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ENVIRONMENTAL QUALITY

H.R. 7796, H.R. 13211, H.R. 14605, H.R. 14627

HEARINGS

BEFORE THE

SUBCOMMITTEE ON SCIENCE, RESEARCH, AND DEVELOPMENT

OF THE

COMMITTEE ON SCIENCE AND ASTRONAUTICS

U.S. HOUSE OF REPRESENTATIVES

NINETIETH CONGRESS

SECOND SESSION

JANUARY 17, 18, 19, 31; FEBRUARY 1, 2; MARCH 12, 13, 14, 1968

[No. 2]

Printed for the use of the Committee on Science and Astronautics

0052027

U.S. GOVERNMENT PRINTING OFFICE

90-064 WASHINGTON : 1968

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ENVIRONMENTAL QUALITY

WEDNESDAY, JANUARY 17, 1968

HOUSE OF REPRESENTATIVES,
COMMITTEE OF SCIENCE AND ASTRONAUTICS,
SUBCOMMITTEE ON SCIENCE, RESEARCH, AND DEVELOPMENT,
Washington, D.C.

The subcommittee met, pursuant to call, at 10:12 a.m., in room 2325, Rayburn House Office Building, Washington, D.C., Hon. Emilio Q. Daddario (chairman of the subcommittee) presiding.

Mr. DADDARIO. This meeting will come to order.

These hearings are a natural sequence to hearings this subcommittee held in 1966. We issued a report on those hearings entitled "Environmental Pollution, a Challenge to Science and Technology," which included a number of recommendations as to the whole question of pollution—air, water, and soil—and its attendant problems.

These hearings will explore the way in which the science resources available to the Federal Government are developed in support of our national goals for environmental quality. Goals and objectives have been spelled out in laws which have passed both Houses of Congress in recent years by overwhelming margins—often without a single dissenting vote. This legislation is a tribute to the leadership of Senators Ed Muskie and Jennings Randolph, Representatives Harley Staggers, Robert Jones, and John Blatnik; just to name only a few of many. The achievement of cleaner air and abundant water supplies depends to a very great extent on scientific research, engineering development, and techno-economic demonstration. But often we see these technical activities subjected to budget cutting and criticism, especially in this current period of fiscal constraint.

This subcommittee wishes to stress the crucial role for science and technology in pollution abatement. As a result of our hearings in 1966, which I have already referred to, we specifically identified two categories in environmental quality and waste management. First, there are problems of gross and obvious pollution where abatement technology is available and the only limitations on progress are the funds and time for construction of control facilities, and perhaps the will to put these to work. This category includes, for example, smoke and fly ash in the air and the treatment of sewage before release into surface waters. Certain regions of the country will have special problems which demand immediate solution. We have plenty to do in these catch-up abatement actions that need not wait for further R. & D. These steps can reverse presently increasing trends in certain pollutants and therefore lead by this method to immense improvements.

Second, some other important pollution problems are so complex that cause and affect relationships are not well worked out. Abatement technology may be costly and inefficient. Since our control efforts can be fully occupied on the gross and obvious problems, a time period for research is available to deal with these more important contaminants. Productive science and engineering in the next few years can give us a much improved control capability. Ingenious abatement methods can lower costs and ameliorate the change of habits and practices which improved environmental quality may require.

We should not, need not, and will not wait upon research to act where we recognize the problems and have feasible solutions. On the other hand, it would be wasteful of time and resources to pursue a crash program where quality deterioration is only vaguely established or where abatement costs probably outweigh benefits. A great deal of hard work is necessary to replace, therefore, conjecture an anecdote with practical control procedures.

Therefore, the current hearings are focused on the research programs of the Federal agencies which must produce an expanded basis of facts and technical options to make our pollution laws work. We believe the testimony will show that it is shortsighted indeed, to consider goals for restoring and maintaining the quality of the environment apart from the supporting research and development.

From our past hearings, a number of specific conclusions and recommendations were drawn. I would like to quote from our report, "Environmental Pollution—A Challenge to Science and Technology," a few items which pertain to the Federal research strategy:

Federal Government scientific activities are not yet channeled to support announced goals in pollution abatement. There is no organization or coordinating group capable of systems analysis and broad management of Federal projects. Insufficient funding has made support of research spotty and disproportionate among problem areas. Agency missions may inhibit long term and comprehensive ecological studies. "Pollution" can cover an enormous variety of Federal agency programs ranging from water resources research to agricultural engineering. Limitations of definition will be necessary for effective program coordination.

To improve our knowledge of what we are about, scientific activity in ecology and related fields should be immediately expanded to provide—

(a) Baseline measurements in plant and animal communities and the environment—an ecological survey.

(b) Continued monitoring of changes in the biosphere.

As an example, I would interject here that there have been alarming stories in the past few years that the accumulation of carbon dioxide in the atmosphere from fossil fuel combustion might cause a "greenhouse effect" and raise the temperature of the earth. Such a climate change would upset the world's weather, melt icecaps, and so forth. Last summer, HEW scientists reported that the mean annual world temperature actually was falling. The reason given (Science Vol. 156, p. 1358) was that particles in the atmosphere were increasing, thereby reflecting more sunlight and decreasing solar radiation reaching the ground. This may be a lesson for us that early impressions of environmental effects are often incomplete and that public statements should be tempered until adequate studies are completed.

(c) Abilities to predict the consequences of man-made changes.

(d) Early detection of such consequences.

(e) Knowledge of the environmental determinants of disease.

Ecological surveys and research should be centralized as to management in some one science-based Federal agency. The scientific activity should be performed (whether in Government laboratories or under contract by local

universities and research institutes) in geographical regions which correspond generally to natural environmental boundaries.

To place pollution abatement on a comparable basis with other national technology programs, systems analysis and management capability should be established within the Federal Government. This approach should be used along with the "planning, programming, budgeting" technique to organize both near and long-term Federal research and operational efforts in pollution abatement. More attention should be paid to interfaces between agency missions which make the management of environmental problems difficult.

We are pleased today to have as our first witness Dr. Donald Hornig, Director of the Office of Science and Technology in the Executive Office of the President. No person is better equipped than he to inform us of the status of Federal programs and to illuminate the very difficult tasks which the laws have given to the technical community. Dr. Hornig is, of course, a person very well known to this particular committee. We have listened to him in the past and always have learned a great deal from his testimony, and it is an association which we treasure. He is accompanied by his Assistant Director, Dr. Ivan L. Bennett, Jr.

(The biographies of Drs. Hornig and Bennett follow:)

DR. DONALD F. HORNIG

Dr. Donald F. Hornig was born in Milwaukee on March 17, 1920, the son of C. Arthur Hornig and the former Emma Knuth. In 1943 he married Lilli Schwenk and they have four children: Joanna, Ellen, Christopher and Leslie.

Dr. Hornig became Special Assistant to President Johnson for Science and Technology on January 24, 1964. He was simultaneously named by the President to be Chairman of the Federal Council for Science and Technology. On January 27, 1964, the Senate confirmed the President's nomination of Dr. Hornig as Director of the Office of Science and Technology in the Executive Office of the President. Dr. Hornig also serves as the Chairman of the President's Science Advisory Committee.

A graduate of Havard University, where he received his B. Sc. degree in 1940 and his Ph. D. in chemistry three years later, he was awarded a Guggenheim grant and a Fulbright scholarship for research at St. John's College, Oxford University, England in 1954–55, and in 1955 was appointed the first Bourke Overseas lecturer by the Faraday Society of London.

After receiving his doctorate at Harvard, Dr. Hornig spent a year as a Research Associate at the Woods Hole Oceanographic Institution in Massachusetts. From 1944 to 1946 he was a Group Leader at the Los Alamos Laboratory in New Mexico and in the latter years he joined the faculty at Brown University as assistant professor. Three years later he became an associate professor and Director of the Metcalf Research Laboratory. He was promoted to the rank of Professor in 1951 and the following year became Associate Dean of the Graduate School. Subsequently he was Acting Dean. In 1957 he joined the faculty of Princeton University and was appointed Chairman of the Department of Chemistry in 1958. Dr. Hornig was the first incumbent of the Donner Chair of Science at Princeton, established in 1958 by the Donner Foundation, Inc.

Dr. Hornig has been an associate editor of the *Journal of Chemical Physics* and a member of the Editorial Advisory Boards of *Spectrochimica Acta* and *Molecular Physics*. He was President, from 1945 to 1947, of Radiation Instruments Company, and served as Chairman of Project Metcalf of the Office of Naval Research in 1951–52. Before coming to Washington in 1964, he was a member of the Advisory Committee, Office of Scientific Research, U.S. Air Force. In 1959 he was appointed to the Space Science Board of the National Academy of Sciences, on which he served until February 1964. In 1960 President Eisenhower appointed Dr. Hornig to his Science Advisory Committee, and he was reappointed by President Kennedy in 1961. In late 1960 he served on the Kennedy Task Force on Space to help formulate policy in this field for the new administration.

In 1962–63 Dr. Hornig served as a member of the U.S. Delegation headed by Dr. Hugh Dryden which negotiated the agreement with the U.S.S.R. for cooperation in certain space activities.

Dr. Hornig was elected in 1954 to a three year term on the Executive Committee, Division of Physical and Inorganic Chemistry, American Chemical Society. He is also a Fellow of the American Physical Society (Member, Executive Committee, Division of Chemical Physics, and Chairman 1957–58); a Fellow of the American Academy of Arts and Sciences; a Fellow of the Faraday Society, London, and of the Washington Academy of Sciences in 1967. He was elected to the U.S. National Academmy of Sciences in 1957, and in 1964 he was named a member of the Board of Overseers of Harvard University. He was elected an Honorary Member of the Rumanian Academy of Sciences in February 1965. Dr. Hornig is a member of the American Philosophical Society (1967); in February 1967 was awarded the Engineering Centennial Award by PMC Colleges, Chester, Pennsylvania; and was the recipient of the 1967 Charles Lathrop Parsons Award of the American Chemical Society on November 30, 1967.

Dr. Hornig has published about seventy papers in the *Journal of Chemical Physics, Journal of the Optical Society of America, Journal of Physical Chemistry, Review of Scientific Instruments, Physics of Fluids, Molecular Physics, Spectrochimica Acta, Discussions of the Faraday Society*, etc. on molecular and crystal structure, infrared and Raman spectra, shock and detonation waves, relaxation phenomena and fast chemical reactions at high temperatures.

Dr. Hornig has been awarded honorary degrees by: Temple University (LLD 1964); Yeshiva University of New York (Doctor of Humane Letters 1965; University of Notre Dame (LLD 1965); Rensselaer Polytechnic Institute (Doctor of Science 1965; University of Maryland (Doctor of Science 1965); Ripon College (Doctor of Science 1966); Boston College (Doctor of Laws 1966); PMC Colleges (Doctor of Science 1967; University of Wisconsin-Milwaukee (Doctor of Science 1967); and Worcester Polytechnic Institute (Doctor of Engineering 1967).

DR. IVAN L. BENNETT, JR.

Dr. Ivan L. Bennett, Jr. was born in Washington, D.C. on March 4, 1922. In 1944, he married Martha Rhodes of Atlanta, Georgia; they have four children: Susan, Paul, Katherine, and Jeffrey.

Dr. Bennett was nominated by President Johnson to be Deputy Director of the Office of Science and Technology in the Executive Office of the President on July 30, 1966 and the Senate confirmed the nomination on August 31, 1966.

After receiving his A.B. degree in 1943 and his M.D. in 1946, both from Emory University, Dr. Bennett continued his postgraduate and residency training in internal medicine at Emory, Johns Hopkins, and Duke; and was certified as a diplomate of the American Board of Internal Medicine in 1954. From 1947 to 1949, he was a guest investigator at the Naval Medical Research Institute in Bethesda.

After 2 years as Assistant Professor of Internal Medicine at Yale University, Dr. Bennett became Associate Professor of Medicine at Johns Hopkins in 1954 and, in 1957, he was made Professor of Medicine and Head of the Division of Biology and Oncology. In 1958 he became Baxley Professor of Pathology and Director of the Department of Pathology at Johns Hopkins University School of Medicine and Pathologist-in-Chief of the Johns Hopkins Hospital.

Dr. Bennett is a member of the editorial board of the *Bulletin of the Johns Hopkins Hospital, Experimental and Molecular Pathlogy, Laboratory Investigation*, and *Annual Review of Medicine*. He has been consultant to the Surgeon General of the Army, to the U.S. Public Health Service Communicable Disease Center, to the Office of Science and Technology, the Office of Emergency Planning, and to the Secretary of Health, Education, and Welfare. He was a member of the Commission on Epidemiological Survey of the Armed Forces Epidemiology Board from 1957 to 1966 and a member of the Pathology Training Committee of the National Institutes of Health in 1965–66. He has also served as Chairman of the Board of Scientific Councillors of the National Institute of Dental Research, Member of the Program-Project Committee of the National Institute for Allergy and Infectious Diseases, Chairman of the Pathology Test Committee of the National Board of Medical Examiners, and Member of the Committee on Influenza Research.

He is a member of the Board of Scientific Advisors of the Armed Forces Institute of Pathology, the National Board of Medical Examiners, and the Executive Committee of the Division of Medical Sciences of the National Research Council.

In April, 1966 he was appointed by President Johnson to the President's Science Advisory Committee.

Dr. Bennett has published about 120 scientific papers and is the editor of a textbook, *"Principles of Internal Medicine."* He is a trustee of the Emory University Medical Alumni Association and is a member of several professional societies including the American Society for Clinical Investigaton and the Association of American Physicians.

STATEMENT OF DR. DONALD F. HORNIG, DIRECTOR, OFFICE OF SCIENCE AND TECHNOLOGY; ACCOMPANIED BY DR. IVAN L. BENNETT, JR., DEPUTY DIRECTOR

Dr. HORNIG. Mr. Chairman and members of the subcommittee. It is a pleasure for me to respond to your request for an executive branch view of how Federal science resources can support the Nation's goals of improving environmental quality. In recent years, through legislation and new programs, a major new impetus has been given to improving the environment in which man lives, as you have indicated, both now and in the foreseeable future.

Now, to accomplish these ends research is needed in an extraordinarily diverse set of fields ranging from fuels and combustion technology to ecology, to epidemiological studies of health hazards, to studies of atmospheric circulation, to the disposal of radioactive wastes, and so on.

The principal immediate thrust is in the Federal Water Pollution Control Administration of the Department of Interior, the National Center for Air Pollution Control, the National Center for Urban and Industrial Waste, and the National Environmental Sciences Center, all in the Department of HEW, but major activities also going forward in Agriculture, in the Bureau of Mines, the Office of Coal Research, and various other bureaus of the Department of Interior; in the Atomic Energy Commission, the Environmental Sciences Services Administration of the Department of Commerce, the National Science Foundation which supports fundamental research, and in the near future HUD and the Department of Transportation will become increasingly involved. Now, what this reflects is that environmental considerations are involved in practically every activity of our society and our Government.

Environmental change, of course, is not a new phenomenon in our civilization. What is relatively new is the increasing scale, variety, and speed of the change which modern technology generates. The ever-increasing magnitude of the problems posed by air pollution, water pollution, and disposal of solid wastes has become a matter of national concern. In our attempts to cope with today's environmental problems, we have relearned what the ecologists have long known—that apparently isolated changes interact in unanticipated ways and that the eventual restoration of environmental quality will depend upon the solution of a series of interrelated problems, none of which can be understood in isolation from its fellows. We have also learned that though problems of environmental change are generated by technology, their solution cannot be viewed as a purely scientific or technological matter for there are important social, economic, and political factors to be weighed in deciding what actions to take.

It is in this overall context that I will address myself to the contributions which Federal science programs can make to improving the environment.

In my statement on January 7, 1966, to the House Committee on Government Operations, Subcommittee on Research and Technical Programs, I suggested a series of questions that need to be answered in determining the allocation of resources to programs involving research and development. What is the magnitude of the need and how important is it compared with other needs? What ideas are available on how to meet the need? I would like to emphasize that. Can the developments be applied in practice? Is society ready to assimilate and to pay for these results? In this area I should add another question, which is: What efforts are being undertaken outside the Federal Government, for instance in the private sector?

These questions must also be asked about research and development on environmental problems before deciding on the amount and character of research required in each area of environmental concern.

It is not enough to recognize the existence of a problem in general terms. Clearly, we know that the Los Angeles area is beset by "smog" and that most of our major streams are polluted by industrial effluents.

Only by detailed analysis of these general statements, however, can we determine those problems which can be solved now as opposed to those where the answer will require new knowledge and new technology.

As an illustration, the Department of Interior has been deeply involved during the past year in bringing together information in greater detail than ever before about the water pollution problem, including the location of pollution sources, types and characteristics of pollution, the magnitude of the problem in relation to population and industrial centers, States, river basins or subbasins; coastal areas, major lake areas, and other significant geographic characteristics.

From such information we can better determine—

what we can do now with existing technology to gain the greatest results with available resources. This is the burden of our action program;

what we can do with developing technology but which has to be tested before acceptance by the public to meet critical or future requirements. This represents our demonstration program;

what we are not yet in a position to do. This will provide the basis for designing our research and development program through which we will seek the knowledge and techniques necessary to accomplish our future objectives.

If such analyses were available in detail we could answer the questions posed earlier in connection with determining the allocation of resources to programs of research, demonstration, and development in the general area of environmental quality. We can determine whether society is ready to assimilate—to accept, pay for, and use—the results of research.

In placing such emphasis upon detailed analysis of the problems of environmental pollution and their interaction, I do not mean to imply that we can or should wait until our understanding is complete before undertaking action. Rather, we should initiate action programs on the basis of the best information available, while continuing to add to our knowledge base so that action programs can be improved continually in the future.

With these matters in mind, my office has established, under the Federal Council for Science and Technology, a Committee on Environmental Quality to bring together, from across the entire Government, the information on policies, programs, and plans that will make it possible for use to establish our future activities on an increasingly more effective base.

This action is along the lines recommended by the committee report last year. It follows a pattern which has worked well in other areas. For example, the FCST established, some 4 years ago, a Committee on Water Resources Research. This committee has recommended a 10-year program for water resources research; it appraises new and developing needs in water resources, maintains an overview of the programs in all agencies of Government, and suggests periodic revisions in the Federal research program.

The decision to organize a Committee on Environmental Quality was made in April 1967, and the first meeting of agency representatives was convened on June 14, 1967. There have been 11 subsequent meetings.

Briefly, this committee has as its principal assignment the consideration of what science and technology can contribute to the vast variety of environmental problems, whether the various programs are adequate, how the programs relate to each other and to the activities in industry and the universities, and what more is needed. The group will assess current efforts, identify needs for changes, and develop ways to implement systematic programs in the area of environmental quality.

We have established a cooperative arrangement with the National Academy of Sciences and the National Academy of Engineering. On July 1, 1967, the chairman discussed the objectives of the FCST Committee in a meeting with the Academy Environmental Studies Board; a joint meeting was held October 1967 to coordinate future activities of the two organizations, and arrangements were made for the executive secretary of the Board to attend committee meetings as an observer, when it was appropriate.

In recent years there have appeared more than a dozen major reports on problems of pollution and environmental quality containing literally hundreds of major and minor recommendations. In order to gain a clear picture of what has emerged from all of these advisory groups, the committee has weighed the whole collection of recommendations and noted areas of consensus, instances of conflict, and some which are already being implemented. These recommendations can be roughly classified and analyzed into a number of areas: (a) Principles, policies, and goals; (b) administrative action, organization, and coordination; (c) research, development, and demonstration; (d) monitoring and surveillance; (e) information and education; (f) compliance (standards and enforcement); and (g) manpower and facilities.

The recommendations are being given very careful consideration, both from the standpoint of suggestions for implementation and as contributing factors to a review of current programs and an assessment of needs.

Mr. DADDARIO. In what way do you spell out instances of conflict? What do you mean by that?

Dr. HORNIG. I do not think there is much overt conflict but I think there is considerable divergence among a number of the reports we have, in the relative degree of emphasis on various problems.

Mr. DADDARIO. You were referring only to conflicts of that kind?

Dr. HORNIG. Yes. I am referring to conflicts in the assessment of what the problems, and the urgency of problems are, and what the nature of the problems is. You mentioned one, for example, in the CO_2 problem. The Tukey committee, for example, noted that at the present rate of burning fossil fuels we can expect our environmental carbon dioxide concentration to rise by 25 percent by the end of the century, and they raised very serious questions as to what the effect of that increase in carbon dioxide concentration would be since it would increase the absorption of solar energy.

Other people have pointed out that they did not adequately take into account the absorption of carbon dioxide by rocks as opposed to the oceans, that there were other factors which might go in the other direction, such as the increasing concentration of dust, ice crystals, and so on, in the atmosphere which would obscure solar radiation, and that we did not know enough, in any case, about the circulation pattern in the atmosphere to predict the consequences. So that this is one question, for instance, which needs to be resolved before we undertake any major programs. No one has any intention of shutting down the burning of oil and coal on account of that recommendation yet.

Mr. DADDARIO. I thought you might include under instances of conflict the problem that might arise from the number of agencies involved and the obvious conflict in bringing them all together and having them work smoothly in a coordinated way over the jurisdictional problems. You must run into this from time to time.

Dr. HORNIG. Well, Mr. Chairman, this does pose problems, in fact sometimes very difficult ones. By and large, I think it is a sound way to do business because the fact is that this is not a homogeneous area. One should surely group, coordinate, and put under common leadership those things which can be pulled together into single programs, but I would not think it would make any sense, for example, to pull together under single leadership the studies on human health, where the expertise and knowledge is in the Department of HEW and NIH, and the problems of radioactive waste disposal, which are also potentially big environmental problems as we build a big nuclear power industry, where the expertise resides in the Atomic Energy Commission. I think it is quite proper that the central focus on these very divergent areas be separated, and the focus established where we have the essential competence and interest in the Government. I think what is important, however, is to maintain a good general overview of these very diverse activities.

Doing this for the President is the job of my office. The rather elaborate committee structure I am describing is how we are trying to see what the entirety consists of. As the work of the committee progresses I may have firmer views with regard to your question, because, as I said, this area spreads over so very many things. What you call environmental quality for one purpose may be connected with weather forecasting on the other. It is not clear at the moment what the best eventual division of effort will be.

Mr. DADDARIO. Mr. Fulton.

Mr. FULTON. Off the record.

(Discussion off the record.)

Mr. DADDARIO. Mr. Bell.

Mr. BELL. Mr. Chairman, while you were talking with the learned doctor I thought I might ask him this question. He was talking somewhat about the administrative problems, and the central focus and conflicts which might arise. I would infer from what he said that he would agree, would he not, that when States have an interest or a particular desire, such as the area of Los Angeles in California, to increase and to better their pollution battle a little bit beyond what the Federal Government wants, you would favor that, would you not, at least having the leeway to do so? There was an amendment which some of us know about called the Dingell amendment.

Mr. DADDARIO. I would say that that is a leading question, but you may answer it, Doctor.

Dr. HORNIG. I would like to see us maintain the highest possible standards of quality everywhere, not to have the lowest common denominator.

Mr. FULTON. Could you go a little further on that point? The question is whether the standards are high and being generalized, or whether should we take them on an instance-by-instance basis? What do you think? Should we be practical, do it that way, or leave our high standards nationally?

Dr. HORNIG. I think that question involves a lot of very complicated problems because when one talks of uniform standards, certainly the circumstances differ very widely from one area to another. On the other hand, if one has a widely fragmented set of standards, we fail to make use, for instance, of the total national market as an incentive to produce abatement devices. I think this is a question which requires very careful consideration.

Mr. DADDARIO. Mr. Bell.

Mr. BELL. I think you recognize there are many differences in States, such as the way the smog, or whatever the pollutant is, affects an area. It seems to me we should have the right to upgrade, to increase, to make better our pollution battle beyond what the Federal Government wants.

Mr. FULTON. Will you yield to me?

Mr. BELL. Yes.

Mr. FULTON. I think I disagree with you both because possibly it should be on a physical basis of pollution basins or environments, more or less unified, rather than either Federal or State. What do you think as to that?

Mr. DADDARIO. I can see no particular disagreement with what you have just said and what Dr. Hornig has been telling us.

As I understand the statement, he does believe the country is vast and that there are so many differences which exist. We have to recognize that you may need to establish different criteria in different places for certain purposes.

Mr. FULTON. I am talking as to standards. Maybe you might have to have three or four States together in a basin concept rather than to do it State by State.

Mr. DADDARIO. I would think that that would be implicit in what has been said. You should comment on that, however, Dr. Hornig.

Dr. HORNIG. I would say that surely political boundaries are not the natural boundaries for pollution problems.

Mr. FULTON. That is my point.

Mr. DADDARIO. Dr. Hornig, in the instances of conflict—and we need not get into it too deeply—during the course of our hearings it was spelled out that in the area of pollution there was an opportunity offered to our whole free enterprise system to involve itself. Through the development of competitive demands, goods would be produced which would be made available to the market. There would be a stimulus through our profit system which would help to bring the problem together once we were able to develop necessary techniques.

In the area of patents, these agencies which you talk about all take a different point of view even though there is a Government patent policy which does involve, as it should, and allow, as it should, a certain amount of discretion to the head of each agency. But the Department of Interior, as an example, is extremely rigid in this regard. You see here the possibility that one agency may not allow the free consumer system to operate as well as other agencies. This could be a serious area of conflict.

Dr. HORNIG. As you well know, Mr. Chairman, the question not only in this area but generally of how we should handle patents derived from Federal investments in research and development, has been a long and controversial one. At present it is pulled together by President Kennedy's patent policy of 1963. Now, there is a general principle which I think is, by and large, observed by the agencies. Just what is done, I might say, is affected by a wide variety of specific legislation affecting the agencies one at a time, which in part directs them to have different policies. So it has been very difficult to produce uniformity.

At any rate, where public money has been invested in producing a commercial product, and this applies to much of this area, in general the patent rights are not left with the performer, under the present policy. There has been some discussion as to whether in these cases where the Federal Government assumes the principal rights, whether in order to obtain commercial development exclusive licenses might be issued, but at the moment there is no policy in this regard.

Mr. DADDARIO. My question then comes down to this: Do you see this as falling within your phrase here of "instances of conflict"?

Dr. HORNIG. Oh, yes. I think that in this general area of the disposition of Government patents it surely was an instance of conflict, both among our agencies and within the Congress and the public.

Mr. DADDARIO. I understand that is so. I was trying to focus upon how it might affect the subject we are talking about because the record does appear to be clear. We are seeking ways and means to get more involvement here. It is, therefore, incumbent on us to look at those conflicts which might in fact deter and prevent the wider involvement of industry in the solution of this particular problem.

Dr. HORNIG. Yes. I would like to add that I consider this a central problem, since I think, and I believe you do, that much of the research, and particularly technological development, ought to be carried out by industry. There is a major question of how we provide suitable incentives in the private area to carry this out, and the patent policy is surely involved deeply in this question of incentives. There is by no means agreement on what kind of incentives are proper to both stimulate industry and protect the public interest.

Mr. DADDARIO. We need not go into this further at the moment, Dr. Hornig. We can look at other ways of stimulating activity. I brought it up only as one instance.

Mr. Fulton?

Mr. FULTON. Have you given any thought to my recommendation to have compacts within a particular pollution or drainage basin? Had you ever thought of compacts by States or regions, as we do on a Great Lakes compact or compacts for bridges? So far the discussion has been either the Federal Government might try to run it all, or a State by State basis, which to me is inadequate.

Could we set up some sort of regional commission that could handle these problems that run across State lines? Is this feasible?

Dr. HORNIG. I think the question of what the best relations are between the States, the Federal Government and the communities is going to take a lot of discussion.

I would not like to propose a simple solution. We have regional airsheds now. We have, for various purposes, evolved regional and basinwide commissions.

Mr. FULTON. May I give you an example?

Dr. HORNIG. I think the problem is to bring in local interests and still to make available, if you like, the large scale resources and inputs of the Federal Government into these efforts.

Mr. FULTON. We in Pittsburgh are in a tristate area, western Pennsylvania, eastern Ohio, and northern West Virginia. State and local handling is inadequate.

For example, I drove to Indianapolis not too long ago. We started at Cleveland with quite a heavy smog and it was clear at Pittsburgh, where we have smoke control. From Cleveland, Toledo, through Gary, Chicago, clear up to Indianapolis, there was a complete smoke pall. To talk about doing it by States or cities in that area is not feasible to me. What do we do about such a great problem?

Mr. DADDARIO. Dr. Hornig, I would like you to answer that question; but taking into consideration that you are to attend a Cabinet meeting this morning, would you let me know when you must leave? At that point, Dr. Bennett may take over for you.

Dr. HORNIG. I will be grateful if you will allow him to continue for me. The matter raised by Congressman Fulton is precisely what is involved in regional airsheds. Pollution does not know political boundaries. One has to look at the natural complexes of polluting sources.

Mr. FULTON. Would you have a method set up within Government to handle pollution sheds or basins?

Dr. HORNIG. This is provided to some extent in the Clean Air Act, as you know. This is still an evolving relationship.

Mr. FULTON. That is what I am getting at.

That is all, thank you.

Mr. DADDARIO. Will you continue as long as you can? We will try not to break in with further questions until you have to leave.

Dr. HORNIG. I have described the Committee on Environmental Quality under the Governmental Council on Environmental Quality. In order to deal with a wide variety of problems, three subcommittees were established to consider programs in their respective areas: (a) Subcommittee on Research, Development, and Demonstration; (b)

Subcommittee on Monitoring, Surveillance, and Compliance; and (c) Subcommittee on Information, Education, Manpower, and Facilities.

The development of recommendations involving principles, policies, goals, administrative action, organization, and coordination was reserved as a full committee function.

As a general comment, it is obvious that the entire area of pollution cannot be covered in a single study. Although initial broad summaries of the status of programs can be developed, the selection of specific study priorities and approaches within each of the subcommittees has been deliberately left flexible, because of the competence of the membership to judge where their efforts can be placed most productively.

The Subcommittee on Research, Development, and Demonstration is undertaking a review of ongoing programs to determine their nature, extent, and balance, and to assess relative priorities. It is concerned with (1) effects of pollution, (2) transportation, distribution, and degradation of pollutants, (3) measurement and instrumentation, (4) exposure to and sources of pollution, (5) research on social, economic, and legal aspects of pollution management, and (6) techniques of pollution abatement.

This all sounds very academic but within it are the kinds of questions we have asked this morning.

The monitoring and surveillance subpanel is presently assembling information from the agencies on (1) the nature, scope, and purpose of their programs, (2) the organization to accomplish these ends, and (3) estimated cost and man-year requirements of present and planned programs.

The Subcommittee on Information, Education, and Manpower is reviewing current Federal programs of education bearing on environmental quality. A jointly financed interagency analysis of national manpower needs for these purposes is being arranged.

Many people have recognized that in this whole area we are short in people who have any experience or expertise in pollution problems.

This study should lead to the development of a methodology for estimating manpower and education needs based upon tasks to be performed. Information programs also will be a focus of subcommittee endeavor.

Ad hoc groups have been formed to consider two additional problems. The first of these is a task force concerned with noise. Noise is a kind of pollution problem which we have just begun nationally to pay any attention to. This panel has received a briefing by the National Academy of Sciences Secretariat of the NAS–NRC Committee on Hearing, Bioacoustics, and Mechanics and is now reviewing Federal programs concerned with noise in the environment.

I might add there are not many. However, exhaustive consideration is being given to the aircraft noise problem specifically by a committee chaired by the Department of Transportation. My own Office has devoted considerable effort to the problem of aircraft noise in the vicinity of airports, but with the formation of the new Department of Transportation, we have turned this responsibility over to Secretary Boyd.

My Office had also been, as you know, concerned in the past year with the problem of sonic boom as a particular problem in aircraft noise and environmental perturbation, and that also is now the re-

sponsibility of Secretary Boyd, although we are still maintaining a general overview.

Mr. DADDARIO. The responsibility remains with you to see that this works out?

Dr. HORNIG. Our general responsibility to advise and assist the President on all major problems and programs with which he is concerned. But the principal responsibility will now be in Secretary Boyd's hands.

Going back to the committee, the second special group is a panel on systematics and taxonomy. The increasing attention being given to the ecological effects of man's activities calls for additional scientists capable of identifying the multiplicity of biological constituents of an ecosystem as a prerequisite to assessing changes. This group will study the demands of existing future programs for systematics and taxonomy.

