extraterrestrial organisms.

Senator ANDERSON. Senator Moss?

Senator MOSS. I was very interested in your testimony, Dr. MacArthur, in having you point out that there are many avenues of research that really we may be containing our thinking on this water research to a much narrower field than we should do.

Would the types of things that you have mentioned here normally come to the attention of this water research listing that we have talked about so that we could take advantage of them.?

Dr. MACARTHUR. First of all, let me say that these examples were very simple examples, and to answer your question, I think Dr. Renne or Mr. Eaton of the Office of Water Resources might answer this better in terms of whether they have technical coordination with other Government agencies, particularly defense and NASA, to keep informed on applicable programs. Of course this is where the Office of Science and Technology should be of assistance.

I come from industry, and I have talked to appropriate people on water problems many times, and this is one area that I have been hammering at. There is a lot of technology being developed for other applications that might be overlooked. Of course the fundamental problem here is one of technical information dissemination which today is a very big problem.

I feel very strongly about this.

Senator MOSS. Is the technology developed in areas like this published widely and therefore readily available?

Dr. MACARTHUR. It is generally in the public domain and most of this work I referred to has been done under Government sponsorship, but there is so much work being done under Government sponsorship and so many reports being generated that it is sometimes difficult to get quickly at what you really want. I think better systems have to be developed and employed to make sure that the technologies available are brought to the attention of the people who can use them. As Senator Allott said earlier today, a lot of people have been in the water research business and have gone over it and over it, and that is true. However, it is one thing to understand and recognize the problems. The other thing is to solve them, and there are many ways of solving any scientific engineering problem, and I feel that in many cases utilizing the technology we have, if it is far enough advanced, is certainly the quickest approach to it.

Senator MOSS. I do appreciate your underlining the fact that many of our commercial organizations are indeed working on this problem and that they contribute greatly in this field.

Dr. MACARTHUR. Yes. As an example of this area of utilizing existing technology the State of California, I think, has taken the lead recently. They have awarded a program to Aerojet General to look at the water situation in the whole State of California and look at it from an overall systems standpoint.

Aerojet General are certainly in category I am talking about.

Senator MOSS. Thank you.

Senator ANDERSON. Thank you. Senator Kuchel?

Senator KUCHEL. I have no questions but I wish to say I am most interested in your statement, Dr. MacArthur. It illustrates pretty concretely why this is a piece of legislation that must be speedily enacted into law.

Thank you very much.

Senator ANDERSON. Thank you, Doctor.

Dr. Kelley, I think you have done a lot of work on monomolecular layers on the ground, and so forth. We appreciate your being here.

STATEMENT OF DR. OMER J. KELLEY, MANAGER, AGRICULTURAL RESEARCH CENTER, STANFORD RESEARCH INSTITUTE

Dr. KELLEY. Thank you, Mr. Chairman, Senator Kuchel, and Senator Moss. I appreciate the opportunity and consider it an honor to talk to you about S. 22.

I am representing, you might say, two groups this morning. I am a member of the Stanford Research Institute staff and also I am a member of the Water Research Council.

Senator ANDERSON. Maybe you can answer this question. Is the Stanford Research Institute a part of Stanford University?

Dr. KELLEY. The only relationship we have with Stanford University is they own us. We have a separate board and president. However, our directors are common in some extent, so that our rules and regulations are different in the university, but the university does own Stanford Research Institute.

Senator ANDERSON. I hope you do not mind my asking that question.

Dr. KELLEY. Of course not. I might mention we have around 2,600 employees at the institute. We are what is known as a nonprofit research organization. We are nontax supported and nonendowed. We do research for the Government and they pay for research on a project-by-project basis. Last year our volume was a little over \$40,000 of research, so we are a sizable research organization.

Senator ANDERSON. Thank you.

Dr. KELLEY. With that as background, I would like to read the statement I have. I will comment just a little bit once or twice in this particular statement.

The Water Research Act passed by the 88th Congress was a step in the right direction, and the Congress is to be commended for this action. As good as it is, however, it still does not go far enough. The present bill now being considered, S. 22, is excellent, and, if passed, will provide the needed legislation for a complete water resource research program.

I come from the western part of the United States where the water needs are already overtaking most of the available water supply. Obviously, however, the West is not alone with respect to water problems today. Water problems exist throughout the United States. That these problems are extremely important and are becoming more critical every day has been clearly documented many times.

Your committee, through the Select Committee on Water Resources of the 86th Congress, has been one of the most active groups in the United States to so recognize and document these problems.

The National Water Research Symposium, which was held in Washington, D.C., in 1961, and supported by the National Association of Soil Conservation Districts and the National Reclamation Asso-

ciation, also did an outstanding job in identifying and bringing research efforts up to date in this important field.

I, therefore, feel that there is no need to attempt to list the many water problems to a well-informed group such as yours. Rather, I should like to discuss the tremendous opportunities that exist for solving the water problems throughout this country and some of the steps that need to be taken to bring about these solutions.

Being a research man, I naturally believe that all problems can be solved by research if enough time and effort, and this means financial support, are devoted to proper research. Obviously, one usually can overresearch a problem, but there is certainly no immediate danger of this happening to our water resource problems.

To be sure, we have made progress in the past with relatively little research. In relation to the amount of money invested, this progress has been substantial, but in relation to the needs and opportunities that exist, it has been slow. The need for solving the many water problems seems to be increasing exponentially with time. In many areas today, all of the immediately available water supplies have already been allocated. In other areas, the quality of the remaining water has become so poor that it has questionable use for human consumption and for agricultural and industrial purposes. While these situations are alarming, they need not be discouraging because science has been progressing.

The real need is to advance knowledge and to apply our newer scientific learning to the field of water resources.

The land-grant institutions of America have excellent research talent and, over the years, have done a fine job of research. They are capable of doing even more and better research with increased financial support. They represent, however, only a part of the talent and a part of the competence that is available for this important research task.

The non-land-grant institutions, both State and private, have a wide diversity of facilities, brain power, and technology that could and should be made available for water resource research. These institutions can bring different kinds of experience, training, and different approaches to water problems.

I might comment here on a water problem we have been working on recently at the institute. A company came to us with a boron problem in their water they wanted to put back into the underground aquifer. Normally, there are several ways one might want to do this. This is not much material to take out of water. This problem has finally been solved by an organic synthesis chemist, a person one would not ordinarily expect to be working in the water field, a man who knows probably little, if anything, about water, certainly nothing about hydrology or plants. But he does know something about organic chemistry and he has synthesized a chelating agent, which is a new agent that will take the boron out of the water, and this is in trace amounts.

I just point this out because I think it shows an example of bringing in other disciplines than one would normally expect in this kind of research.

Just think for a moment of the vast storage and transportation facilities that are being planned today which will permit water to be

transported not only within a State but from one region to another. Such facilities set in motion a whole series of problems requiring research not only in the physical and biological sciences, but also in the social and legal and political areas. In many cases, the required solution of the problem involves the interworking of these various factors.

I would like to consider one problem that has always been of particular interest to me, that is the loss of water through evaporation from soil surfaces. If we take the State of Arizona, for example—this would apply in a lot of the Western States—about 80 million acre-feet of water falls every year in the State of Arizona. If you try to account for this in terms of underground accretions or streams-flow, one can only account for about 5 or 6 million acre-feet. What happens to the rest of it? The remainder of this water is lost either through evaporation from the soil surfaces or through evapotranspiration from nonbeneficial plant growth. Here is an area where very little research is being done today. Practically nothing.

If one could find a way of preventing, say, the soil surface from taking in the water and collecting this water runoff, this would be a tremendous source of water.

In a 12-inch rainfall belt, 1 acre will yield 20,000 gallons of water. If one is to collect this water by runoff, there are three or four things necessary. First you have to make the soil impervious to water; secondly, one has to prevent plant growth; third, one has to stabilize the land so it will not erode. These three problems offer a straightforward situation. Today we know we can make soil impervious to water very easily. This is no problem and can be done without much cost. We can keep the plants from growing. We certainly do not know how to prevent land erosion when we take off the plant growth.

I point this out because it is important to find a way of saving the water in such a problem. Such research will require physiologists, chemists, biologists, engineers, and economists to just obtain answers.

There are two important aspects of scientific research on any problem. One is the advancement of the sciences needed for the solution of the problem and the other is research oriented to a solution of the problem using the level of scientific knowledge available in the required sciences.

The private research institutions are generally more oriented to problem solving than public agencies, and they have a great capacity to bring a multidisciplinary approach to the solution of any given problem.

The tax-supported research institutes are generally more oriented to research designed to advance knowledge in a given discipline, and these advances can then be put together for problem solving. The point I wish to make is that both approaches are important and necessary, and the bill that we are discussing today would make it possible for both approaches to be used to the fullest extent.

It is our belief that the program envisioned by this bill will be extremely efficient and in the best interest of the taxpayers. It is designed to require a minimum number of Federal employees and to use facilities that are already in existence in State and private institutions.

The research will all be done by contract or grants and, hence, can take full advantage of centers of excellence for any given phase of the research problem.

Scientists of outstanding caliber can be made available through this approach. A scientist will not have to be at a given location or a specific Federal laboratory for his services to be used. Another very important feature of this type of research is that nonproductive efforts can be quickly terminated and new and important problems studied as they arise.

The program envisioned in Senate bill 22 has long been needed.

I thank you.

Senator ANDERSON. Thank you very much, Dr. Kelley.

Since you came from Senator Kuchel's State, I am going to let him start off the questions.

Senator KUCHEL. Dr. Kelley, I am happy indeed to have you come here from the State I have the honor to represent in part, and spell out some of the almost unbelievable areas in which scientific research can be utilized for the public good in solving domestic problems.

The specific example you gave with respect to the rainfall in Arizona is astounding. In our State north of where you live it seems almost incredible that after many generations we still have floods which permit a tremendous loss of water. This represents another kind of question that is going to have to be resolved by research and then by appropriate legislation in the Congress.

There is no need for me to make a long comment except to tell you that many months ago the senior Senator from Arizona, Mr. Hayden, had a group of us together and we listened to people in the Atomic Energy Commission giving their views on how vast quantities of water might be transhipped into areas of shortage from areas of surplus, and be done in a fashion that would permit the Federal Government to participate on an economically feasible basis.

The proposed legislation before us today is going to pass. I think the comments made by the chairman of this committee, by some of my colleagues here on duplication, certainly indicates a sound approach where duplication of effort is inimical to the public interest.

I think we will help to avoid duplication of effort by utilizing the techniques, and if I may say so, the brains, of all kinds of institutions of higher learning—public, private, land grant, and nonland grant—and to that extent I think it is very good for you and the gentlemen who have preceded you to demonstrate the multiplicity of scientific questions which arises in this field.

All I can say is that I thank you very much for coming here and making the statement.

Dr. KELLEY. Thank you.

Senator ANDERSON. Senator Moss?