The kind of problem with which you are well acquainted is the kind that is generated by the large-scale use of pesticides, which we need to do for agricultural purposes, but which we know to change the overall biological balance, but in fact in many cases we do not know what the longrun effects of changing that biological balance in nature may be.

Regular contact is being maintained with the National Committee for the International Biological Program since much of that committee's planning is dependent upon systematics.

Currently, the committee is preparing for its use a series of situation papers dealing with specific pollution-related topics. These papers will be used as a basis for establishing priorities for further committee actions.

I would emphasize that the Committee on Environmental Quality is an interagency group whose main role is one of technical coordination. We hope it can develop policy and program recommendations as well; but it should be clear that some problems cannot be tackled effectively through an interagency committee. Experience has shown that such problems as the selection of a lead agency or the establishment of a new activity are very difficult for an FCST committee.

The establishment of the group has precipitated an interesting and significant reaction.

On the mistaken assumption both within and outside Government that the FCST committee is a focal point for all environmental-quality related activities, inquiries have come in from public and private organizations, calling attention to problems, both old and new, that extend far beyond the committee's charter.

Mr. DADDARIO. Dr. Hornig, if it is not a focal point, where is the focal point? If there is not one, why should we not have one?

Dr. HORNIG. It is the best focal point we have. As I mentioned, many of the problems get way outside of the area of science and technology and research and development. It is not the focal point of all action programs. The focal point for the water pollution program is the Water Pollution Control Administration. The focal point for air pollution problems is HEW.

As I said, our role is to maintain a general overview for the President.

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Mr. DADDARIO. But since all of these in some ways are connected, you really cannot separate them. In some way they do meld in one with the other. Doesn't there need to be, even though the operational responsibility may be in these agencies as you have spelled out, a way to figure out how they are interrelated? Doesn't there need to be a focal point? They cannot operate in isolation one from the other.

Dr. HORNIG. Within the general area of my responsibilities this is exactly what this committee and my Office is trying to provide. I am simply saying that there are a lot of problems that go beyond the scientific and the technical and the related ones.

Mr. FULTON. Even political.

Dr. HORNIG. Many of the problems are political. I think any focus that does not include the Congress would not make sense.

Mr. Chairman, may I be excused and allow Dr. Bennett to continue?

Mr. DADDARIO. Yes, Dr. Hornig. We would like to send some questions to you, or perhaps arrange for you to come back.

Dr. HORNIG. I would be very happy, if questions developed, to come back and talk further with the committee. I am very sorry to have this discussion cut off because I hoped to have a chance to talk further with you.

Mr. DADDARIO. We regret you are leaving.

Dr. HORNIG. The President has called a Cabinet meeting as you know, and I am not quite sure what the subject is.

Mr. DADDARIO. You better go and find out what it is about. Mr. Fulton would like to speed you off with a comment.

Mr. FULTON. We hope that this talk of economy will not give the impression that Congress does not back very strongly adequate research and development in many fields, including pollution. That is the first point. Second, on the chairman's statement, Senator Murphy, of California, and Senator Boggs, of Delaware; Mr. Bell, of California; and all the members of this subcommittee have certainly contributed to the legislation for cleaner air and cleaner water in this Congress. This cuts across party lines.

Dr. HORNIG. Mr. Congressman, I am pleased to hear these words, and I hope you speak for the majority.

Mr. DADDARIO. Dr. Hornig, I would amend Mr. Fulton's remarks by listing all Members of Congress.

Dr. Bennett, would you take up where Dr. Hornig has left off, please?

Dr. BENNETT. This situation has necessitated increased effort by the staff of OST and, in addition, the President's Science Advisory Committee plans to establish a continuing Panel on the Environment. This will provide a mechanism for utilizing the talent and interests of persons and groups outside the Federal Government for penetrating analysis and objective criticism and suggestion.

Mr. DADDARIO. When you say an increased effort, do you include an increased staff? Will you add people particularly qualified in this field?

Dr. BENNETT. This has involved the taking on of additional staff, although not into positions that were necessarily created specifically for that purpose. For example, Dr. Donald King who is here with us this morning has been devoting almost all of his efforts to this field since he came with the Office early last year.

Mr. DADDARIO. We will submit some further questions on that particular subject, because I think it is important that it be spelled out just how this activity is being performed and what your capability is manpowerwise to do it. You may continue.

Dr. BENNETT. The Panel will have as its charter a mandate to maintain an overview of environmental problems and the steps being taken to solve them; to survey the direction and emphasis of current programs and assess their relative priorities; to identify problems receiving inadequate attention; and to keep the President advised on progress and opportunities. The Panel's scope of interest and responsibility will include pollution of air, water, soil, and the biota; the total earth environment; and resource conservation and exploitation.

As the members of this subcommittee so well know, the problems of environmental pollution are no respecters of national boundaries. They are worldwide. The recent report of the Department of Commerce Panel on Electrically Powered Vehicles, for example, emphasized the need and the opportunity for international cooperative programs on pollution abatement.

In this connection OST has taken the lead in assisting the State Department with plans for a Europe-wide meeting of environmental scientists next year to develop realistic collaborative programs in this area. This endeavor will emphasize technological advances in much the same fashion that the international biological program will stress basic scientific research.

Earlier, we made reference to the enormity and complexity of the problems of environmental change. It is predicted that our capability to produce electric power will triple by 1980, reaching 492 billion kilowatts with an output of 2.3 trillion kilowatt-hours. By 1975, it is expected that 105 billion gallons of gasoline will power the 130 million vehicles on our highways.

It is this sheer size and complexity that has led to the frequent suggestion that the use of systems analysis would help to clarify the problems we are facing and point the way to effective solutions. Such methods can be useful at various levels in the hierarchy of problems. For example, the disposal of solid wastes for a community, the abatement of pollution of a single stream, or the multiple problems of management of an entire river basin or airshed. OST has recently undertaken to clarify the benefits and limitations of this approach.

We are in the process of bringing together several of the Nation's foremost authorities in the physical and social sciences who are interested in the environment and understand the problems and techniques of managing large, interrelated regional systems.

We look forward to this effort as a means of moving the day closer when we can more effectively use our vast capabilities to gather, store, and use data; to bring this capability to bear in helping to develop more and improved alternatives to complex multivariable problems from which we can select appropriate responses to our growing environmental concerns.

We cannot delay action, of course, until we are able to lay down a massive, global strategy. We can, however, undertake action programs in the realization that their implications may be far reaching, and be prepared to modify and improve them as our basic understanding and analytical capabilities improve.

Finally, Mr. Chairman, I would like to address myself to the very difficult matter of the development of criteria and standards applicable to regulation.

As we have ventured into a more exact approach to these problems, we have come to realize the profound need for better physiological and toxicological data on the long-range effects of low doses of pollutants on man and other components of the environment. We have had forcibly brought home to us the fact that even the acute effects of most pollutants are so poorly characterized that criteria of health alone cannot be utilized in many cases to set precise limits and that a combination of the best available information, the best available opinion, a knowledge of what is technically possible and an understanding of the economic and social implications of regulatory actions are all required before action can be taken.

Mr. DADDARIO. Dr. Bennett, recently Dr. Lawrence E. Hinkle of Cornell University Medical College stated at a recent program in Congressman Ryan's district:

> At the present time I believe that there is no really clear cut evidence that pollutants, other than microbial agents, at the levels at which they occur ordinarily in the air or water in the U.S., are responsible for any significant amount of disease in our population

He goes on to say:

> We have every reason to believe that sooner or later some of these substances, alone or in combinations, may have profoundly bad effects upon the health of our population.

And finally he says:

> At the present time we have no good laboratory or experimental methods for detecting the pollutants in our environment that may be the most important causes of future ill health.

What are we doing to unravel this medical quandary as expresed in these typical statements from the profession? What do they add to in present Federal policy? How can we avoid vague fears of unscrupulous alarmists, and hasty inefficient action—in the absence of facts?

Dr. BENNETT. That is a rather all-encompassing question. I would like to say first——

Mr. DADDARIO. It is all encompassing but at the same time when we begin to discuss the question of criteria and health, and we put it in such vague terms—we slide all around the problem—the fact remains that there are conflicts. Because the question of health is so important, we should come to some definite understanding as to what the dangers to our health might be. Until we do, it seems to me to be quite difficult for us to develop the importance in comparison with other needs. Is society ready to assimilate and pay? How can we come to answers to these questions unless the people really know whether or not there is something to one side of this conflict or another? Do the pollutants in the air really affect our health or don't they? Some people say that the tendency could lead to an irreversible problem that once reached we could not possible overcome regardless of what we did. If that is so, shouldn't we be putting our efforts to it more than just assume, as we have now, that we should operate on vague generalities?

Dr. BENNETT. Mr. Daddario, let me say this: The problem is not that we lack evidence that some of these pollutants affect health. We

are lacking evidence that they actually cause disease. There is abundant evidence that individuals already suffering from chronic disease have aggravated symptoms. There is abundant evidence that pollutants cut down on performance of otherwise healthy individuals. There is abundant evidence that they are harmful to certain plants. On the other hand, the area in which we are almost totally lacking in knowledge is what the effect will be of exposure to relatively low concentrations of materials over a period of 10, 20, or 30 years.

At the present time we have literally no way to extrapolate this. It is quite clear that if we are ever to have this information we must set up a mechanism for making these observations prospectively. In the meantime, lacking these observations and this information, we have to use criteria other than severe damage to health in trying to pick a number to set a standard. There are many other reasons for setting criteria. Eye irritation is perhaps a minor matter of health but it certainly is a major annoyance. We do have very good knowledge about certain of the effects of these pollutants on plants and physical structures. Therefore, since we lack quantitative health evidence, one can only say that our knowledge base should be expanded by setting up programs to get this information. At the present time, as I am sure will be brought out later on in these hearings, the responsible people in HEW are setting up such long-term programs.

Mr. BELL. Doctor, you spoke on page 10 of your prepared statement about systems analysis being used in this effort. Are you talking about the systems type of analysis that certain corporate enterprises are involved in? Is this the type of thing you are speaking of?

Dr. BENNETT. Yes, sir.

Mr. BELL. Computer effort.

Dr. BENNETT. It is the type of activity that has characterized several sectors of industry up until now.

Mr. BELL. As you know many of our governmental agencies make certain contracts with private industry today. Are you suggesting that maybe we change that and allow the systems type of analysis to be worked on in many instances by private organizations?

Dr. BENNETT. I am unaware of the obstructions to which you refer.

Mr. BELL. There is some objection to many of our Government agencies making Federal contracts in this field with private corporations because it may give them a competitive advantage for later work. I am wondering if you would be in favor of this.

There is also the question of support service contracts in view of the recent rulings.

Mr. DADDARIO. If you have some problems with that, we could have Mr. Bell supply the question to you. You could supply the answer for the record.

Dr. BENNETT. Yes, sir.

Mr. FULTON. If the gentleman will yield, my point is that when we are going into research, development, and effectuating programs to clean up the air, the water, and the environment, we must watch that we are not trying to change the commercial lines favoring one group over another. On page 10 of your statement there is an inference to me that you are saying that electrical-powered vehicles are better than oil- or gasoline-powered vehicles. From my point of view, it is no part of the jurisdiction of the Government to decide that either gasoline-,

oil-powered vehicles, or electrical vehicles are better. For example, if the Government wishes to work with a particular industry on developing whether the pollutants must be removed from the fuel in the first place, during the burning, or in the exhaust or stack gases, that is a question within the industry.

I am afraid that the Government goes beyond its prerogatives when it tries to determine the direction of industries. That to me and my party should be a matter of private enterprise and of public acceptance and consumer demand. The Government should not try to say to a group of industries, you are not as good as the others. Therefore, you must change or give up your particular industry in the United States. When this happens, I think the Government is going too far. I agree with Dr. Santayana, the Spanish philosopher, formerly of Harvard and now deceased, when he said one of the things about the U.S. Government is that the Government is always trying to reform the people and the people are always trying to reform the Government, and luckily neither gets very far with the other. If we are going to have a change, we must be careful that we are operating within the lines that are set up by free enterprise, freedom of choice, and consumer demand. I think that is one of the great strengths of the U.S. system. We have this direction and judgments made by tens of millions. We do not have just one decision by the Federal Government. Would you comment on that?

Dr. BENNETT. With specific reference to what is on page 10 of the testimony, where we referred to the report of the Department of Commerce Panel on Electrically Powered Vehicles, in a sense, that is a misnomer for that Panel. I believe in these hearings later the deliberations of that Panel will be described, and they actually considered the possibilities for electrically powered vehicles and found that present technology is not favorable for this. A great deal of their report deals with possible improvements in the internal combustion engine. One of their points is that air pollution from internal combustion engines is a problem that is increasing at a more rapid rate in other countries than in the United States. For instance, in Japan and Western Europe, the increase in the number of vehicles since the war is such that they are experiencing a more rapid rate of increase in pollutants than we are in the United States.

Mr. FULTON. That is no reason the Government should adopt birth control programs for gas-powered vehicles.

Mr. DADDARIO. Dr. Bennett, I think Mr. Fulton's statement stands as a statement of philosophy and principle of his own.

Mr. FULTON. I wonder if you agree with it.

Mr. DADDARIO. I think you have gone as far as you need to answer it.

Dr. BENNETT. I would like to remove any implication, if I may, that the Office of Science and Technology favors electrically powered vehicles. I think there will be testimony concerning the Commerce report later in the hearings.

Mr. FULTON. Thank you.

Mr. DADDARIO. I would like to make the observation there is no interference which prevents industry from performing research activities of its own in this area. In most of the industries, which have an interest, there is research.

Dr. BENNETT. That is true.

Mr. DADDARIO. Is there a question, Mr. Ryan?

Mr. RYAN. I was simply going to state for the record that I am sure on this committee that there is basic disagreement, certainly on my part, with Mr. Fulton's stated philosophy. I would hope that the witness does not agree with Mr. Fulton's statement. I do not think we need to go into it further this morning except to make that clear. I think the Government has a clear responsibility in this area and the Government should set standards for pollutants. It is up to the industry to comply or not to comply, whereas it is up to the Government to show industry how to comply.

Mr. DADDARIO. I think Mr. Ryan's statement, as Mr. Fulton's, ought to stand on the record as their own particular statements. I do not believe that you as the witness, Dr. Bennett, need to qualify your remarks to either of them.

Mr. FULTON. But should he?

Mr. DADDARIO. May I ask you to proceed?

Dr. BENNETT. Perhaps the latter part of the statement will clarify the matter somewhat.

Decisions concerning sulfur oxide emissions exemplify this problem. Although the health effects of concentrations found in most localities are debatable, the irritation and annoyance are reasonably clear. Observations concerning the effects made under controlled circumstances in the laboratory may or may not be applicable under more complicated conditions when it is admixed with other atmospheric contaminants in the presence of smog, for example. Yet the standards adopted may have far-reaching effects upon energy policy and can affect a wide range of industries quite differently.

In some cases changing to fuel of low sulfur content may suffice. But since not enough low sulfur fuel is available in many regions, effective means of getting rid of the sulfur economically will be needed—and that is a technical problem. Whether it should be removed from the fuel, in the first place, or removed later during burning or from the stack gases, will depend on the processes developed. Moreover, the best process will not be the same in every circumstance. The problem appears to be the selection of the best and most efficient process in any given situation.

The Federal Government, through HEW and the Bureau of Mines, is financing research on these problems and a great deal is being done as well in industry laboratories with their own funds. The development of adequate incentives to private effort will clearly have to be a key part of our program and in the end the cooperation of everyone concerned will be necessary for success.

Mr. DADDARIO. Thank you, Dr. Bennett.

Mr. Roush?

Mr. ROUSH. I have no questions, Mr. Chairman.

Mr. DADDARIO. Mr. Bell?

Mr. BELL. Yes, Mr. Chairman.

You mentioned, Doctor, in Dr. Hornig's statement relative to the transportation problem that you still make an effort to study in the area of noise abatement? Is that correct?

Dr. BENNETT. While the Office of Science and Technology took the lead in the original study of the problem of noise from jet airplanes, that responsibility has now been transferred to the Secretary of Trans-

portation, and there is a special committee giving continuing attention to that specific problem of noise chaired by the Department of Transportation.

Mr. BELL. I believe, as Dr. Hornig answered Mr. Daddario's question, the committee is still active in a study of this. Isn't that the answer he gave?

Dr. BENNETT. A member of our staff sits in on the meetings of this committee, and its is part of Dr. Hornig's responsibility to keep abreast of that activity and to advise the President if and when the necessity arises.

Mr. DADDARIO. The operational activity is shifted, but the supervisory control remains with OST.

Mr. BELL. I was wondering if it would be appropriate for me to ask questions relative to that matter.

Dr. BENNETT. It might clarify things if I pointed out that the original study was begun before there was a Department or Transportation.

Mr. DADDARIO. OST at the present time just has the responsibility of reporting to the President as to what activity is taking place in the Department of Transportation on this particular subject.

Dr. BENNETT. That is correct, plus adding our own comments and recommendations.

Mr. BELL. I see.

Mr. Chairman, would it be appropriate for me to ask a couple of questions relative to this?

Mr. DADDARIO. You certainly may, Mr. Bell.

Mr. BELL. The International Airport of Los Angeles is partially in my district. This is quite a problem in noise abatement. Can you inform me as to any new development in this area? As I understand it, the power that an airplane has is really its lifeblood, and every attempt to control noise from a plane results in curbing power to some extent. Is this generally a true statement?

Dr. BENNETT. In general this is the trade-off that one is faced with.

Mr. BELL. What is the direction in which you see the Department of Transportation going? Is it the direction of cutting the power to cut the noise, increasing the power and bringing the uplift higher and quicker, or a higher level at a quicker rate, thus causing less noise?

Dr. BENNETT. I can answer only in a very general way, but I will be very glad to supply more specific information. Whatever is done will involve very long-term programs. The best answer at the present time, we believe, would be to relocate airports, but this is exceedingly difficult in terms of finding the proper territory to do it. It is a long-range thing. Even if it were possible, which it is, to design engines that make slightly less noise but produce essentially the same amount of power, one is faced with the economic problem of the replacement of all of the engines now in use, and it would probably be as long as a decade before that would be economically feasible. So that in the short term it appears to be a problem for which there is no good answer.

In the long term there are some possible answers, but whether they will be feasible is not simply a question of science and technology.

Mr. BELL. On changing the airport suggestion because of the supersonic planes, isn't this an implication that Howard Hughes has the right idea of establishing an airport in Nevada for Los Angeles?

Dr. BENNETT. So far as the supersonic plane is concerned it will create no more disturbance than our present transports when it comes in and leaves the airport because at that time it will be traveling at subsonic speeds.

Mr. FULTON. If the gentleman will yield, I have the Greater Pittsburgh Airport in my district so we have the same problem.

I have made recommendations that nobody, but nobody will adopt. I believe the runways of planes should be put underground, and secondly——

Mr. DADDARIO. Will you send that down to the Secretary?

Mr. FULTON. I was in Navy Air in World War II and I know that the runways are used for taxiing and for revving up the engines. Why isn't that done underground? Then, when you come out, you are on an inclined slope and up and out you go.

The second point is this: I went out and saw the atomic cannon fired. I was amazed to hear that pine forests and young pine trees are the best absorption of sound in any kind of energy waves which go down and come up. Why don't we have the airports planted like a Christmas tree reservation. Trees could be planted on the side of the runways to absorb the sound. Smaller trees could be planted near the runways so that if the plane runs off there is no damage, and bigger trees outside. The trouble is when I use some imagination everybody snickers and laughs a little bit, but the alternative to moving the airport out of Los Angeles is to cut the sound and reduce the runway traffic. What do you say to that?

Dr. BENNETT. I do not disagree. I would simply say again——

Mr. FULTON. You do not disagree?

Dr. BENNETT. I do not disagree.

Mr. FULTON. I welcome you to the society.

Dr. BENNETT. But I would say again that while these are partly matters of science and technology, the prime difficulty is that economic, social, and political factors create obstacles to the implementation of such ideas. That is really all I am saying.

Mr. DADDARIO. Which seriously is a real problem in this whole particular area.

Dr. BENNETT. It is, yes.

Mr. DADDARIO. Mr. Brown.

Mr. BROWN. I have no questions.

Mr. DADDARIO. Mr. Mosher?

Mr. MOSHER. Can we get back briefly, Mr. Chairman, to Dr. Hornig's comment on page 9, which you have already discussed. The implication was that there are problems both old and new that extend far beyond the charter of the Committee on Environmental Quality. Is there an implication that there needs to be created some organ with a greater charter, some agency or group or committee with a larger charter? Or is the only organization available with a larger charter probably with Congress itself? Are these the problems that Dr. Hornig is referring to here which only the Congress can deal with? If that is the case, is the Committee on Environmental Quality preparing program suggestions for the Congress? Can we ultimately expect specific recommendations from this committee in these larger areas beyond the scope of any present interagency authority? For instance, the Congress created fairly recently the Presidential Commission on

Marine Sciences and Engineering, and really put on that Commission the job of very fundamental recommendations to Congress which we will be getting toward the end of this year in the Commission's report.

Can we expect that type of report ultimately from this Committee on Environmental Quality?

Dr. BENNETT. Let me say I am quite sure the deliberations and analyses of this interagency committee will result in the identification of problem areas that will eventually be brought to Congress for action. However, at the present time, we do not feel a need for another study group. This area has been studied by many, many groups and the initial problem was to take the existing recommendations, to compare them with what is going on, and to see what additional authority might be needed and where additional research might be needed. The authority already exists for the Office of Science and Technology to be the focus for these activities.

You will recall that the President's Science Advisory Committee had a panel a few years ago that published a report, one of those which described the problems of restoring quality to the environment, but that panel then went out of existence. The recognition of the fact this is a continuing problem has led now to the decision to reestablish this panel on a continuing basis and not as an ad hoc group that makes recommendations and then disbands. Thus, there will be an arm into the agencies through the Federal Council Committee, there will be an arm to the outside public, to the private sector, through the activities of this PSAC panel and, as I have already indicated this has necessitated an increased effort in the Office of Science and Technology devoted to this broad area of environmental quality. So that we feel the authority exists and the creation of this Committee of the Federal Council for Science and Technology really triggered these other actions which are not surprising. I think there was a realization that something of this sort was needed, but the committee is what finally made things begin to move.

Mr. MOSHER. Mr. Chairman, can we assume there will be a continuing and active liaison between this subcommittee and its staff and the Committee on Environmental Quality?

It seems to me there is a need for probably more communication than there has been in the past between this committee and the Congress.

Mr. DADDARIO. Mr. Mosher, there has been. Since we had our last hearings on the subject, we have continued such a relationship and it certainly is our intention that we will continue it. I think the question you ask is a very good one as to what recommendations we might expect from the activities that are going on under the aegis of OST. And I, too, think a corollary to that would be recommendations to be made as to how mechanisms can be developed within the executive branch so interagency problems can be adjusted.

I offhand would disagree with Dr. Hornig where he said in answer to one of my questions that the proliferation of activities going on in all of these agencies is the way in which to do it. I would think it ought to be more concentrated; perhaps not in one agency but certainly not spread around as much as it presently is.

I think the jurisdictional problems which exist with congressional committees and one thing and another must prevent us from homing in on the issues as they develop. I do think, Mr. Mosher, that the question you ask leads us to seriously keep involved in this over a period of time until we can see these things brought to a better understanding.

Mr. RYAN. Let me raise a question which was alluded to by Dr. Hornig and which you have discussed.

The public is more and more conscious of questions affecting the environment; first water and then air and now noise. This has become foremost in our thinking on questions of environmental pollution. I would wonder what role the Office of Science and Technology played, if any, in the decision to proceed with the SST, whether or not the question of sonic boom was studied by the Office of Science and Technology as it related to the development of the SST, and whether that was presented and really taken into consideration.

You spoke of the fact that as an SST comes into an airport, it will be traveling at subsonic speed, therefore the noise problem might not be any greater than the present jet traffic. However, it has been suggested by some that the sonic boom problem is such that the SST will not be able to fly overland either in the United States or Europe. If this is so, was this factor taken into consideration?

Where does the Office really affect the decisionmaking process in the Federal Government? Let's use the SST as an example.

Dr. BENNETT. Mr. Ryan, I would be very glad to supply the answer to that but I really am unable to give a response off the top of my head. I will be glad to see to it that you receive an answer to your question. The sonic boom study was begun before I became associated with the Office. It had been almost completed. The responsibility has been transferred to the Department of Transportation, but I can get that information for you and I will be glad to make it a part of the record.

Mr. DADDARIO. Do you include in that, Mr. Ryan, the physiological and psychological effects on man?

Mr. RYAN. Yes; I do.

Mr. DADDARIO. Would you include that?

Dr. BENNETT. Yes, indeed.

(The information may be found in the answer to question 19 appearing on page 37.)

Mr. RYAN. That raises the broader question—maybe you have some comment on it—what should the role of the Office of Science and Technology be in the decisionmaking process, whether it is constructing SST's or undertaking some other major problem?

Mr. DADDARIO. Can you supply that for the record?

Mr. RYAN. Unless you feel you can comment on it now.

Dr. BENNETT. I can comment on that.

Our role is to obtain the scientific and technological information that enters into decisions of this type and to make appropriate recommendations. We are but one input into the decisionmaking apparatus and while we are free to express our opinion, and do so, there are many others, both within and without the Government, who are also free to express their opinions.

Mr. RYAN. I think that may be the problem. I think that is something this committee should really look at as we go along.

Mr. DADDARIO. Of course, we cannot impose on them the policy-making responsibilities which are those of the Executive, who acts on the recommendations given by the Committee, or perhaps the responsibility of the Congress.

Mr. RYAN. I am not suggesting that. I am suggesting there should be a greater ability to focus responsibility than there is.

Mr. DADDARIO. Yes; I understand. I just wanted to be sure we were not abrogating some of our own responsibilities in this area.

Mr. RYAN. No; I would never argue that we should.

Mr. DADDARIO. Mr. Lukens?

Mr. LUKENS. No questions.

Mr. DADDARIO. Mr. Winn?

Mr. WINN. Thank you, no questions.

Mr. DADDARIO. Mr. Fulton?

Mr. FULTON. One of the questions Mr. Ryan brought up, I think, should be explored a little further. Should there be some sort of a relationship between the Office of Science and Technology with a group such as the National Space Council? Should you have that kind of a setup, using that simply as a form?

Dr. BENNETT. I would say I see no need for any additional focus for this area within the Executive Office structure.

Mr. FULTON. So your Office would be a channel of information as the chairman has mentioned. The policy is set by members of the Cabinet and members in the particular field with a science and management capability through a separate council. That would be my suggestion. I hope you consider it.

That is all.

Mr. DADDARIO. Dr. Bennett, I appreciate your coming here today both to assist Dr. Hornig and acting as you have as a pinch-hitter for him. You have been extremely helpful.

We have a number questions which I hope we may submit for the record and which we will get to you as quickly as possible. Our staff will be in touch with you on that.

Dr. BENNETT. Will that list of questions include the formulation of that posed by Mr. Ryan?

Mr. DADDARIO. We will put together both Mr. Bell's questions and Mr. Ryan's questions and they will be submitted as theirs to you.

Mr. FULTON. Could I congratulate you and Dr. Hornig on the excellent statement, and congratulate you also on your wisdom and your imagination.

Mr. DADDARIO. Mr. Fulton is happy you have joined him in a sort of committee of two.

Questions Submitted to Dr. Donald F. Hornig, Director, Office of Science and Technology.

Question 1. In your testimony you indicated that the role of OST is to "maintain a general overview for the President" regarding environmental quality. You indicated also that the main role of the Committee on Environmental Quality is "one of technical coordination" and that the focal point for water pollution problems is the Department of Interior and for air pollution the Department of Health, Education, and Welfare. In his testimony, Dr. Buckley indicated that the Committee's survey of what Federal agencies are doing in the pollution field was to make a solid base of information for any serious judgments concerning overlap, what areas are not covered, and whether the right programs and problems are being attacked.

Specifically, what is the role of OST in this regard? What can it do if it finds unnecessary overlap, that areas are not well covered, or that the priorities are not correct? Is this authority primarily one of persuasion rather than decision making?

Answer. As a member of the Executive Office of the President, OST is a staff office to the President. According to Reorganization Plan No. 2 of 1962, the Office is to . . . "assist the President in discharging the responsibility of the President for the proper coordination of Federal science and technology functions." More particularly, it is charged with advising and assisting the President with respect to: "Review, integration, and coordination of major Federal activities in science and technology. . ."

Its first role, therefore, is to understand, and to assist the agencies to understand, the program as a whole so that priorities, overlaps, and gaps can be identified. When a redefinition of roles and missions is called for, it can be formally effected through such mechanisms as a Bureau of the Budget circular. Presidential memorandum to the heads of the concerned agencies, or through an Executive Order. Most actions, however, are undertaken through discussion and persuasion, and this proves quite effective when the relevant facts are known and understood. Agreement achieved in this way can be formalized if necessary through a written interagency agreement. Finally, considerable leverage can be exercised through our role in the formulation of the President's budget each year.

Question 2. The FY 1969 budget notes "The obligations of the Coast Guard for the conduct of research and development will increase from $9 million in 1968 to $17 million in 1969. Major elements of this increase are research on the control of pollution by oil or other wastes and the development of buoy technology to collect oceanographic and environmental data." How is this coordinated between the Department of Transportation and the Department of the Interior?

Answer. The joint Interior-Transportation study on oil pollution revealed the need for considerable research on techniques for preventing spills, and for handling oil and other hazardous substances once they are on the water. During the course of this work, and also in the preparation of the Administration bill on oil pollution control, informal agreement has been reached by the Interior and Transportation Departments that the mechanical aspects of oil pollution control will be the subject of research by the Coast Guard, and the chemical aspects by the Interior Department.

Programs of the Federal Water Pollution Control Administration and the Coast Guard are being coordinated in detail through meetings between the two agencies.

Question 3. Agency cognizance in automobile air pollution would appear to include the Department of Health, Education, and Welfare for standards setting, the Department of Transportation for inspection and maintenance, the Department of Commerce for economic effects on industry and the Department of the Interior for fuels relationships. Has OST become involved in this or similar coordination problems? Please describe the procedures by which comprehensive Federal policy and practice can come about in such complex environmental quality issues.

Answer. The division of responsibility is correctly stated in the question, except that the Department of Transportation's responsibility for inspection and maintenance relates only to the certification that HEW grants for the development of State and local air pollution inspection programs are consistent with the highway safety program. An administration proposal to extend this requirement to the inspection and maintenance of air pollution controls was rejected by Congress.

In connection with automobile air pollution, the report prepared on this subject by a panel of the Commerce Technical Advisory Board was the result of a request from the Director of OST to the Department of Commerce to explore the implications of the 1965 PSAC report on environmental quality, with specific attention to this area.

With regard to a comprehensive Federal policy for environmental quality issues, I can prescribe no simple procedure for arriving at one. It involves the entire fabric of the economic, social and political system. The central problem is to understand what is involved in achieving a "livable environment," which costs are associated with steps to achieve it, what the ramifications of any steps proposed to improve it may be, and how the federal, state and local governments,

as well as the private sector, can be organized to deal with it. This necessarily involves not only the Executive Office and the executive agencies, but the Congress and the public. A comprehensive public policy must evolve from both general and detailed analyses and studies, including both technical and policy studies, plus continuing discussion at all levels. OST plays a part in this through reports such as "Restoring the Quality of Our Environment," through the Federal Council Committee on the Quality of the Environment, the PSAC Panel on the environment, and through staff efforts.

OST is naturally involved in the coordination of these programs in which many agencies participate, although until now no serious coordination problems have arisen.

In a Memorandum of April 21, 1967, the President directed OST to provide advice on the allocation and use of research funds for the control of sulfur emissions, as well as on the appropriate research role of the various federal agencies.

OST is also involved through the direction by the President of January 30, 1967, that the Office "sponsor a thorough study of energy resources and engage the necessary staff to coordinate energy policy on a government-wide basis." Fuels are, of course, included in energy.

Question 4. "Liaison committees" proliferate in the environmental quality area. Please provide a complete list of these arrangements, their membership and scope of activity.

Answer. The following list identifies a number of the major groups concerned with the physical aspects of environmental quality. Also included are interagency agreements since much of the most significant coordination takes place via this mechanism rather than committees. In both instances, the lists may be incomplete because of (1) the difficulties in assembling detailed information over a short period of time, and (2) the deliberate omission of "environment related" arrangements or those of regional or local interest. Examples of the latter are the numerous groups concerned with the study or development of various rivers and/or river basins.