Senator MOSS. I do not think I have any questions of Dr. Kelley. I also compliment him on his presentation and his suggestion that private institutes can be most helpful in moving into the various phases. The thing that I come back to which I commented on before is the great diversity of research that impinges on this one thing of preserving the water or improving the water. It is obvious that we must extend into many different fields, some that probably do not even occur to us at this time. We should be flexible enough and diversi-

fied enough that we can make sure that we are probing in every direction where research can be beneficial.

Thank you, Dr. Kelley.

Senator ANDERSON. Thank you, Doctor. We appreciate your statement very much and hope you will keep in touch with the committee.

Dr. Bregman is our next witness.

When we finish today—we have one more witness after Dr. Bregman—we will adjourn until 10:30 tomorrow morning. There is an executive session of the committee at 9:30, and I thought it best to save an hour for that, so we will start tomorrow morning at 10:30.

STATEMENT OF DR. JOHN I. BREGMAN, MANAGER, WATER RESEARCH CENTER, IIT RESEARCH INSTITUTE, CHICAGO

Dr. BREGMAN. Mr. Chairman, Senator Moss, I am honored to have this opportunity to appear before you on behalf of the two organizations I represent. I would like to begin my statement by identifying them for you.

The first group is the Water Research Center at the Illinois Institute of Technology, of which I am manager. Some 1,600 scientists and supporting personnel at the IIT Research Institute are engaged in a wide variety of Government and industrial research programs. We cover a number of scientific disciplines such as physics, chemistry, metallurgy, ceramics, astrosciences, electronics, mechanical engineering, life sciences, and computer technology.

The recent upsurge in research in various phases of water resources has led to the establishment of a water research center in our organization so that our activities in this area may be better coordinated and tuned to the national needs.

The other organization I represent today as their chairman is the Water Resources Research Council. This is a nationwide group made up of representatives of a number of universities, research institutes, and industrial firms that are concerned with our water problems. A partial list of organizations represented on the council is as follows: Indiana University, Cochrane Corp., Midwest Research Institute, Travelers Research Center, IIT Research Institute, Mellon Institute, Ionac Chemical Co., Princeton University, Cornell University, Battelle Memorial Institute, Massachusetts Institute of Technology, University of Florida, Stanford Research Institute, Resources for the Future, Inc., Melpar, Inc., Cyrus W. Rice & Co., Dorr-Oliver, Inc., Drew Chemical Corp., Johns Hopkins University Industrial Water Engineering Magazine, Polytechnic Institute of Brooklyn.

At a meeting of this council held in Washington in December of this past year, the situation with regard to water resources research was the subject of an all-day conference. The conferees then adopted the following resolution which I would like to read to you:

We, the members of the Water Resources Research Council, meeting at the Brookings Institution, Washington, D.C., on December 17, 1964, and representing universities, research organizations, and industries of America recognize the vital importance of water as a natural resource and the critical role of research in providing knowledge to assure the conservation and best possible use, in the broadest sense, of the national water resource, and do hereby commend the 88th Congress for its wisdom and foresight for passing the Water Resource Research Act of 1964; and

Whereas the Water Resource Research Act of 1964 is a significant step forward, it is still inadequate to meet the water resource needs; and

Whereas water resource problems are becoming more critical throughout the Nation: Therefore be it

Resolved, That we request the U.S. Congress to implement in full the appropriations recommended in title I of the Water Resource Research Act of 1964 and take any additional action necessary to enact legislation as stated in Senate bill 2 of the 89th Congress as it relates to title II of that bill; and be it

Resolved, further, That we make known to the Congress the availability of research talent and facilities that can be brought to bear on national water resource problems only through the full implementation of title II, as stated in the original S. 2 of the 88th Congress.

Gentlemen, I would like to sum up the attitudes of the organizations that I represent with the following comments:

First, we would like to congratulate the U.S. Senate, in general, and this committee and subcommittee specifically, on the awareness of our national water difficulties that you showed last year when you passed the Water Resources Research Act of 1964.

It is particularly encouraging to observe that in addition to the immediate corrective measures that can be taken in the area of water pollution prevention and to the longer range program of the conversion of saline water to fresh water that you have developed, you also have had the foresight to recognize that the ultimate solution to the more effective utilization of our national water resources is dependent to a great extent on breakthroughs in research on new approaches to water conservation and reuse.

It is true that we are not yet utilizing all our knowledge on pollution prevention and water conservation, but it is also true that dramatic new developments are necessary that can only come about through an adequate research program.

The Senate version of last year's bill, S. 2, made a promising start toward marshaling the research capabilities of our country into an attack on the problem. The final version of the bill as passed by Congress, however, fell far short of our needs. While making a commendable start toward developing and utilizing water research technology at land-grant colleges, the bill, for all practical purposes, eliminated the use of the tremendous amount of water resources know-how that exists elsewhere.

There are large numbers of scientists, expert in water technology, who are anxious to use their knowledge on this problem of national concern and who are frustrated by their inability to do so under the present law. These scientists are employed by universities, research institutes, and industrial firms as well as State and municipal agencies and constitute the overwhelming bulk of our national talent in this area today.

Go to any meeting of significance in almost any phase of water technology today and you cannot help but be impressed by the facts that (a) there is a larger supply of talented researchers in water technology available in our country today than in all the rest of the world put together; and, (b) the overwhelming majority of these talented scientists cannot contribute to our water resources research effort under the present law.

A further ironic touch is the fact that much of the background and knowledge that these frustrated researchers in universities and research institutes have was developed with Government money under

contracts for other purposes by other Government agencies. To fail to utilize this talent that the Government has paid to develop at a time when it is desperately needed just does not make sense.

We urge you, at least from our point of view, and from the point of view of economy, efficient technology, and plain honest patriotism, to allow us to use these skills for our country's benefit.

I should also like to call to your attention the fact of industry's representation and participation in our efforts. Industry has been the whipping boy for a long time in many of our water problems. They now say to you: "We have water technology know-how available and we are anxious to use it to help solve the Nation's water resources difficulties." How can we fail to take advantage of this large reservoir of ability?

I would like to interrupt the statement for a minute here to give you a few examples perhaps pertinent to the industrial problems and to the reuse of water that I think you might find to be of interest.

In 1958, I gave a talk before the Oklahoma Refiners Council on the problem of the reuse of river waters which have been polluted with chromates.

In many refineries, down in Texas, especially, practically entire rivers flow into one end of the refinery and flow out the other end—they flow out contaminated by chemicals such as chromates used in corrosion abatement. I have written a book on this subject. There has been a great deal of effort on the development of materials other than chromates because chromates poison the river water, they are toxic to fish and what have you. Industries realize that sooner or later the States will ban the use of chromates. However, the development of an adequate replacement, one which is effective and economic so that industry can use it, I believe, is beyond the scope of any one particular industrial company. This is the type of problem for which basic knowledge developed by the Government would be valuable because then we could turn to industry and say, "here is a solution to this problem; here is a solution that is economical; here is a solution that we insist that you use because of that fact."

As another example, during the past 5 or 10 years there has been a very dramatic development in connection with the discovery of new chemicals called polymer chemicals that are used to clarify turbulent river water or to settle mine waters in the copper industry, for example, and in the uranium industry. These chemicals, used in very low dosages, have resulted in the savings of a great deal of money and the ability to reuse water because it purifies it. However, most of the work done has been empirical and the knowledge and development of these chemicals belongs to a few organizations, and it is a tightly held secret.

I know this because I helped develop some of these myself when I worked for an industrial water-treating company.

Now, we feel very strongly that a basic research program aimed at an understanding of the mechanism of how these polymeric coagulants work, what the basic chemistry is, how they attach themselves to the clay, to the copper deposits, how they bring this material down, what goes on, we believe will lead to the development of even better coagulants in that this information made available free on a Nation-wide scale will go a long way toward enabling the more efficient purification of a great deal of our water and making it more usable.

Now, getting back to my statement—in terms of specifics, the present water resources research law is deficient in that the funding allocated under title II for research by groups of the types that I represent is pitifully small. The larger sum that last year's Senate bill provided would have allowed the start of an adequate program.

The final amount provided for in the bill is only a token sum. In addition, the complication created by the provision for submission of contracts to congressional committees means, from a very realistic point of view, that title II funding will either be eliminated by the Government, or by the executive branch, or will be filled with delays that are intolerable to scientific groups that must be able to schedule their manpower on the basis of some sort of a timetable.

The same provision applied to other Government research areas would drastically curtail our national research effort.

In conclusion, gentlemen, I urge you to restore the provisions of last year's Senate bill so that our experts in water technology—regardless of whether they are affiliated with universities, research institutes, or industry—can pitch in and devote their abilities to the solution of one of our most pressing problems: sufficient pure water.

Thank you, Mr. Chairman.

Senator ANDERSON. Thank you very much. Of course, the Senate reached that point that you advocate.

Senator MOSS?

Senator MOSS. That is about the only comment I would have, Mr. Chairman. I think this is a very eloquent support of the views of this committee.

Dr. BREGMAN. Thank you, sir.

Senator ANDERSON. Thank you very much for being here. We appreciate your coming today.

Dr. BREGMAN. Thank you, sir.

Senator ANDERSON. Mr. Rice.

STATEMENT OF JAMES K. RICE, PRESIDENT, CYRUS W. RICE CO., PITTSBURGH, PA.

Mr. RICE. Mr. Chairman, Senator Moss, I would like to identify myself. I am a consulting chemical engineer, and I am president of Cyrus W. Rice Co., a research consulting firm, specializing in the technology of industrial water and waste water, and may I apologize for not having copies to distribute to the committee. My remarks are brief. Some of them will be extemporaneous.

My interest in S. 22 has three roots; as a citizen I am interested in appropriate and efficient use of Federal funds.

I might add I certainly appreciated the comments of the chairman and other members of the committee on this subject this morning.

As the head of a profitmaking research and consulting firm, I am interested in the gainful employment of its talents, and as a consulting professional engineer with long experience in industrial water research, I am interested in the problems of its use and disposal. These interests are compatible; I will not attempt to separate them in the remarks that follow.

As the committee is well aware, the various divisions of the Federal, State, and local governments are actively engaged in conducting

or sponsoring research in certain sectors of the general area of water resources. One of the sectors that remains to be covered adequately is that concerned with water for and from industry.

Those problems that are peculiar to a specific industry are and generally should remain in the province of privately sponsored research. There are many problems, however, that are common to most industries, and are properly the subject of publicly sponsored research if they are to be solved in any reasonable period of time and in a coordinated fashion.

The evaporative processes are a good example of a common industrial water use. And here I refer to the processes of using water to make steam for power, for heat, and to use water for cooling by evaporating that water.

The water quality requirements for efficient energy utilization in steam systems are set largely by the necessity to prevent deposit formation in the units that superheat the steam and in the turbines that use it. Can we find a means to prevent these deposits so that the quality requirements can be lowered and water supplies of much lower quality requirements utilized economically? Would this then allow use of waste waters directly?

Industry generally rejects unwanted heat to water. Some of the heat rejection is to water passing through the equipment once and to waste; some to water that is recirculated through a spray tower where air cools it by evaporation and the water returns to cool the process.

In either case, the heat rejected results ultimately in the evaporation of water to atmosphere. Can the rate of this evaporative process, particularly in the river from industrial use, be enhanced by practical means?

And here I digress from my notes. You have heard much about the means of conserving the evaporation of water, reducing the evaporation from bodies of water. Here this may seem to be just the opposite, the problems of enhancing evaporation from water in certain areas in certain streams might allow the absorption by that stream of heat that is otherwise designated as thermal pollution which affects the quality of the stream.

What is necessary to successfully substitute water waste of various kinds for the fresh water normally used to supply recirculated cooling tower systems? How can brackish waters be used economically for cooling system makeup?

In both examples given, successful research would allow poor quality water that is not suitable as a potable source to be substituted for water that is potable and in so doing either preserve or create additional water resources.

The private research in industrial water treatment in the past has been generally in the direction of improving the quality of the water that is furnished to boilers and to cooling towers.

In practice, the treatment to improve the quality supplied to these processes removes matter from the water and in so doing generates several additional parts of waste matter for every part that is removed from the supply. If, instead, the processes themselves could be made more tolerant and could use very much lower quality supplies, less wastes would be generated and previously unusable sources would be tapped.

Much of the ground water in the United States, as I understand, is considered to be brackish. It is not used industrially because of the expensive process of removing the contaminants that make it brackish and make it unsuitable in current technology.

Solutions to problems of the use of the water in an as-is state would allow an economical use and may then create effective supplies where these are now not able to be tapped for industrial purposes.

Senator ANDERSON. I am sure you know that the program of saline water conversion involves two plants for brackish water, also. One is at Redfield, S. Dak., I believe, and one at Roswell, N. Mex. The Redfield plant is working very well. The one at Roswell is not.

Mr. RICE. Mr. Chairman, these processes are in the line of making a higher quality water from the brackish water, as you are well aware. The remarks that I was making are in the direction of allowing an industry or a process to use the water without that purifying step.

As you are also probably aware, the purifying step itself generates waste and that these, in turn, become a problem. If the water can be used as is and ways found to do so economically, it then saves some of the waste and it also, hopefully, would save the cost of that purifying process.

Research on problems such as I have discussed requires a close contact with industry and experience with industrial water treatment. It requires a knowledge of the processes that use the water. Many organizations with such contact and experience and which are capable of relevant research in this sector are either profitmaking research firms or nonprofit private research institutions.

Title II of Public Law 88-379, as it now stands, has the practical effect of excluding these private profit and nonprofit research organizations from research on water resources problems.

The Congress recognized that there is an immediate need for research on water resources, that the existing organizations were not covering all of the sectors of needed research, and that there exists a shortage of trained and experienced people to conduct the research.

I believe it to be consistent with these expressed aims to urge that the talents and experience of the private profit and nonprofit research organizations be utilized fully in this search for solutions to water resources problems.

Amendment as proposed by S. 22 would help to accomplish the goals intended by the law.

Senator ANDERSON. I quite agree with you that this would be desirable and we are hopeful that it can be done.

Senator Moss, do you have any questions?

Senator Moss. I appreciate your statement, Mr. Rice, and it is in accord with my viewpoint.

Senator ANDERSON. Thank you, Mr. Rice.

We appreciate all of you who appeared here this morning, and we will stand in recess until 10:30 tomorrow morning.

(Whereupon, at 12:28 p.m., the committee took a recess until tomorrow, Wednesday, March 3, 1965, at 10:30 a.m.)

WATER RESOURCES RESEARCH

WEDNESDAY, MARCH 3, 1965

U.S. SENATE,
SUBCOMMITTEE ON IRRIGATION AND RECLAMATION,
OF THE COMMITTEE ON INTERIOR AND INSULAR AFFAIRS,
Washington, D.C.

The subcommittee met, pursuant to recess, at 10:30 a.m., in room 3110, New Senate Office Building, Senator Clinton P. Anderson (chairman of the subcommittee) presiding.

Present: Senators Anderson and Jordan of Idaho.

Also present: Jerry T. Verkler, staff director; Stewart French, chief counsel; and Richard N. Little, minority counsel.

Senator ANDERSON. The committee will be in order.

The first witness this morning is Dr. Allen F. Agnew, director of Water Resources Research Center, Indiana University.

Dr. Agnew, proceed, please.

STATEMENT OF DR. ALLEN F. AGNEW, DIRECTOR, WATER RESOURCES RESEARCH CENTER, INDIANA UNIVERSITY

Dr. AGNEW. Mr. Chairman and other distinguished gentlemen, I am director of the Water Resources Research Center at Indiana University. I am personally honored and so is my university to be invited to appear before you to discuss Senate bill S. 22.

I have a prepared statement, and I would like to depart from that, occasionally, Mr. Chairman, if I may.

Senator ANDERSON. If you will.

Dr. AGNEW. As background, I am a geologist, and I have spent 13 years with the U.S. Geological Survey in water work, in the metal mines in Wisconsin and in California, and in ground water work in the State of Iowa. Then I followed this with 7 years as State geologist of South Dakota where half of our work was in water research.

Now I am at Indiana University and we have a field station out in Montana so that we can provide both the western and the eastern look to our water problems and in educating our students and in conducting our research.

Returning to the statement, the passage of Public Law 88-379 was a welcome recognition by the U.S. Congress of the need for a greater water research effort as we attempt to solve the problems that are already upon us, and as we tackle those which will be even more important for the future development of our Nation—the water problems of the future.

The Congress is to be commended upon this investment in our country's future, as recognized not only through its appropriations for water research by university centers under Public Law 88-379, but

also through its appropriations to Federal agencies for their ongoing programs of in-house research and data gathering on water matters.

To depart again, these are exceedingly important activities for providing a groundwork for research by the university centers.

In addition, some industries that create some of these problems will probably be thereby encouraged to invest additional capital in such research.

The awarding of title I designation by the Office of Water Resources Research to States with the land-grant school as the base provides a valuable mechanism for implementing the provisions of Public Law 88-379. It is cheering to see that 14 of those schools have already been so designated, and it is hoped that the 89th Congress in this session will provide supplemental funds so that all of those States in which the land-grant institution or a combination of such institutions that show they are qualified can be designated by the end of fiscal year 1965.

Satisfying though this progress is, as the result of title I of Public Law 88-379, there remains a large resource of research centers and institutes or institutions, both university and nonuniversity in affiliation, whose great research capabilities could be brought to bear on water problems if a workable title II provision could be achieved. Such is one of the purposes of Senate bill 22, introduced by Senator Anderson on January 6, 1965.

This bill would restore the intent and meaning of the Senate version of S. 2 of the 88th Congress, and would thus provide for research grants to be made to non-title-I water research centers for specific projects under an arrangement that is common and successful in several Federal agencies. The requirement of review of project proposal by the Senate and House Committees on Interior and Insular Affairs is a subject which constitutional lawyers should be better able to judge than I.

Why does the Congress wish to review the proposals? This review provision would be excessively consumptive of congressional time, and it is difficult for me as a scientist to recognize what scientific bases or values the committee members would bring to such an evaluation unless some of them are scientists. Each proposal should be judged on its merits, and according to the capabilities of the proposer to carry it out. The bill under consideration, S. 22, effectively removes this objection.

Non-land-grant universities, such as Indiana University, and similar universities in virtually every State could thus receive support that would enable them to carry out research with a far greater total effect. Some of these universities, like Indiana University, have had a viable water resources research center actively engaged in planning and carrying out water research with new emphasis for several years.

Another provision of S. 22 would increase the funds available under Public Law 88-379 from \$1 million annually to \$5 million initially and increasing to \$10 million, thus restoring the impact of this law to the magnitude originally envisioned by the sponsors of S. 2 and companion legislation in the last Congress.

As was brought out so effectively in the hearings on S. 2 and companion measures 1½ to 2 years ago, the demand for water is increasing by a staggering amount, the quality-control specifications are be-

ing refined and otherwise modified as new users and more reuse enter the picture, and water-management decisions with wide-reaching effects are being forced upon us while we are yet ill prepared to cope adequately with the questions.

As I pointed out in my statement to this committee 2 years ago—through Senator McGovern by the way, because I was then in South Dakota—the need for an expanded program of gathering basic data is immense, the need for new methods of handling these data is just as great, and the need for training and educating the personnel who will do this data gathering, research, and decisionmaking is even greater. A healthy start toward the solution of these problems is provided by Public Law 88-379, and its impact will be boosted significantly by an effective title II.

Furthermore, the provisions in the act of an inventory of water resources research projects and of the coordination and cooperation of water research groups, both within and outside the Federal agencies, augur well for an exceedingly valuable total water research effort.

And to digress briefly, at our university and at other universities, in planning for projects in setting up the project proposals, we request from a science information exchange information on similar projects to make sure that we are not covering the same ground. We check with the Federal, State, and interstate agencies which are likewise involved in water research matters either directly or by granted funds. And, as an example of this, the water resources research centers at the universities are beginning to meet in clusters of centers.

For example, we have one meeting set up for the Middle West in about a month to discuss mutual problems, exchange information, so that this type of cooperation, coordination, will be achieved, and that there will be as little as possible of the duplication that was mentioned yesterday in some of the questioning.

Now, as Dr. Morgan pointed out, some duplication that appears on paper as duplication is not necessarily duplication as the work proceeds.

Senator Moss asked Dr. MacArthur yesterday about the broadening of the look in water resources, and this is a point I would like to stress. This is a place where the universities can have much to contribute. They can broaden the multidisciplinary approach to water research matters, not only from the standpoint of the agricultural, engineering, hydrological views, but also from the standpoint of the economic look, the recreational look, the legal aspects, the management and planning aspects. So you can see that the breadth that is needed in our water thinking in the future is available to the universities and through these centers.

You have heard yesterday, and you will hear again today about some of the exciting avenues that this water research can take today and in the future.

It is most invigorating for those of us who are working in the field to be training people who will be able to carry out these tasks in the future.

One of the points that was mentioned yesterday is the matter of thermal pollution. Mr. Rice pointed out that much of the water in the United States is brackish, and, therefore, we are spending funds on means to purify this water to make it less brackish, and he was

looking for research which might enable industry to use brackish water as well as to use the pure water. This would sidestep the intermediate process of purifying the water and getting rid of the waste products that this purification envisions.

I might point out in some parts of the country areas that have been known to have brackish water have been found by recent studies to have pure water at higher or lower levels. In South Dakota we were able to find this. The State geological survey, working in an area that is a brackish water area—as you know, the point at Webster, S. Dak., is an example of this—was able to find sands that had potable water.

This is exploration that has to be carried on by the Federal agencies such as the Geological Survey and water research centers.