The list principally contains groups composed of representatives at the operating level directly concerned with continuing activities. No attempt was made to record the numerous informal arrangements concerned with problems of immediate or ad hoc interest.

The various Federal Councils with interest in the area such as the Federal Council for Science and Technology, the Federal Radiation Council, the Water Resources Council, The Marine Council and the President's Council on Recreation and Natural Beauty were omitted.

It is anticipated that as a Committee created by the Federal Council for Science and Technology develops, some of the previously established coordinating mechanisms may prove unnecessary.

FEDERAL COUNCIL FOR SCIENCE AND TECHNOLOGY INTERAGENCY COMMITTEES

1. Interdepartmental Committee for Atmospheric Sciences.

(a) Coordinate basic research activities in the atmospheric sciences.

(b) Commerce; Transportation; Agriculture; National Science Foundation; Atomic Energy Commission; Federal Communications Commission; Defense; National Aeronautics and Space Administration; State; Health, Education, and Welfare; Interior.

Observers: Office of Science and Technology, Bureau of the Budget, Commerce, National Academy of Sciences.

2. Committee on Environmental Quality.

(a) Identify and coordinate Federal programs concerned with pollution and other aspects of the environment.

(b) Office of Science and Technology; Commerce; Transportation; Interior; Atomic Energy Commission; Housing and Urban Development; Health, Education, and Welfare; Defense; National Science Foundation; Agriculture.

Observers: Smithsonian Institution, Council of Economic Advisers, Bureau of the Budget, National Aeronautics and Space Administration, Federal Power Commission, State.

3. Committee on Scientific and Technical Information.

(a) Establish liaison among the Federal agencies on information systems and develop programs to improve communication networks.

(b) Office of Science and Technology, Atomic Energy Commission, Defense, National Library of Medicine, National Aeronautics and Space Administration, Veterans Administration, State, Agriculture, Commerce, Interior.

Observers: General Services Administration; Transportation; Health, Education, and Welfare; Housing and Urban Development; Smithsonian Institution; Office of Emergency Planning; State; Post Office Department; U.S. Information Agency; Federal Communications Commission; Small Business Administration; Commerce; Central Intelligence Agency; Bureau of the Budget.

4. Committee on Solid Earth Sciences.

(a) Coordinate Federal activities and identify current and needed programs in this area.

(b) Interior, U.S. Geological Survey, Smithsonian Institution, National Science Foundation, Agriculture, Atomic Energy Commission, Defense, National Aeronautics and Space Administration, Housing and Urban Development, Commerce.

Observers: Office of Science and Technology, Bureau of the Budget, State, Arms Control and Disarmament Agency, Transportation.

5. Committee on Water Resources Research.

(a) Evaluate current efforts pertaining to water resources research and develop long-range plans for needed research.

(b) Office of Science and Technology; National Science Foundation; Interior; Tennessee Valley Authority; Transportation; Atomic Energy Commission; Defense; Water Resources Council; Health, Education, and Welfare; National Aeronautics and Space Administration; Agriculture; Housing and Urban Development; Commerce.

Observers: Council of Economic Advisers, Bureau of the Budget, State.

Other Interagency Groups.

6. Interagency Committee on Meteorological Services and Interagency Committee on Applied Meteorological Research.

(a) Assist the Office of the Federal Coordinator for Meterological Services and Supporting Research (Commerce) in the preparation of plans.

(b) Agriculture; Commerce; Health, Education, and Welfare; National Science Foundation; Atomic Energy Commission; Defense; National Aeronautics and Space Administration; State.

Observer: Interior.

7. Federal Committee on Pest Control.

(a) Provide advice to the Secretary of Agriculture and the Food and Drug Administration on pesticide use.

(b) Agriculture; Health, Education, and Welfare; Interior; Defense.

Observers: State; Housing and Urban Development; National Science Foundation.

8. Armed Forces Pest Control Board.

(a) Coordinate Defense pest control programs.

(b) Defense; Health, Education, and Welfare; Interior; Agriculture.

9. Interagency Aircraft Noise Abatement Advisory Committee.

(a) Coordinate development of satisfactory solutions to the aircraft noise and sonic boom problems.

(b) Transportation; Housing and Urban Development; Agriculture; Defense; Health, Education, and Welfare; National Aeronautics and Space Administration; Office of Science and Technology.

10. Federal Advisory Committee on Water Data.

(a) Plan and carry out a program of data acquisition and to store and make available the data obtained.

(b) Housing and Urban Development; Federal Power Commission; Agriculture; Commerce; Atomic Energy Commission; Defense; Health, Education, and Welfare; Tennessee Valley Authority.

11. Interagency Committee on Coordination of Sewer and Water Programs.

(a) Develop procedure to facilitate administration of water and sewer programs.

(b) Bureau of the Budget, Commerce, Interior, Agriculture, Housing and Urban Development.

12. Steering Committee—U.S.-German Cooperative Program in Natural Resources, Pollution Control and Urban Development.

(a) Joint study in air pollution, solid waste, water pollution, coal research, noise abatement, electric power, and urban planning.

(b) Interior; State; Housing and Urban Development; Health, Education, and Welfare.

13. Land Use Under Open Space and Outdoor Recreation Programs.

(a) To coordinate the planning and acquisition of land under the Outdoor Recreation Program.

(b) Housing and Urban Development and Interior.

14. Coordinating Urban Planning Assistance with Soil Conservation Services.

(a) To set forth requirements for coordinating land use planning under 701 with Resources Conservation and Development Projects.

(b) Housing and Urban Development and Agriculture.

15. Advances for Public Works Planning.

(a) To notify and consult with other agencies on applications for public works planning advances, where the planned projects are of interest to those agencies.

(b) Department of Transportation; Health, Education, and Welfare; Commerce; Agriculture; Housing and Urban Development.

16. Agreement Between United States Department of Agriculture and Housing and Urban Development on Assistance to Small Communities for Water and Sewer Facilities.

(a) To make determinations regarding jurisdiction over sewer and water grants in towns under 5,500 population.

(b) Agriculture and Housing and Urban Development.

17. Planning in Bureau of Land Management Areas.

(a) When an application for a planning grant is contemplated and BLM lands are situated within or adjacent to the planning area, the BLM State Office is invited by the State planning agency to coordinate its multiple-use management and disposition programs with the 701 planning program.

(b) Interior and Housing and Urban Development.

18. Relating Airport Location and Expansion to Comprehensive Planning.

(a) The FAA is notified of a locality seeking 701 assistance so that an airport interest in the area may be related to comprehensive planning.

(b) Transportation and Housing and Urban Development.

19. Coordination of Site Selection for Roads and Public Housing.

(a) To avoid possible conflicts over sites selected for public housing units and those planned for highways.

(b) Transportation and Housing and Urban Development.

20. HUD-HEW "Umbrella Agreement."

(a) To provide for coordination and cooperation between HUD's 701 comprehensive planning and HEW's comprehensive health planning where interests or responsibilities are shared.

(b) Health, Education, and Welfare and Housing and Urban Development.

21. Flooding Potential in Urban Areas.

(a) To provide for receipt from Corps of Engineers of flood plain studies.

(b) Defense, Housing and Urban Development.

22. Cooperating in Research, Administration, and Management of Fish and Wildlife Resources on Forest Service Land.

(a) Reciprocal advisory agreement in Forest Service lands and fish hatchery operation.

(b) Interior and Agriculture.

23. Effects of Dredging, Filling and Excavating on Fish and Wildlife and Water Pollution.

(a) Defense notifies Interior of anticipated activities and consults on potential consequences.

(b) Defense and Interior.

24. Licensing and Regulation of Proposed Nuclear Installations.

(a) Interior advises the Atomic Energy Commission on new nuclear installations.

(b) Interior, Atomic Energy Commission.

25. Recreation Use for Hydroelectric Projects.

(a) Interior provides advice on recreation use plans for projects subject to licensing by the Federal Power Commission.

(b) Interior, Federal Power Commission.

26. Research and Development Contract on Packaged Boilers.
(a) Systems, concepts, and evaluation of packaged boilers burning coal will include air pollution analyses for Health, Education, and Welfare.
(b) Interior; Health, Education, and Welfare.

Question 5. In your testimony you indicated that OST advises the Bureau of the Budget regarding environmental quality. What types of advice are given? Is it primarily regarding the technical content of agency programs or does it also include advice as to overall priorities as evidenced by their budget allocations?

Answer. This advice includes priorities among program areas, the technical content of agency programs, program priorities in the areas of research, development, and demonstration, advice about budgetary estimates in relation to priorities, advice concerning expansion of inadequately funded programs where authority exists, and advice concerning revision of allocations where estimates are not commensurate with the nature or priority of a task.
The efficacy of any advice is limited by the legislative history of many of these programs and the many Committee jurisdictions involved.

Question 6. How many people are there on the staff of OST or the Federal Council working in the area of environmental quality? What does the effort represent in terms of man years? What activities do they perform?

Answer. There are currently 6 members of the professional staff of OST (out of a total of 19) who devote a significant portion of their time to environmental quality activities. Their combined efforts in this area, strictly defined, represent the equivalent of two to two and one-half man years.
Activities include (1) overall program organization and coordination, (2) staff studies on specific problems such as environmental health and general programs related to environmental quality such as energy policy (3) participation on departmental and interdepartmental panels (4) chairing FCST interdepartmental committees on water resources and environmental quality (5) working with the Budget Bureau on technical and managerial questions (6) responses to inquiries from Congress, public agents, industry, universities, professional societies, and individuals (7) evaluation of reports in the area and proposing means for implementing desirable recommendations (8) organizing the new PSAC continuing Panel on the Environment (9) maintaining liaison with the National Academy of Sciences and Engineering, and (10) provision of advice to the President on related policy issues.
As public interests and commitments in environmental quality have increased, the need for greater staff strength has become apparent. Accordingly, another full-time senior staff member will be added to the Office on April 21, 1968, and one additional full-time professional position has been requested in the 1969 budget. Filling this position should permit OST to imporve its capabilities for discharging its increasing responsibilities in environmental quality.

Question 7. Do you view the Councils such as those proposed by Mr. Dingell (H.R. 7796) or Mr. Tunney (H.R. 13211) a constructive addition to the decision-making process regarding the whole question of environmental quality or are such functions adequately provided by OST and the Federal Council?

Answer. We are preparing reports on H.R. 7796 and H.R. 13211 which will be submitted to Bureau of the Budget for clearance along with reports of other agencies.

Question 8. Concerning the Survey of Federal Expenditures for Pollution Research and Development, please supply a table of expenditures by agency and activity for the current fiscal year.

Answer. A copy of the requested information is attached. Details are included in 1967 and 1968 expenditures.

90-064—68——3

TABLE 1.—EXPENDITURES REPORTED BY THE FEDERAL GOVERNMENT ON POLLUTION RESEARCH, DEVELOPMENT, AND DEMONSTRATION (EXCEPT PESTICIDES) IN FISCAL YEAR 1968

[Thousands of dollars]

	Fiscal year 1967				Fiscal year 1968		
	Including pesticides	Excluding pesticides			Excluding pesticides		
	Total	Intramural	Extramural	Total	Intramural	Extramural	Total
1. Effects of pollution	44,258	12,891	22,152	35,764	16,294	25,188	41,943
(a) Directly on man	17,508	6,463	6,123	12,645	8,960	5,601	14,632
(b) On crop plants and domestic animals	5,234	753	2,731	3,484	1,418	2,617	4,035
(c) On nondomesticated plants and animals	9,256	2,200	4,513	7,375	2,324	4,745	7,459
(d) On laboratory animals	6,289	----------	6,289	6,289	----------	6,808	6,808
(e) On materials or structures	414	249	165	414	304	229	533
(f) On environments	(5,481)	(3,201)	(2,280)	(5,481)	(3,263)	(4,982)	(8,245)
(1) Air	736	352	384	736	302	242	544
(2) Freshwater (eutrophication)	1,742	1,101	641	1,742	960	1,603	2,563
(3) Marine	873	683	190	873	701	320	1,021
(4) Urban	155	----------	155	155	50	1,076	1,126
(5) Rural	1,050	1,000	50	1,050	1,150	453	1,603
(6) Wild	----------	----------	----------	----------	----------	----------	----------
(7) Soils	65	65	----------	65	65	----------	65
(8) Mixed	202	----------	202	202	----------	598	598
2. Transport, distribution, and fate of pollutants	29,586	5,247	12,941	18,602	5,830	13,003	19,090
(a) Movement	16,002	4,571	11,431	16,002	4,884	10,996	15,880
(b) Degradation	2,186	676	1,510	2,186	946	2,007	2,953
3. Measurement and instrumentation	14,736	6,836	4,083	11,536	7,090	4,296	12,042
4. Exposure to and sources of pollution	2,403	1,782	621	2,403	2,341	747	3,088
5. Social, economic, and legal aspects of pollution	1,891	319	1,572	1,891	684	2,022	2,706
6. Prevention and control of pollution	118,967	25,832	49,826	75,779	31,142	74,414	105,666
(a) Research	66,195	13,171	17,153	30,445	16,782	18,612	35,504
(b) Development	29,272	2,951	18,883	21,834	3,812	30,709	34,521
(c) Demonstration	23,500	9,710	13,790	23,500	10,548	25,093	35,641
Total obligations	211,841	52,907	91,195	145,975	63,381	119,670	184,535

Note: Fiscal year totals and numbered category totals may exceed the sums of the respective rows and columns because some agencies did not provide detailed breakdowns. Research and development estimated at $132,600,000 in fiscal year 1967 and $136,500,000 in fiscal year 1968 not conducted for pollution-related purposes also contributes to understanding and controlling pollution. $9,000,000 of this in fiscal year 1967 and $10,000,000 in fiscal year 1968 was spent on aircraft noise.

TABLE 2.—*Pesticides research conducted or supported by the Federal Government*[1] *in fiscal year 1967. Data gathered and supported by the Federal Committee on Pest Control (FCPC)*

	Expenditures (thousands)
1. Effects of pollution[2]	$8,494.6
(a) Directly on man	4,862.9
(b) On crop plants and domestic animals	1,750.4
(c) On nondomesticated plants and animals	1,881.3
(d) On materials or structures	
(e) On environments:	
(1) Air	
(2) Freshwater (eutrophication)	
(3) Marine	
(4) Urban	
(5) Rural	
(6) Wild	
2. Transport, distribution,[3] and fate of pollutants	10,985.2
(a) Movement	
(b) Degradation	
3. Measurement and[4] instrumentation	3,200.4
4. Exposure to and sources of pollution	
5. Social, economic, and legal aspects of pollution	
6. Prevention and control[5] of pollution	43,188.5
(a) Research	
(b) Development	
(c) Demonstration	
Total obligations	65,868.7

[1] Includes data from Department of Agriculture; Defense; Health Education, and Welfare; Interior; Atomic Energy Commission; National Science Foundation; and the Tennessee Valley Authority.
[2] Included as categories B–3 and D on the FCPC questionnaire.
[3] Included as category E–1 on the FCPC questionnaire.
[4] Included as category F on the FCPC questionnaire.
[5] Included as categories C1–11 and E–2 on the FCPC questionnaire.

TABLE 3.—TOTAL ESTIMATED EXPENDITURES BY AGENCY ON POLLUTION RESEARCH, DEVELOPMENT, AND DEMONSTRATION

Agency	Total by agency, fiscal year 1967			Fiscal year 1968 excluding pesticides
	Pesticides	Other than pesticides	Total	
Agriculture	45,966	9,303	55,269	10,203
Commerce		1,243	1,243	1,288
Defense	622	1,873	2,495	1,484
HEW	13,794	44,917	58,711	54,692
HUD		124	124	
Interior	4,053	57,460	61,513	83,802
State	478		478	
Transportation		305	305	766
AEC	412	30,187	30,599	31,441
NASA		80	80	200
NSF	493		493	
TVA	48	483	531	659
Total	65,866	145,975	211,841	184,535

Question 9. What is the plan to use this data as a management tool?

Answer. The budgetary analysis will be used to identify existing programs. Particular attention will be given to the balance among programs, to coordination of activities and to areas which might require additional effort. Assessments and recommendations of the Committee will be submitted to FCST and OST. Following approval, the information will be used by the agencies in developing their programs, by OST in advising the President on Policy issues and in consulting with the Bureau of the Budget. It will, of course, be available to the Congress in assessing the overall program and its balance.

Question 10. Will you designate additional lead agencies? Are the data good enough to compare relative emphasis or priorities?

Answer. It is not possible to say at this time whether lead agencies will be designated, other than those already given clear authority by the Congress. In general, the designation of lead agencies has not been particularly successful except when, as in meteorological services, a single agency is clearly dominant.

Emphasis and priorities do not derive from data in any mechanical way, but must be based on analysis of many factors plus good judgment. A great deal more data are needed to make sound analyses and judgments.

Question 11. Have any steps been taken to implement recommendations of this Subcommittee in October 1966 "toward establishing systems analysis and management capability within the Federal Government"? Please describe.

Answer. Steps have been taken to implement the Subcommittee's recommendation in environmental fields such as water and air pollution and solid waste disposal. In water pollution research, substantial steps are being made in developing "P–P–B" analysis. In addition, the testimony presented by Assistant Commissioner Leon Weinberger before the Subcommittee on January 31, indicates a systematic evaluation of research problems and programs underway by his agency.

Within HEW, air pollution and solid waste disposal programs are both undertaking activities that will lead to increased utilization of program analysis and development in a "systems" sense (see also Answer to Question No. 20).

Question 12. Concerning "health" vs. "resource" concepts for environmental quality: The Department of the Interior seems to be emerging as the champion of environmental quality. Could you discuss the pros and cons of recognizing one agency as an "assessment function" for all Federal activities which affect environmental quality?

Answer. OST regards the "health vs. resource concepts for environmental quality" as an artificial dichotomy based upon traditional missions of Departments. The Department of Interior is not, in our view, any more the champion of environmental quality than is the Department of Health, Education, and Welfare or the Department of Housing and Urban Development.

There are numerous, legitimate reasons for preventing pollution ranging from those which pertain directly to health such as purifying drinking water to those associated with other values, such as wildlife preservation or the beauty of a landscape. One of the most difficult tasks ahead will be deciding on the relative values we are willing to assign to various aspects of environmental quality as a basis for subsequent action.

Economic or cost-benefit analysis in the areas of mineral, forest, or fuel resources are quantifiable. In contrast, specific indicators for aesthetics, health, and preservation of animal and plant species are less easily quantified but not necessarily less important as components of "quality" in the environment.

The assignment of an "assessment function" to a single agency would imply self-assessment if the agency had program reponsibility. It would also imply the assessment of the programs of one agency by another peer agency. In the past this concept has proved unsatisfactory or even unworkable.

To place our national program in context, it is necessary to emphasize that the United States economy is product-market oriented. In response to this fact, we have developed a Federal science structure which provides a capability for responding to specific segments of the economy. This arrangement prescribes that agency responsibilities should extend through a continuum from research, through intermediate activities to action programs. This facilitates the smooth flow of research discoveries into programs which can exploit and utilize them. The advantages of such a system are obvious.

Wastes are produced or spun off in the course of the production process and

can be treated in this context. Presumably the abatement of these waste problems rests in examining, in their entirety, specific production-marketing processes to determine the points at which established controls may be applied most successfully and economically. This approach associates environmental quality responsibilities with agency missions, and recognizes that specific segment of the economy may be both sinners and sinned against. Calling attention to cases of the latter, particularly, is a responsibility we all share. It affords a useful device for insuring the recognition of broad problems. Efforts by one agency to assess the efforts of other agencies at the same level in the government often are not successful.

Question 13. Secretary Gardner has stated regarding Federal leadership in environmental quality: "We believe such leadership should come from a department or agency whose fundamental responsibilities are fully consistent with the central purpose of controlling air pollution and improving the management of solid waste problems—and that purpose is to protect the public health and welfare." What is the rationale for water quality in which water pollution control is separated from health relationships and placed in the Department of the Interior?

Answer. This question was largely answered in the preceding statement. A number of water quality problems are of a "resource" nature. The Department of Health, Education, and Welfare has responsibility for health aspects of water quality. The transfer of the authority for general control of water pollution from HEW to Interior was based upon judgments that the general problem was one of conservation of resources rather than "health and welfare," and that the water quality control program must be integrated with overall water and related land resources planning and development.

Question 14. Do you believe that the public health impacts of air and water contaminants will be dfined adequately to provide motivation for environmental improvement? Please explain.

Answer. Where environmental contaminants have public health impacts, they should most assuredly be the principle consideration in motivating improvements. The definition of the effects on human health is a difficult problem. This point is further discussed under Question 16. As mentioned previously, however, there are other values which must be considered in environmental quality. Levels of contamination for which no adverse effects on health can be demonstrated may be undesirable for aesthetic or other reasons. This would necessitate establishing standards which are unreleated to health.

At any rate, there are ample reasons for not delaying action until the exact qualification of effects on human health has been accomplished.

Question 15. What is the basis of national policy for the environment—human health and welfare or resource management?

Answer. This point was discussed under Question 12, and amplified in the responses to Questions 13 and 14.

Question 16. Dr. Bennett stated "we are almost totally lacking in knowledge on what the effect will be of exposure to relatively low concentrations of pollutants over a period of 10, 20, or 30 years." When do you estimate that we will have such knowledge and what will it cost to obtain it? When do you estimate that HEW will have sufficient knowledge to issue reliable criteria for such low concentrations?

Answer. Many of the pollutants with which we are concerned currently have been in our environment for long periods of time; for example, those resulting from various combustion processes. However, with accelerated industrialization and increased population density these problems have been aggravated. Other contaminants have been introduced into our environment comparatively recently, and their long-term effects have not yet been established. In short, the majority of our pollution problems have been of comparatively recent concern. It will be a long time before reliable information on long-term effects is available.

Synthetic organic pesticides are a case in point. Their use became widespread in the late 1940's and 1950's. A significant concern for the hazards, the persistent chemicals presented was expressed in the 1950's culminating in the publication of "Silent Spring." Although monitoring of man, his food supply and various components of his environment indicate there are no short-term effects, the question still remains of long-term hazards which have not yet been expressed. For example, there are illustrations that these materials accumulate in food chains.

Improved usage techniques have been developed as well as substitute materials which can be used for many pest control problems.

Experimentation and observation will be required perhaps indefinitely to condemn or exonerate specific pollutants suspected of causing chronic harm, if there are no indications of short-term hazards. The principal question rests in how many years or generations must pass before we will be convinced that a particular contaminant is not injurious. In addition, new materials are constantly being introduced into the environment which will require similar vigilance. In view of these facts, it is impossible to estimate with any certainty either the time span or cost required to be positively certain of the concentration levels which will not adversely affect our environment. However, large volumes of information are being accumulated and, when a significant body of information is available, informed judgments are made and standards established with a considerable margin of safety. As additional information is accumulated, standards may be lowered or raised.

Our alternative is to wait until experimentation convinces us beyond a doubt that no harmful effects to the environment will result from the introduction of a new factor into it. As mentioned previously this may require generations to demonstrate. The net effort would be a moratorium on the application of science and technology.

Question 17. What role does OST play in assessing the economic considerations inherent in setting air and water criteria or standards such as the cost of compliance versus the overall benefit, and the effect it will have on the competitive position of various industries within the economy and the total scheme of things? IF OST does not do it, whose responsibility is it?

Answer. Section 305(a) of the Clean Air Act as amended assigns responsibility for economic studies of air pollution to the Secretary of the Department of Health, Education, and Welfare.

"In order to provide the basis for evaluating programs authorized by this Act and the development of new programs and to furnish the Congress with the information necessary for authorization of appropriations by fiscal years beginning after June 30, 1969, the Secretary, in cooperation with state, interstate, and local air pollution control agencies, shall make a detailed estimate of the cost of carrying out the provisions of this Act; a comprehensive study of the cost of program implementation by affected units of government; and a comprehensive study of the economic impact of air quality standards on the Nation's industries, communities, and other contributing sources of pollution, including an analysis of the national requirements for and the cost of controlling emissions to attain such standards of air quality as may be established pursuant to this Act or applicable State law."

Sections 16(a) and 18 of the Federal Water Pollution Control Act as amended vests similar authority in the Secretary of the Interior.

Section 16(a): In order to provide the basis for evaluating programs authorizing by this Act, the development of new programs, and to furnish the Congress with the information necessary for authorization of appropriations for fiscal years beginning after June 30, 1968, the Secretary, in cooperation with State water pollution control agencies and other water pollution control planning agencies, shall make a detailed estimate of the cost of carrying out the provisions of this Act; a comprehensive study of the economic impact on affected units of government of the cost of installation of treatment of facilities; and a comprehensive analysis of the national requirements for and the cost of treating municipal, industrial, and other effluent to attain such water quality standards as established pursuant to this Act or applicable state law. . . .

Section 18: The Secretary of the Interior shall conduct a full and complete investigation and study of methods for providing incentives designed to assist in the construction of faciilties and works by industry designed to reduce or abate water pollution. Such study shall include, but not be limited to, the possible use of tax incentives as well as other methods of financial assistance. In carrying out this study the Secretary shall consult with the Secretary of the Treasury as well as the head of any other appropriate department or agency of the Federal Government.

A coordinating mechanism was established by the President in his memorandum of April 21, 1967, which stated in part:

"The other area requiring attention is the consideration of economic incentives for pollution control and the determination of the economic effects of pollution

control. In my message to the Congress on Protecting Our National Heritage. I asked Secretary Gardner and the Chairman of the Council of Economic Advisers to explore appropriate measures to encourage industry and local governments to abate pollution. This effort should be expanded to cover the effects of air pollution control on industry and trade, both foreign and domestic."

As a result of these actions, a Federal Committee on the Economic Impact of Pollution Abatement was established with chairmanship in the Council of Economic Advisers. In both of these areas, as in all areas related to science and technology, however, OST has a mixed responsibility: (1) to maintain an overview of programs; (2) to encourage agency efforts directed toward the resolution of all aspects of science-based problems; and (3) to undertake studies in major problem areas involving science and technology, and to assure proper scientific and technologic inputs into studies of economic, social and political implications of environmental problems.

Question 18. In his testimony, Dr. Buckley indicated that of the $185 million the Federal Government was spending in 1968 related to pollution, about $5 million was being spent on the social, economic and legal aspects of pollution. Do you believe this is a proper ratio regarding new technology versus assessing the implications of that technology?

Answer. There is inadequate emphasis currently on social, economic, and legal studies related to pollution. In the amended tables, the expenditures for research in this area are $2.7 million, rather than the $4.6 million mentioned at the Hearings.

Until comparatively recently, we have had little information on the effects of pollution, this situation is improving. Without these basic data, it has been impossible to evaluate social, economic or political alternatives for developing abatement programs and applying technology for control.

Probably our greatest problems rest in institutionalizing abatement programs. Political jurisdictions usually do not coincide with pollution patterns; and all industries do not pollute equally, which suggests that selective abatement may be appropriate. Inadequate attention to questions such as these may result in economic mistakes of considerable magnitude.

An expansion of efforts in these kinds of areas is undoubtedly warranted.

Question.—Please supply a list of the social, economic, and legal studies which are being undertaken.

The requested list of current studies follows:

Department of Commerce

Distribution of Expenditures for Water and Sewage Systems;
Legislative History and Bibliography—Air and Water Pollution;
Water and Air Pollution Control Programs of the Pulp Industry;
Research (BDSA–OAAIA) (Projections of value added for 50 major polluting industries).

Department of Health, Education, and Welfare

Methodology for Studying Socio-Economic Effects of Air Pollution;
Air Pollution Control Costs;
Effects of Air Pollution on Optimal Urban Form;
Effect of Region on Air Pollution Control Programs;
The Organizational Factors in Air Pollution Control;
USSR Literature on Air Pollution and Related Diseases;
Air Pollution Control Political Process Conference;
Social Consequences of Use of Human Research Subjects—Economic Cost of Employee Illness or Death Caused by Industrial Pollutants;
Solid Wastes Operations Methodology Research for Optimum Management System;
Systems Analysis of Solid Wastes Management;
Cause and Effect Relations by Mathematical Models for Optimal Systems Operations;
Markets for Solid Wastes and Related Materials;
Management-oriented Municipal Cost Accounting Procedures for Analysis of Solid Wastes Problem;
Solid Wastes Cost Indices;
Funding Guidelines for Solid Waste Activities;
Cost-Benefit Relations of Solid Wastes Management;
Manpower Requirements, Union and Organized Labor Relations to Solid Wastes Management Systems;

National Survey of Community Solid Wastes Practices, etc., Statistical Data Processing-Mathematical Relationships;
State Solid Wastes Planning Guidelines Including Technical and Administrative Assistance;
Review of State Plans (Solid Wastes);
Relations and Economic Impact of Solid Wastes Disposal Activities on Land Use Patterns;
Regional and National Bases of Costs and Benefits Associated with State Solid Waste Management Plans;
Environmental Interfaces of Solid Wastes System and Interrelationships with Planning Processes;
Guidelines, Criteria and Standards for Solid Waste Management Systems;
Model Codes, Ordinances and Statutes for Urban, Regional and State Agencies;
Development of Training Courses for Public Officials;
Technical-Economic Study of Waste Disposal Needs and Practices;
Economic Study of Yeast Production;
Application of Systems Concepts to Solid Wastes Management;
Proposal for Improved Refuse Collection, a Comparative Study of One-Man Operation;
Systems Analysis of Solid Wastes;
Consumer Attitudes Toward Mineral Taste in Domestic Water;
Dynamic Evaluation Procedure; Refuse Handling System;
Using Waste Formed in Vegetable and Cheese Production;
Citric Acid From Citrus Wastes by Fermentation;
Systems Analysis for Shipborne Municipal Incineration;
Gully Reclamation Method—Landfill Demonstration, Nebraska;
California Integrated Solid Waste Management System;
Patterson, Clifton, Passaic, Wayne, Regional Solid Waste Program.
San Jose/Santa Clara County, Solid Waste Disposal Demonstration Project;
Erie County Refuse Disposal Project;
Maricopa County-wide Solid Waste Disposal;
County-wide Sanitary Landfill Refuse Disposal Project—Broome County, New York;
Des Moines, Metropolitan Area Solid Waste Study and Investigation;
Developments of Master Plan for Solid Waste Collection and Disposal, New Orleans, La.;
Farmington River Valley Solid Waste Disposal Study and Investigation;
Solid Waste Disposal Study for Flint and Genesee County, Metropolitan Area, Michigan;
Western Jefferson County, Wisconsin Solid Waste Disposal Study;
Solid Waste Collection and Disposal Study, Harrison County, Mississippi;
Tocks Island Regional-Interstate (Pa., N.J., and N.Y.) Solid Waste Management Study;
Study and Investigation and Solid Waste in Appalachian Regional Demonstration Area—Ten Counties in West Virginia;
Comprehensive Study of Solid Waste Disposal, Cascade County, Montana.

Department of the Interior

Delaware Estuary and Bay Water Quality Sampling and Mathematical Modeling;
Interstate Regional Planning for Water Supply and Waste Disposal;
Water Rights Related to Water Quality Storage;
Economics of Water Quality for a Regional System;
The Economics of Water Supply and Quality;
Economic Evaluation of Water Quality;
A Mathematical Model for Regional Treatment;
Data Collection Economics for Water Pollution Studies;
Mathematical Models of Hydrologic Systems;
Economics of Multi-purpose Playa Lake Modification;
Studies on Effects of Watershed Practices on Streams;
Use of New Analytical Methods for Water Resources Development;
Effects of Water Pollution in San Francisco Bay;
Water Quality Management on the Wisconsin River;

Alternative Economic Responses to the Acid Mine Drainage Problem in Southeastern Ohio;

The Effect of Quality Factors on the Demand for Water-Based Recreation;

Economic Factors in the Establishment of Water Quality Stream Standards;

Industrial Water and Waste Disposal Requirements in New Jersey;

A Case Study of Attitudes of Local Decision-Makers Toward Water Pollution Abatement in Selected Massachusetts Communities on the Connecticut River;

The Law of Water Pollution Control;

A Comparison of State Water Pollution Control Laws and Programs;

Economic Analysis of Alternative Water Pollution Control Measures;

Pollution Taxes and the Costs of Water Quality Management;

Study of Relationships Between Water Pollution and Industrial Development in South Carolina;

Economic Factors in the Establishment of Water Quality Stream Standards;

Industrial Water and Waste Disposal Requirements in New Jersey;

Integration of Connecticut Water Rights Laws and Pollution Control Laws;

The Effectiveness of Governmental Action for Water Pollution Control in New Jersey;

Water Quality Management on the Wisconsin River;

Stream Pollution and Recreation;

The Impact of Imposing a Water Quality Standard on a Live Stream;

The Use of Taxes, Subsidies, and Regulations to Control the Effluent of the Textile Industry;

Survey of Water Quality Requirements in Alaskan Campgrounds With Projections of Recreation Demands and Benefit/Cost Analysis for Site Selection.