A statement yesterday about acid mine drainage causes me to make a comment here. Senator Moss, I believe it was, asked where this drainage problem is, and the States of Ohio, Pennsylvania, West Virginia, Illinois, and Indiana were mentioned. Along this line I might point out that the strip mining problems are not just acid mine drainage problems, but they are also the problems of reclamation of the land, and the restoring of it to recreational potential.

This is an area of interest to some of the water research centers, and certainly, it would be of interest to one of the committee members, Senator Simpson of Wyoming, that reclamation of strip mining there has just begun between one of the coal mining companies and the State natural resources commission, I believe it is.

In concluding my statement, Indiana University congratulates the past Congress in achieving the first step, which resulted in Public Law 88-379, and we urge the present Congress to take the next and equally important step, in passing Senate bill 22.

Thank you.

Senator ANDERSON. Thank you, Dr. Agnew.

Off the record.

(Discussion off the record.)

Senator ANDERSON. Back on the record.

Do you have any questions?

Senator JORDAN. No questions.

Senator ANDERSON. Dr. Agnew, your statement was a most interesting and constructive one. I thank you for your discussion of apparent duplication. I quite agree with you. Things that look like duplication very many times are not, and we are very happy that you said that things that look alike not necessarily are alike upon examination of them.

Come again. We appreciate hearing from you.

Dr. Gregor, professor of physical chemistry and director of the Ion Exchange Laboratory, Polytechnic Institute of Brooklyn, is our next witness.

**STATEMENT OF DR. HARRY P. GREGOR, PROFESSOR OF CHEMISTRY
AND DIRECTOR OF THE ION EXCHANGE LABORATORIES, POLY-
TECHNIC INSTITUTE OF BROOKLYN**

Dr. GREGOR. Mr. Chairman, gentlemen, I am professor of physical chemistry at the Polytechnic Institute at Brooklyn, and I want to

thank you for allowing me to present this statement before the committee. I have a prepared statement.

Senator ANDERSON. Go right ahead and read it, and interpolate as you wish.

Dr. GREGOR. I would rather speak extemporaneously.

Senator ANDERSON. We will include your statement in full at this point and you may proceed as you wish.

(The statement referred to follows:)

STATEMENT OF DR. HARRY P. GREGOR, PROFESSOR OF PHYSICAL CHEMISTRY, THE POLYTECHNIC INSTITUTE OF BROOKLYN

I am privileged indeed to present this statement before the Senate Committee on Interior and Insular Affairs in support of S. 22, the water resources research bill. I want to lay particular emphasis upon the fact that research talent and facilities, both of which are available, can be brought to bear upon the problems of natural water resources only through the full implementation of title 2, as stated in the original Senate bill 2 of the 88th Congress.

My professional interest in water resources stems from my early research work while a graduate student at the University of Minnesota, where, under the guidance of Prof. K. Sollner, I prepared the first permselective ion-exchange membranes. The possible applicability of these membranes to desalination did not enter into my mind at that time. This research was pure and basic, aimed solely at expanding our total knowledge; it was of interest at that time to but a few laboratories throughout the world. Today our work on vastly more improved and complex membrane systems stems from this basic attitude and approach, but our work is also motivated by the extreme practical importance of these membranes.

I have had many opportunities to serve my Government: supervising research projects and grants at the Polytechnic Institute; serving as a "core" member of the National Academy of Sciences-National Research Council Woods Hole Committee on Desalination; and more recently serving as a member of the Water Resources Research Council which met at the Brookings Institute recently.

The purposes of the water resources research bill make particularly good sense to me. The Congress has already authorized substantial programs of research on water desalination and renovation, and in these two areas I think we are making good progress. Progress is not spectacular because this is an old and most difficult problem; difficult because we must produce pure water at a cost which is negligible compared with the cost of almost every other known chemical product. These research programs are, by their enabling legislation, necessarily restricted to the study and employment of certain techniques. The broader charter of the water resources research bill will remove these constraints and make possible truly interdisciplinary studies, employing the talents of diverse parts of a university. For example, by the modification of existing technology it is my feeling that we can considerably decrease the amount of irrigation water now needed in many water-poor regions of the United States. But such an attack, however, requires a team which includes agronomists, polymer chemists, and engineers. I would like to have appended to this testimony a recent letter of mine to the editor of the New York Times on this subject, published on June 30, 1964.

At the present time, only land-grant colleges have broad Federal support for work on these national water resources problems. I teach at a private, technical university; one which derives its major support from tuition and from sponsored research for specific projects from governmental agencies. I am proud of our contributions relating to water resources. A significant part of the basic research carried out in this country on membrane phenomena is done within the laboratories of the Polytechnic Institute. We make a number of different kinds of membranes and study their properties in the chemistry department, and in the chemical engineering department we study the application of membrane processes ranging from desalination to their use in artificial kidneys.

We have in the institute many outstanding scientists and engineers who could contribute substantially to this major, national problem were they brought into it. For example, we have an internationally known Polymer Research Institute, where outstanding research and development on plastics is conducted. Not only must this available staff be supported in the water resources problem areas but, what is more important, this will attract graduate students to this research.

Students have a natural propensity to gravitate in their research work toward popular, well-funded fields; such as, atomic energy, molecular biology, and space sciences.

The water resources research bill will allow private institutions to encourage graduate student interest in water resources problems. This bill will not only provide the necessary hands and minds for the solution of these problems; of greater consequence, it will develop scientists and engineers oriented toward problems of water resources.

I want to thank this committee for the opportunity of presenting my views.

Dr. GREGOR. I am here to lay particular emphasis on the fact that research facilities and talents which are available today can be brought to bear on this water resources problem only through the full implementation of title II as was stated in the original bill, S. 2 of the 88th Congress. I have been interested in water resources since I was a graduate student at the University of Minnesota under Professor Sollner, because it was there I prepared the first permselective ion-exchange membranes. This was my graduate research and at the time, of course, I knew nothing about their applicability.

These were new systems and I was not particularly interested in applications, and this was research that I imagine could be called very pure and very basic because it was simply done for the purpose of expanding our knowledge.

We had no practical application in mind, and it was so pure that only a few laboratories throughout the world were interested in it.

We are still doing work on membranes but now, of course, many laboratories throughout the world are very much interested in this. And I think that the membrane processes seem to be some of the most promising ones for desalinization, renovation, and other purposes.

As a consequence of my research in membrane phenomena, I have been adviser to several agencies of the Government. We have a number of projects and grants in various agencies of the Government. I have served on a number of committees. I was a member of the National Academy of Sciences, the National Research Council, the Woods Hole Committee that wrote the report on desalinization. More recently I was at the Water Resources Research Council meeting at the Brookings Institute.

I have examined this bill, and the purposes of the water resources research bill make particularly good sense to me. We already have substantial programs on research in desalinization and renovation and other areas. I think the progress we are making is good. It certainly is not spectacular. It is an old and extremely difficult problem, because of the economic limitations; that is, you must produce a chemical product; namely, pure water, at a cost that is fantastically low, if compared with the cost of almost any other chemical.

This, of course, makes it so difficult. The research programs we have already underway are necessarily restricted by the enabling legislation to certain techniques and certain areas. The broader charter of the research bill will remove these restraints and allow what is known today as interdisciplinary study. By that means, people from all different parts of the university participate in the same problem area.

An example which I would like to cite is my feeling that if we use these interdisciplinary talents we can solve some of the problems much more expeditiously. For example, I think we can reduce the

amount of irrigation water needed in many parts of the United States simply by having a team going from agronomists to polymer chemists, engineers, and so forth, looking at the problem. I wrote a long letter to the editor of the New York Times recently and it is appended to my testimony, and may I ask that it be included in the record.

Senator ANDERSON. It will be so included.
(The letter referred to follows:)

[From the New York Times, June 20, 1964]

TO PURIFY WATER

USE OF NEW TECHNOLOGY URGED IN IRRIGATION PRACTICES

The writer is professor of chemistry at the Polytechnic Institute of Brooklyn. He participated in writing the 1961 National Academy of Sciences-National Research Council Report on Desalination.

TO THE EDITOR:

Your June 17 editorial "A Problem With Mexico" makes reference to excessive salt in the runoff from American irrigation projects which draw slightly brackish but usable water from the Colorado River (at 850 p.p.m., or parts per million), use it and then dump a saline product at 3,000 p.p.m. into water used by Mexican farmers. At 1,000 p.p.m. water is barely potable; 3,000 p.p.m. water is toxic to crops. Your editorial emphasizes the potentially dangerous political consequences of our contamination of water pledged by treaty to Mexico.

The Southwest possesses wonderfully fertile soil but woefully inadequate water resources. A truly practical solution to this problem requires far more than additional canals to distribute already over-allocated irrigation water.

Our new water technology can make such efficient use of water now available that we can supply our own and Mexico's needs amply. We must cease employing ancient irrigation practices and use technology available today.

CONCENTRATIONS OF SALT

The problem of excessive salinity arises primarily because almost all irrigation water contains appreciable concentrations of salt. When crops are irrigated, a significant portion (about one-third) of the water is evaporated from the surface of the soil, leaving behind a salt crust. Much of the remaining water is lost to the subsoil.

Since this concentrated salt on the surface of the soil is toxic to most plants, the farmer is obliged to overirrigate to keep washing the accumulated salt down into the subsoil.

The price of most irrigation waters varies from 3 to 5 cents per 1,000 gallons; these also contain an appreciable salt content. Modern electro-dialytic and ion-exchange desalting processes enable us to reduce salt contents down to negligible levels of 1 to 2 p.p.m. at a cost of about 10 cents per 1,000 gallons of 1,000 p.p.m. water.

With truly desalted water, the need for overirrigation vanishes, and 2 out of every 3 gallons now used can be saved.

The farmer can effect additional, substantial water savings by laying down beneath the surface soil a water-impervious coating. This task appears formidable, but with modern technology it is low in cost and highly practical. Water requirements are reduced thereby by an additional factor of one-third of the truly desalted water.

SAVINGS POSSIBLE

In highly arid regions, further savings of water can be achieved by placing layers of plastic between plant rows or by spraying with substances that retard evaporation there. An additional one-third of desalted water can thus be saved. An additional amount can be saved by treatment of plants with substances which appear to control opening and closing of stomata, thus reducing transpiration. Thus, we can reduce water demand from 3 volumes to 1 by desalting, and down to 0.4 or even to 0.1 volumes by additional procedures.

Many areas of the Southwest could be transformed from water-poor to water-sufficient regions by this simple expedient of purifying already usable water. Even sea water, when desalted at a cost which is about \$1 per 1,000 gallons today, could be used for agriculture with this new methodology.

The United States, through its Office of Saline Water of the Department of Interior, is eminently equipped to lead the assault along these lines. The research has been done. All that is required is a sensible approach, unhampered by traditional practices.

HARRY P. GREGOR.

LEONIA, N.J., June 18, 1964.