Department of Agriculture

Economic Analysis of Water Pollution by Pesticides and Other Agricultural Wastes;

Legal Aspects of Water Quality Standards and Enforcement as Related to Agriculture and Rural Resources;

Economic Studies of Fertilizer Use;

Economic Analysis of Animal Waste Disposal in Farm Management;

Disposal and Utilization of Wastes for Agricultural Processing (Economics of Marketing By-Product Wastes);

Welfare and Institutional Economics in Analyses of Water Resource Management Problems; and Water Quality Management in Small Watersheds;

Economic Effects of Pesticides and Other Wastes on Natural Resources Quality;

Economic Studies of Sediment Control.

(Submitted by Mr. Ryan:)

Question 19. In order to better understand the role that the Office of Science and Technology plays in the decision-making process, would you please explain what role it played in the decision to proceed with the SST. Was the question of sonic boom, including its physiological and psychological effects upon man, studied by OST, and were these factors really taken into consideration in the decision to proceed with the SST? Did your office advise that the SST may never be able to fly over land or was this possibility considered?

Answer. The Director of OST sat with the President's Advisory Committee on the SST, chaired by Secretary McNamara, and participated in its deliberations. OST also worked closely with the Committee on the Sonic Boom of the National Academy, which was set up at the President's request, and insured that its review was carefully considered by the McNamara Committee.

At the request of the Chairman of the President's Advisory Committee on the SST (PAC–SST), Secretary McNamara, Dr. Hornig later assumed direction of an interagency sonic boom study program. This interagency effort was advised by the National Academy of Sciences Committee on Sonic Boom and carried out by USAF and various contractors, including the Stanford Research Institute. Naturally, the central problem of interest in these studies was the suitability of SST's of various design for commercial overland flight. The effects of sonic booms on structures, animals and people were included in the studies directed by OST and the principal conclusions included in a report which was released to the public. Studies are still continuing but now they are under the direction of the Department of Transportation.

(Submitted by Mr. Bell:)

Question 20. In your prepared statement you indicated that systems analyses would be used to help clarify some of the problems in pollution because of the sheer size and complexity of the problem.

(a) Is it expected that this effort will be done in-house or contracted out?

(b) If contracted out, is there the danger that a company which does the analyses will have a significant competitive advantage over other organizations regarding the development of hardware to combat pollution? How does the Federal Government protect against this possibility?

(c) Please discuss the possible use of the systems analyses capability of private industry in light of the October 1967 ruling of the Civil Service Commission suggesting that it is illegal in many instances to use contractor-supplied personnel to perform work ordinarily handled by Federal employees.

Answer. (a) The prepared statement indicated that the use of systems analysis has frequently been suggested to clarify problems we as a Nation are facing and to point the way to effective solutions. It further indicated that OST has "recently undertaken to clarify the possibilities and limitations of this approach".

Our initial action has been to bring together several persons skilled in systems analysis to explore the value of undertaking an objective analysis of the use and limitations of systems analyses as a guide to those in public decision-making positions. At the present time OST does not propose to directly involve itself in an operational program in the application of systems analyses.

(b) As indicated in (a) above, no contractual work is now planned by OST. In response to the general nature of the question, it is potentially true that any non-governmental firm might gain some advantage through contractual or other work programs in which they might engage with Government. Systems analysis, more usually, would involve a planning process rather than hardware development, although there would be exceptions to this.

(c) Civil Service Commission rulings are, of course, to be followed. In relation to systems analyses capability of private industry, it is likely that Government will use such outside help on specific research tasks or other related matters as necessary. For usual program analyses, Government agencies are prepared or are preparing to carry out needed tasks involving systems analyses with their own staffs.

Mr. DADDARIO. Our next witness is Dr. John Buckley, who has been of great help to this committee on several occasions. We are pleased to have you here this morning, Dr. Buckley. Dr. Buckley is Director of the Office of Ecology in the Department of Interior, but today he is here representing the Committee on Environmental Quality of the Federal Council on Science and Technology.

(Dr. Buckley's biography follows:)

DR. JOHN L. BUCKLEY

Education: BS, New York State College of Forestry, MS, PhD (wildlife management).

Professional history: Professor of wildlife management; asst. chief, wildlife research branch. Bureau of Sport Fisheries and Wildlife, director, Patuxent Wildlife Research Refuge, chief, Office of Pesticides Coordination, Bureau of Sport Fisheries and Wildlife.

Affiliations: National Research Council; AAAS, Wildlife Society; Arctic Institute.

Fields of special competence: Wildlife ecology, population fluctuations; environmental contamination.

STATEMENT OF DR. JOHN L. BUCKLEY, COMMITTEE ON ENVIRONMENTAL QUALITY, FEDERAL COUNSEL FOR SCIENCE AND TECHNOLOGY

Dr. BUCKLEY. Thank you, Mr. Chairman. It is a privilege to be here and I am sorry I am disorganized as usual. The large stack of papers here is witness to this.

The principal item I wish to lay before the group this morning is what we consider to be the best summary available at this time of expenditures on pollution research in the Federal Government. The last of the addition on the individual pieces was finished at 1 o'clock this morning and the summary at 10 minutes of 10. If there are some arithmetic errors, I hope the committee will permit me to make some changes in the fairly near future.

In the interests of time, Mr. Chairman, I will skip through the testimony here quite rapidly and request my prepared statement be included here.

(The statement follows:)

PREPARED STATEMENT OF JOHN L. BUCKLEY, CHAIRMAN, RESEARCH, DEMONSTRATION, AND DEVELOPMENT SUBCOMMITTEE OF THE FEDERAL COUNCIL FOR SCIENCE AND TECHNOLOGY'S COMMITTEE ON ENVIRONMENTAL QUALITY

The decision to form a Research, Development, and Demonstration Subcommittee was reached at a meeting of the Committee on Environmental Quality on August 22, 1967. The minutes of the next Committee meeting on September 12, 1967, show that:

> Two major activities of the Subcommittee on Research, Development, and Demonstration will be (1) to review the ongoing research program with a view to understanding how rapidly answers are accumulating; and (2) to review the priority and balance of the proposed program. Inherent in both review activities is the desirability of assuring covering of gaps and preventing unplanned overlap. Trends in intra-mural vs. extra-mural research will be studied, especially as they relate to manpower.

The Subcommittee held a series of meetings through the early fall at which it discussed how it could best gather the necessary information to carry out these duties. The possibility of obtaining the required information from the Defense Documentation Center or from the Scientific Information Exchange was discussed, but a trial run with the Defense Documentation Center suggested that problems of definition would be exceedingly difficult. It was therefore concluded that we should simultaneously query these information systems and the Government departments and agencies known to have programs in this area (a preliminary result from the Science Information Exchange is shown in Appendix 4). This would provide us with a useful base of information together with some insights into the ways in which we can best use the established information systems. A copy of the questions and instruction sheet that went to the Government departments and agencies is attached as Appendix 1.

Basically, the Research, Development, and Demonstration Subcommittee intended to find out how much of what kinds of research was being conducted by whom and with what results in the areas of understanding and controlling pollution. With such a base of information, it should be possible to determine what is being done; to assess in some measure the balance of the programs; and the data acquired should supply a useful basis for evaluating priorities. (Parenthetically, it is necessary to note that the Subcommittee recognizes that each Federal agency supports the research that is most urgent in the conduct

of its own mission; it is possible, however, that the "mix" of research developed by the several departments and agencies may not be the optimum for the nation as a whole.) Only with a factual background describing today's program is it possible to enter upon a meaningful evaluation of these questions.

Table 1 provides the results from the questionnaire. It is quite certain that this table is the best representation so far obtained of Federal efforts in research, development, and demonstration related to pollution. At the same time, we are aware of a number of items that must be considered in using this table. First, the footnotes to the table indicate that there is a considerable amount of transfer of funds within the Government aimed at the most efficient solving of problems. We have attempted to identify such moneys so that there is no "double counting" in the funds. Second, data were already available on funds spent on pesticide research in fiscal year 1967 and it did not seem fruitful to ask each agency again to supply the information. The 1967 pesticide data were gathered under the auspices of the Federal Committee on Pest Control, which kindly made the data available. They are included in Table 2. There is a small amount of pesticide research also reported in Table 1 but we believe this to be less than $2 million. Third, for purposes of our tabulations, intramural is considered as work done by Federal employees. Fourth, and very much to the point, much of the research, demonstration, and development reported here is directly pertinent to understanding and controlling pollution, but would be conducted for other reasons even if we were not supporting pollution control at the Federal level. Thus, better means of pest control and improved combustion are both desirable for increased efficiency. They also both contribute to reduction of pollution. We have identified some moneys of this sort but believe much more detailed analysis is necessary to really understand this factor. Fifth, investigations and research on pollution control are required as part of any military research, development, test, and evaluation program (reference to DOD Directive 5100.50). It is difficult, if not impossible, to separately identify all research on the problem, since a large effort is undertaken with regard to systems effectiveness, or military personnel protection. The data on pollution research cost thus do not include many such expenditures.

The Subcommittee considers its most important task the evaluation of the material supplied in response to Part II of the questionnaire. Several approaches have been taken by different agencies. One, by the Federal Water Pollution Control Administration, consists of a presentation of research on "effects of pollution" in the form of a matrix. A part of this is supplied as Appendix 2 to demonstrate this approach. Another, developed by the Public Health Service, requires a relatively elaborate coding but permits display of a large amount of data on a single sheet. An example is shown as Appendix 3.

I appreciate the chance to appear before your Committee and to describe the activities of the Research, Development, and Demonstration Subcommittee of the Committee on Environmental Quality. Many of the Subcommittee members are in the Hearing room and between us we will be pleased to try and answer any questions you may have.

Thank you.

TABLE 1.—EXPENDITURES REPORTED BY THE FEDERAL GOVERNMENT ON POLLUTION RESEARCH, DEVELOPMENT, AND DEMONSTRATION (EXCEPT PESTICIDES) IN FISCAL YEAR 1968

[Thousands of dollars]

	Fiscal year 1967				Fiscal year 1968		
	Including pesticides	Excluding pesticides			Excluding pesticides		
	Total	Intramural	Extramural	Total	Intramural	Extramural	Total
1. Effects of pollution	44,258	12,891	22,152	35,764	16,294	25,188	41,943
(a) Directly on man	17,508	6,463	6,123	12,645	8,960	5,601	14,632
(b) On crop plants and domestic animals	5,234	753	2,731	3,484	1,418	2,617	4,035
(c) On nondomesticated plants and animals	9,256	2,200	4,513	7,375	2,324	4,745	7,459
(d) On laboratory animals	6,289	----------	6,289	6,289	----------	6,808	6,808
(e) On materials or structures	414	249	165	414	304	229	533
(f) On environments	(5,481)	(3,201)	(2,280)	(5,481)	(3,263)	(4,982)	(8,245)
(1) Air	736	352	384	736	302	242	544
(2) Freshwater (eutrophication)	1,742	1,101	641	1,742	960	1,603	2,563
(3) Marine	873	683	190	873	701	320	1,021
(4) Urban	155	----------	155	155	50	1,076	1,126
(5) Rural	1,050	1,000	50	1,050	1,150	453	1,603
(6) Wild	----------	----------	----------	----------	----------	----------	----------
(7) Soils	65	65	----------	65	65	----------	65
(8) Mixed	202	----------	202	202	----------	598	598
2. Transport, distribution, and fate of pollutants	29,586	5,247	12,941	18,602	5,830	13,003	19,090
(a) Movement	16,002	4,571	11,431	16,002	4,884	10,996	15,880
(b) Degradation	2,186	676	1,510	2,186	946	2,007	2,953
3. Mesaurement and instrumentation	14,736	6,836	4,083	11,536	7,090	4,296	12,042
4. Exposure to and sources of pollution	2,403	1,782	621	2,403	2,341	747	3,088
5. Social, economic, and legal aspects of pollution	1,891	319	1,572	1,891	684	2,022	2,706
6. Prevention and control of pollution	118,967	25,832	49,826	75,779	31,142	74,414	105,666
(a) Research	66,195	13,171	17,153	30,445	16,782	18,612	35,504
(d) Development	29,272	2,951	18,883	21,834	3,812	30,709	34,521
(c) Demonstration	23,500	9,710	13,790	23,500	10,548	25,093	35,641
Total obligations	211,841	52,907	92,195	145,975	63,381	119,670	184,535

Note: Fiscal year totals and numbered category totals may exceed the sums of the respective rows and columns because some agencies did not provide detailed breakdowns. Research and development estimated at $132,600,000 in fiscal year 1967 and $136,500,000 in fiscal year 1968 not conducted for pollution-related purposes also contributes to understanding and controlling pollution. $9,000,000 of this in fiscal year 1967 and $10,000,000 in fiscal year 1968 was spent on aircraft noise.

TABLE 2.—*Pesticides research conducted or supported by the Federal Government* [1] *in fiscal year 1967. Data gathered and supplied by the Federal Committee on Pest Control (FCPC)*

[Thousands of dollars]

1. Effects of pollution [2]	8,494.6
(a) Directly on man	4,862.9
(b) On crop plants and domestic animals	1,750.4
(c) On nondomesticated plants and animals	1,881.3
(d) On materials or structures	
(e) On environments:	
(1) Air	
(2) Freshwater (eutrophication)	
(3) Marine	
(4) Urban	
(5) Rural	
(6) Wild	
2. Transport, distribution [3] and fate of pollutants	10,985.2
(a) Movement	
(b) Degradation	
3. Measurement and [4] instrumentation	3,200.4
4. Exposure to and sources of pollution	
5. Social, economic, and legal aspects of pollution	
6. Prevention and control [5] of pollution	43,188.5
(a) Research	
(b) Development	
(c) Demonstration	
Total obligations	65,868.7

[1] Includes data from Department of Agriculture, Defense, Health, Education, and Welfare, and Interior, and from the Atomic Energy Commission, National Science Foundation, and the Tennessee Valley Authority.
[2] Included as categories B–3 and D on the FCPC questionnaire.
[3] Included as category E–1 on the FCPC questionnaire.
[4] Included as category F on the FCPC questionnaire.
[5] Included as categories C1–11 and E–2 on the FCPC questionnaire.

APPENDIX 1. QUESTIONNAIRE AND INSTRUCTION SHEET ON RESEARCH, DEVELOPMENT AND DEMONSTRATION OF POLLUTION

(Instructions for Questionnaire on Pollution Research, Development, and Demonstration Supported or Conducted by the Federal Government)

1. On each questionnaire sheet indicate organization to which the response applies.

2. On Part I of questionnaire, include fiscal year 1967 and expected fiscal year 1968 funds.

3. Pollution, for purposes of this questionnaire, is defined as follows:

"Environmental pollution is the unfavorable alteration of our surroundings, wholly or largely as a by-product of man's actions, through direct or indirect effects of changes in energy patterns, radiation levels, chemical and physical constitution and abundances of organisms. These changes may affect man directly, or through his supplies of water and of agricultural and other biological products, his physical objects or possessions, or his opportunities for recreation and appreciation of nature."

4. On Part II, indicate the subjects or fields in which work is performed, but not the funds or manpower involved.

5. Pesticides need not be included because necessary information is available from the recently completed study of the Federal Committee on Pest Control.

6. Those who prepare this information are cautioned to retain their working papers. Questions generated by this study that cannot be answered by the report of this study will be referred to the appropriate agencies. It is probable that this study will be repeated in the future; therefore, the working papers will be of asssistance in preparing future inputs.

7. Members of the Research, Development, and Demonstration Subcommittee will be glad to answer questions that arise in the course of completing the questionnaire. Members are:

Dr. John L. Buckley—USDI
Code 183–4091
Dr. Helmut K. Buechner—Smithsonian
Code 144–5945
Mr. Jared J. Davis—AEC
Code 119–4155
Dr. Edward S. Deevey—NSF
Code 183–7888
Dr. Louis B. C. Fong—NASA
Code 13–27695
Col. Alvin F. Meyer, Jr.—DOD
Code 11–69377
Dr. Cecil H. Wadleigh—USDA
Code 1233–571
Dr. Douglas L. Worf—PHS
Code 13–22575

QUESTIONNAIRE ON POLLUTION RESEARCH, DEVELOPMENT, AND DEMONSTRATION SUPPORTED OR CONDUCTED BY THE FEDERAL GOVERNMENT

Part I—Obligations (rather than Expenditures) Fiscal Year 1967 and Fiscal Year 1968. Include *all* funds obligated. (Indicate separately any funds *received from* other Federal agencies.) Show intramural and extramural separately.

1. Effects of pollutants or pollution.
   (a) Directly on man.
   (b) On crop plants and domestic animals.
   (c) On non-domesticated plants and animals.
   (d) On materials or structures.
   (e) On environments:
      (1) Air e.g., inadvertent weather modification.
      (2) Freshwater e.g., eutrophication.
      (3) Marine (including estuaries) e.g.
      (4) Urban e.g.
      (5) Rural e.g.
      (6) Wild e.g.

[Effects included here are those exerted on a whole system rather than on its separate parts. Do *not* report research here that is reported under (a)–(d)]

2. Transport, distribution, and fate, including accumulation and degradation of pollutants.
   (a) Movement—including physical and biological movements (cycling).
   (b) Degradation—physical or chemical changes.
3. Measurement and instrumentation.
4. Exposure to and sources of pollution.
5. Social, economic, and legal aspects of pollution.
6. Prevention and control of pollution.
   (a) Research
   (b) Development
   (c) Demonstration

Part II—Research on pollution. Details of research conducted or supported by agency. Include all R D & D conducted regardless of source of funds, and all R D & D you support outside Federal Government. The following descriptions of categories are to be used:

Include support of all research directed toward understanding and controlling pollution, such as bio-geo-chemical cycling, study of unpolluted control areas, etc. Responses may be in tabular form.

1. *Effects.*—Each report should show what organism or group of organisms, or community or ecosystem is being studied; what pollutants or kinds of pollution, including noise and heat are being studied; what kinds of effects are being measured, such as mortality, behavior, physicological changes, etc. Pollutants may affect individuals, populations, communities of plants and animals, or ecosystems. The kinds of effects for *individuals* may range from death to subtle behavioral changes; for *populations*, in addition, they may include changes in natality and mortality rates and other population parameters; for *plant and animal communities*, they may also include changes in species in the community; and in *ecosystems* that may include altered rates of such processes as photosynthesis, bio-geo-chemical cycling, etc. For experimental work, the kinds of pollutants should be specifically listed to include each chemical compound with some indication of the rage of concentrations, mode of exposure and combina-

tions with other environmental factors; or in the case of noise, light, heat, etc., pertinent descriptions should be included. Be as specific as possible here. Each substance or kind of pollution should be related to a particular species and kind of effects under investigation. As much of the foregoing material as is applicable should be supplied for epidemiological studies.

2. *Transport, distribution, and degradation.*—The whole array of physical, chemical, and biological processes involved in movement of pollutants in the environment is of concern. Aside from the obvious distribution of pollutants poured into our waterways, or air pollutants released into the atmosphere by combustion, other substances are included. For example, pesticides which are applied to farm fields may move to the atmosphere as vapor, or as solids or liquids attached to airborne particles; or may be washed into water courses; or may be picked up and incorporated into the plant and animal tissues and transported with these. Thus, studies of atmospheric circulation, the hydrologic cycle, migratory patterns of birds or fishes, and marketing patterns of agricultural produce may all contribute directly to understanding this problem. The locus, rates, and kinds of changes that take place in the pollutants also are of concern, and studies on atmospheric chemistry and metabolic alteration are included here.

3. *Measurement and instrumentation.*—Studies devoted to the detection, identification, and quantification of pollutants or effects of pollutants are included here. Because such measurements are so closely related to instrumentation, instrument development is also included.

4. *Exposure to and sources of pollution.*—The exposure to the same pollutant from various sources (e.g., lead in air, water, and food) and the relative contribution of different sources of the same pollutant or pollution is the central issue here. For example, carbon dioxide may come from volcanos, forest fires, respiration, power generation, and a whole host of other sources of combustion; the hydrocarbons in the atmoshpere come from volatiles produced from growing trees, from combustion in motor vehicles, from combustion (and lack of combustion) in jet aircraft and diesel engines, etc.

5. *Social, economic, and legal aspects of pollution.*—Attitudes, likes and dislikes, political organization related to control, etc.

6. *Control of pollution.*—Control of pollution or, more properly, management of pollution may include prevention through use of a non-polluting technology; removal of pollutants that are formed before they enter the environment; or treatment of some part of the environment to remove the pollutant. Research here will grade into development and on into demonstration where the intent is to gradually move a laboratory discovery into a practical operating system or device which the public or some segment of it can be convinced to use.

APPENDIX 4 (TO TESTIMONY OF DR. JOHN L. BUCKLEY)

FEDERAL SUPPORT FOR FISCAL YEAR 1967 ON POLLUTION—AIR, SOIL, AND WATER

Agency	Extramural			Intramural		
	With funds	Without funds	Funds	With funds	Without funds	Funds
USDA	8	76	$104,818		36	
AEC	34	3	1,244,174		12	
Commerce	2	3	111,100	35	1	$2,694,940
DOD	19	11	625,000	15	13	340,000
HEW	213	1	8,680,905	12	2	434,550
HUD	1	1	26,650			
Interior	396	41	10,248,551	61	87	2,872,852
NASA	8	2	1,136,000	1		123,000
NSF	17		662,200			
TVA		1			13	
VA					11	
Total	698	139	22,839,398	124	175	6,465,342

Note: The statistics in this table represent only those research grants and contracts registered with the Science Information Exchange by Federal granting agencies.

GENERAL SIGNIFICANCE OF S.I.E. COMPILATIONS

Compilation of data from Science Information Exchange (S.I.E.) are subject to some inherent limitations and exceptions. Wherever possible, S.I.E. will note and estimate the significance of these conditions as they apply to each compilation. There are also the general limitations noted below that should be recognized in order to avoid possible misinterpretation, confusion, and contradictory conclusions, when comparing these data with other sources.

S.I.E. is an inventory of research tasks, where "task" means a small uniquely identified unit of research work.

The dollar values recorded by S.I.E. are intended only to show the annual level of effort (or support) for each individual task.

Sums, totals, and compilations of S.I.E.'s research task records are not designed to reflect budget data. Therefore, S.I.E. dollars sums and totals cannot be reconciled with budgets that are essentially inventories of total dollars. The latter allocates all R.&D. dollars to specified categories. S.I.E. counts only those dollars that are annually allocated to a selected list of items identified as basic and applied research tasks. This does not include many categories of overhead, general support, construction, fellowships, etc.

S.I.E. dollar sums and totals can be used as a comparative *index* of *relative* emphasis and distribution among agencies, or recipients, or geographical areas, of subject fields, etc., for one or a series of years, if the inherent limitations and exceptions are clearly recognized in each case and applied to the derivation of conclusions. For example:

(1) S.I.E. receives no research records classified for national security.

(2) S.I.E. receives no dollar values for most inhouse research tasks.

(3) At this time, S.I.E. receives few records of development projects and programs.

In comparing S.I.E. data with other sources, it should be noted that many projects and tasks are on the borderline between applied research, advanced technology, and development. The decision for inclusion or exclusion is abritrary, and may differ among agencies, and by individuals. These may total fairly large sums, and corresponding discrepancies.

(4) S.I.E. focuses on the research task, *per se*. Contracts, grants, and funds allocated to general research support, such as interdisciplinary laboratories, institutional grants, etc. that are not related to specific research tasks may not come to S.I.E. or may be accounted differently.

(5) S.I.E. registers research tasks according to the fiscal year in which the research began. This may or may not agree with the fiscal year in which the funds were budgeted, committed, or obligated.

(6) S.I.E. records the *annual cost* (level of effort) for a grant or contract that may extent over several years. Some agencies assign the budget cost of a single 3-year grant to one fiscal year, in compiling their reports.

(7) S.I.E. can only report on tasks that have been registered by the participating Agencies. All Federal Agencies do not register their entire programs so that S.I.E. can not guarantee complete coverage for any given program, subject, or agency.

(8) The S.I.E. collection has grown rapidly over the years as agencies have initiated and/or increased their registration. Comparative trends over a series of years in some categories may reflect the growth of the Exchange rather than changing emphasis in the research area or program.

(9) With any compilation, S.I.E. will note and estimate the significance of these limitations, as far as possible, if requested to do so.

Dr. BUCKLEY. Dr. Hornig's statement pointed out the existence of this committee and the reason for it. I would like to start with a history of the actions the subcommittee has taken.

We spent some time discussing in the fall how we might best get at an understanding of what the pollution research program in the Federal Government was. One of the suggestions, and a useful one, was that we query the Department of Defense Documentation Center, and we did. This is one of five volumes of this size which describes

individual undertakings that deal with pollution research in the Federal Government. It is a rather unmanageable document at this point in time. It has no figures in here on dollars. It includes many things which are important in understanding pollution, but just what to do with it and how to digest it has been beyond us so far.

We have also asked for similar kinds of information from the Science Information Exchange, managed by the Smithsonian Institution, and the printout from there I think will be even more voluminous than the one we have obtained this way. A preliminary tabulation on expenditures is appendix 4 to my prepared statement.

Our problem I think is not in obtaining sufficient information, our problem is trying to find it in a compact enough form to be useful to us.

Having basically looked at information readily available, we asked the agencies to supply responses to a questionnaire, a copy of which is present in the appendix to the prepared testimony here.

We did not ask about expenditures on pesticides or pest control-related research because these data had already been gathered by another group under the Federal Committee on Pest Control, which is made up of representatives of the Departments of Agriculture, Interior, Health, Education, and Welfare, and Defense. The data were similar enough that we have included them here in table 2 of this testimony. The total figures on 1967 expenditures which we thought related to pollution that was spent on pesticides and pest control research was $65,868,000. The other data gathered have not been summarized in all of the detail we would like as yet. The total expenditure in 1967 reported here is $146,890,000. In 1968, it has increased to $184,925,000. The overall totals, assuming the same level of pesticide research expenditures in fiscal year 1968 as in fiscal year 1967, would be at least $210 million in 1967 and $250 million in 1968.

I must point out that there are underestimates of the amount of money actually expended that is germane to research on understanding and controlling pollution. There are moneys in here, substantial amounts of them, which would be spent regardless of whether pollution was a problem or not. For example, there is a need to increase the efficiency of pest control for agricultural reasons, and the research devoted to improving control methods is included here because it does reduce, or will permit us to reduce the amount of pollution, but it equally would go on regardless of this particular problem, but perhaps not so vigorously.

The same thing applies to many other areas. Some of these are included, some are not. So the figures are inaccurate and underestimates to that degree.

In addition to asking for data on funds, we also asked the agencies to tell us as precisely as possible the kinds of research they were conducting. We have not progressed far with the analysis of these data. Some of the approaches to analyzing this information are included in part in several appendices to the prepared testimony here. One example is from the Federal Water Pollution Control Administration, the second one is from the Public Health Service.

The high points I would like to point out in the numbers as they exist here now are that in 1968, $45 million is programed for research on the effects of pollution—the effects of pollution on man, on crop plants and animals, on nondomesticated plants and animals, on ma-

terials or structures and in the environment in general, including air, fresh water and marine, and soils. This is less than one-fourth of the total money programed.

The second item is on transport and distribution and fate of pollutants, which is $20 million. The basic reason for undertaking research on effects of pollution is to achieve an understanding of how much of any particular pollutant we can tolerate without detriment to those things we want. At the same time, in order to understand where to take an action and how to control the levels, it is necessary to understand about the transport or movement of these pollutants. That is what the second item is.

The third one is easily understood, measurement and instrumentation, with $11 million expended in this field.

The next item queried here was on exposure to and sources of pollution. What we meant by this was the fact that some pollutants occur in a variety of different environments and reach man or the other targets in a variety of different ways. As, for example, lead from gasoline.

Also, it is the fact that a number of different sources may contribute to the pollution at a particular point, such as a variety of sources contributing sulfur oxides to the atmosphere, which may affect an individual at a given place. The amount of money expended here is $3 million.

For social, economic, and legal aspects of pollution, the total expenditure is somewhat less than $5 million. And more than half of the total expenditure, $99 million in this year, is intended to be spent on the prevention and control of pollution, that is research, development and demonstration, in this area.

Mr. Chairman, I think that summarizes what I now know about the expenditures of the Federal Government.

Mr. DADDARIO. Your total figure then comes to $184,926,000?

Dr. BUCKLEY. That is correct, plus the estimated figure on pesticides.

For fiscal year 1967, an additional total of $65,870,000 was spent on pesticide research related to pollution.

Mr. DADDARIO. How do you see this figure going in the future? What do we need to do dollarwise, Doctor?

Dr. BUCKLEY. I would rather talk about it with hindsight, Mr. Chairman.

Mr. DADDARIO. Look at it from hindsight then.

Dr. BUCKLEY. It is quite clear it has increased and it is quite clear some parts of it will increase. Even in these 2 years, 1967 and 1968, it is clear a larger proportion of the total is devoted to applying what we know, finding how to apply this, how to control pollution and how to prevent pollution immediately in 1968 than it was in 1967. The amount we are spending that basically relates to standards, criteria, and understanding how much pollution we can tolerate has not increased as rapidly as this. I think this is a reasonable trend. There is a great deal that we know almost well enough to apply and where fairly small amounts in development and demonstration are likely to pay off. And that is one of the trends which is clear in the data at this time.

Mr. DADDARIO. You have put figures together but some of it is not yet in manageable form, but I am sure it will be. How do you plan to use it? Why have you done it, and what does this information allow you to do that you presently are not able to?

Dr. BUCKLEY. In order to make any serious judgments on how much overlap there may be between programs of different agencies and, second and more particularly, what areas are not well covered, and third, to understand how well research is being conducted, how well the right programs and problems are being attacked, we felt it was necessary to have a base of solid information. That is the direction in which we are interested in heading.

I have noted in the written testimony here the fact that we are interested in this whole problem of priorities, but we have a firm belief that the individual agencies do a pretty good job of attacking the problems that seem to them the most pressing. The question becomes not so much whether the funds are well spent, but whether the mix across the Government as a whole, looking at the large problems of pollution, seems to be reasonably placed. We think again it will provide a basis for this and we hope to offer some comment on this at some time in the future.

Mr. DADDARIO. Follow that through a bit. Since you do come to an assessment of the quality of the work being done, how does it apply insofar as priorities are concerned. Do you see any problem in the mechanics of putting together this interagency situation, because obviously it needs to have some coordination?

Dr. BUCKLEY. It certainly needs to have some coordination and it certainly has a considerable amount of it now and it is exercised both through the OST and the Bureau of the Budget, with the budgetmaking process and advisory function. OST feels here, and I think to a considerable extent, this committee may be in a position to avoid the confusion of committees, the Committee on Environmental Quality and its Research Subcommittee may be in position to provide information to OST and to the Bureau of the Budget which will be useful to them in these decisions.

On the other hand, we are touching on a general problem—there are some things that committees do well and one of them I think is the gathering of information and the sorting of this and placing it in appropriate perspective and the exchange of information that results from it. When one comes to the resolution of very real differences, I am not sure this can in fact be done by a committee. The committee can provide the information that other people can use in the process.

Have I evaded that one sufficiently?

Mr. DADDARIO. You are doing pretty well.

Dr. Buckley, agencies also do pretty well at recognizing what is popular. If they have pollution activity going on and know, as Mr. Ryan pointed out, that the public is demanding something be done, they do have a tendency to enlarge their activities. They may do it very well, but somebody has to see that what needs to be done is done and that the funds are directed in the proper way.

As I look at your testimony, there seems to be no real mechanism yet to be able to impose the necessary authority so that this might be done.