Dr. GREGOR. In it, I point out rather briefly that if one alters the techniques of irrigation and at the same time uses desalination methods that are not very different from those available today, that we can drastically, I believe, cut down the need for the irrigation water.

Now, at the present time, only land-grant colleges have this broad Federal support for this kind of interdisciplinary research. I teach at a private university, a technical university, and it derives its major support from Government research projects.

We are very proud of the many contributions we have already made to the water resources problem. In our laboratories we do a significant part of basic research in membranes, making them, studying their properties, and in the chemical engineering departments, in using them. We have a broad range of objects all the way from desalination to their possible use in artificial kidneys.

Of course, we have at the university many other outstanding scientists and engineers who could contribute substantially to this problem if they could be brought into it.

For example, we have an internationally famous polymer research institute where a substantial part of the basic research in polymers and plastics in this country has been done.

I think a staff would be supported by the water resources research bill. More important, this kind of staff will attract graduate students, graduates who gravitate in their research work toward popular, well-funded fields such as atomic energy, molecular biology, and space sciences.

It is true that it is hard to get a graduate student to warm up a test tube without a Federal fellowship of one sort or another. The water resources research bill will allow graduate students to continue their interest in water resources problems. This will provide the necessary hands and minds on the part of the graduate students on the needs for these problems and I think more important, it will develop scientists and engineers who are oriented toward these problems.

Thank you very much for the opportunity and for giving me the time to express my views.

Senator ANDERSON. The subcommittee appreciates your presentation here today. When we have somebody here who can say, "I prepared the first permselective ion-exchange membranes," we have somebody here to listen to.

I am interested in this letter to the Times, because my attention was called to it some time ago in connection with our problems with Mexico. I do not necessarily agree with all the things you attribute to the problems with Mexico. Nevertheless, we do have a problem, and we are trying our best to solve it.

You have an interesting point here when you point out the savings possible if it were not necessary to wash out these salts. Everybody who does irrigate, I think, is aware of the problem.

Do you have some questions, Senator?

Senator JORDAN. No, thank you.

Senator ANDERSON. Thank you very much for coming here, and please keep us on your correspondence list. Write to us when you think we need some help and tell us what you are thinking about, because we are going to need all the suggestions we can have from persons like you.

Dr. GREGOR. That is very kind of you. Thank you.

Senator ANDERSON. Dr. Wolman.

STATEMENT OF DR. M. G. WOLMAN, JOHNS HOPKINS UNIVERSITY, UNIVERSITIES COUNCIL ON WATER RESOURCES

Dr. WOLMAN. Mr. Chairman, I am here today as a representative of the Universities Council on Water Resources, and inasmuch as I am pinch-hitting in a way, I was called in at a point where I did not have time nor the facilities at Johns Hopkins University to reproduce some copies of my testimony. I can offer you, for the purposes of following it, a very poor draft here, but it might be useful.

Senator ANDERSON. You go right ahead.

Dr. WOLMAN. My name is M. Gordon Wolman, and I am professor of geography at Johns Hopkins. I am appearing as a member of the executive board of the Universities Council on Water Resources as a substitute for the chairman, Prof. D. F. Peterson, of Utah State University, who is in Morocco and unable to attend at the present time.

The Universities Council on Water Resources is an association of universities in the United States established to encourage graduate education and research in water resources. Originally the Universities Council on Hydrology, membership has grown from 10 universities in November 1962 to 38 in July 1964 and present membership in the Universities Council on Water Resources includes 44 universities, as well as 4 foreign universities who are affiliates.

At its meeting in Denver on June 16, 1964, the Universities Council on Hydrology passed a resolution on the Water Resources Research Act. As this resolution was directly related to Senate bill 22—S. 2, at the time, now S. 22. I would like to read the resolution since I am speaking for the organization at the present time. I will append some remarks to it at the conclusion.

Whereas the legislation embodied in the proposed Water Resources Research Act is of major importance to national programs in water resources development and to programs of evaluation and research in this field; and

Whereas the Universities Council on Hydrology (UCOH) represents 38 universities in the United States interested in education in water resources fields; and

Whereas at its meeting on June 16, 1964, UCOH endorsed its transformation to the Universities Council on Water Resources in order to include the full spectrum of disciplines interested in water resources; and

Whereas it is a principle of overriding importance that all centers of excellence in water resources should be permitted to contribute without restriction to the activities under this act in order that the full manpower resources of the country be brought to bear on this important program: Be it, therefore,

Resolved, That the sense of title II of the Senate version is essential to the purposes of this act ; and be it further

Resolved, That, to the same end and in order to achieve maximum effectiveness, the widest possible latitude on the part of the individual States in the designation of institutional responsibility for their water resources programs be encouraged. We believe the Senate version (sec. 100) best achieves this goal; on the other hand, the provision of the House version (sec. 100) encouraging cooperative action between established water resources institutes or centers and other institutions within each State is important. Both concepts should be retained ; and be it further

Resolved, That UCOH strongly endorses sections 204 and 205 of the House version placing responsibility for cataloging and coordination of water resources research in the Office of the President ; and be it further

Resolved, That with responsibility for coordination and review firmly fixed, and mindful of the fact that Congress may review and legislate further at any time, we believe that the 10-year limitation of the House version (sec. 100) is unnecessarily restrictive and may discourage long-term investment by the States in facilities and manpower. We urge its deletion ; and be it further

Resolved, That because of the urgency and importance of the objectives of the act, we believe that the administrative function should be placed at the level of the Office of the Secretary of the Interior.

Now, obviously, some of these elements are redundant, Mr. Chairman, in view of the present, but I think the critical issue here rests with the first resolution, that which is that it is the sense of the title II of the Senate version is essential to the purposes of the act. And that this is what is appropriate here to S. 22.

Senator ANDERSON. By that do you mean both the provision as to the funds for private organizations and the fact that Congress should not review ?

Dr. WOLMAN. Yes, sir ; but I think the emphasis was particularly here, and here speaking again for an organization I am a little bit cautious about extending beyond the language, but I would say that the emphasis was primarily on the distribution of centers of excellence on the special talents of a wide variety of people and research and perhaps less direct concern on our part with the question of review.

I presume that we would rest that more directly in the hands of a critical evaluation of legal and other aspects.

Senator ANDERSON. My own personal view at the time was that if responsible officials had complete freedom to select individuals and organizations and associations and institutes, such selections might be made on a more scientific and long-range basis if it were not necessary to come back to Congress for approval.

Dr. WOLMAN. What I would like to do is separate myself into two people. I would like to add several items for the record and speak very, very briefly from a personal point of view as a scientist interested in this area.

May I do that ?

Senator ANDERSON. We will be glad to have your testimony both ways.

Dr. WOLMAN. What I would like to introduce in the record is the membership list of the Universities Council on Hydrology, as of June 1964 that is, those who endorsed the resolution, per se.

Senator ANDERSON. Without objection, it is so ordered.

(The list referred to follows:)

UNIVERSITIES COUNCIL ON HYDROLOGY

MEMBER UNIVERSITIES, JUNE 1964

University of Arizona, Tucson, Ariz.
 Auburn University, Auburn, Ala.
 University of California, Berkeley, Calif.
 University of California, Davis, Calif.
 University of California, Los Angeles, Calif.
 University of California, Riverside, Calif.
 California Institute of Technology, Pasadena, Calif.
 University of Chicago, Chicago, Ill.
 Colorado State University, Fort Collins, Colo.
 Cornell University, Ithaca, N.Y.
 Georgia Institute of Technology, Atlanta, Ga.
 University of Idaho, Moscow, Idaho.
 University of Illinois, Urbana, Ill.
 Indiana University, Bloomington, Ind.
 University of Iowa, Iowa City, Iowa.
 Iowa State University, Ames, Iowa.
 Johns Hopkins University, Baltimore, Md.
 University of Kansas, Lawrence, Kans.
 Massachusetts Institute of Technology, Cambridge, Mass.
 University of Michigan, Ann Arbor, Mich.
 Michigan State University, East Lansing, Mich.
 University of Minnesota, Minneapolis, Minn.
 University of Nevada, Reno, Nev.
 University of New Mexico, Albuquerque, N. Mex.
 New Mexico State University, University Park, N. Mex.
 Pennsylvania State University, University Park, Pa.
 Princeton University, Princeton, N.J.
 Purdue University, Lafayette, Ind.
 University of Southern California, Los Angeles, Calif.
 Stanford University, Stanford, Calif.
 University of Texas, Austin, Tex.
 Texas A. & M., College Station, Tex.
 Texas Technological College, Lubbock, Tex.
 Utah State University, Logan, Utah
 Virginia Polytechnic Institute, Blacksburg, Va.
 Washington State University, Pullman, Wash.
 University of Washington, Seattle, Wash.
 University of Wisconsin, Madison, Wis.

FOREIGN UNIVERSITIES WITH AFFILIATE STATUS IN UCOH

University of Alberta, Edmonton, Alberta, Canada.
 University of New South Wales, Broadway, New South Wales, Australia.
 University of Saskatchewan, Saskatoon, Canada.

Dr. WOLMAN. I would like to introduce in the record the universities council present roster. What we did between June and now was to include a broader spectrum of university participation beyond the aspects of hydrology, to include legal, social, and other parts of the university environment. In other words, we have expanded the scope of the program.

As I mentioned, there are 40 something universities involved, and 4 foreign affiliates.

This is quite a large group. I am introducing into the record not only the membership list, but the delegates to the council from the individual universities, and I think if you look these over, you will see the

breadth of interest that Mr. Agnew referred to earlier ranging from agricultural economics to chemistry, to botany, to geography, to agronomy, and so on. I think the roster itself is a better description than anything I could offer of the true breadth of interest in the Universities Council on Water Resources.

This breadth of interest includes not only the specialists, but also includes the breadth of universities, both land-grant and private universities in all of the States. And these then are the ingredients of my testimony I think most appropriate directly to the council itself.

I would like to add, if I may now, some very brief personal observations on this.

I happen to be, of course, from a private university which also has a long, I would say 20 something year, history of interest in the area of water resources. It happens that in the State of Maryland the water resources interests are divided between the universities. At the University of Maryland there is a very strong program and has been for many years in marine aspects, biological aspects of the environment.

At Johns Hopkins there has been a long concern with sanitary engineering, problems of pollution and a 10- to 15-year project concerned with urban hydrology and massive problems of design of urban drainage systems.

Looking back on the work that has been done in various institutions in the United States, I think you would find that there are a number of non-land-grant institutions which for reasons not explainable by me have a long continuing interest in the water resources field. Stanford University, for example, California Tech, the University of California Technology, the University of Chicago, the work of Professor White and his group there on flood plains which has already been taken cognizance of by the Congress, Harvard University, MIT, Johns Hopkins, and a number of others have had a continuing interest on a fundamental basis with problems in water resources.

I think that we believe as individuals that the sponsorship of research in a truly inquiring fashion does require a distribution system which, if not handled with some care, can lead to duplication or repetition, but, on the other hand, does really require, if new ideas are to come about, the broadest possible spectrum of views as Professor Gregor said earlier in the approach to the problem.

If the problem is really difficult, it is usually very difficult for somebody else to set up a nice scheme for the obvious solution of the problem. If it was that obvious, the chances are that many of the important ones would have been solved before. They require new turns of mind, new twists of mind, and the spread of some of the available funds for research among a variety of people. This is a personal opinion only. I think it is likely to lead to challenging new ideas which are really essential in the intent of Congress in this matter.

I would like to leave it there. I would be happy to answer any questions.

Senator ANDERSON. It has been a stimulating discussion. I appreciate it very much.

The second list you mentioned will be included in the record at this point.

(The list referred to follows:)

Universities council on water resources, October 30, 1964

University	Delegates	Alternates
University of Arizona, Tucson, Ariz.	J. W. Harshbarger, head, department of geology. M. M. Kelso, department of agricultural economics.	E. M. Laursen, head, department of civil engineering. A. L. McComb, head, department of watershed management.
Auburn University, Auburn, Ala.	W. S. Bailey, acting director, water resources research institute. (Additional delegate to be named.)	
University of California, Berkeley, Calif.	D. K. Todd, department of civil engineering. S. V. Wantrup, department of agricultural economics	P. J. Zinke, school of forestry. E. A. Pearson, hydraulic and sanitary engineering.
University of California, Davis, Calif.	V. H. Scott, chairman, department of irrigation. Charles Hardin, department of political science.	R. H. Burgy, irrigation.
University of California, Los Angeles, Calif.	W. A. Hall, director, water resources center. Ernest Englebert, department of political science.	
University of California, Riverside, Calif.	C. W. McKell, department of agronomy. H. P. Bailey, department of geography.	N. T. Coleman, department of soils and plant nutrition.
California Institute of Technology, Pasadena, Calif.	N. H. Brooks, department of civil engineering. Jack E. McKee, department of environmental health engineering.	
University of Chicago, Chicago, Ill.	G. F. White, department of geography. H. R. Byers, department of geophysical sciences.	
Clemson University, Clemson, S.C.	L. G. Rich, dean, college of engineering. W. H. Wiley, dean, college of agricultural and biological sciences.	H. L. Hunter, college of arts and sciences. A. W. Snell, department of agricultural engineering.
Colorado State University, Fort Collins, Colo.	D. B. Simons, chief, civil engineering section. Stephen Smith, chairman, department of economics.	R. A. Schleusener, department of civil engineering. P. O. Foss, department of political science.
Cornell University, Ithaca, N.Y.	L. B. Dworsky, director, water resources center. David Allee, Department of agricultural economics.	L. S. Hamilton, department of conservation.
Georgia Institute of Technology, Atlanta, Ga.	C. E. Kindsvater, director, water resources center. R. S. Ingols, director applied biology.	H. K. Menhinick, school of architecture. W. M. Snyder, school of civil engineering.
University of Idaho, Moscow, Idaho.	C. C. Warnick, department of engineering. W. E. Folz, Department of agricultural engineering.	G. L. Corey, agricultural engineering.
University of Illinois, Urbana, Ill.	V. T. Chow, department of civil engineering. John Cribbet, college of law	
Indiana University, Bloomington, Ind.	A. F. Agnew, chairman, water resources research center. J. W. Millman, department of business administration.	Shelby Gerking, college of arts and sciences. Reynold Carlson.
University of Iowa, Iowa City, Iowa.	J. W. Howe, department of mechanics and hydraulics. H. S. Smith, department of civil engineering.	H. H. McCarty, department of geography. A. C. Tester, department of geology.
Iowa State University, Ames, Iowa.	Don Kirkham, department of agronomy. H. P. Johnson, department of agricultural engineering.	E. R. Baumann, department of civil engineering.
Johns Hopkins University, Baltimore, Md.	M. G. Wolman, department of geography. J. C. Geyer, chairman, department of sanitary engineering and water resources.	
University of Kansas, Lawrence, Kans.	R. L. Smith, department of civil engineering. W. J. Argersinger, department of chemistry.	
Massachusetts Institute of Technology, Cambridge, Mass.	P. S. Eagleson, department of civil engineering. R. M. Solow, department of economics and social science.	

Universities council on water resources, Oct. 30, 1964—Continued

University	Delegates	Alternates
University of Michigan, Ann Arbor, Mich.	E. F. Brater, department of hydraulic engineering. L. E. Craine, natural resources.	Robert Zahner, department of forestry. Ayers Brinser, school of natural resources.
Michigan State University, East Lansing, Mich.	L. L. Quill, director, institute of water research. E. H. Kidder, department of agricultural engineering.	W. J. Hinze, department of geology. Raleigh Barlowe, chairman, department of resource development.
University of Minnesota, Minneapolis, Minn.	Wm. C. Walton, school of earth sciences. C. E. Bowers, St. Anthony Falls Hydraulic Laboratory, Mississippi River at 3d Ave. SE.	
University of Nevada, Reno, Nev.	G. B. Maxey, desert research institute. Jean B. Wycott.	Richard G. Orcutt, department of civil engineering. Clarence M. Skau.
University of New Mexico, Albuquerque, N. Mex.	B. T. Bower, department of civil engineer.	
New Mexico State University, University Park, N. Mex.	A. E. Utton, school of law. H. R. Stucky, department of agricultural, engineering and agricultural business. W. Viessman, department of civil engineer.	
Ohio State University, Columbus, Ohio.	G. P. Hanna, Jr., department of civil engineering. G. O. Schwab, department of agricultural engineering.	
Pennsylvania State University, University Park, Pa.	J. C. Frey, director, institute of research on land and water resources. W. E. Sopper, department of forestry.	R. E. Parizek, department of geology. B. A. Whisler, department of civil engineering.
Princeton University, Princeton, N.J.		
Purdue University, Lafayette, Ind.	Dale Swartzendruber, department of agronomy. J. W. Delleur, school of civil engineering.	
University of South California, Los Angeles, Calif.	S. Butler, department of civil engineering. C. Q. Christol, chairman, department of political science and international law.	R. H. Merriam, department of geology. Aurelius Morgner, chairman, department of economics.
Stanford University, Stanford, Calif.	Rolf Eliassen, department of civil engineering.	S. N. Davis, department of geology.
University of Texas, Austin, Tex.	E. F. Gloyna, department of civil engineering. W. L. Moore, department of civil engineering.	H. C. Bold, department of botany. C. W. Johnson, department of law. J. H. Mackin, department of geology. J. R. Stockton, department of business statistics.
Texas A. & M. University, College Station, Tex.	E. T. Smerdon, department of agricultural engineering. K. R. Tefertiller, department of agriculture economics.	W. B. Davis, department of civil engineering. Vance Moyer, department of oceanography and meteorology.
Texas Technological College, Lubbock, Tex.	Keith Marmion, school of engineering. Herb Grubb, department of agriculture economics.	
Utah State University, Logan, Utah.	D. F. Peterson, dean, college of engineering.	Joel Fletcher, engineering experiment station, department of civil irrigation engineering.
Virginia Polytechnic Institute Blacksburg, Va.	B. D. Gardner, department of agriculture economics. J. M. Wiggert, department of civil engineering. Byron Cooper, head, department of geology.	H. M. Morris, department of civil engineering.
Washington State University, Pullman, Wash.	E. R. Tinney, division of industrial research. Millard Hastay, department of economics.	Walter Gardner, department of agronomy.
University of Washington, Seattle, Wash.	T. H. Campbell, department of civil engineering. J. A. Crutchfield, department of economics.	
University of Wisconsin, Madison, Wis.	A. T. Lenz, department of civil engineering. J. H. Beuscher.	

ADDITIONS TO UCOWR MEMBERSHIP AND AFFILIATES SINCE OCTOBER 30, 1964,
LISTING

Members:

University of Colorado
University of Hawaii
University of Oklahoma
University of Missouri

Affiliate:

International Course in Hydraulic Engineering

Senator ANDERSON. Senator Jordan.

Senator JORDAN. No questions.

Senator ANDERSON. Thank you very much for coming. I will extend the invitation to you; if you have ideas, do not hesitate to send them in to us. We need guidance in this field, and we need all the help we can get.

Mr. Fricke.

STATEMENT OF MILTON FRICKE, OF PAPILLION, NEBR., CHAIRMAN, WATER RESOURCES COMMITTEE, NATIONAL ASSOCIATION OF SOIL AND WATER CONSERVATION DISTRICTS; ACCOMPANIED BY PHILIP M. GLICK, GENERAL COUNSEL, NATIONAL ASSOCIATION OF SOIL AND WATER CONSERVATION DISTRICTS

Mr. FRICKE. Mr. Chairman, I am chairman of the Water Resources Committee of the National Association of Soil and Water Conservation Districts.

Just a little aside here: this, in the past, has been the Watershed and Water Resources Committee. The problems that come up in watersheds have forced us, or caused us, to drop the watersheds and go to water resources as a committee, because they are so great and reach far beyond these things.

We testified for S. 2 and are glad that much of it did get passed. We are now here for Senate bill 22.

I represent 2,975 conservation districts across the United States, Puerto Rico, and the Virgin Islands. From here, I will read directly from the notes.

NACD supported passage of S. 2 for several reasons:

First, we believe that research is a most promising and necessary element in the solution of America's water problems and requires national support.

Second, we approve of the investment of larger shares of public funds in the advancement of comprehensive research in this field.

Third, we believe that research of the kind needed should supplement, rather than supplant, efforts already underway in private and public institutions across the Nation.

And, fourth, we are convinced that water resources research should be conducted by a broad variety of organizations each contributing particular talents, skills, and facilities.

The Water Resources Research Act as it was enacted is eminently satisfactory on the first three of these counts. On the fourth, however, we feel that it is inadequate; that it does not give sufficient emphasis to the conduct of research by universities, foundations, and agencies other than land-grant universities. Such emphasis was given in the original title II of S. 2.

For this reason, the governing body of our association—the NACD council which represents all of our State associations and individual conservation districts—took action at our annual convention in Portland, Oreg., last month, supporting passage of S. 22 which is now before your subcommittee. In its action, the council states:

The Water Resources Research Act of 1964 holds genuine promise of contributing substantially to the research and knowledge which are vital to sound progress with the conservation, utilization, and development of the Nation's water resources. While we concur with the general purpose of title II of the act, as adopted, we believe it is unduly restrictive and, indeed, may hamper accomplishment of the intended purposes.

We believe that the program as enacted should be expanded as proposed in the original Senate bill to enlist all centers of competence in such work.

There are three major considerations which we believe justify the passage of S. 22.

First. Since the inception of congressional action to expand water resources research through support of this general kind, there has been an enormous increase in national awareness of the problems caused by population growth, industrial development, urbanization, and the consequent expansion of water use. For this reason, there is growing support for research into the technology of weather modification, saline water conversion, the use and management of water supplies, and other factors involved in water development and utilization that offer the only hope of meeting the water requirements of many areas of the Nation in the present generation, and of the Nation as a whole in another 35 to 50 years.