Dr. BUCKLEY. I would suggest that that question is more appropriately directed to either Dr. Hornig or Dr. Bennett than it is to myself, but second, I was pointing out as far as the committee is concerned I do not know of any other effective way to gather together the basic information that is necessary to make judgments, and the next stage of it you have described is one of judgment. It is a matter of balance, how much of this should go in which direction.

I think as a committee we can provide a valuable service in gathering and arranging the data that describes today's programs and the whole of today's program as well.

May I point out a piece here from the Water Pollution Control Administration that looks as though it may have considerable promise as a way of getting an understanding of the research going on in the "effects" part of this. We will have a fairly elaborate matrix that will show across one side the species of organisms, plants and animals, algae, or man, on which experiments have been conducted and about which something is known in regard to any given set of pollutants which will be listed on the left side. And out of this, without saying how well it is done or how completely, a simple check mark will make clear whether at least there is some effort going on. I think it is one of the questions that comes up in trying to use such things as this document or the SIE document. No investigator ever understates what he is going to accomplish when he writes this so he talks about the whole range of pollutants he is interested in and perhaps the whole group of responses of a single organism or sometimes a whole range of organisms. If you go by this kind of statement, it tends to overstate the amount of effort, the amount of knowledge we so far have gathered.

We think the approach we have laid out here will point out more effectively than most have, at least the holes, and consequently, either permit a judgment as to whether it is necessary to fill these holes or whether they are quite rational.

Mr. DADDARIO. I agree with you that the question I put to you is not one you have the responsibility to answer. I do believe that Dr. Hornig should be charged with the responsibility of answering that question. At the same time, it does appear that your work gives us the basis upon which we can come to a determination as to what in fact is going on.

Dr. BUCKLEY. I certainly hope so because a lot of work has gone into this on the part of many people other than myself. Most of the Subcommittee on Research is here in the room, and they are the ones who have done this. I am sure they are not the full audience we have but they are among the people present.

Mr. DADDARIO. It is the responsibility of this committee to make recommendations to the Congress as to how it does appear to work out. The work you are doing is extremely important from the standpoint of how we come to some policy judgment about that.

We are pleased to see what you have put together, and it gives me a feeling of optimism about the chances of doing something tangible and beneficial.

Dr. BUCKLEY. Thank you, Mr. Chairman.

Mr. DADDARIO. Mr. Ryan?

Mr. RYAN. No questions.

Mr. DADDARIO. Mr. Winn?

Mr. WINN. Mr. Chairman, I am privileged to sit with this committee and I want to commend you on your line of questioning. The line that concerns most of us is exactly who is going to serve as a clearinghouse or the central agency for all of these many activities that are now underway. A lot of money is being spent. I think most of us are concerned about that.

I would like to ask, Dr. Buckley, maybe I did not understand you correctly, but there are five volumes of the size you referred to there on the table. You say you do not know what you are going to do with it.

Dr. BUCKLEY. I said that, having queried the system, the way in which information was provided from it is not one that is useful to us in trying to understand what we wanted to do here. This is not a criticism of the system. This is a simple statement, for the reason that information that was put in here was for a very different reason and the key words that are available for sorting it out were not put in as a part of it. And you cannot use automatically an information or data system that already exists to withdraw those things that you may want if you did not know at the time you made the system you might want it. So if the basic information that you need is not present in the system, you cannot extract it and this is our problem.

The obvious thing seemed to us to go to existing systems and we did that, but we convinced ourselves in fairly short order it was not a manageable way of handling this particular problem.

Mr. WINN. I may not read you correctly yet, but it almost looks like putting 22 ballplayers on a football field without the ball.

Mr. DADDARIO. May I interject a thought here?

Mr. WINN. Yes.

Mr. DADDARIO. I know that we have some difficulty from time to time in reconciling figures from different departments on the same subject, and they do not necessarily tell you the same thing. But how will this be affected, as you understand it, by the planning program in the budget which is aimed at reconciling differences so that everybody is going to be speaking the same language? I know that is coming and it should give you some help. If not, are you going to be able to put this together so that it will in fact be meaningful?

Dr. BUCKLEY. I will answer the last one first.

Yes, they can be put together in a way they are meaningful, and the information in here is valuable to us, but it is voluminous enough that the sheer weight of it does not permit you to boil this down as easily as getting it some other way. This will offer a very good cross-check in what information we have obtained in other ways.

As to the problems of whether the program planning and budgeting system will lead us to a common language in here that answers these questions, I am not prepared to say. It certainly will not worsen the situation, and very likely will markedly improve it.

We had some semantic difficulties, for example, even with the word "intramural," which to most of us simply means it is going to be done in the Federal Government. We found, when we tried to sit down and put the numbers together, intramural meant different things to different people. With some this is where you have a close enough control over the way the money is spent that you really are

managing all of the details of it. Some of the people, however, may not be Government employees, they may be contract employees, and this leads us into the question as to what fraction of that is intramural and which is extramural. Or one of the other agencies felt it was extramural if they transferred the money to some other Federal agency which in turn used it within the Government, and this is intramural in the terms of use of Federal money. But we were trying to sort out from here the amount of money which was transferred between agencies to accomplish a more efficient use of this. And so had we not discovered this difference in the use of terms, we would have obscured that particular point.

Mr. WINN. Did you coordinate these five documents with industry or is it strictly Government?

Dr. BUCKLEY. This is strictly Government. There will be some industry information in here when the contracts of the Federal agencies have been with non-Government agencies, but this represents only Federal money except insofar as there may be a cooperative project where there is some Federal and some non-Federal funds. This, incidentally, is one of the points we need to push and we intend to push. Recognizing that expenditures outside of the Federal Government are a very substantial part of this whole thing, we thought that perhaps the most useful way to do this would be through the National Academy of Science, National Academy of Engineering Environmental Science Board, and this is one of the groups we have talked with as to how to do this.

Mr. WINN. Thank you.

Mr. DADDARIO. Mr. Fulton?

Mr. FULTON. The question comes up as to who is making these decisions in the Bureau of the Budget. For example, when the Federal agencies and departments make their presentation of budget request and justification to the Bureau of the Budget, who in the Bureau, the number and type of personnel, make these judgments on these particular questions of preventing pollution? What kind of technical personnel are there as distinguished from people of accounting, bookkeeping, or fiscal procedures? Are there people of technical competence who make the judgments on major programs in the Bureau of the Budget on a system basis?

Dr. BUCKLEY. Congressman Fulton, I am not going to answer the question in view of the fact I believe it much more appropriate for the Bureau of the Budget to do this.

Mr. FULTON. You are making the recommendations to certain people. If I were passing my recommendations over to the other side of the street, I would certainly look to see who I was passing them to.

Dr. BUCKLEY. The Bureau of the Budget has observers on this committee and subcommittees here and so it is fed back in the deliberations of the group as they go along into the system in the Bureau of the Budget. As to who the individuals are, some of them are technically qualified individuals, others come from different backgrounds.

Mr. FULTON. How many are there?

Mr. DADDARIO. You have no way of knowing that?

Dr. BUCKLEY. No. In a way it is the entire Bureau of the Budget.

Mr. FULTON. I checked the Bureau of the Budget regarding NASA's budget one time and found there were only five people of technical competence trying to make the decision on a $5 billion budget within 10

days. What is happening here? If nobody knows now, maybe you should check it?

Dr. BUCKLEY. I am sure, Congressman, not all the decisions are made in any one place in the Bureau of the Budget, not all of the preliminary decisions. The final decisions are always made in the same place. But I suspect those tend to be only the major ones. Certainly each of the individual agencies takes these matters through the respective examiners for that agency.

Mr. FULTON. That is correct, but again, with the chairman's permission, how do we get these decisions collected in a way that they are balanced? How do you make judgments not just on the fiscal procedures, accounting, and bookkeeping, but on a technical competence? How is that done?

Would you put a statement in the record on that and let it go? Obviously the people who are feeding the information into the Bureau of the Budget do not know what happens to it once it gets in.

Dr. BUCKLEY. Certainly, to some extent the Office of Science and Technology and many of its staff members participate in advising the Bureau of the Budget at the time decisions are made. So here is another way in which it is done. But I am not prepared to tell you what weight is given to any pieces.

Mr. FULTON. Is the decisionmaking process not on fiscal and accounting bases, but technical competency as among systems? I will appreciate it if you put it in the record.

Mr. DADDARIO. You asked if you could with my permission. I would like to comment on it. I have no objection to it. I do think from the standpoint of Dr. Buckley's testimony he has explained to us as a member of this committee he is putting together this information, but because of this difference in language that they do have a problem.

I would expect that the Bureau of the Budget has the same problem, unless they understand all of the language. If they do, it would be much clearer. So we can assume they do not.

Mr. FULTON. I did not want to go that far in my criticism, but I certainly wanted to put my finger on the focal point of where the problems come together once the information is obtained, which seems to be the Bureau of the Budget.

May I ask some short questions about your form here? You have the effects of pollution. Then you have, under "environment," fresh water. I understand by fresh water you mean bodies of water, either ponds, lakes, streams, creeks, rivers; is that right?

Dr. BUCKLEY. That is correct.

Mr. FULTON. And that by eutrophication I imagine you mean both artificial and natural feeding of that pond.

Dr. BUCKLEY. What we intended was to simply use that as an example of the kind of thing which affected not only an organism in the water but which affected the system of water as a whole, and we meant the same kind of questions, though there are not any catch words of the sort to apply to the others.

Mr. FULTON. You meant artificial and natural?

Dr. BUCKLEY. We meant understanding of the whole system of environment here in this case and not this alone. That was intended as an example rather than an individual specific item itself.

Mr. FULTON. So you mean eutrophication of the pollutants and not atrophication of the nutrients?

Dr. BUCKLEY. Our concern is with the entire interaction of the pollutants and water insofar as it changes either one or the other one.

Mr. FULTON. Either artificially or naturally increased?

Dr. BUCKLEY. Either artifically or naturally increased, or even without change insofar as someone is trying to understand the dynamic processes that go on.

Mr. FULTON. I love you scientists when you come here to us and use words which I am sure you expect to be over our heads.

Do you know whether it is rich in dissolved nutrients but frequently shallow and in seasonal oxygen deficiencies in the hypolimnion?

Dr. BUCKLEY. No, sir.

On the other hand, I would think the seasonal oxygen deficiency in any of the stratified parts of the water may be of concern.

Mr. FULTON. When you are speaking of animals outside of men, you are speaking of both retromingent and nonmingent, I take it.

Dr. BUCKLEY. To be truthful, I do not know whether I am. Your Greek is better than mine.

Mr. FULTON. That is all.

Mr. DADDARIO. Mr. Fulton, I do not know if you heard Dr. Buckley. He did say he thought your Greek was better than his. All I can say, this has all become Greek to me.

Mr. FULTON. I enjoy these big words.

Mr. DADDARIO. Dr. Buckley, I hope you might sometime in the next few weeks go over the chart so there will be no question but that it is mathematically in order. Mr. Carpenter will be in touch with you so that it may be submitted for the record.

I would like to make an observation and ask a question. When we came to prophecies about this problem last year, we did feel that the present level of research, development, and demonstration funding in this whole area would most likely tend in the next several years to some $300 million. This is the reason I asked you the question earlier. You are already to $184 million plus. I wonder if it appears to you this is the direction in which it is going.

Dr. BUCKLEY. I have no doubt but what that is the direction in which it is going. At the same time there is this problem of what one counts in and what he does not. So I do not really want to get involved in numbers. I think the trends shown on here are really fairly good representations of the way things are and how close to the number you quote of $300 million we are right now—this is the best estimate I can give you now.

Mr. DADDARIO. These are only estimates and they appear to be generally following the same direction.

Tomorrow this committee will have before it Dr. John Middleton, Director of the National Center for Air Pollution Control, Department of Health, Education, and Welfare, and Dr. Walter Hibbard, who is Director of the Bureau of Mines, Department of the Interior.

We want to thank you, Dr. Buckley, for your testimony and thank the members of the committee for having been here. We will adjourn until tomorrow morning at 10 o'clock at the same time and place.

Mr. FULTON. I would like to compliment Dr. Buckley too and hope when you come back again you will break these big words down a little for us. But I must say your perspicacity is equal to your perspicuity.

Mr. DADDARIO. I think Dr. Buckley will be using different words when he comes to the committee the next time.

(Whereupon, at 12:15 p.m., the committee adjourned, to reconvene at 10 a.m., Thursday, January 18, 1968.)

ENVIRONMENTAL QUALITY

THURSDAY, JANUARY 18, 1968

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
SUBCOMMITTEE ON SCIENCE, RESEARCH, AND DEVELOPMENT,
Washington, D.C.

The subcommittee met, pursuant to adjournment, at 10 a.m., in room 2325, Rayburn House Office Building, Washington, D.C., Hon. Emilio Q. Daddario (chairman of the subcommittee) presiding.

Mr. DADDARIO. This meeting will come to order.

Today's testimony will deal with air pollution. The Air Quality Act of 1967 establishes a sequence of activities leading finally to enforcement of emission restrictions in order to assure the sort of air quality which society chooses to have. The first step is to promulgate criteria; that is, descriptions of the way in which pollutants damage the environment. Not only is this the first step toward clean air but it seems to be the most difficult to achieve.

There are, of course, pollution problems where the criteria can be established with little trouble and with little help from science. Pittsburgh and St. Louis citizens could decide to eliminate particulate matter from the air on the basis of what their eyes have told them to do about sources and effects which are visible.

Los Angeles inhabitants need no instruments to gage the level of eye irritating oxidants in the atmosphere. However, as the monitoring of urban air composition has proceeded in the past few years some contaminants have been identified which produce no immediate effect on human senses. They are invisible to the citizen. By their chemical nature these contaminants are inferred to react with materials, plants, and within the body, but we must count on science to tell us when we are being exposed to these pollutants and what the response will be in terms of health and welfare.

Therefore the new law makes the scientific basis of criteria, as I see it, the first order of business. The responsibility is squarely on the scientific community and research management to produce sufficient facts for administrative judgment.

Unfortunately science policy issues are abundant in which scientists do not agree with one another. Regardless of the eventual reconciliation inherent in the scientific method, this subcommittee has witnessed some pretty ragged arguments among technical people.

Air quality criteria is no exception. We are not so much interested in the pros and cons on a particular pollutant as we are in the ability of environmental epidemiology to resolve these matters. I believe there may be a danger that the Air Quality Act will be prevented from

working in a timely manner if criteria setting cannot proceed, which is acceptable to public health officials, industry, local government and the consumer.

Dr. Rene Dubos warned us in prior hearings, and I quote:

We must abandon, in fact, the Utopian hope that regulations can protect us completely from all health dangers in the modern world.

We are aware that objectivity in human health matters is very difficult to maintain. None of us wishes to err in the wrong direction. Recently environmental quality has also generated an emotional response in the public. There is a widespread public opinion that we should no longer sacrifice aesthetic values or threaten the health of living things in the pursuit of technological achievement and economic gain.

I am particularly concerned with impacts on the environment which may be irreversible and very difficult or costly to fix up if waste management is not proper.

Balancing this somewhat intuitive feeling is the knowledge that pollution control means expense and change, even disruption, for a highly technical society. Unnecessary changes stemming from unfounded fears would divert dollars and effort from other vital national programs.

In a sense we want to have our cake and eat it, too. It is up to science to tell us how close we can come to this optimum. We realize that environmental effects cannot be known with the certainty of a surveyor's trajectory to the moon, but confidence can be increased that decisions and pollution control are well justified by the facts.

Today's witness, Dr. John T. Middleton, who is Director of the National Center for Air Pollution Control, Public Health Service, Department of Health, Education, and Welfare, is particularly well qualified to give us advice, to give this committee some basis on which to work in this particular field.

We are happy to have you here, Dr. Middleton. I wish you would come forward with your assistants and, if you would be kind enough to identify them for the record, please.

Dr. MIDDLETON. Thank you.

Mr. DADDARIO. It might also be well if Dr. Walter Hibbard, Director of the Bureau of Mines, comes forward at this time.

Proceed, Dr. Middleton.

(The biographies of Dr. Middleton, Dr. Ludwig, and Dr. Blomquist follow:)

DR. JOHN T. MIDDLETON

John T. Middleton, Director of the National Center for Air Pollution Control, was Professor and Director of the University of California State-wide Air Pollution Research Center at the time of his appointment to the newly-created National Center on January 1, 1967.

Born in Illinois in 1912, he received his education in California, where he was awarded his B. S. degree from the University of California, and Missouri, where he received his Ph. D. from the University of Missouri.

Dr. Middleton has taught and conducted research in mycology and plant pathology at the University of California at Los Angeles and at Riverside. His pioneer studies of the environment as a regulating factor in disease development in agricultural crops enabled him to first recognize photochemical air pollution as an adverse economic factor to California agriculture in the mid-1940's.

Dr. Middleton has served as Chairman and member of the California Motor Vehicle Pollution Control Board since its inception in 1960 as well as on the Gov-

ernor's Interagency Committee on Air Pollution and the Executive Task Force on Waste Management.

He has at various times served as a consultant to the U.S. Public Health Service, the National Advisory Committee on Community Air Pollution, the Executive Office of the President and the Office of Science and Technology, and to the World Health Organization. As an adviser he has provided assistance to several European and American Governments in the evaluation of air quality and the development of air pollution control programs.

Dr. Middleton has been a member of the Air Pollution Control Association since 1960 and has served on its Technical Committee on Agriculture and the Standing Committee on Publications. He has also represented the Association on the Committee for Continuing Education of the Engineers Joint Council.

Dr. Middleton is a member of a number of professional associations and societies including American Association for the Advancement of Science, American Chemical Society, Air Pollution Control Association, Netherlands Plant Pathology Society, and the Society of Sigma Xi. An author and lecturer, he is a recognized international authority in the broad field of air pollution.

Dr. John H. Ludwig

PRESENT POSITION

Associate Director for Control Technology Research and Development Programs, National Center for Air Pollution Control, U.S. Public Health Service, Washington, D.C. The Control Technology Programs comprise about 200 research scientists, engineers, meteorologists and supporting personnel. Areas of interest include chemistry and physics of atmospheric pollutants, engineering with respect to technology of pollution control and meteorology.

PROFESSIONAL BACKGROUND

(*a*) 1955 to present: National Center for Air Pollution Control, U.S. Public Health Service

(*b*) 1951 to 1955: Division of Water Pollution Control, U.S. Public Health Service

(*c*) 1949 to 1951: Consultant in Sanitary Engineering

(*d*) 1934 to 1949: Structural and hydraulic design engineer on water resources development projects for the U.S. Bureau of Reclamation and the Corps of Engineers, and service with the Army Air Forces as a meteorologist in Greenland.

EDUCATION

B.S. in Civil Engineering, University of California, 1934; M.S. in Civil Engineering, University of Colorado, 1941; Meteorology Training, New York University 1943–44; M.S. and Sc.D. in Industrial Health, Harvard University, School of Public Health, 1956–57.

ORGANIZATIONS

Air Pollution Control Association, American Meteorological Society, American Public Health Association, American Society of Civil Engineers, Registered Professional Engineer in States of California and Oregon. Member of Phi Beta Kappa, Tau Beta Pi, Chi Epsilon, Sigma Xi, Delta Omega. Diplomate of the American Academy of Environmental Engineering.

Edward T. Blomquist, M.D.

Dr. Edward T. Blomquist is Associate Director, National Center for Air Pollution Control, Bureau of Disease Prevention and Environmental Control, U.S. Public Health Service.

A native of De Kalb, Illinois, Dr. Blomquist received his M.D. degree from the University of Chicago and his degree in public health from the University of Michigan. Since his internship at the Marine Hospital at Seattle, Washington, he has been a commissioned officer in the Public Health Service. He was on sea duty with the Coast Guard during World War II and afterwards served with

the state health departments of Oregon and California. He became Chief of the State Aid Branch of the Division of Tuberculosis in 1948 and Assistant Chief of the Division in 1949.

Dr. Blomquist was appointed Medical Officer in Charge of the Arctic Health Research Center in Anchorage, Alaska, in 1951. There he directed both basic and applied research on problems of public health peculiar to low temperature areas.

After completing his Alaskan tour of duty in 1954, he became Chief of the Federal Government's Tuberculosis Program, a position he held for eleven years. He joined the Public Health Service air pollution program in January 1965 as Assistant Chief, Division of Air Pollution, and under the newly organized National Center for Air Pollution Control he is Associate Director for Standards and Criteria Development. In this capacity he directs work on health and other effects of air pollution.

Dr. Blomquist is a member of the American Medical Association, the American Trudeau Society, the American Association for the Advancement of Science, and the American Public Health Association.

STATEMENT OF DR. JOHN T. MIDDLETON, DIRECTOR, NATIONAL CENTER FOR AIR POLLUTION CONTROL, DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE; ACCOMPANIED BY DR. JOHN H. LUDWIG, ASSOCIATE DIRECTOR FOR CONTROL TECHNOLOGY, RESEARCH, AND DEVELOPMENT, AND DR. EDWARD T. BLOMQUIST, ASSOCIATE DIRECTOR FOR CRITERIA AND STANDARDS DEVELOPMENT

Dr. MIDDLETON. May I present my Associate Director for Control Technology, Research and Development, Dr. John H. Ludwig, and my Associate Director for Criteria and Standards Development, Dr. Edward T. Blomquist.

Dr. HIBBARD. I have with me my Assistant Director for Mineral Research, Dr. Harry Allen.

Mr. DADDARIO. We are happy to have you all here and we are happy to have you, Dr. Middleton.

Dr. MIDDLETON. I am pleased to have this opportunity to discuss with you the activities of the Department of Health, Education, and Welfare in the area of air pollution research and control. In the period since your 1966 hearings on environmental pollution, important new dimensions have been added to the Department's air pollution program. I am referring, of course, to the enactment of the Air Quality Act of 1967, which became law last November 21 and which is destined to have a profound influence on all the air pollution research and control activities of government and industry for many years to come.

The enactment of the Air Quality Act marked the start of a new era in the Nation's attack on the growing problem of air pollution—an era in which the knowledge we already have about this problem and its prevention and control will be systematically and scientifically applied in all parts of the country, while at the same time, a greatly increased effort will be made to develop the additional knowledge we must have if we are to prevent the air pollution problem from continuing to grow and worsen.

The Air Quality Act offers no shortcuts to effective control of air pollution. There is no shortcut to the solution of such a complicated problem. Air pollution is a byproduct of all the major growth factors of modern society; it is rooted in the way we build our cities, the ways

in which we provide transportation for ourselves and our goods, the ways in which we derive energy from our fuel resources, the ways in which we produce and use a multitude of goods and services, and the ways in which we dispose of all the leftovers of modern life. The effects of air pollution are diverse and often subtle. Polluted air contributes to human sickness, disability, and premature death; it soils and damages buildings and materials of all kinds; it injures and destroys farm crops and other vegetation; and it blights our cities and degrades the quality of our lives.

A problem such as air pollution, which has such far-reaching economic, social, and technological ramifications, must obviously be attacked along a broad front. The solution does not lie only in the enforcement of laws and regulations or only in the application of engineering techniques or economic formulas. Achieving effective control of air pollution will require a combination of these approaches and many others. Moreover, it will require the combined efforts of all levels of government and all segments of industry.

In the 4 years since the enactment of the Clean Air Act of 1963, the Nation has made progress in the fight against air pollution. Federal grants have helped to produce an unprecedented expansion of State and local governmental control programs. Federal abatement action has paved the way for State and local agencies to join the Federal Government in attacking interstate air pollution problems in several places, including the National Capital area.

National standards have been adopted for the control of air pollution from new motor vehicles, thus extending to the entire Nation the initial benefits of technological progress in dealing with one of the most important aspects of the total problem of air pollution.

Finally, the increasing emphasis placed on control action during the past 4 years has served not only to bring a few more sources of air pollution under control, but also, and more significantly, it has helped to stimulate a greatly intensified effort to develop new and improved control technology—an effort which has already begun to bear fruit, particularly with respect to motor vehicle pollution and sulfur pollution arising from fuel combustion.

But there are still many gaps remaining to be filled. Our scientific and technical knowledge in many areas is still incomplete. We need more complete information on the importance of the many pollutants whose adverse effects are not as readily apparent as are the effects of such common contaminants as the sulfur oxides, photochemical smog, and visible particulate matter. Economic data on the impact of air pollution and the costs of controlling it are still not as precise as we would like them to be. Needs for manpower must be better defined and plans made for meeting them. Above all, since air pollution is inherently a regional problem, we must make certain that we attack it on a regional basis.

The Air Quality Act of 1967 was developed in full awareness of how comprehensive an effort it will take to achieve truly effective control of air pollution in this country. This new legislation is a blueprint which, if properly employed, will allow us to correct all the important deficiencies in our current control efforts—the gaps in our scientific and technical knowledge, as well as the inadequacies in our application of existing knowledge.

The Air Quality Act sets up a research and control system which will be coordinated at the Federal level but will involve a high degree of participation by other levels of government and by all segments of industry. I will take just a few minutes to explain, without going into great detail, how the Air Quality Act will affect air pollution research and development activities in the months and years ahead and, more importantly, how these activities and control activities are interrelated and interdependent.

Air pollution, as I have already said, is inherently a regional problem, simply because the air, whether polluted or not, flows freely across the boundary lines that divide States and cities. This means, of course, that in most, perhaps all, places where air pollution is a problem, effective control action will require the coordinated efforts of numerous local governments and, in many instances, of two or more States. This is fully recognized in the Air Quality Act.

One of the chief purposes of the act is to insure that State governments, in cooperation with municipal and county governments, will develop and apply air quality standards on a regional basis in all parts of the country. Toward this end, the Department of Health, Education, and Welfare will designate air quality control regions, each of which will consist of a group of communities that share a common air pollution problem. Air quality control regions will be designated on the basis of such factors as meteorology and topography, jurisdictional boundaries, and the extent of urban-industrial concentrations.

States will not actually be obligated to begin developing air quality standards for any pollutant until the Department of Health, Education, and Welfare publishes air quality criteria for that pollutant and information on available control techniques applicable to the various sources of that pollutant. Air quality criteria will describe the effects of air pollutants on health and property. They will reflect the best available scientific knowledge, even though that knowledge may not be as complete as we would like it to be. The information we will publish on control technology will identify the best techniques available for reducing pollutant emissions at their various sources, whether those techniques involve the application of control equipment, changes in fuel used or industrial processes, or any other practical approach. Since air quality criteria and information on control technology must be published before States can be called upon to begin developing air quality standards, the Air Quality Act must clearly be implemented as fully as possible on the basis of the best scientific and technical knowledge already available, while at the same time, an expanded research effort is undertaken to fill the gaps in this knowledge. Any other course would inevitably result in a slowdown of the Nation's efforts to deal with a problem that is already serious and threatens to reach critical proportions all too soon.

Mr. DADDARIO. At this point your statement appears to support the idea that States should not act at the present time, and that they ought to wait until you establish this criteria.

What arrangements have you made in order to allow States which do have the capability, even though such criteria do not presently exist, to move ahead?

Dr. MIDDLETON. Mr. Chairman, the Division of Air Pollution, recently changed to the National Center for Air Pollution Control, for many years has advocated, in research programs, the development of knowledge which would allow States to move in the area of exercising control of those pollutants they recognize as important adverse factors affecting the public health and welfare.

There are several States in the Nation that have moved in this direction and have adopted ambient air quality standards.

There are many States which contain areas of pollution of some magnitude which have not adopted such standards.

The thrust of the Clean Air Act amendments is to assure that all States become involved in protecting the health and welfare of the people. It is neither the purpose of the Clean Air Act to deter States from moving forward in those areas where they can nor to slow down States that wish to move rapidly to protect their citizens and their property.

Mr. DADDARIO. But that does run counter to your statement where you say, "Since air quality criteria and information on control technology must be published before States can be called upon to begin developing air quality standards." You appear to be putting yourself in a position where the States which wish to go ahead are impeded, and those which do not necessarily want to need not be pushed in that direction. Nor do you have any way to motivate them to begin sooner rather than later.

Dr. MIDDLETON. It would appear that way but it is not.

Mr. DADDARIO. Tell me why.

Dr. MIDDLETON. It would appear to delay action at the State level. These new amendments to the act state that the criteria that are to be published must be properly understood and that the mere publication of criteria does not herald the immediate establishment of standards without some additional information.

Many standards that are adopted in States often are adopted as goals rather than something that is to be legally met; and very often control techniques may not be available to meet the standards States adopt. In an effort to correct this, the amendments to the Air Quality Act bring about two kinds of additional knowledge designed to enhance the capability of States to actually carry out the standards they adopt.

In this regard, you can see they are not inconsistent.

Mr. DADDARIO. Is there any danger that a State which is aggressive and which does move ahead may find itself in the future, perhaps, in a position where its criteria deviates somewhat from that which you have developed, running counter to any aid and assistance which you would give, and be penalized as a result?

Dr. MIDDLETON. I can see the possibility of this. I think it is rather unlikely because the law permits States to have more stringent standards, if they so elect; and there is an opportunity for the Secretary of the Department of Health, Education, and Welfare to make a finding about the suitability of these standards.

Mr. BELL. I think what the chairman is thinking of is your statement on page 7, of your prepared statement, which would indicate that you would preclude a State which wanted to be aggressive from being aggressive.

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A good example is my own State, California, Los Angeles in particular, where they really have a crying need for some immediate action.

If they were to sit around and wait for some criteria which you would send out and they were therefore precluded from acting, this could be quite a difficult problem.

I think that is what the chairman is trying to state. Is that not right?

Mr. DADDARIO. I am really interested in Dr. Middleton's approach to this. I do think the record should spell out how flexible your approach will be in States such as Mr. Bell's which do wish to move ahead aggressively at this time. If they do find themselves in disagreement, perhaps you should have a very flexible approach to this, and they would not be penalized.

I think it is important that there be action as long as this is not capricious action.

Dr. MIDDLETON. Mr. Chairman and Mr. Bell, having been a former Californian and also the chairman of the motor vehicle control board in that State, and having had some concern about the quality of air in that State, I felt what I had learned there perhaps could be applied in other places. I think this piece of philosophy should suggest to you that the Federal Government does not propose interfering with progress at the State level, but to do all it can to enhance a more rapid and aggressive attack on air quality throughout the Nation.

Mr. BELL. I appreciate very much your statement.

Dr. MIDDLETON. I hope I have answered your question; perhaps I have not responded to your satisfaction. I would be glad to try further.

Mr. DADDARIO. It is difficult for you to establish the exact path which we will follow in the future. What we are trying to do here is to find out what your present intentions are and how flexible you are for the future.

The opposite end of this discussion gets to the States least aggressive and not anxious to move ahead. You say they cannot be called upon really to begin developing these standards until you do publish criteria. Is there any informal program going so that they might be stirred to do something in accordance with your advice and assistance?

Dr. MIDDLETON. Yes; there is much going on. The remaining portions of my testimony, I think, will bear further on that.

I think the most significant single event that assures that more is being done than would appear to be done, is that of our abatement and control activities in which, where there are serious air pollution problems today, and the Secretary has, in consultation with the Governors of the affected States brought about air pollution consultations, the Center has subsequently called abatement conferences for the purpose of controlling air pollution.

Beyond the abatement conference protocol, we have the control agency development program which is designed to aid States, municipalities, and local governments in developing air pollution control programs on a matching fund basis. So, it is through the development, the identification of air pollution problems at the local level, and by the initiation of air pollution control programs at local and State levels that the Center has already aided States in moving forward toward

setting air quality standards and providing them with technical assistance to research State goals in advance of Federal promulgation of air quality criteria.

I pick out this important example of a very aggressive attack, with significant funding, designed to achieve air pollution control through aid to the States.

I think this may satisfy the questions and suggest we proceed.

Mr. DADDARIO. You go ahead and we will break in wherever we feel it is necessary.

Dr. MIDDLETON. The publication of air quality criteria for a pollutant and information on applicable control technology will be the signal for States to begin developing air quality standards for that pollutant and detailed plans for implementation of the standards in air quality control regions that have been designated by the Department of Health, Education, and Welfare. Air quality standards will prescribe limitations on ambient air levels of pollutants in a region; since the fundamental purpose of setting such standards is to provide for the protection of public health and welfare, State governments will be expected to consider, among other things, the air quality criteria that have been published in accordance with the Air Quality Act. States will also be expected to take into consideration the published information on control technology.