In the face of this growing concern, we cannot afford to restrict our efforts to one group of research agencies or to provide inadequate funds to advance such research.

Second. A great deal of essential study needs to be prosecuted in fields which have not been explored sufficiently in the past. These areas of concern often relate to the nonphysical aspects of water development and management which are just as important as the physical aspects. One topic of this kind urgently needing investigation involves the efficiency and propriety of the organizational, managerial, and administrative arrangements that exist in the United States for the improvement of water supplies, the construction of water facilities, and the operation of works of improvement on a multiple-purpose basis.

The Federal Government's regulatory authority in this field is sharply limited. State authority, on the other hand, is extensive. Yet, in many instances, the agency best able to coordinate such efforts is local or regional in nature. There is undoubtedly a proper role in these matters for all levels of government, but the proper role and the necessary administrative arrangements that would be required to promote beneficial balance need careful exploration.

Our point here is that, in addition to the institutes being established at the land-grant universities under title I of the act, there are a host of other educational and research organizations, including universities, foundations, and other private and public bodies, which are eminently qualified to carry on research of this kind as well as other kinds of water research. It appears to us that the present title II unnecessarily and arbitrarily restricts the full participation of this whole array of organizations in the expanded research effort even though they have the interest, capabilities, and facilities that would allow them to make an important contribution.

The more groups and agencies that are working on these problems—general and particular—the sooner we will get results. The passage of S. 22 would allow a greater number and variety of institutions to participate in this endeavor.

Third. Under the Water Resources Research Act, as enacted, there will undoubtedly be pressure from eligible institutions to encourage equitable geographical distribution of research grants under the present title II. If the money available is limited to the funds presently authorized under the act, that is, \$1 million per year, it is immediately evident that there is a risk that no one project will be financed adequately. The result will be to emphasize small projects at the expense of those of a more significant kind; and the funds, in effect, will be in danger of being frittered away.

It is sound economy to increase funds available under title II to the contemplated level of \$10 million which seems, in our opinion, the minimum necessary to support the kind of work which needs to be done.

In summary, our conviction is that the Nation—as well as our constituent conservation districts across the country—will benefit greatly from the Water Resources Research Act of 1964. But the benefits will be greater, and the work of higher total quality, if S. 22 is passed in order that all institutions capable of contributing be utilized fully, that comprehensive and nonphysical as well as particular and physical research be accomplished, and that the funds available for this work be utilized efficiently in the public interest.

We appreciate this opportunity to present the views of the National Association of Soil and Water Conservation Districts to you.

Senator ANDERSON. Thank you, Mr. Fricke. We were particularly happy to have this commendation from a large organization as effective in the field as your organization is. I do hope that all those groups will let the House know also how they feel.

The difficulty arose in the House, not in the Senate the last time.

You point out that since it is only \$1 million a year in total, no one project can be adequately financed. I think that is a very important statement.

Mr. FRICKE. That is what we believe. There are so many big problems we know they need care, and with \$1 million, and dividing it very far it will not amount to enough to do the job, and it is a big job.

Senator ANDERSON. And if a very large project comes up, there ought to be sufficient funds to see it through, which there may not be under the present circumstances?

Mr. FRICKE. That is right. These problems are coming real fast to us now as water supplies seem to be shortening up. The population explosion and other reasons cause a demand for water that amounts to more than we ever dreamed of a few years ago.

The one thing that could come out of this would be a resource of water people who are knowledgeable in these problems as they come up.

Senator ANDERSON. Off the record.

(Discussion off the record.)

Senator ANDERSON. On the record.

Do you have a comment to make, Mr. Glick?

Mr. GLICK. Mr. Chairman, I would like, if the chairman will permit me, to supplement Mr. Fricke's remarks with two brief comments.

Senator ANDERSON. Please identify yourself.

Mr. GLICK. I am Philip M. Glick, and I serve the soil conservation districts of the country and the National Council of Soil and Water Conservation Districts as their legal adviser.

There are only two additional comments I would like to make. The first is that, as this committee well knows, the President and his legal advisers feel that the requirement contained in title II of the present statute that every proposed research project formulated under title II that is about to be approved shall be submitted to the appropriate congressional committees for study and review for a stated period before the research project may be authorized, is unconstitutional.

We are very much afraid, therefore, in the soil conservation district program, that if that provision remains in the law, as it is today, and is not removed from the statute, as S. 22 would do, that the net effect would be that title II would be totally inoperative and that even the \$1 million that is now authorized in title II would not be available for research by institutions other than the land-grant colleges.

Senator ANDERSON. If I may break in there, I am not a lawyer, so I speak very freely on these legal points. But I am inclined to agree with you and I talked to the President before he signed the bill and told him if he would sign the bill we would do our best to see that that provision got taken out. It was not in the Senate bill originally. This measure, S. 22, would delete it from the law. If the House insists upon it, there is nothing we can do about that, because the House is the ruler of its own fate.

I quite agree with you that we should not leave this possible deterrent in the law, and expect to get the best results from them.

My feeling is, personally, that very few title II grants will be made until that point is cleared up. I am fully satisfied not only with what President Johnson said, but with what President Eisenhower said in a similar situation. I am glad to have you here in support of this.

Mr. GLICK. Thank you very much, Mr. Chairman. On behalf of the districts we are very happy to hear this. And we do hope the committee in its own report can make clear that the effect of that provision is not only to limit the land-grant colleges in the program, but so long as the President and his legal advisers take the position they do—which I myself as a lawyer, I must say, I concur in, I think they are right—so long as that remains true, title II becomes totally inoperative.

The second point, Mr. Chairman, I would like to make briefly is this: The soil conservation districts of the country have always been interested in watershed stabilization, the control of floods, and in water resource conservation and development. This is so true that there is a wide movement, as the members of this committee well know, now across the Nation to amend the State soil conservation district laws to change the name of the soil conservation districts to soil and water conservation districts.

The work that the districts, 3,000 of them spanning the entire country, have been doing for the last 25 years has convinced us that there is one very important institutional area of study that needs a great deal of future research, and that is this: to determine what

is the proper function or set of functions to be carried on in the area of water conservation and development by the Federal Government. What is the appropriate area to be carried on by the separate State governments? And what is the appropriate area of operation and responsibility to be assigned to local units such as the counties and the soil and water conservation districts?

Now, we are very much concerned that the individual land-grant colleges, focusing as they do on direct problems of agriculture and on the problems of local projects, are not likely to concern themselves with this large problem which is rather political science and public administration in character rather than strictly agricultural, and we hope, therefore, that under title II the National Association of Soil & Water Conservation Districts will be able to encourage a number of other universities and research foundations, that is other than the land-grant colleges, to enter into research in this very important, critical, and difficult problem of the assignment of appropriate responsibilities to Federal, State, and local government levels.

This is why we earnestly support the bill introduced by you, Mr. Chairman.

Thank you very much.

Senator ANDERSON. As sponsor of this legislation, in both the last and in this Congress, I am, of course, heartily in favor of utilizing other schools. I was raised in a State bordering on Iowa. I recognize that people in Iowa have reason to be very proud of the State college at Ames, and also they are proud of the University of Iowa.

Now, to go back to the question about what the President said about legislative interference with an Executive function. We have counsel with us, Stewart French who today is celebrating 15 years of continuous service with this committee, and very good service. We are happy that he has finished those 15 years as capably as he has and he tries to protect me and other members of the committee, because of what I said the President said. I may have misquoted the President a little bit. On signing S. 2 into law, the President said:

Although this legislation is so phrased that it is not technically subject to constitutional objection, it violates the spirit of the constitutional requirement of separation of power between the executive and legislative branches.

He did not say the provision is unconstitutional, but did point out that it certainly violated the spirit. As long as the President feels that way about it, as long as the Bureau of the Budget has people who occasionally confer with him, I have great doubts as to how much money is going to be available for putting title II into effect until that particular issue is resolved by Congress and the President.

I appreciate your being here, Mr. Glick, and I hope you will come back and help us from time to time.

Senator Jordan?

Senator JORDAN. No questions.

Mr. FRICKE. May I impose this much, Mr. Chairman. I would like to introduce two gentlemen behind me, Gordon Zimmerman, our executive secretary, and David Unger, the assistant secretary.

Now, as to these things you ask that we do within our limited resources, we will do all we can to be of help.

Senator ANDERSON. You do not have such limited resources because you have thousands and thousands of good farmers who look to the

work you are doing, and that is a pretty fair-sized representation itself.

Mr. GLICK. Two million of them.

Senator ANDERSON. That is certainly a goodly number.

Are there any people here who wanted to be heard? If not, we will conclude this hearing, with the record to be kept open for 10 days so that anyone who wishes to submit a statement or additional material may do so.

The chairman expresses his thanks on behalf of the committee to those people who have testified and testified so capably on this proposal.

Thank you very much.

(Whereupon, at 11:25 a.m. the committee adjourned.)

(Under authority previously granted the following communications were ordered printed:)

THE NATIONAL ASSOCIATION OF SOIL AND
WATER CONSERVATION DISTRICTS,
Washington, D.C., March 4, 1965.

Hon. CLINTON P. ANDERSON,
Chairman, Subcommittee on Irrigation and Reclamation, Senate Committee on Interior and Insular Affairs, Washington, D.C.

DEAR SENATOR ANDERSON: During the hearing on March 3 before the Subcommittee on Irrigation and Reclamation of the Senate Committee on Interior and Insular Affairs on the bill S. 22, designed to amend Public Law 88-379: "An Act to establish water resources research centers, to promote a more adequate national program of water research, and for other purposes;" at which you presided, you invited me to supplement my testimony before the committee with a written opinion on the question of the constitutional validity of the second sentence of section 200 of that act. I am glad to respond to that invitation with this letter.

The second sentence of section 200 of the act reads as follows:

"The Secretary shall submit each such proposed grant, contract, or other arrangement to the President of the Senate and the Speaker of the House of Representatives, and no appropriation shall be made to finance the same until 60 calendar days * * * after such submission and then only if, within said 60 days, neither the Committee on Interior and Insular Affairs of the House of Representatives nor the Committee on Interior and Insular Affairs of the Senate disapproves the same."

When the President approved this act on July 17, 1964, he issued a statement in which he commented on the provision just quoted, as follows:

"One provision of the bill, however, causes me serious concern, and I request its deletion. The Secretary of the Interior, in administering the program is required, in effect, to obtain the approval of the committees of the House and Senate for each water research grant or contract. Although this legislation is so phrased that it is not technically subject to constitutional objection, it violates the spirit of the constitutional requirement of separation of power between the executive and legislative branches. It is both inappropriate and inefficient for committees of the Congress to participate in the award of individual contracts or grants."

I respectfully submit that the provision quoted from section 200 does more than violate "the spirit" of the constitutional requirement of separation of power between the executive and legislative branches. I believe that the provision is invalid under the Constitution of the United States because it does, in fact, violate this constitutional requirement.

If the provision said that the Secretary of the Interior may not proceed with any proposed research grant or contract if either of the two named committees disapproved the proposed action, its constitutional infirmity would be more clear, but the infirmity is still present in the provision as worded in section 200.

In that provision, the Secretary is first required to submit each proposed research grant or contract to the President of the Senate and the Speaker of

the House of Representatives; the proposals must lie before the Senate and House for at least 60 calendar days; and thereafter "no appropriation" may be made "to finance the same" if, within said 60 days, either of the two named committees has disapproved the proposal.

It is undeniable that the Congress may constitutionally refuse to make an appropriation of funds even where the appropriation has been lawfully authorized. This constitutional power of the Congress to withhold an appropriation is, however, so well established that it is clearly not necessary for the Congress expressly to reserve the right to refuse to make an authorized appropriation. The only apparent purpose that this provision can serve, therefore, is to make it possible for a point of order to be made to defeat any appropriation that may be included in an appropriation bill to finance the provisions of the act, in any case where the appropriation would apply to a proposed research grant or contract which the Secretary of the Interior had approved but which either of the name committees had disapproved.

The necessary legal effect of the quoted provision is, therefore, to authorize either of the named committees, by disapproving the proposed action of the Secretary, to set aside the approval of the Secretary of the Interior so long as any Member of the Congress were willing to make a point of order against the proposed appropriation.

The Congress may certainly set aside an executive action of which it disapproves by enacting a statute to that effect, but I submit that the Constitution does not authorize it to set aside an executive action of which a committee of Congress disapproves by making any and every appropriation intended to effectuate that executive action subject to a single Member's point of order by which the Congress itself would be bound. It is my opinion, therefore, that the quoted provision does more than violate the spirit of the constitutional requirement of the separation of power; I am afraid that it violates the requirement itself.

Respectfully submitted.

PHILIP N. GLICK,
General Counsel.

WATER RESOURCES RESEARCH CENTER,
INDIANA UNIVERSITY,
Bloomington, Ind., March 5, 1965.

HON. CLINTON P. ANDERSON,
Chairman, Subcommittee on Irrigation and Reclamation, Committee on Interior and Insular Affairs, U.S. Senate, Washington, D.C.
(Attention Stewart French, chief counsel).

DEAR SENATOR ANDERSON: During the course of testimony in favor of Senate bill S. 22 on March 2-3, 1965, the question of duplication and coordination of research effort was posed to Dr. R. R. Renne, and was discussed by him and later by Dr. Walter Morgan and myself.

Recognizing the need to prevent unnecessary duplication in water research matters, we at Indiana University had called a meeting of the directors of water research centers in the upper Middle West for April 9, 1965, to consider the many problems of information exchange among the research centers, and also between the centers and the State, interstate, and Federal agencies involved in water matters.

When I mentioned this to you at the close of the hearings on March 3, you kindly suggested that I send a copy of the agenda of this forthcoming meeting, for inclusion in the record of the hearings. We are pleased to enclose it herewith, as it bolsters our statements regarding duplication which were given during the hearing.

Again, we wish to commend the 88th Congress on the enactment of Public Law 88-379, and we urge the passage by the 89th Congress in its 1st session of Senate bill S. 22, which will provide a workable title II and will authorize increased title I appropriations that are more adequate to fulfill the great amount of research that needs to be done, as our Nation attempts to solve its water problems.

Sincerely yours,

ALLEN F. AGNEW, *Director.*

AGENDA FOR THE MEETING OF THE DIRECTORS OF THE MIDWEST UNIVERSITY WATER RESEARCH CENTERS, INDIANA UNIVERSITY, APRIL 9, 1965

- 9:00 a.m.: Introductory remarks.
 9:15 a.m.: Status of water research at the university centers, a 5- to 10-minute statement by each of the 10 directors.
 10:30-10:45 a.m.: Coffee.
 10:45 a.m.: Interuniversity water research—Allen F. Agnew, Indiana University.
 11:05 a.m.: University and nonuniversity water research—J. I. Bregman, Illinois Institute of Technology.
 11:25 a.m.: University water research and the State water administrative or regulatory agency—John E. Mitchell, B. A. Poole, Indiana Department of Conservation; Stream Pollution Control Board.
 11:55 a.m.: University water research and the interstate compact or commission—Edward J. Cleary, ORSANCO.
 12:25 p.m.: Head for lunch.
 12:40-2:15 p.m.: Luncheon—Speaker, R. R. Renne, Director, Office of Water Resources Research, U.S. Department of the Interior: University water research and the Federal agency.
 2:15 p.m.: Head back to the meeting.
 2:30 p.m.: University water research and the UCOWR—J. W. Milliman, Indiana University.
 2:50 p.m.: Additional discussion regarding any of the items discussed thus far.
 3:20 p.m.: Suggested structure to provide for a regular (annual, semiannual?) meeting of this type, rotating among the universities.
 3:50 p.m.: Other items.
 4:00 p.m.: Adjourn.

STATE UNIVERSITY COLLEGE OF FORESTRY,
 SYRACUSE UNIVERSITY,
 Syracuse, N.Y., March 2, 1965.

Hon. HENRY M. JACKSON,
 Chairman, Committee on Interior and Insular Affairs,
 U.S. Senate, Washington, D.C.

DEAR SENATOR JACKSON: Senate bill 22 authorizing an appreciation of \$5 million in the fiscal year 1966 for title II, section 200, of Public Law 88-379 of the 88th Congress, has come to my attention. As an important State college deeply concerned with watershed management, particularly as it relates to forest lands, and with water pollution and deterioration of watersheds that may result from injudicious logging actions of the forest products industries, we strongly favor this amendment.

Our college is not a part of the land-grant system and hence, is not eligible for direct grants under title I. Several other important forestry schools, notably those in Michigan and Washington, to name but two, are not parts of land-grant institutions and hence, also are ineligible for research funds under title I, yet each is in a position to make substantial contributions to water resource research and management. I am sure your committee is fully aware of the need for research in water, as one of the major renewable resources of our Nation.

Sincerely yours,

HARDY L. SHIRLEY, *Dean.*

NORTHEASTERN UNIVERSITY,
 DEPARTMENT OF CIVIL ENGINEERING,
 Boston, Mass., February 24, 1965.

Senator HENRY M. JACKSON,
 Chairman, Senate Committee on Interior and Insular Affairs,
 Washington, D.C.

DEAR SENATOR JACKSON: At Northeastern University, a privately supported institution, we are very much in favor of passage of S. 22 amending title II of the Water Resources Act of 1964.

We would plan to expand our activities in water resources research if moneys were available for this work. We already carry on very active programs in civil engineering and other subjects bearing on water resources planning both at the undergraduate and graduate levels.

This department alone produces roughly one-third of the civil engineering graduates in the Northeastern United States. Our graduate programs are similarly successful. At present we have 350 undergraduate and about 100 graduate students enrolled in our civil engineering curricular. From past experience about one-half of these enter the field of sanitary engineering or its affiliated areas of professional work. Our cooperative plan of education and our location near the largest centers of consulting engineering in the United States (Boston and New York) makes this institution and its professors keenly aware of problems in hydraulic engineering and related fields as they arise.

Sincerely yours,

ERNEST L. SPENCER,
Professor of Civil Engineering.

APPENDIX

U.S. DEPARTMENT OF THE INTERIOR,
OFFICE OF THE SECRETARY,
November 3, 1964.

UDALL ANNOUNCES PROPOSED PROCEDURES FOR SPEEDING WATER RESOURCES RESEARCH GRANTS

Secretary of the Interior Stewart L. Udall today announced proposed rules that will guide the administration of the new Office of Water Resources Research in its program of assistance to universities and other research entities under the Water Resources Research Act of 1964.

The proposed regulations, said Secretary Udall, are aimed at developing procedures that will speed the allotments of Federal funds to qualified recipients. All States are eligible for an allotment for one research center in each State. The Department has \$1 million available for these allotments to State water research centers or institutes for the current fiscal year. The allotment to each State center is \$75,000 the first year, and the new act provides for larger allotments in succeeding years.

In addition, matching grants are authorized for specific water research projects. The Department has \$250,000 available for this now. The act authorizes appropriations for these matching grants that can grow to \$5 million per year by fiscal year 1969.

In approving the proposed regulations, which appeared in the Federal Register October 29 and which are subject to revision following receipt of comments from the public, which will be accepted for consideration until November 18, 1964, Secretary Udall praised the act as making possible "full engagement of the Nation's intellectual capabilities in meeting the Nation's water problems.

"New and improved means of dealing with water problems of local, State, regional, and national levels will result from enlisting the competence of the universities and other research entities," Secretary Udall added. "Administration of the program should insure that these results are achieved.

"This new program enlarges the tradition of Federal support for non-Federal agency research that provided for cooperative Federal-State agricultural research," he continued. "We have the opportunity and the responsibility for an even wider extension of water resources research cooperatively with all who have competence."

Secretary Udall emphasized also that administration of the program should provide for freedom of research and for recognizing the initiative of the research workers themselves.

Dr. John C. Calhoun, Jr., science adviser to Secretary Udall and Acting Director of the Office of Water Resources Research (OWRR), said the proposed rules and regulations were developed in consultation with persons and organizations experienced in research and water resources administration. These include Federal and State agencies and officials, representatives of the university community and other research organizations, and many others interested in objectives of the act.

"The basic objective of these rules is to get the program started—to make the allotments as quickly as possible consistent with substantial progress in basic and applied research," Dr. Calhoun said.

Dr. Calhoun explained that the proposed rules and regulations are directed primarily to administration of the program, rather than to the subject matter of the research and training it will support. The rules provide information as to eligibility for grants, how applications may be made, the type of information required, what comprises permissible expenditure of funds, frequency of research reports, audits, fiscal and accounting procedures, and other details.

Dr. Calhoun said that, initially, the funds will permit award of grants to water resources research institutes in only 14 States, but that the goal of the program is to reach all States and Puerto Rico. Applications for allotments in the present fiscal year, which ends June 30, 1965, will be received by OWRR at any time. All applications received by December 5, 1964, will be considered in the initial competitive group. The selection and awarding of allotments will be based on an evaluation of the requests.

For the time being, Dr. Calhoun explained, awards will not be made under that section of the act (title II) which provides for arrangements with others than the State institutes. He pointed out that President Johnson, in signing the enabling legislation, was concerned about a requirement of the act that congressional clearance be obtained for such arrangements.

"Although applications for such research projects may be submitted and will be reviewed by the Office of Water Resources Research, no further action will be taken on them until the provision to which the President objects is removed from the act," Dr. Calhoun said.

Dr. Calhoun reemphasized Secretary Udall's statement that this new program can bring to bear on water problems all the research ability of the country. He added that this will greatly strengthen Federal, State, and local efforts to meet the Nation's growing water use requirements.