The Air Quality Act sets up a timetable which States must follow in developing air quality standards and implementation plans, and requires that the standards and plans be reviewed by the Department of Health, Education, and Welfare. In addition, the act prescribes the procedures to be followed in the event that a State either fails to meet its obligations or submits standards which are not consistent with the provisions of the act.

And finally, the act makes it clear that States will be expected to assume the major responsibility for seeing that their plans for implementation of air quality standards are carried out. If action by a State proves inadequate, however, provision is made for enforcement at the Federal level.

I indicated, a few moments ago, the importance of research to expand and improve our knowledge of the adverse effects of air pollution and of ways to prevent and control it. The Air Quality Act provides for a substantially accelerated research effort, with special emphasis on finding new and improved ways of dealing with the complex and very serious problems associated with motor vehicles and the use of sulfur-containing fuels.

We will, of course, expand the work being done in our own facilities and in those of other Federal departments and agencies. But we will have to rely, too, on the many industries that are capable of contributing to the search for practical solutions to the various technical problems involved in controlling air pollution; indeed, we have already begun moving toward much greater utilization of the resources of industry.

The Air Quality Act also provides for continuation of many of the activities initiated under the Clean Air Act of 1963. One of these activities is the abatement of interstate and intrastate air pollution problems; this activity, as I have already noted, has been productive in several places in the country.

In addition, the Air Quality Act provides new authority for court action to curtail pollutant emissions in emergency situations—that is, when adverse meteorological conditions threaten to produce an episode of extraordinarily high air pollution levels in any place in the country.

Mr. DADDARIO. What criteria have you established to come to this conclusion so that the Secretary may take steps? What forces him to make a determination that there is going to be an episode of extraordinarily high air pollution? How can he forecast it early enough and move quickly enough in the courts. What criteria will the judge have before him in order to come to a conclusion since you have already said that the establishment of this criteria is presently too tenuous?

Dr. MIDDLETON. I don't believe I suggested the establishment of criteria as tenuous. I think the relationship of criteria to standards, and the fact that air pollution control is the responsibility of State and local governments is the thrust I have been trying to present to you and the role of the Federal Government in being certain that the information that is available is categorized and cataloged so that it can be properly used.

In the event it is not used or, in the event it fails to work, then there are other courses of action. It is to this point I now speak in the case of emergency actions.

Mr. DADDARIO. I understand that and I am not trying to get into any argument with you, Dr. Middleton. What we are trying to do here is to see how this works. We know we must come to some judgment sooner or later on criteria and this has to be based on better information than we presently have available. Therefore, there needs to be a lot of work done. We are trying to arrive at a judgment; how long it will take us to get to the point where we do have criteria. I wonder, since you bring up this episodic situation, and because there is uncertainty, what is the emergency control which the Secretary can put into effect under these circumstances?

How do we know there will be such an episode? What criteria presently exist which will establish a set of facts early enough for us to say that 5 days or 10 days from now this will happen? How do you then get into court in order to get a judge to know enough about this so that you can explain it to him in such a way that he can recognize what the criteria are?

Dr. MIDDLETON. If it is your pleasure to have this subject discussed at this time I will be glad to do so. Since we are dealing with emergency actions, which is a specific part of the law; namely, section 108(k), I would like to call on Dr. Ludwig to answer the first part of your question which relates to the prediction systems developed and how they are employed.

Mr. DADDARIO. Is that section 108(k) or 208(k)?

Dr. MIDDLETON. I will give the exact citation.

Mr. DADDARIO. Just so the record will be straight.

Dr. MIDDLETON. If you have a copy of the law before you, you will find it on page 13. It is section 108(k) and it relates in its entirety to your particular question of air pollution episodes.

Mr. DADDARIO. I think it would be fine if Dr. Ludwig can go ahead and go into this at this time.

Dr. LUDWIG. Yes, Mr. Chairman. What I would like to comment on is the prediction system as it applies to the meteorological aspects. In the National Center over the last 10 years there has been developed, in cooperation with the Environmental Sciences and Services Administration, a system where every day we determine and carry, over the U.S. Weather Bureau network, a warning system termed "an air pollution potential advisory."

What these do is designate large areas of the country where the ventilation of the atmosphere is very minimal. This is both in the vertical and in the horizontal. Essentially it is concerned with low horizontal sweep of the air out of the region and a very limited mixing depth where the pollutants can mix vertically into the atmosphere.

Mr. DADDARIO. What is the mechanism through which you establish this?

Dr. LUDWIG. This is done at the present time by the U.S. Weather Bureau in Suitland, Md. It is done by professional meteorologists.

Mr. DADDARIO. Is this information made available to you on a daily basis?

Dr. LUDWIG. Yes. This information is transmitted by a teletype network and is made available to all major Weather Bureau stations in the whole country. This has already been set up.

In addition to this, at the present time, in some of the major communities of the Nation we have additional meteorologists who are working on schemes which will further improve on this locally. This is the second thing that is going on.

Mr. DADDARIO. Are they also U.S. weather people?

Dr. LUDWIG. Yes. These are Environmental Science and Service Administration people who have been assigned to the National Center and who work as a portion of the National Center for Air Pollution Control.

Mr. BELL. Does this work throughout the country as a coordinated effort, or just in this area here?

Dr. LUDWIG. This service goes on all over the country for the whole continguous 48 States.

Mr. BELL. You are talking about predictions. What kind of a time-lag do you have on this?

Dr. LUDWIG. At the present time we are predicting the continuation of low-ventilation potential for a period of 36 hours.

At the present time, also, we are attempting to improve this system so that we can predict it on a 12- to 24-hour period in advance.

Mr. BELL. Then you would be able to have information back here that tomorrow morning in Los Angeles, for example, you will have a smog alert. Is it that type of thing you are talking about?

Dr. LUDWIG. That is right in part. We issue air pollution potential advisories. These advisories do not predict air pollutant concentrations per se but rather meteorological elements which, when combined with source configurations, can lead to a buildup of pollution in an area.

Mr. BELL. What is your degree of accuracy? Have you checked that out?

Dr. LUDWIG. Yes. We have issued advisories for most all of the major air pollution stagnation conditions, for instance, the one which occurred Thanksgiving a year ago in the eastern seaboard. At the present time, yesterday, an alert went out for the area in the south-

eastern part of the country. This covers the area of northern Florida, Georgia, South Carolina, and so on.

Mr. BELL. You must have coverage in Los Angeles, too?

Dr. LUDWIG. Yes.

Mr. BELL. How accurate have you been there?

Dr. LUDWIG. We have been very accurate in this location, also. I want to make one thing certain. What we are predicting is the stagnation of the atmosphere. This does not necessarily coincide with the formation of photochemical smog which has some additional input to it.

Mr. DADDARIO. What are you alerting the people in north Florida to do? You put this together. You have alerted them. Now what happens?

Dr. MIDDLETON. What happens at this point is a matter of considerable concern to the Secretary of the Department, and in our efforts to implement this section, since this is a new provision of the law, we have assembled in the Center an emergency task force which is concerned solely with emergency actions.

It is headed by the chief of the abatement program, Mr. William Megonnell; he is now in the process of developing, Mr. Chairman, the details that will be required to actually bring about an effective emergency action to control episodic air pollution events.

Since the problem becomes a local one, and effective control can be achieved only at the local basis, we are developing the kinds of criteria—and I use the word to mean the elements involved—which will tell local control officials the levels of pollution their monitoring system should be sensitive to, and to bring about an action to curtail recognized sources of pollution.

These are some of the kinds of items involved in emergency action planning; the finite detail is not now available.

Mr. DADDARIO. Would this include sufficient information so that you could come to some judgment about the effect this might have on people who are suffering from respiratory illnesses? Would you then give advice to the local people that they should move such people out of a zone? Are these the types of things you are concerned with?

Dr. MIDDLETON. There is a proposal now being considered in the New York area in which the Center is looking toward taking care of the difficult health cases you speak of by providing them with special medical attention, such that hospitals may be alerted and be on the watch for people who are in either poor health or in nursing homes and who may need special attention.

Mr. DADDARIO. This brings us to the criteria again, Dr. Middleton. How do you know what type of smog conditions do in fact effect people with respiratory illnesses? Are you guessing at it? At what level would you put up a danger flag so such a serious step could be taken?

I would expect that sometime there will develop such a serious condition and you would have to make recommendations to local authorities.

Dr. MIDDLETON. We are quite prepared to do this with the State and local governments involved, of course. The criteria concerned are the ones we were beginning to speak about but which we have not completed because I have not been able to finish my testimony.

Some of the organizational materials on these charts would help you to see how this comes about. If it is your pleasure that I be responsive at this particular time, I should say we know quite a bit about many pollutants. We know much about particular ones. There are some we do not know as much about as we would like. But the ones that have adverse effects on health have been known for some time; and we are improving our knowledge of them. For those pollutants for which we have information, such as the oxidants, sulfur oxides, and some particulate matter, we recognize adverse health levels. We have published criteria on sulfur oxides already; we shall reevaluate them in time. We are in the process of publishing other critieria as reported to the Senate Public Works Committee.

At this time I would like to call on Dr. Blomquist, a doctor of medicine, to comment further on our health criteria.

Mr. DADDARIO. Why don't we come to that after Dr. Ludwig finishes his statement? I think it is important that he does explain the way in which you are developing a system of meteorological knowledge. Then we will come to Dr. Blomquist.

Mr. RYAN. Mr. Chairman, I would like to go back to the question you asked because it is a very key question. That is, do you now have a system so that when you issue an air pollution advisory, some action follows in the local government? I ask this question because in November 1966, at the time of the Thankgiving Day inversion in New York City, you did predict the stagnation of the air and all the conditions that led to that inversion. You predicted it some 24 hours before it happened, as I recall. Yet, New York City and New York State did nothing. It was 24 hours after Thanksgiving Day, when it started, that New York City issued the first alert, 48 hours after you had given them notice. New York City received the warning on Wednesday, November 23 at 12:07 p.m.; the official alert was issued on Friday, November 25 at 1:15 p.m.

What are you planning to do in the future to get action at the local level? It is all very well to be able to predict the episode. It is more important, if the local government fails, that you, with your knowledge, take action so that the people in the local areas are protected. There was a 48-hour time gap between the issuance of the air pollution advisory and the first public alert in New York City, which is inexplicable, over Thanksgiving Day. If it had not been for the fact that it was a holiday, we would have had a great deal more than the 168 excess deaths which occurred during that period.

Mr. DADDARIO. Following what Mr. Ryan just said, I think it gets back to the point that I just touched on. At that stage of the game could you go to court to force the local government to do something?

Dr. MIDDLETON. I am suggesting that the local government itself wishes to do something. I am suggesting that the State of New York and the city of New York wish to do something. The difficulties of integrating air monitoring and the recording of information on pollutant concentration, the difficulties in identifying the specific sources of the principal pollutants are the items that the local control agencies need to stipulate; such as the air pollution potential predictions come and the levels of pollution begin to rise, there can be agreement in the New York-New Jersey metropolitan area that when selected pollutants

reach a certain threshold there shall be a stipulated course of action to control those sources.

This course of action that you asked me to describe is not now describable. We are in the process of enumerating, because of the knowledge we have from the basic abatement conference, the principal pollutant sources. We are attempting through the conference recommendations to actually abate those sources in order to forestall having to call for emergency action.

Mr. RYAN. I understand that, but assume that today you issued an advisory notice such as you did on November 23, 1966, what would you do today to avoid a repetition of what happened in 1966, Thanksgiving Day? What would you do now? With all due respect, I do not want to hear about plans for the future which are still to be worked out, but what specific action would you take today?

Dr. MIDDLETON. Our specific action would be to go to the New York area with the man in charge of these emergency actions in the event of this prediction, and to pick up the points you enunciated. Let us assume that we have the prediction that in 24 hours there will be an alert situation. We then see its validation. The air monitoring networks suggest the level of sulfur oxides is rising, and when they rise to some threshold level, some specific number, then a course of abatement action must take place. This course of action is the responsibility of the local air pollution control agent.

Mr. RYAN. Suppose it fails to take action.

Dr. MIDDLETON. If the local group fails to take action, then the Secretary can call upon the Attorney General to ask for a cease and desist order to abate this particular nuisance, this particular problem, this particular disastrous source of pollution affecting the health of persons. It is because we may need a more rapid control action than this that we wish to be assured that the State and local officials in fact do have an implementation control plan and that it is workable. That is why through our control agency development program, when we award matching funds to the city and State of New York, as an example again, Mr. Ryan, we want to be sure that in their workable plan there is a scheme, a plan, which will bear directly upon the new provisions.

Mr. RYAN. Do they have a workable plan today?

Dr. MIDDLETON. I do not know whether Mr. Heller, the Commissioner in that area, now has a workable plan. I believe one is in formation, and I am sure that he expects the important pollution elements to be controlled at that time.

Mr. RYAN. I would think that over a year later there would be a workable plan in effect, and not one in formation. I would hope that your agency would see to it that one is developed as rapidly as possible because we face, in New York, at any time a similar emergency situation.

Mr. DADDARIO. Dr. Middleton, following again Mr. Ryan's question, if we ran into an emergency situation, could you, for example, establish a procedure under the law as it presently exists to prevent all traffic from moving to the city of New York if this situation were deemed to be dangerous enough? How would you do it?

Dr. MIDDLETON. Dr. Blomquist suggests that the city of New York already has a plan of this kind in mind, but if the city of New

York failed to actuate this plan and carbon monoxide, for example, were the principal element, then the Secretary would be able to ask the Attorney General to go to the Federal district court and see that this source of pollution was controlled.

Mr. DADDARIO. Dr. Ludwig's statement indicates that you are developing the kind of system in which you can have confidence if an emergency of this kind does come about. You would have a system which can work without scaring everybody half to death.

Dr. MIDDLETON. To have the predictability, the capability of a high percent win, saying, "Yes, this is the event," so we can begin in advance of the rising levels of pollution, as Mr. Ryan well knows occurs, before they really get up to certain points, if we have the assurance this thing will last for 36 hours, that we have the assurance that it would be in the interest of the public health and welfare to begin throttling sources of pollution, then an effective emergency action can be achieved.

But when we get to the necessity of describing the specific course of action, I am unable now to give you the precise detail of this action. I believe this is the responsibility of State and local governments to work out. It is the responsibility of the Federal Government to see that there is a workable plan so that the Secretary may act with dispatch and confidence of success.

Mr. DADDARIO. A workable plan upon which local and State governments can proceed confidently.

Dr. MIDDLETON. Yes.

Mr. RYAN. I would strongly suggest, instead of New York City having a plan in mind, that it have a workable plan in being. I wonder if you would be willing to set a timetable right now as to when you expect New York City to submit to you a workable plan, because I do not think we can permit this situation to go on any longer.

Dr. MIDDLETON. When I said plan, I was thinking not of a scheme or an idea, but in fact what you have enunciated.

Mr. RYAN. Right.

Mr. DADDARIO. Mr. Brown?

Mr. BROWN. No questions.

Mr. DADDARIO. Mr. Bell?

Mr. BELL. Dr. Middleton, you said something to the effect that in Los Angeles the major problem of pollution was motor vehicles. Do you know of any major cities throughout the country where the major problem is not motor vehicles?

Dr. MIDDLETON. Putting your statement in the negative, no. The motor vehicle is the largest single source of pollution throughout the Nation; perhaps 75 percent.

Mr. BELL. Then the answer to Mr. Daddario's question would have to be something in the order of control of motor vehicle movement, is that right?

Dr. MIDDLETON. The motor vehicle produces several kinds of pollutants. Power generation produces other kinds of pollutants. Depending upon the nature of the city, its economy, its sources of pollution, therefore, one needs to control various pollutants to different levels.

That gets back to the regional aspect. So, in Los Angeles, as an example, where many of the stationary sources have been very well controlled, this isolates the automobile as being one of the more significant sources. In other areas where stationary sources of pollution

have not been so well controlled, the automobile may not be so overwhelmingly important.

Mr. BELL. As far as you know, in the type of situation which Mr. Ryan just described, does Los Angeles have a workable plan that can be brought into action?

Dr. MIDDLETON. Los Angeles takes pride in its alert system and its course of action and the fact that they have developed something that they believe works well. It has been tried and tested at low levels, and I am quite sure they are hopeful they will never have to try it at the high levels because the ultimate relief is to expect the State to move in and take care of the local problem.

The issue here is, over the years since there has been an air pollution control district in Los Angeles since 1947, that they have had considerable time to evolve the kind of program required to protect the health and welfare of persons and property in the area.

Mr. BELL. It is your feeling that Los Angeles has one of the better plans?

Dr. MIDDLETON. They have one of the workable plans. I am sure that even in Los Angeles they feel the plan can be improved.

Mr. BELL. I would certainly think so. I was caught out there in November and the smog in Los Angeles was quite sickening, really. It is a terrible situation.

Dr. MIDDLETON. I think you would be very happy, then, to learn about the proposed new regulations the Department of Health, Education, and Welfare has published in the Federal Register, as I had expected to mention in my testimony, making the standards and requirements, the emission standards of the motor vehicles, the sole responsibility of the Department of Health, Education, and Welfare, more stringent, better to cope not only with the Los Angeles problem, but with the growing problem of carbon monoxide, a very important factor in the pollution in New York City. We must proceed with dispatch to better the control of motor vehicles wherever they are.

Mr. BELL. I certainly concur in this. When Mr. Ryan speaks of his city, I can speak with double emphasis for Los Angeles.

Mr. MOSHER. Is this plan in Los Angeles one which provides for the instant or immediate use of police power to forbid the movement of cars and that sort of thing? What is this plan? In other words, when an emeregency arises, can the local authorities in Los Angeles stop traffic and require people to keep their cars in their garages and not use them?

Dr. MIDDLETON. Mr. Megonnell suggests that the most workable part of their plan, their scheme of action, is that which is related to the stationary sources, in which they have an alert system and a radio communications system and key men identified in certain key industries that would be responsible for controlling sources of pollution. At the time levels approach specific concentrations, then the Los Angeles Air Pollution Control District through its radio communication with the identified sources says, in effect, "We expect this pollution to continue for such and such a period of time; we call Alert 1; you are to proceed with your predetermined control action." The action is very specific. I regret I do not know the specific detail.

Mr. BELL. But they can stop cars?

Mr. MOSHER. You already said the stationary sources were not the prime source.

Dr. MIDDLETON. I said in Los Angeles they have been very well controlled, and the motor vehicle in that area was relatively more important.

Mr. BELL. What about the motor vehicle? You do have a program to stop the motor vehicle; is that correct?

Dr. MIDDLETON. The higher levels of alert in Los Angeles are such that the Los Angeles County Air Pollution Control District calls upon the executive power of the Governor's office to prescribe the needed additional actions.

Mr. BELL. What are those additional actions?

Dr. MIDDLETON. As I understand—and I may be wrong in these specific numbers, and if I am incorrect, I would like to have the record changed——

Mr. DADDARIO. You may, of course, correct the record.

Dr. MIDDLETON. When the ozone level approaches either 1 or 1½ parts per million instantaneous reading, then the county of Los Angeles advises the Governor of this alert situation and invites State support to control the local problem. This then is the force for abating the motor vehicle movement. Los Angeles County itself, as I understand it, does not do this.

Mr. BELL. What can result from that if you stop the motor vehicles?

Dr. MIDDLETON. Chaos.

Mr. BELL. What would be the result from such actual direct action?

Dr. MIDDLETON. The direct action in that case——

Mr. BELL. The Governor has been notified and the Governor has this prescribed pattern and makes his statement that we are in this crisis. Then what happens?

Dr. MIDDLETON. May I say as a long-term resident of California—this issue has never been settled. I would propose not to settle it before you today. The course of action really is that because the motor vehicle is a State-taxed instrument and the motor vehicle pollution control is a State responsibility, and as such it moves outside of the realm of a county air pollution control action. I believe it is for this purpose that one calls upon the Governor to exercise statewide executive restraints on motor vehicles. I am not at all sure the State has an action plan to curb movement of motor vehicles in Los Angeles.

Mr. BELL. In other words, you do not really know whether the Governor of the State of California can act in case the situation requires.

Dr. MIDDLETON. I know perfectly well the Governor can act for the protection of public health and welfare. I do not know that the Governor has a plan.

Mr. MOSHER. It has not been tried?

Mr. BELL. It has not been tried, and it has not been revealed to you what his plan would be. It would affect Los Angeles County, obviously, probably as much as any place in California. He actually has not delivered to you a plan of what he would do?

Dr. MIDDLETON. I have not learned of this for a number of reasons. I do not say this defensively. On November 21, last, this legislation became law, and I have not had the opportunity of doing more than establishing within my own organization a very important group of people who are responsible as a Task Force for Emergency Actions.

I have not been able in this period of time to develop all the information that would be required to be completely responsive to your question, Mr. Bell.

Mr. BELL. Is there a place where I could find out what the action would be?

Dr. MIDDLETON. I will find out and will tell you.

Mr. BELL. I would appreciate that.

(The information requested is as follows:)

The Los Angeles County Air Pollution Control District adopted emergency regulations in 1954, because of widespread concern that air pollution in Los Angeles might produce disasters similar to those which have occurred in other places in the United States and Europe.

The system set up under these regulations provides for issuance of daily air pollution forecasts by meteorologists of the Air Pollution Control District. Forecasts are based on data on airflow patterns, inversions, atmospheric mixing height, wind speed, and other factors. Forecasts of adverse conditions are brought to the attention of the Air Pollution Control Officer, so that preparation can be made for taking any emergency action deemed necessary.

The District maintains a network of air sampling stations, some of which are operated continuously. Data are telemetered to the District's headquarters, where an around-the-clock communications center is operated.

Following are the alert stages which have been established for toxic air contaminants (in parts per million) in Los Angeles County:

Contaminant	Alert stages		
	1st	2d	3d
Carbon monoxide	100.0	200	300.0
Nitrogen oxides	.3.0	5	10.0
Sulfur oxides	3.0	5	10.0
Ozone	.5	1	1.5

Whenever air contaminant concentrations reach prescribed percentages of the first alert values, the District's staff begins intensive monitoring. If a first alert levels is reached, notification by telephone is given to principal air pollution control and police officials of the County; enforcement staff members in patrol cars are notified by radio; mass media and selected industrial sources are notified by telephone or radio; and members of the Emergency Action Committee are advised. There is a general warning to the public to curtail driving and other air-polluting activities; no open burning of any type (even those few fires normally allowed under variance or permit provisions of the Los Angeles regulations) is permitted; and industrial sources are informed that they may have to cease certain operations.

Should concentrations approach second alert levels, a meeting of the Emergency Action Committee is called to determine whether a second alert should be declared. If a quorum of the Committee is not available and second alert levels are reached, the Air Pollution Control Officer is empowered to declare the alert. In addition to the actions undertaken during the first alert, industry is requested to discontinue operations in accordance with pre-arranged and scheduled voluntary shutdown plans. When voluntary implementation is ineffective, the Control Officer is authorized, with advice of the Emergency Action Committee and approval of the Air Pollution Control Board, to require curtailment of industrial activities.

If third alert levels are reached, the Air Pollution Control Board may request the Governor to declare a state of emergency and take actions under the California Disaster Act. To date, no alert has gone beyond the first stage.

As for reduction of motor vehicle traffic during alerts, the Air Pollution Control Officer is required to take all necessary steps, by using the facilities of the appropriate mass communication media, to request the general public to cease all non-essential use of motor vehicles in the Los Angeles Basin and to form car pools when practical. Compliance with such requests is totally voluntary.

In 1955, a committee of scientists, administrators, police, traffic, highway, and air pollution authorities, instituted an investigation to determine whether and how automotive traffic could be controlled during air pollution alerts. All the problems involved in such action were investigated, and after much deliberation, the group reported that it would be physically impossible to stop all or any significant portion of the vehicular traffic in Los Angeles County. This decision was based on conditions that may be unique to Los Angeles County. Public transportation in the County is grossly inadequate, and great dependence is placed on private automobiles. There is a multiplicity of local police jurisdictions, with little overall coordination, and there are not near enough law enforcement officers to cover the many thousands of miles of streets and highways in the County.

Even though it was concluded that, as a practical matter, it would be impossible for the Air Pollution Control Officer to enforce regulations requiring cessation of automobile travel during emergency conditions, plans were developed to assist in voluntary reduction of motor vehicle traffic. A significant element in this program is the encouragement of the use of employee car pools, in cooperation with industrial plants and businesses, during critical smog periods. During such times, business and industrial establishments are immediately requested to urge their employees to travel in car pools previously organized under the leadership of the employer. Cars remaining in company parking lots are protected by company guards. Such measures can remove thousands of automobiles from highways and streets, thereby materially lessening emissions from auto exhausts and greatly minimizing the intensity of smog attacks.

Plans for the establishment, maintenance, and operation of such car pools by employers of large numbers of people have been requested and received by the Air Pollution Control District. Knowledge of the geographic location of the larger masses of automobiles has been used to develop a comprehensive plan embracing the entire Los Angeles Basin, so that, in the event emergency action becomes necessary, it would be possible to request car pooling in areas where critical air pollution concentrations are occurring or can be expected to occur.

Mr. RYAN. May I make an observation? As a parochial New Yorker, I thought I would never hear that some other city is ahead of New York. I find it rather inexcusable that New York does not have a workable plan.

Let me urge you, Dr. Middleton, to insist at the soonest possible moment that they come forward with an effective plan, because we face another disaster any day. I think all of us recognize the potential.

Dr. MIDDLETON. I can only add, Mr. Ryan, I recognize this—I want to say, perhaps, better than you, but that might be presumptuous. It is because of this emergency that I have attempted to do what we have done, which may seem modest at the moment, but that is only because of its recent action and our first opportunity for acting in this way by specific congressional directive.

Mr. RYAN. Prior to the enactment of the Clean Air Act Amendments of 1967, you have had the New York-New Jersey abatement conference procedure available since last January.

Dr. MIDDLETON. Yes, we have had other courses of action, but we have not done the specific things that your chairman has very well chosen to emphasize—the need to have a course of emergency action that is not merely a plan but actually a workable one—and that it relates to what the health effects of the pollutants shall be. This, in turn, gets back to your original question: What are the criteria to abate and prevent the air pollution episode?

Mr. DADDARIO. You are presently developing the kind of people who can give help to the State and local governments so such emergency legislation and such emergency action can be taken?

Dr. MIDDLETON. This, I can assure you unequivocally, is the case.

Mr. BELL. I have one more question, Mr. Chairman.

Dr. Middleton, I was not quite clear on your answer to Mr. Ryan as to what your action would be if a State or locality were told that this situation was occurring. When this situation did occur, when they did not act and when the Federal Government enjoined them to act, no action was forthcoming. Could the Federal Government act?

Dr. MIDDLETON. We would act through the Office of the Attorney General and the Justice Department and see that control took place.

Mr. BELL. In other words, you could actually move in there after the Attorney General acts and bring about whatever changes were necessary—to stop motor traffic, let us say?

Dr. MIDDLETON. Whatever the Attorney General was able to bring forth through the Federal court as an injunctive measure would be that which would take place.

Mr. BELL. I guess that means stop traffic, right?

Dr. MIDDLETON. I am attempting to say I cannot make a judgment for the Federal court.

Mr. BELL. I assume that is right.

Mr. FELTON. I think the question is: Can you move against a class, or do you have to move against an individual? Can you seek an injunction against a class, as all automobile drivers cannot come into the city; or do you have to move against a specific individual or industry, as x industry cannot emit certain pollutants?*

Dr. MIDDLETON. Mr. Felton, I am sure you recognize this is a matter of considerable debate in the General Counsel's Office of the Department as well as in the Department of Justice. We are hopeful that the opinion will suggest we move against classes rather than individuals.

Mr. DADDARIO. Dr. Middleton, if we could have Dr. Ludwig continue to spell out how you are putting together this capability and how you intend to work it now from a 36-hour forecast to something on the order of 12 to 24. You are about at that stage of the game.

Dr. LUDWIG. Yes. The present air pollution potential advisories predict the continuation of existing air stagnation condition for an additional period of 36 hours. What we are now attempting to do is to be able to forecast the onset of these events 24 hours in advance and, in addition to this, to quantify it. In other words, to designate when they will start, how long they will last, and the severity of the particular stagnation; for example, weak, medium, or severe. We are trying to make this a better tool for the kind of emergency action that we are talking about.

At the present time we update these forecasts every day. For example, we issue one of these advisories which indicates that stagnation will continue for another 36 hours. The next day we will issue an advisory which says it will either continue another 36 hours or end the advisory after a certain period of time.

These advisories, which go out to all the Weather Bureau offices, are then transmitted to the State and local agencies. Any industries that want to be kept informed, when these advisories are issued, are privileged to notify the local Weather Bureau station and they will be advised that an advisory has been issued for the particular period in a certain area.

The other piece of information, of course, which compliments an advisory, is the air monitoring information that the State and local agencies maintain in their areas. These advisories and a monitoring

*See Appendix D, page 583, for an advisory opinion of the Legislative Reference Service, Library of Congress, which indicates that a class action against automobile drivers could not be maintained.

of the air quality that exists in the area are the basis of the action to shut down what sources, and so forth.

Mr. DADDARIO. Dr. Ludwig, at the time when you come to the judgment that there is a serious episodic situation developing, do you take extraordinary steps to accent the information? How do you do that? To whose attention do you call it, beyond the Weather people in that area?

Dr. LUDWIG. The fact that an advisory is to be issued is called to the attention of the State and local air pollution agencies in that region so they can do special sampling and take other appropriate action if they so desire.

Mr. DADDARIO. Do you have people available at that time, recognizing the manpower as it exists to be a difficult one, who can give assistance and who are qualified? Do you have people you can move around from one part of the country to another in case it is necessary?

Dr. LUDWIG. At the present time we do not have a mobile group to do this. One of the areas being considered by a task force study group is the action that we will take under the new act and the type of organizational setup we need to assist in this kind of operation.

Mr. DADDARIO. Do you plan the use of a mobile force of this kind?

Dr. MIDDLETON. Yes. In addition to what Dr. Ludwig has told you, Mr. Chairman, in each of the Department's regional offices we have a regional representative who is specifically carrying out the work of the National Center for Air Pollution Control. This, then, is the arm of the Department in the region designed to aid the local agencies in making air pollution control decisions. We have hourly communication with them. While this is helpful, it is not really the answer that we seek for the solution of this episodic emergency problem.

If I could take just a moment to point out the sequence of criteria, the adoption of ambient air quality standards, the State then having a period of time to give the Secretary its implementation plan. It is in the implementation plan that we would except the State to outline in detail what course of action they have planned for emergency action. We are attempting through the new legislation to see that the preventive aspects take place so we can minimize the need for the crash emergency actions. Again, the whole thrust is to be sure that at the State and local government level those political subdivisions understand there is an air pollution problem and that they can do something about it, and that they actually do have a plan to do something about it. This would include, specifically, the emergency actions required.

Mr. DADDARIO. Dr. Middleton, you may then proceed from where you were or with Dr. Blomquist, as you desire.

Dr. MIDDLETON. If I may finish the last few pages, I think it will give us a little further overview of what the National Center for Air Pollution Control is, what its responsibilities are, and how, if they are marshaled properly, we can prevent episodes and see that we go about preventing air pollution so we do protect the public health and welfare.

Another activity that will be continued is the awarding of matching grants to local, State, and regional governmental agencies to help them create and carry on effective programs for the prevention and control of air pollution. These grants will also be available to assist such agencies in meeting the new responsibilities which will be placed upon

them under the provisions of the Air Quality Control Act. In addition, funds may also be made available to support the work of planning commissions set up by States to assist in the development of air quality standards in interstate air quality control regions.

The establishment of national standards for the control of air pollution from new motor vehicles, first authorized by the 1965 amendments to the Clean Air Act, will also be continued. Such standards are now in effect for 1968 model cars and light trucks using gasoline as their fuel. Two weeks ago, we proposed more stringent standards for such vehicles for initial application in the 1970 model year. In addition, standards were proposed for the control of smoke emissions from diesel buses and trucks.

Our activities relating to the prevention and control of air pollution from Federal installations will also continue. There has been marked progress in this work, due in large part to the high degree of cooperation we have been getting from other Federal departments and agencies. For the first time, the Federal Government now has a detailed inventory of air pollution sources at all its installations and comprehensive plans for control action, wherever such action is necessary.

A number of new activities will be initiated under the Air Quality Act in support of the research-and-control system which the act sets up. Among these will be a program for registration of fuel additives, whose use already contributes, and in the future may well contribute even more, to all environmental pollution problems; a study of the need for and effect of national emission standards for major industrial sources of air pollution, with a report to the Congress due 2 years from enactment of the act; a comprehensive study of the economic costs of controlling air pollution, including costs that will be incurred by both government and industry; an investigation of manpower needs in the air pollution field and of needs for training programs; and, finally, a study of ways to control air pollution from aircraft and of the feasibility of establishing national emission standards applicable to aircraft.

In implementing the provisions of the Air Quality Act, we will have opportunities to solicit the advice and assistance of all those segments of the Nation's population who are concerned with the problem of air pollution and who are in a position to help us. The act provides for the creation of a Presidential Air Quality Advisory Board as well as technical advisory committees. The membership of these groups will include State and local officials, representatives of business and industry, scientists, and so on.

This completes my summary of the provisions of the Air Quality Act. This legislation, as I said at the beginning of my statement, opens a new era in the Nation's fight against the threat of air pollution. Exactly how fast our progress in this new era will be will depend heavily on how promptly and effectively all levels of government and all segments of industry pursue the roles they are expected to play. The Air Quality Act binds all levels of government and industry together and provides for us all a comprehensive plan for attacking air pollution; if any of us fails to do his job, the plan cannot completely fulfill the promise it holds. In signing the act, President Johnson re-

minded us that "It is a law—not a magic wand to wave and cleanse our skies. It is a law whose ultimate effectiveness rests with the people."

A great deal of work must be done to translate the law into action. Air quality criteria must be developed. Air quality standards must be set and enforced. An accelerated research effort must be undertaken. All this and more must be accomplished if we are to stop the rising tide of air pollution and begin to turn it downward. I believe that under the provisions of the Air Quality Act, this can be done. I assure you that the National Center for Air Pollution Control will strive to carry out, as promptly and as thoroughly as possible, all of its responsibilities under the act, so that States, local governments, and industry will have the tools they need to move the Nation toward better control of air pollution.

Mr. DADDARIO. Dr. Middleton, how do you view the present Federal Agencies' involvement in this? What is the number of agencies which deal with pollution in one way or another? How are they being brought together? Should there be some more concentration of this activity under one agency or a special agency?

Dr. MIDDLETON. I think you can see, Mr. Chairman, that the Air Quality Act of 1967 is a clear congressional directive to the Secretary of the Department of Health, Education, and Welfare to see that the provisions of the act are carried out. Since to carry them out requires the assistance of other departments and agencies, the Center uses the Office of Science and Technology as well as our collaborative research enterprises between agencies and departments.

The Provision of a Presidential Air Quality Advisory Board is the instrument that the Secretary will use as the essential element in seeing to it that the proper coordination and public policy posture is assumed. Over the years we have transferred funds to other agencies where expertise in areas reside. Through the knowledge of the programs, we have been able to espouse some particular points, and encourage others.

In regard to the Bureau of Mines—you were thoughtful enough to include Dr. Hibbard this morning—you will note that we have a very considerable effort involved in the fuel resources and how they can be best used for air pollution prevention. It is through our knowledge of areas of concern that they have offered their services, through the transfer of funds, through the directives of the present act and law, and by the Presidential memorandum to Secretaries and heads of agencies of April 21 last year, stating that the President continues to look to Secretary Gardner as the lead person in this area, that we have evolved at a very high level a capability of communication with concerned departments for effective action for air pollution control.

I think Dr. Ludwig's exposition to you about the air pollution predictions system and the fact that there is a Department of Commerce effort with ESSA people assigned and stationed in our National Center for Air Pollution Control, shows there is a very fertile field for the use of Federal people and resources cohesively to bring about a truly effective program.

We have similar relationships with the Department of Agriculture, as a further example of improved use of the Federal Establishment.

These are examples of how we have gone about collaboration and how we shall continue to do this. It is rather clear that the central

responsibility is ours, and through the recognition of the large dimensions of the task we are trying to involve as many other agencies as we can, as well as the private sector, much more extensively than in the past.

Mr. DADDARIO. You are not suggesting that the Secretary of Health, Education, and Welfare can tell another Secretary or another agency head that he ought not to be spending some money in a field particularly related to, let us say, research in the air pollution area? What you say appears to me to mean that you can get help from these places and you can coordinate this activity and the information, but you cannot necessarily impose upon another agency a requirement to do something extra. You cannot say to them: "You are spending more money in this field than you ought to because other things appear to the Secretary of Health, Education, and Welfare to have a higher priority." This is the age-old problem which affects research in a multitude of areas. This matter of bringing cohesiveness to it, Dr. Middleton, is not so simple.

Dr. MIDDLETON. I quite recognize that, Mr. Chairman, and I say we are bringing about cohesiveness with a degree of modesty. Having been a professor at the University of California and having several campuses ——

Mr. DADDARIO. You mean cohesiveness and not chaos.

Dr. MIDDLETON. I mean cohesiveness and not chaos. I think the same kinds of independent elements we have in university systems exist in the Federal Government. This is to be espoused. I think where one finds excellence, one needs to identify it and capture it.

We capture this by knowing, for example, that many of the people in Dr. Hibbard's area are concerned with this problem of how we use our raw sources to advantage without causing air pollution.

Mr. DADDARIO. He may be concerned about it in a way differently than the Secretary of Health, Education, and Welfare because of the difference of their missions, and they may, in fact, both be justified, but one ought to have a priority above the other. Who makes that determination?

Dr. MIDDLETON. I think this is done by program planning and comparison of schedules to see what the priorities are. We can bring these kinds of things together through program planning, and then through the Office of Science and Technology, which has offered its coordinating role, as well as through the Bureau of the Budget, appropriate budget assignments can be effected.

Mr. DADDARIO. Dr. Middleton, we stand at a stage of the game where the future of pollution control really is ahead of us. We are developing a base upon which we can make a formidable mark. Would this not be the time to take a serious look at all of the work that is being done and come to some judgment about how to bring it together in a more meaningful way, rather than to try to do it through this cohesive informality that you are talking about?

Dr. MIDDLETON. I do not think the cohesive informality, Mr. Chairman, if I may suggest this, is as loose as perhaps you suggest. If we wish——

Mr. DADDARIO. I would think it would be looser.

Dr. MIDDLETON. The informality of transferring funds to another agency on a contractual arrangement for the production of goods is rather a firm way to expect material results. This is not just interest in the problem. It is expecting the departments and agencies to produce answers to problems. We do this by quarterly reports, by terminal accounts, by having task forces of people who share in making decisions on what should be done. There is a whole variety of things that have been arranged prior to my coming, and there are many more since I have come, that lead to bringing the principals involved together at the working level for a much better understanding of what the issues are so that they can be properly investigated.

Mr. DADDARIO. Dr. Middleton, I do not suggest that you could sit here today and come up with the solution to this problem. However, it does appear to me we have an opportunity to do much more in drawing together this whole situation and putting it into order so that determinations can be made which can more effectively, efficiently, and expeditiously bring about our objectives in this area.

I feel, although the dangers which fall upon us may not be imminent, the time ahead may be the only opportunity we have to effectively control the great damage which might come to us 50, 100, or 200 years from now. Certainly, this committee will look very carefully into the structure of the activity which is taking place today, to see if, in fact, it can be improved. I do think that you also should be looking at that in that way.

It is not enough just to bring together people and develop another committee so these people can meet and talk about what they are doing. It seems to me there needs to be more of an overhauling here than the use of joint committee activity. This is fine in some cases, but it ought to be, I think, more finely formed.

Dr. MIDDLETON. Mr. Chairman, I quite agree with this concept. It is toward that end that the Congress itself determined that there should be a Presidential Advisory Board for Air Quality. I think this should be a good sign that there is broad concern. I think the fact that our national advisory committees come from many places across the country, representing the private sector as well as the public sector, connotes something else.

More importantly, we are not dealing with this as a new issue. We have program plans and schedules that contemplate the reality and the dimension of the problem. This is not a new issue. It is an old issue.

Mr. DADDARIO. It is not a new issue, but it is an issue which we are beginning to look at as it ought to be looked at. The great expenditures in this area are in the future. It is not a new issue, but one which has developed a force of public opinion which demands that we do something in a very serious way. Because, as our past hearings indicate, this will be extremely costly, we ought to put together a mechanism which can see to it that these funds are expended in as efficient a way as possible and that we do tie together the local and State government activities, regions, or what have you, so that we will have effective administration and management.

Dr. MIDDLETON. May I suggest that beyond the relationships within the Government we have the developing relationships with the private sector, and we expect to deeply involve them, not only in developing research and development for control technology purposes, but also for providing the facts as they relate to the production of criteria. In this regard you might be interested in the fact that in fiscal year 1966, about 30 percent of our budget was used in non-Federal research categories.

In 1967 we increased this from 30 percent to about 70 percent. We are marshaling the resources of private industry, all segments of industry, nonprofit institutions, a variety of technical resources, to bring new talent to bear, new ideas, newly involved people, so through the mechanism of the leadership of the Department of Health, Education, and Welfare I think we are not only succeeding in bringing about some Federal relationship improvement but, more significantly perhaps, we have been able to involve more significant external forces to have a concern with air pollution and its control.

Mr. DADDARIO. Mr. Brown?

Mr. BROWN. I do not want to take a great deal of time on this but there are a couple of aspects of the research program that I would like to have you comment on very briefly.

One aspect of the total problem of controlling our environment and its pollution is that action in one field tends to sometimes have an effect in another field; for example, the control of air pollution may have an effect on water pollution or ground pollution.

I would like to know, in your program do you have adequate mechanisms for recognizing and dealing with this problem so that the total environment is maintained at some type of optimum level, and in the effort to provide clean air we do not at the same time produce adverse effects in other aspects of our environment?

Are you coordinating with those people trying to clean up the water and ground at the same time?

Dr. MIDDLETON. May I ask Dr. Ludwig to respond?

Dr. LUDWIG. Mr. Brown, we are quite aware of the interactions between the cleanup of air pollutants with the cleanup of water pollutants or the problems that are involved in solid waste disposal.

In the development of our program we don't look to the transferring of our problems to one of these other forms of disposal as an adequate solution. For instance, there is a great interface with the solid waste people who are interested in the disposal of these wastes by whatever means possible. One of these is incineration.

Of course, we have an interest in controlling pollution from incineration that extends from the development of add-on devices right back through improving the process so that it is nonpolluting to begin with. This requires that we do coordinate our programs with the solid waste programs in this regard.

We have a similar interface with the water pollution program, for instance, the development of one specific area for sulfur control involves the injection of dolomitic materials into the furnace. We are carrying this through to the point of what do you do with the slurry that you get finally which consists of gypsum and limestone and fly ash; how do you dispose of this?

You don't throw it down the sewer. This is integrated into the process as a piece of the control technology that is accountable to air rather than tossing it over for somebody else to take care of.

Mr. BROWN. Organizationally, the responsibility in these areas of water and solid waste disposal are in other jurisdictions, is that true?

Dr. LUDWIG. That is right. The solid waste is in HEW but the water pollution is in the Federal Water Pollution Control Administration.

Mr. BROWN. One other question on the research aspect.

I see from your chart there in that central box you have research on controlled technology for motor vehicles, fuel combustion and industrial processes.

How broad do you envision the scope of the research effort that you are authorized to support? For example, does this include support of development of completely new technologies in transportation such as the electric-powered vehicle? Would it include the very broad research in terms of basic recycling processes which would have a major effect on the whole design of a city or something of that sort?

Have you developed limits on your mandate? Are you searching for these limits at the present time?

Dr. LUDWIG. No. I would say that in looking at the problem, we categorize these in first, second, and third generation types of activity.

For instance, as an example, in the control of sulfur from powerplants, we have a group of prospective control methods that we put in the first generation category, which consists of getting into and through the full demonstration stage as soon as possible those techniques that appear most promising at the present time.

At the same time that we are doing this we are developing on the bench scale new categories of control possibilities which we would hope to be able to put into the pilot plant in full demonstration scale in 4 or 5 years from now.

While we are doing this, in the third generation type of activity, we are taking a look at new power system concepts, whole new ways of producing power where you integrate air pollution control into the power system itself. An example of this would be to develop gasification that was particularly adaptable to a certain form of power generation.

We are considering the full gamut of activities here which look down the road of how to reach the goal that is going to be necessary 20, 30 years from now.

Mr. BROWN. This again brings up some very interesting problems because in the total picture of stationary power production facilities we are moving rapidly toward nuclear power. Nuclear power is not going to pollute the air but an awful lot of water in trying to dispose of these wastes in the ocean, or it may have some other effects which are no concern of yours. They should be of concern to those who worry about the total environment.

This may be even beyond the nuclear power stage developments in other powers which would provide some other similar type of problems. It bothers me a little in terms of the responsibility of Congress for the total development in all of these areas, that there might not be adequate central coordination and planning for the kinds of problems that develop here.

You might not worry about the nuclear power wastes because they do not involve air pollution, but somebody has to worry about them. They should be closely coordinated worriers, actually.

Dr. MIDDLETON. Mr. Chairman, I concur in the concern.

May I give you a specific example for Mr. Brown of how we begin to meet this in a rather modest way.

We have a member of the National Center for Air Pollution Control assigned to work with the Bonneville Power Authority. This group is concerned not only with hydroelectric and atomic energy systems, but also with burning of fossil fuels for power production. Our representative is a specialist in effluents from combustion of fuels as well as radioactive wastes, and works on an ongoing daily basis with the people who are concerned with all of the new forms of power generation.

Consideration is given at that working level to plans suggested for all sources for deriving power. Through this liaison the Center has established effective air pollution abatement protocols and ongoing, regular, professional contact with all the Federal agencies concerned, as well as public agencies associated with power development.

This may be too low level to meet your needs, but it does cite another example, may I suggest, of ways that informal associations often meet to provide practical solutions.

Mr. BROWN. It seems to me, getting back to the type of problem the chairman raised earlier about organization, we may be in the future needing to move in the direction of an organizational framework which is concerned broadly with the problems of a satisfactory environment for the human being, physical environment—I am not talking about the psychological or political environment—physical environment.

Perhaps some framework similar to the present ESSA would deal broadly with all of these problems and coordinate them. It seems that placing your operations under HEW is a recognition of its effect upon the health, I presume, of the ordinary human being.

As you pointed out, there are far larger consequences, for example, on agriculture. Why don't we put it in the Department of Agriculture?

There are economic effects on the automobile industry. Why don't we put it in the Department of Transportation?

It is a basic thing which we are trying to develop with the environment. HEW deals with human beings as human beings, and a logical arrangement might ultimately be to group all of these concerns with the environment into one kind of a structure to deal with them on that basis.

Do you visualize this as occurring or being reasonable? Is it something that might develop over the course of the next few years?

Dr. MIDDLETON. In response, I should say that HEW has a prime role in this not solely because of its effect on the health of persons, but also its effect on welfare.

The real answer to your question is that there needs to be a concern for the total environment. To do this prudently, we need to exercise best use of the several components that need to be involved.

It is obvious to me that this is a matter of real concern to the executive branch; the President has often stated his concern. His concern for this and his measures for bringing about some resolution of the problem will hasten restoration of the quality of our environment.

We have, as a matter of fact, with the Commerce Technical Advisory Board Report on Electric Powered Vehicles, involved Commerce. The Department of Transportation, as well as HUD are involved with HEW.

As an example, the Bureau of the Budget is bringing together the several elements in a few days to discuss this particular problem of motor vehicle pollution as it affects the total environment. It seems to me these are the mechanisms that are extant that can be exercised by the executive branch.

Mr. BROWN. I recognize that the devices that you described are being used to secure the type of focus that we need and no system is going to be perfect. Obviously we don't expect that, but we do expect something that is logical.

In connection with your work in California, did the Motor Vehicle Pollution Control Board report to the Department of Health in California or some other organization?

Dr. MIDDLETON. It reported directly to the Office of the Governor. It was responsive to the Governor's Office.

Mr. BROWN. I have no further questions.

Mr. DADDARIO. Dr. Middleton, could we then proceed with Dr. Blomquist?

Mr. RYAN. Mr. Chairman.

Mr. DADDARIO. I am sorry, I did not know that you wanted to be called on, Mr. Ryan.

Mr. RYAN. I realize the time is late but, Dr. Middleton, as you know, during congressional consideration of the Clean Air Act of 1967, I argued for a different approach from the one adopted by the Congress. I felt that the approach adopted by the Congress was too State oriented and would result in a number of built-in delays. What I would like to ask, referring to page 6 of your testimony, you state that the Department will designate air quality control regions. I think the Department also is required under the act to designate atmospheric areas and define them.

Could you tell us what the timetable is for this? Before we can get State action and before the States submit plans and statutes, there are certain steps that the Department of Health, Education, and Welfare has to take. Can you give us specifically what you see as your timetable?

You already designated atmospheric regions.

Dr. MIDDLETON. Mr. Chairman, Mr. Ryan, in response to the Congress' wishes, we have placed special emphasis on key items. One of these is the description of atmospheric areas. The atmospheric areas of the United States have already been described and published in the Federal Register, I believe January 10.

Mr. RYAN. What is the next step?

Dr. MIDDLETON. The next step is to designate air quality control regions in which the Department of Health, Education, and Welfare will have areas of particular concern on the health and welfare. May I refer especially to the fact that this may or may not involve a compact between the States, agreements between the States or among themselves, but call attention to the fact when one deals with compacts with States, that under section 102(c) there is a particular item of interest perhaps to you.

If I may read it. This is a partial reading of that section:

> It is the intent of Congress that no agreement or compact entered into between states after the date of enactment of the Air Quality Act of 1967, which relates to the control and abatement of air pollution in an air quality control region shall provide for participation by a state which is not included in whole or in part in such air quality control regions.

We are attempting to enunciate that the designation of air quality control regions shall identify a community of interest in a common air pollution problem. This, then, suggests some of the principles involved in the designation of air quality control regions. They will be descriptive of and include the communities and political jurisdictions that have the problem and are able to cope with it. This means that there will be many, many such air quality control regions scattered across the country in those critical problem areas. The exact number I cannot forecast, but we are talking of more than 100. I am hopeful that we will be able to designate several of the more important ones before the close of this fiscal year. This is a task, Mr. Chairman, that requires considerable scientific enterprise and a great deal of technology.

Mr. DADDARIO. Does it require just enterprise or does it require research so that such a scientific and technical capability can be developed and so that airsheds or air regions, however you may put it, can in fact be established firmly?

Dr. MIDDLETON. I advisedly use the word "enterprise." Much of the information that is required, most in fact exists. It takes ingenuity and effort to see that what exists can be brought into the format that is required; namely, for this particular purpose, mathematical modeling of cities, diffusion gradients for pollutants, the nature of the urban community, probable growth factors. All of these elements when put together are the essence of the principles involved in the description of air quality control regions.

I am saying that to do this initially will be an arduous task and an exacting one, but it can be done and it can be done shortly. After the first few have been well worked out, it is my opinion that the several more that are required will emerge much more quickly.

I will be nonspecifically responsive, if I may, on how many at what particular time, except to say we expect to have several before the end of this fiscal year and many, many more in the next fiscal year.

Mr. RYAN. As you designate those air quality control regions, will you simultaneously or at a later point issue the air quality criteria for those regions? I am trying to understand the timetable.

As I understand it, after you issue the criteria, the States still have 15 months in which to submit a plan to you.

Without prolonging this discussion this morning because the time is short, how soon can we expect the first State to come forward with a plan under the statute?

Dr. MIDDLETON. Under the statute, if we publish today an air quality criterion for some pollutant, within 90 days we would expect—and by "published" I mean properly announced—we would expect in 90 days the State to indicate its intent to adopt an ambient air quality standard. The State then would have, as you are enunciating very clearly, 6 months in which to adopt this standard. It would then have an additional 6 months in which to provide, for the Secretary's consideration, an implementation plan.

This, then, means that a year and 3 months would elapse prior to any abatement activity on the part of State or local government. The applicability of those adopted standards, so far as the Federal Government is concerned, is in the air quality control regions. We need not to do things just in sequence but in parallel, which is a terrific task. We need not only now to designate the air quality control regions but simultaneously publish criteria so that we can bring about a State action. Toward this end, Dr. Blomquist and his staff are working assiduously to produce the appropriate technical documents with the appropriate consultation with the Federal agencies as well as the private sectors and the academic world to see that the criteria we enunciate in fact display the scientific facts in an exercise of superior judgment and lucid written description.

Once this is done, with the control techniques available and the costs thereof, the triggering mechanism is set in motion. Toward this end, we are asking that there be appointed a National Advisory Committee on Air Quality Criteria. We are proposing a prescribed membership. We have in the meanwhile staff activities directed toward development of specific pollutant criteria. A list of these were given, Mr. Chairman, to the Senate Public Works Committee. This listing is being changed in sequence because of the added need now to have control technology and their costs. Publishing them in the time frame we had originally described will be changed to meet the control technology and costs that we presently have available.

We would expect to have by the close of this fiscal year, certainly, criteria on particulate matter, a consideration of the reevaluation of sulphur oxides, and perhaps carbon monoxide. These are the principal pollutants in many places and they are the ones which would initiate the actions that you have mentioned.

Mr. RYAN. I am concerned about the fact that the act requires you to recall your criteria on sulphur oxides.

I think that was a mistake. It was written into the law. How soon can you reissue it? I will correct that. That is the way you read the law, isn't it?

Dr. MIDDLETON. Yes.

They will be reevaluated and, toward this end, we have the mechanisms in motion for their reevaluation. When they will be published bears on some other issues over which I have little control. There will be no effort wanting to have them ready for publication shortly.

Mr. RYAN. Let me urge you to move with dispatch on this.

Mr. Chairman, might we have that listing which Dr. Middleton mentioned for our record?

Mr. DADDARIO. Yes.

(The information requested is as follows:)

The listing of planned publication dates of air quality criteria cited by Dr. Middleton appeared on pages 2334–2335 of Part 4 of the record of hearings on the Air Quality Act before the Subcommittee on Air and Water Pollution of the Senate Committee on Public Works. That listing is now nearly a year old.

Air quality criteria are now being prepared in accordance with the following schedule: Publication in Fiscal 1968: particulate matter and (following reevaluation of the criteria originally published in March 1967) sulfur oxides; publication in Fiscal 1969: oxidants, carbon monoxide, hydrocarbons, and nitrogen oxides; planned for later publication: beryllium, fluorides, hydrogen sulfide, lead, odors, and polynuclear hydrocarbons.

Mr. RYAN. Also, a copy of the atmospheric air regions that you have already designated?

Dr. MIDDLETON. Pleased to supply them.

[Federal Register, Vol. 33, No. 10—Tuesday, Jan. 16, 1968]

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE—OFFICE OF THE SECRETARY

AIR POLLUTION PREVENTION AND CONTROL—DEFINITION OF ATMOSPHEREIC AREAS

Notice is hereby given that, pursuant to section 107(a)(1) of the Clean Air Act, as amended by the Air Quality Act of 1967 (Public Law 90–148), the Atmospheric areas of the Nation are defined as set out below on the basis of those conditions which affect the interchange and diffusion of pollutants in the atmosphere.

Important meteorological parameters that affect the interchange and diffusion of airborne pollutants are the frequently, persistence, and height variation of stable (inversion) layers of air and speed and direction of wind. Accordingly, the boundaries of the Atmospheric areas are based on annual averages of (a) low-level inversion frequency, (b) maximum depths of vertical mixing, and (c) the frequency of light winds.

Collectively, an assessment of these parameters provides a measure of the dilution climatology of an area, that is, a history of the experience of air movements as it relates to the dilution of pollutants. This conceput of dilution climatology is embodied in the High Air Pollution Potential (HAPP) Advisory System, initiated by the National Center for Air Pollution Control (NCAPC) in the eastern United States in 1960 and the western United States in 1963, and now administered by the Environmental Science Services Administration (ESSA). The HAPP Advisory System provides a forecase of weather conditions conducive to the accumulation of air pollutants over large areas, a factor which was considered in the definition of these Atmospheric areas.

Because of the direct relationship of the area boundaries to the average meteorological conditions of large-scale areas, these bounaries do not necessarily reflect the actual meteorology in the immediate vicinity of the boundaries. In other words, there will always be special "boundary conditions" characterized by the movement of air, together with airborne pollutants, across the boundary. The boundaries are shown as zones on the map in order to reflect this boundary condition.

Furthermore, since the boundary between any two areas is defined by average annual conditions it is transitory on the basis of shorter period (e.g., seasonal or diurnal) variations in meterological conditons, with the result that Pittsburgh, for example, is under the influence of the average dilution climatology of the Appalachian Atmospheric area during certain times of the year and under the influence of the Great Lakes-Northeast Atmospheric areat at other times during the year. Similarly, Portland, Oreg., New York City, or any other place in the near vicinity of an Atmospheric area boundary could be under the influence of a neighboring Atmospheric area during certain periods.

Major topographical features are also reflected in the delineation of Atmospheric areas. The eastern boundary of the two Atmospheric areas on the West Coast lies for the most part at the 2,000- to 3,000-foot elevation contour interval on the western sdope of the first major mountain chain, and it marks in general the inland extent of the major influence of maritime air. The boundary between the Rocky Mountain Area and the Great Plains Area is essentially located at the 3,000- to 4,000-foot elevation contour interval. The effects of the Great Lakes and the Appalachian Mountains are apparent in the location of boundaries between Atmospheric areas in the eastern United States.

A brief description of each Atmospheric area is given in the attached table, including the geographical extent of each area and the major characteristics of the dilution climate. Definition of Atmospheric areas outside of the continguous United States has been deferred.

The existence of Atmospheric areas, as defined herein, does not in any way limit the designation of Air Quality Control regions pursuant to section 107(a)(2) of the Clean Air Act, as amended.

Dated: January 9, 1968.

[SEAL]

JOHN W. GARDNER, *Secretary.*

DESCRIPTION OF ATMOSPHERIC AREAS AND THEIR CHARACTERISTICS, AIR QUALITY ACT OF 1967

Atmospheric area	Extent of area	Meteorological and topographical characteristics
California-Oregon coastal area	Extends about 20 to 50 miles inland from the Pacific Ocean.	Maritime air penetration; prevailing shallow vertical mixing depths; topographic restraints on ventilation in coastal valleys and basins.
Washington coastal area	Extends about 20 to 30 miles inland from the Puget Sound region, from which the eastern boundary extends southwestward to the vicinity of Longview on the Columbia River and then westward to the coast.	Precipitation, cloudiness, and relatively high winds are dominant features of the climate, which distinguishes this area from the adjacent areas. Storm activity is frequent, particularly during winter and spring seasons; the frequent storm passages result in a low occurrence of persistent stagnation.
Rocky Mountain area	Extends eastward from the California-Oregon and Washington coastal areas, to terminate as a north-south oriented eastern boundary, essentially corresponding to the 3,000- to 4,000-foot mean sea level contour interval which in general defines the easternmost extension of the major mountain ranges. This eastern boundary stretches from the Canadian border in Montana southward through extreme eastern Colorado, eastern New Mexico, to the Mexican border, to include the Big Bend region of Texas.	Topographic restriction, channeling of winds, particularly frequent surface-based inversions at night, and relatively deep mixing depths during the afternoon are prevalent features of the dilution climate of the area.
Great Plains area	Extends eastward from the Rocky Mountain area to the Mississippi River south of Missouri; to the north it includes most of Illinois, southwestern Indiana, southwestern Wisconsin, and all but extreme northeast Minnesota.	Relatively flat terrain, which stretches from the Canadian border to the Gulf of Mexico, characterizes the topography. The dilution climate is characterized by negligible persistent atmospheric stagnation and the frequent occurrence of relatively high winds with rapidly changing meteorological conditions.
Great Lakes-Northeast area	In addition to regions adjacent to the Great Lakes this area includes the northern ⅔ of the States of Indiana and Ohio, the Allegheny Plateau area of northwestern Pennsylvania, all of New York State but the extreme southern part of the Hudson River Valley, and the New England States north of the Connecticut-Rhode Island coastal area.	The meteorology is characterized by frequent storm passages with attendant high winds and generally good dilution conditions. During the spring and early summer months, winds blowing from over the cold waters of the Great Lakes and Atlantic Ocean enhance low-level stability in regions adjacent to these bodies of water.
Appalachian area	The eastern boundary of this area, which extends from northern New Jersey southward through southeastern Pennsylvania, eastern Virginia to the Atlantic coastline at the South Carolina border, is correlative for the most part with the 300- to 500-feet mean sea level contour interval. This contour interval at the foothills of the Blue Ridge Mountain Range distinguishes the relatively flat coastal plain to the east from the Appalachian Mountains. The area extends southward to the Gulf of Mexico, including northern Florida, and is bounded in the west and north by 2 other atmospheric areas.	Dominant features of the dilution climate include light wind speeds and the most frequent stagnation conditions of any region east of the Rocky Mountains.
Mid-Atlantic coastal area	Encompasses the Atlantic coastal plain from extreme southwestern Connecticut, including the New York City and Long Island region, southward to the South Carolina border at the coastline, and extends inland to the Appalachian area.	Shallow mixing depths, less frequent low-level stability and higher wind speeds are features of the dilution climate that distinguishes this coastal area from those adjacent.
South Florida area	Extends south from the Daytona Beach-Cedar Key line to include the southern half of Florida.	The climate of this area is predominantly tropical-marine in nature. Atmospheric stagnation is practically nonexistent; there is a small frequency of low-level stability; and relatively good vertical mixing prevails.

Source: Federal Register, vol. 33, no. 10, Tuesday, Jan. 16, 1968.

Mr. DADDARIO. What don't you have control over? What prevents you?

Dr. MIDDLETON. The exercise of the esteemed judgments of our consultants, the fact that I would like to have enough time for free consultation so that the people we ask to participate in our National Ad-

visory Committee are free agents, that they in fact come together because we ask them to come because they have something to offer.

This means that they have to become involved. Bringing this about is not just something that one legislates; this is done by a variety of techniques, some of which this committee is well accustomed.

Mr. DADDARIO. This gets you back to that formula you have established for yourself in bringing together the best possible people in order to accomplish your objectives.

Dr. MIDDLETON. Yes, sir.

Mr. DADDARIO. This is the status at the moment?

Dr. MIDDLETON. Just the normal clearance system in government seems to be an arduous task. My restlessness is something that I will apparently have to be content with.

Mr. DADDARIO. Mr. Bell?

Mr. BELL. Dr. Middleton, as I understand—and I hate to belabor this question. But relative to State and National rights as far as State rights are concerned, as I understand it, a State can take a more stringent action on air pollution.

You say on page 8, "The act prescribes procedures to be followed in the event a State either fails to meet its obligations or submits standards which are not consistent with the provisions of the act."

Again we go back to that situation, if a State were to take some actions that were not consistent with the provisions of the act, acting perhaps in advance of what your office would want them to do, what would be the situation? Would you be able to say no if Los Angeles or California decided to move on something that was not exactly consistent with the provisions of the act? You would be able to prevent them from acting, is that correct?

Dr. MIDDLETON. Again, Mr. Bell, I need to reiterate our desire to see States such as California step forward and offer some leadership. It is not the intent of the Federal Government to forestall control of air pollution at the State and local level. Consistent with the act in this sense can be construed to mean that when the criteria are published and the State says they intend to adopt a standard, the standard they then promulgate, or propose, when sent to the Secretary, is found to be consistent with the published criteria. If the standard is half as potent as it should be, based on criteria, it is nonconsistent and poorer.

Mr. BELL. The State standard is better?

Dr. MIDDLETON. The State standard in that case is a larger number, which means less good. Not half, meaning twice as good. Are we confused or together at this point?

Mr. BELL. I think we are together.

Dr. MIDDLETON. I mean if the State comes up with a standard that is poor and inconsistent with the criteria, then there is a course of action to bring the views together and make a finding. The finding is binding.

Mr. BELL. In other words, what you really are saying is if they reach an impasse where there is a difference of opinion, it would be the same thing. Try to bring the views together. You are not going to say the Federal Government must bring your standards into a system with our provisions?

Dr. MIDDLETON. We are saying the standard advocated, recommended by the State and reviewed by the Secretary, must be consistent

with the information given to the State enabling them to allow a standard to be established. What is "consistent," I have only used as an illustration here. They, the States, may be less concerned with the particular pollutant and decide they are not going to have an "adequate" standard; that is, it will not protect the health of people.

In this case the Secretary perhaps would indicate the inadequacies of the State standard and perhaps by consultation, indicate to the State the need for its improvement.

In the event this is unacceptable to the State, a legal course of action and establishment of a hearing board, making a finding, resolves the issue.

Mr. BELL. On page 10 you made a statement relative to the 1968 model cars and trucks. You said that 2 weeks ago you proposed more stringent standards for such vehicles for initial application of the 1970 model years. I do not believe in the rest of the statement that you indicated what those were.

Dr. MIDDLETON. No, I did not. I can introduce this material for the record.

Mr. BELL. If you would.

Dr. MIDDLETON. The Federal Register provides very extensive documentation of what these standards are.

Mr. DADDARIO. Please do so.

(The standards referred to may be found in the Federal Register, vol. 33, No. 2, pp. 110–130, dated Jan. 4, 1968, and entitled "Control of Air Pollution from New Motor Vehicles and New Motor Vehicle Engines—Proposed 1970 Standards.")

Mr. BELL. Thank you, Dr. Middleton. I appreciate your very fine statement and your answers to the questions. I remember hearing considerable praise about your efforts in Los Angeles and the good job you have done.

Dr. MIDDLETON. You are very generous. Thank you.

(Dr. Middleton's complete prepared statement follows:)

PREPARED STATEMENT BY DR. JOHN T. MIDDLETON, DIRECTOR, NATIONAL CENTER FOR AIR POLLUTION CONTROL, PUBLIC HEALTH SERVICE, DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Mr. Chairman and members of the Subcommittee, I am pleased to have this opportunity to discuss with you the activities of the Department of Health, Education, and Welfare in the area of air pollution research and control. In the period since your 1966 hearings on environmental pollution, important new dimensions have been added to the Department's air pollution program. I am referring, of course, to the enactment of the Air Quality Act of 1967, which became law last November 21st and which is destined to have a profound influence on all the air pollution research and control activities of government and industry for many years to come.

The enactment of the Air Quality Act marked the start of a new era in the Nation's attack on the growing problem of air pollution—an era in which the knowledge we already have about this problem and its prevention and control will be systematically and scientifically applied in all parts of the country, while at the same time, a greatly increased effort will be made to develop the additional knowledge we must have if we are to prevent the air pollution problem from continuing to grow and worsen.

The Air Quality Act offers no short cuts to effective control of air pollution. There is no short cut to the solution of such a complicated problem. Air pollution is a by-product of all the major growth factors of modern society; it is rooted in the way we build our cities, the ways in which we provide transportation for ourselves and our goods, the ways in which we derive energy from our fuel resources, the ways in which we produce and use a multitude of goods and

services, and the ways in which we dispose of all the leftovers of modern life. The effects of air pollution are diverse and often subtle. Polluted air contributes to human sickness, disability, and premature death; it soils and damages buildings and materials of all kinds; it injures and destroys farm crops and other vegetation; and it blights our cities and degrades the quality of our lives.

A problem such as air pollution, which has such far-reaching economic, social, and technological ramifications, must obviously be attacked along a broad front. The solution does not lie only in the enforcement of laws and regulations or only in the application of engineering techniques or economic formulas. Achieving effective control of air pollution will require a combination of these approaches and many others. Moreover, it will require the combined efforts of all levels of government and all segments of industry.

In the four years since the enactment of the Clean Air Act of 1963, the Nation has made progress in the fight against air pollution. Federal grants have helped to produce an unprecedented expansion of State and local governmental control programs. Federal abatement action has paved the way for State and local agencies to join the Federal Government in attacking interstate air pollution problems in several places, including the National Capital area. National standards have been adopted for the control of air pollution from new motor vehicles, thus extending to the entire Nation the initial benefits of technological progress in dealing with one of the most important aspects of the total problem of air pollution. Finally, the increasing emphasis placed on control action during the past four years has served not only to bring a few more sources of air pollution under control, but also, and more significantly, it has helped to stimulate a greatly intensified effort to develop new and improved control technology—an effort which has already begun to bear fruit, particularly with respect to motor vehicle pollution and sulfur pollution arising from fuel combustion.

But there are still many gaps remaining to be filled. Our scientific and technical knowledge in many areas is still incomplete. We need more complete information on the importance of the many pollutants whose adverse effects are not as readily apparent as are the effects of such common contaminants as the sulfur oxides, photochemical smog, and visible particulate matter. Economic data on the impact of air pollution and the costs of controlling it are still not as precise as we would like them to be. Needs for manpower must be better defined and plans made for meeting them. Above all, since air pollution is inherently a regional problem, we must make certain that we attack it on a regional basis.

The Air Quality Act of 1967 was developed in full awareness of how comprehensive an effort it will take to achieve truly effective control of air pollution in this country. This new legislation is a blueprint, which, if properly employed, will allow us to correct all the important deficiencies in our current control efforts—the gaps in our scientific and technical knowledge, as well as the inadequacies in our application of existing knowledge. The Air Quality Act sets up a research-and-control system which will be coordinated at the Federal level but will involve a high degree of participation by other levels of government and by all segments of industry. I will take just a few minutes to explain, without going into great detail, how the Air Quality Act will affect air pollution research and development activities in the months and years ahead and, more importantly, how these activities and control activities are interrelated and interdependent.

Air pollution, as I have already said, is inherently a regional problem, simply because the air, whether polluted or not, flows freely across the boundary lines that divide States and cities. This means, of course, that in most, perhaps all, places where air pollution is a problem, effective control action will require the coordinated efforts of numerous local governments and, in many instances, of two or more States. This is fully recognized in the Air Quality Act. One of the chief purposes of the Act is to insure that State governments, in cooperation with municipal and county governments, will develop and apply air quality standards on a regional basis in all parts of the country. Toward this end, the Department of Health, Education, and Welfare will designate air quality control regions, each of which will consist of a group of communities that share a common air pollution problem. Air quality control regions will be designated on the basis of such factors as meteorology and topography, jurisdictional boundaries, and the extent of urban-industrial concentrations.

States will not actually be obligated to begin developing air quality standards for any pollutant until the Department of Health, Education, and Welfare publishes air quality criteria for that pollutant *and* information on available control techniques applicable to the various sources of that pollutant. Air quality criteria will describe the effects of air pollutants on health and property. They will reflect the best available scientific knowledge, even though that knowledge may not be as complete as we would like it to be. The information we will publish on control technology will identify the best techniques available for reducing pollutant emissions at their various sources, whether those techniques involve the application of control equipment, changes in fuel use or industrial processes, or any other practical approach. Since air quality criteria and information on control technology must be published *before* States can be called upon to begin developing air quality standards, the Air Quality Act must clearly be implemented as fully as possible on the basis of the best scientific and technical knowledge already available, while at the same time, an expanded research effort is undertaken to fill the gaps in this knowledge. Any other course would inevitably result in a slowdown of the Nation's efforts to deal with a problem that is already serious and threatens to reach critical proportions all too soon.

The publication of air quality criteria for a pollutant and information on applicable control technology will be the signal for States to begin developing air quality standards for that pollutant and detailed plans for implementation of the standards in air quality control regions that have been designated by the Department of Health, Education, and Welfare. Air quality standards will prescribe limitations on ambient air levels of pollutants in a region; since the fundamental purpose of setting such standards is to provide for the protection of public health and welfare, State governments will be expected to consider, among other things, the air quality criteria that have been published in accordance with the Air Quality Act. States will also be expected to take into consideration the published information on control technology.

The Air Quality Act sets up a timetable which States must follow in developing air quality standards and implementation plans and requires that the standards and plans be reviewed by the Department of Health, Education, and Welfare. In addition, the Act prescribes the procedures to be followed in the event that a State either fails to meet its obligations or submits standards which are not consistent with the provisions of the Act. And finally, the Act makes it clear that States will be expected to assume the major responsibility for seeing that their plans for implementation of air quality standards are carried out. If action by a State proves inadequate, however, provision is made for enforcement at the Federal level.

I indicated, a few moments ago, the importance of research to expand and improve our knowledge of the adverse effects of air pollution and of ways to prevent and control it. The Air Quality Act provides for a substantially accelerated research effort, with special emphasis on finding new and improved ways of dealing with the complex and very serious problems associated with motor vehicles and the use of sulfur-containing fuels. We will, of course, expand the work being done in our own facilities and in those of other Federal departments and agencies. But we will have to rely, too, on the many industries that are capable of contributing to the search for practical solutions to the various technical problems involved in controlling air pollution; indeed, we have already begun moving toward much greater utilization of the resources of industry.

The Air Quality Act also provides for continuation of many of the activities initiated under the Clean Air Act of 1963. One of these activities is the abatement of interstate and intrastate air pollution problems; this activity, as I have already noted, has been productive in several places in the country. In addition, the Air Quality Act provides new authority for court action to curtail pollutant emissions in emergency situations—that is, when adverse meteorological conditions threaten to produce an episode of extraordinarily high air pollution levels in any place in the country.

Another activity that will be continued is the awarding of matching grants to local, State, and regional governmental agencies to help them create and carry on effective programs for the prevention and control of air pollution.

These grants will also be available to assist such agencies in meeting the new responsibilities which will be placed upon them under the provisions of the Air Quality Act. In addition, funds may also be made available to support the work of planning commissions set up by States to assist in the development of air quality standards in interstate air quality control regions.

The establishment of national standards for the control of air pollution from new motor vehicles, first authorized by the 1965 amendments to the Clean Air Act, will also be continued. Such standards are now in effect for 1968-model cars and light trucks using gasoline as their fuel. Two weeks ago, we proposed more stringent standards for such vehicles for initial application in the 1970 model year. In addition, standards were proposed for the control of smoke emissions from diesel buses and trucks.

Our activities relating to the prevention and control of air pollution from Federal installations will also continue. There has been marked progress in this work, due in large part to the high degree of cooperation we have been getting from other Federal departments and agencies. For the first time, the Federal Government now has a detailed inventory of air pollution sources at all its installation and comprehensive plans for control action, wherever such action is necessary.

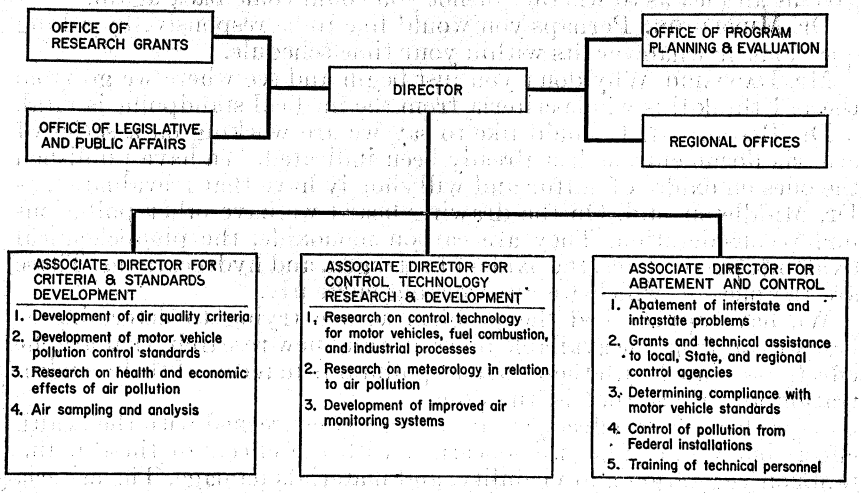
A number of new activities will be initiated under the Air Quality Act in support of the research-and-control system which the Act sets up. Among these will be a program for registration of fuel additives, whose use already contributes, and in the future may well contribute even more, to all environmental pollution problems; a study of the need for and effect of national emission standards for major industrial sources of air pollution, with a report to the Congress due two years from enactment of the Act; a comprehensive study of the economic costs of controlling air pollution, including costs that will be incurred by both government and industry; an investigation of manpower needs in the air pollution field and of needs for training programs; and finally, a study of ways to control air pollution from aircraft and of the feasibility of establishing national emission standards applicable to aircraft.

In implementing the provisions of the Air Quality Act, we will have opportunities to solicit the advice and assistance of all those segments of the Nation's population who are concerned with the problem of air pollution and who are in a position to help us. The Act provides for the creation of a Presidential Air Quality Advisory Board as well as technical advisory committees. The membership of these groups will include State and local officials, representatives of business and industry, scientists, and so on.

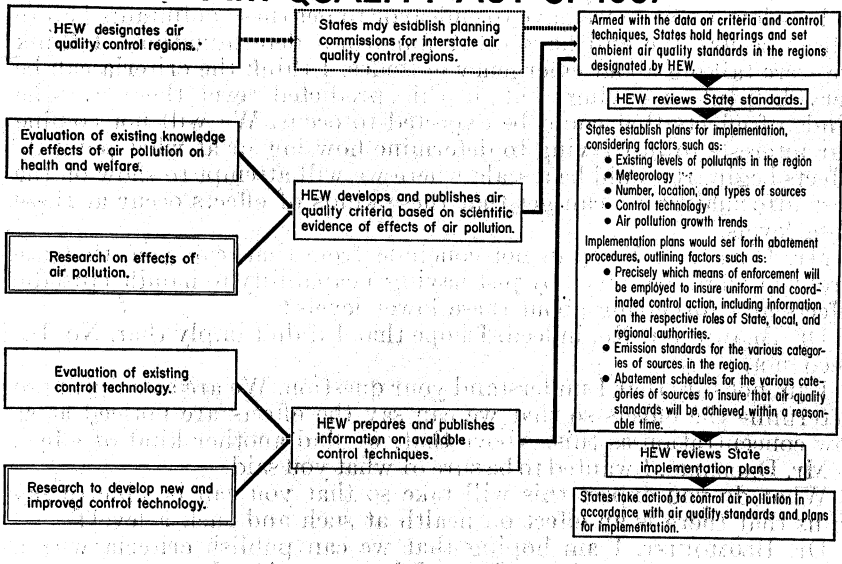
This completes my summary of the provisions of the Air Quality Act. This legislation, as I said at the beginning of my statement, opens a new era in the Nation's fight against the threat of air pollution. Exactly how fast our progress in this new era will be will depend heavily on how promptly and effectively all levels of government and all segments of industry pursue the roles they are expected to play. The Air Quality Act binds all levels of government and industry together and provides for us all a comprehensive plan for attacking air pollution; if any of us fails to do his job, the plan cannot completely fulfill the promise it holds. In signing the Act, President Johnson reminded us that "It is a law—not a magic wand to wave and cleanse our skies. It is a law whose ultimate effectiveness rests with the people."

A great deal of work must be done to translate the law into action. Air quality criteria must be developed. Air quality standards must be set and enforced. An accelerated research effort must be undertaken. All this and more must be accomplished if we are to stop the rising tide of air pollution and begin to turn it downward. I believe that under the provisions of the Air Quality Act, this can be done. I assure you that the National Center for Air Pollution Control will strive to carry out, as promptly and as thoroughly as possible, all of its responsibilities under the Act, so that States, local governments, and industry will have the tools they need to move the Nation toward better control of air pollution.

NATIONAL CENTER FOR AIR POLLUTION CONTROL



AIR QUALITY ACT OF 1967



90-064—68——7

Mr. DADDARIO. If we might proceed just a bit longer. Could we have Dr. Blomquist run as quickly as possible through the criteria. It may give us an idea as to whether or not you could come back again.

Dr. MIDDLETON. Perhaps you would like to be responsive by asking questions or whatever fits within your time schedule.

Mr. DADDARIO. Why don't you just begin and see where we go from there. I think this whole criteria from the medical standpoint is vital.

Dr. BLOMQUIST. I should like to say we are working on a series of criteria documents, as has already been indicated. We have published the ones on oxides of sulfur and will shortly have that reevaluated, as Dr. Middleton said. On the drawing board we have other pollutions under consideration. They are carbon monoxide, the photochemical oxidants, particulates, the oxides of nitrogen, and hydrocarbons. Those are the ones on which we are working currently.

We have approached the problem as one trying to determine as best we can from the available literature and new research what are the effects associated with these various pollutants in terms of their concentration and time; that is, the dose.

As we look at the effects, we are primarily concerned with the health effects but we are likewise concerned with the effects of these pollutants on vegetation and visibility, and materials damage. The criteria will include the relationship of concentration with health and the kinds of effects as expressed in various parameters.

The documents that we have on the drawing boards are divided pretty well into four areas. There will be a discussion as well as documentation on these effects in these four areas. Then we try to answer from the experimental data the critical question; namely, how accurately can we predict at what level these effects begin?

I think the most important question that most people are asking is to how low a low do we have to endeavor to get these pollutants before effects occur? We will have other important determinations. I think we were talking about emergency episodes. I think the criteria can be very helpful in saying that at this predicted level these are the kinds of effects that could be expected to occur. We will not confine our interests to just trying to determine how low or at what point do effects begin. It would be a scale where we will attempt to show on the best information we can get that these kinds of effects occur at these dose levels.

Mr. DADDARIO. You can not conclude from that, can you, that the problem might be solved by just having a capability to handle episodic effects and forgetting about these lower levels?

Dr. BLOMQUIST. No, indeed. I hope that I didn't imply that. No. Indeed not.

I am not sure that I understand your question. We are attempting to determine the effects so that we can say the effects are noticed at as low concentration as this. Above that, we find another kind of effect.

Mr. DADDARIO. I wanted to be sure of what you said.

What do you expect this will take so that you can be able to say to us that there is an effect on health at such and such a level?

Dr. BLOMQUIST. I am hoping that we can publish criteria within this calendar year on the ones that I have mentioned on our drawing board. I hope that we can get those out in the year 1968.

Am I answering your question?

Mr. DADDARIO. Yes.

What does the situation, as you see it at the moment, appear to be tending to? Are we correct in assuming that there are ill effects? Is there some substance to the validity of those who believe that the ill effects of air pollutants are extremely small to health?

Dr. BLOMQUIST. I think I would mention two points that are the most difficult in our experience: One would be that we are attempting to develop a curve or a linear relationship between effects and concentration in time. The research that is available does not always give us the precise points on this curve or line.

This is one of the biggest problems, the lack of objective data for all these points that we would like to be able to answer.

Then I think another big problem we are having is just how do we express the interpretation in the light of the criticism that we have had on the SO_x document? I think it has been suggested that there are differences of opinion on interpreting the data. I think that you made reference to it earlier, that you can get a group of highly competent scientists together, but the same facts do not always lead everyone to the same conclusion.

This is particularly true when we are trying to determine the critical level at which effects of significance occur. This is mostly due to two factors: One is the lack of precise knowledge on every point and the other is a difference in interpretation.

Mr. DADDARIO. Does that suggest when you publish this criteria it will leave something to be added which will necessitate additional research?

Dr. BLOMQUIST. I think this is true. I think we have to recognize this is a growing science and that the last word is not out now.

We must plan and we have planned that criteria will be revised from time to time. I don't think I would like anyone to feel that criteria are established now and forever. Obviously, with new information, additional facts will need to be considered as time goes on.

Mr. DADDARIO. Doctor, I don't often get into Mr. Bell's State of California, but the California State Department of Health recently published a report which said, and I quote: "Although smog is known to have serious adverse health effects, it is not a causative factor in lung cancer."

Would you agree it is not, that that is based on proper medical testimony?

What causative effects does it have on other types of diseases, if any? Is there one of those areas where you just have got to come to certain conclusions based on information——

Dr. BLOMQUIST. I think this is one of the gray areas. I think it is, for the facts I mentioned before, the data we have, but I think there is also a difference of opinion as to what you mean by cause.

I think in terms of disease we are generally taught to think that a single etiological agent directly causes a clinical entity, TB being one; you have to have the tubercle bacilli to get TB. I think what we are dealing with here in many situations are conditions of multiple causative factors, multiple etiology. Some of them may be primary and some may be secondary.

I think part of the controversy gets into what we are talking about as a cause. I think the major issue is that a direct cause——

Mr. DADDARIO. What do you see that we need to do in order to be able to come to such a clear understanding about this or to a much clearer one than presently exists. Can we eliminate this confusion and have a level of confidence about the criteria established by which people can then move ahead and get support and be willing to act under emergencies as they arise?

Dr. BLOMQUIST. I am compelled to say that the first thing I think is better facts. I think every effort toward research to get the facts should be the primary objective.

Mr. DADDARIO. As you develop your criteria, you say you have certain flaws in it. What does it lead you to conclude as to how much more information you ought to have and as a medical man how you ought to go about getting it?

Dr. BLOMQUIST. I think that one of the major advantages of going through what we are doing in reviewing the literature and evaluating it, is that we are better able to point out what questions should be given priority and further research. I think this will be one of the major benefits of our criteria documents.

I think what we will have to do is to be willing to say that we will do the best we can with the facts we have. That does not mean we do not do anything. I do not think that we can delay and delay because we do not have the conclusive facts.

Mr. DADDARIO. In which direction should we go? Should we approach this medical question from the least common denominator point of view? As an example, I understood Dr. Bennett yesterday to say air pollution does not cause disease but it aggravated health conditions of persons already diseased or weakened. Do you agree or disagree with that? How do we establish whether your position prevails or whether that of the Office of the Science Adviser to the President prevails?

Dr. BLOMQUIST. I think we want action.

I would think action is necessary whether it aggravates a disease or causes it, I am thinking——

Mr. DADDARIO. Wouldn't it have a great deal of effect on what we are willing to pay if we could know that it does have an ill effect at a quicker level than we expect, or if we can understand that it does not? If it does in fact aggravate those who have already some kind of an illness, we would then approach it in a different way altogether?

Dr. MIDDLETON. Are we speaking of the point of mixture and the fact we have direct and indirect and additive effects? I think that is the point Dr. Blomquist is trying to bring out.

Mr. DADDARIO. Of course, we are. That is the reason why it is so important at this stage of the game we know as much as possible about what we are doing, because it has, as Dr. Middleton suggests, so many complications. My fear is that we could easily come to the conclusion that it just aggravates rather than causes, and therefore establish a criteria which is not as good as it ought to be.

Dr. BLOMQUIST. It worries me.

Mr. DADDARIO. It worries you, too?

Dr. BLOMQUIST. Yes.*

Mr. DADDARIO. Dr. Blomquist, this is a matter about which this committee has been greatly concerned.

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*See page 115 for an additional statement by Dr. Blomquist.

Hearings we held some time back indicate we ought to be concerned. I hope we might have the opportunity to submit a series of questions about this. I think this is an important part of these particular hearings.

It may be necessary for you to come back, but we will try to see whether we can establish this for the record.

Dr. BLOMQUIST. I would be glad to.

Dr. MIDDLETON. We are very grateful for your real concern.

Mr. DADDARIO. We would next like to hear from Dr. Hibbard. Dr. Hibbard is an old friend so I have been able to hold him here until the end.

Dr. Hibbard and I went to Wesleyan together. We were in the same class and have had a long friendship. I am pleased he is with the Bureau of Mines. I know of his ability and competence.

While I apologize for the late hour I hope he might summarize his statement and then we can see where we go from there.

(The biography of Dr. Hibbard follows:)

DR. WALTER R. HIBBARD, JR.

Dr. Walter R. Hibbard, Jr., internationally known metallurgical engineer, has been director of the Bureau of Mines since December 1, 1965, following his appointment by President Lyndon B. Johnson in October of that year.

Dr. Hibbard's selection to head the Government agency charged with the major responsibility for the conservation and development of the Nation's mineral resources came after notable successes in earlier careers in education and research and development, and in directing metallurgy and ceramics research for one of America's largest industrial concerns.

Born in Bridgeport, Conn., on January 20, 1918, Dr. Hibbard was graduated from Wesleyan University, Middletown, Conn., in 1939, and received a Doctor of Engineering degree from Yale University in 1942.

Following his military service in World War II as a naval officer attached to the Bureau of Ships, he joined the faculty at Yale as an Assistant Professor and later became Associate Professor.

Dr. Hibbard's growing reputation in the teaching and research fields attracted the attention of industry, and in 1951 he was recruited by the General Electric Company for its Research and Development Center in Schenectady, N.Y. There he progressed to the position of Manager of Metallurgy and Ceramics Research directing a broad range of fundamental and applied research projects, a position he held when selected to become Director of the Bureau of Mines.

Dr. Hibbard's achievements in such fields as the plastic deformation of metals and the metallurgy of copper and its alloys have won him wide recognition from many professional societies. In 1950 he received the Raymond Award of the American Institute of Mining, Metallurgical, and Petroleum Engineers. From 1957 to 1961 he served as director of the Institute, and in 1967 he is serving as its President. He recently was named by AIME to receive the Institute's James Douglas Gold Medal, awarded for his notable career. For many years a registered professional engineer, Dr. Hibbard has served as President of the Metallurgical Society of the AIME, and is a past chairman of the Society's committees on the metallurgical profession and on engineering management. In January 1963, he was one of ten eminent metallurgists elected to the newly created grade of Fellow of the Metallurgical Society. In addition, Dr. Hibbard belongs to the British Institute of Metals and the New York Academy of Sciences, and is a fellow of both the American Academy of Arts and Sciences and the American Association for the Advancement of Science. He also is a member of the Materials Advisory Board of the National Academy of Science, and was recently its Chairman. In 1966 he was elected to the newly organized National Academy of Engineering.

Dr. Hibbard is the author of more than 70 scientific papers and has been widely recognized as a major contributor to the science of metallurgy. In 1957, he was a member of the exchange delegation of United States metallurgists visiting the Soviet Union.

He has been elected to many honorary and professional fraternities including Phi Beta Kappa, Sigma Xi, Alpha Chi Sigma, and Gamma Alpha. He also holds an honorary Doctor of Law degree from the Michigan Technological University, Houghton, Michigan.

Dr. and Mrs. Hibbard have three children and reside in Rockville, Md.

STATEMENT OF DR. WALTER R. HIBBARD, DIRECTOR, BUREAU OF MINES, DEPARTMENT OF THE INTERIOR; ACCOMPANIED BY DR. HARRY ALLEN, ASSISTANT DIRECTOR FOR MINERAL RESEARCH

Dr. HIBBARD. I would like to point out that our mission and responsibility in this important problem area is for research on the control, at the source, of pollutants produced as a result of the production, processing, handling, and utilization of the Nation's mineral and mineral fuels resources. Authority for conducting such research derives from the Bureau's organic act which states that scientific and technologic investigations shall be conducted on the extraction and utilization of mineral substances with a view to conserving resources through the prevention of waste, increasing safety, and on behalf of the Government to investigate mineral fuels. It is important that the science and technology and the economics are generated to assume an adequate supply of mineral raw materials and at the same time to maintain the quality of the environment or improve it in many cases.

Much of the pollution is the result of inefficiencies. If we had really effective processing and utilization, with efficiencies approaching 100 percent, pollution from this source would be reduced significantly.

Moreover, from the standpoint of conservation there is a need to do this.

We work very closely with the Department of Health, Education, and Welfare and with industry. Much of our effort is funded by the Public Health Service. We report regularly to PHS on our program in toto with regard to those aspects which are related to air pollution, and in particular we report quarterly on those activities funded by the Air Pollution Control Center.

Last August, when I testified before your subcommittee, I pointed out that there was a lack of technology. There was much scientific understanding but technology was missing.

I am very pleased to report that the efforts of government, industry, and universities have resulted in a substantial advance in the technical feasibility of controlling and abating some of these sources of pollution.

There are many ways one can attack the SO_2 problem. Many are in a demonstration or pilot stage. It is clear, for example, that automobile exhaust pollution can be solved technologically without changing the basic modes of transportation.

The question of——

Mr. DADDARIO. You say "can be." Do you find some fault with the present control techniques? Is it worth the estimated $500 million it is costing us in order to add such exhaust mechanisms?

Dr. HIBBARD. I meant technically it is possible to put a device into existing designs of automobiles which will lower the exhaust approximately to the proposed 1970 standards.

The major unresolved aspect of this is the cost and how we get it to the public.

What I am saying is that the technology exists. The engineering is yet to come. This is a substantial advance from a year ago.

Mr. DADDARIO. When you say there is a substantial advance in the application of our technology, comparing your view of this with your testimony a year ago, do you see any increase which has taken place in this capability, one which allows you to believe that the increase in this application of technology capability will, in fact, be greater as we go along, or do you find obstacles which prevent our making such advances?

Dr. HIBBARD. I think within the last year, due to the stimulus and recognition of the problem, there has been a very splendid increase in efforts of industry and of the Government. There is a lot less lipservice to the problem and a lot more action.

I believe these problems are technologically solvable, and I believe with the kinds of ingenuity and capability we have in the manufacturing, scaling up, and cost reduction of these devices, particularly in the automotive industry, there is no reason to believe that pollution abatement cannot be done on an economically acceptable basis.

We cannot do it tomorrow because there is a timelag associated with all engineering effort.

I think the other areas we are concerned with, for example, the problem of SO_2 from smelter stacks, with the price of sulfur advancing as it is and with the development of technology, many of the smelters in the West now have SO_2 control devices. The operators of these smelters do this because it is good business, and they are stimulated in this effort for the purpose of recovering sulfur as well as to abate pollution.

The other areas with which we are concerned have to do with control of the dust and particulate matter from the large tailings piles and waste heaps which are the products of mining. These problems have not been solved. I think we know technically what can be done to solve them. For example, one of the ways of keeping dust off a tailings dump is to wet it down and eventually grow vegetation on it.

I think in the case of some of the burning dumps in Pennsylvania, old spoil banks of coal mines, we know technically what to do to put out the fire. Nevertheless, the cost of doing this is going to be very large, at least if we do it using the technology we know today.

The problem with respect to dumps, therefore, is how either to improve our technology to reduce the costs or how to take the technology we have and apply it at today's costs.

Mr. DADDARIO. Which ought we to do, use our present knowledge and apply it, or develop new knowledge—or both?

Dr. HIBBARD. What we would like to do is to add to the technology so it would be economic to rework these dumps, and to find values in them which would pay for the costs of restoring the land by moving them away or otherwise disposing of them.

In some of the spoil banks and tailings dumps out West, we are finding ways of doing this. We are analyzing them to see if there is enough silver, gold, or copper or whatever other values they might contain to make it worth while to rework them. Then we can dispose of them at the same time.

In the case of the burning coal banks in Pennsylvania we have scratched our heads and looked as far as we can for solutions, but these dumps are gigantic. There are two of them, one containing 8 million cubic yards and the other with 6 million cubic yards and both are burning.

Just to truck it away will cost about $1 a cubic yard.

The economics of this thing will require much more attention.

Mr. DADDARIO. Are you developing an internal manpower capability so that you can foreseeably create this kind of capability? What are your limitations here?

Dr. HIBBARD. The whole question is one of urgency. In many of these problems the greater the effort the sooner the answer will come.

I think in our own organization we have the manpower to do this in an orderly way at a certain rate. If that is not soon enough then we ought to have more manpower.

I think this is also true with regard to Dr. Middleton's staff.

Aside from the technology itself it takes a certain length of time and a certain technical capacity to actually apply the remedies and preventive devices to industry or to an automobile.

Here again we may not have countrywide the total capability to do this as fast as we may wish.

The answer to you is the tradeoff between time and effort.

In my initial statement I said I thought we would solve these problems. The whole question is one of time.

Mr. DADDARIO. When you were talking about automobiles and the ability to take what we have and within a reasonable period of time do something about it, it makes me wonder what we do about the situation as it presently exists. If a truck is not maintained properly and is allowed to run around in the streets, say, it can overcome by its presence everything else we have done in thousands of cases. What steps are we taking in order to eliminate this particular problem? If we do not do that we are really spending a great deal of money to accomplish nothing.

Dr. HIBBARD. That is a real tough one. You can do things temporarily when the pollution problem is serious in a particular area. You can divert from the use of coal to natural gas. You can ask people not to drive cars into town, and so on. You can tell all the apartment house owners to stop incinerating trash for a period of time. But how to handle these problems on a more permanent basis is really a question of what we are willing to pay. This is not a dollar payment but a payment in terms of convenience and capability of doing things.

I am not sure that answers your question.

Mr. DADDARIO. It gets at it except that it does appear that the mechanisms presently planned in the automobile area work fine when installed. However, unless they are maintained you soon get back to the level where that vehicle would have been if that additional mechanism had not been put on the car.

Dr. HIBBARD. Technology is trying to find ways of doing this so that these mechanisms will not deteriorate so soon.

One of the devices we have been using is actually developed by Du Pont. It has been operated 50,000 miles by the Du Pont Co. without serious deterioration.

The other question is really a regulatory one. An alternative, for example, is to have a car inspected every month or every 2 weeks. This is why I say it is a matter of tradeoff with what you are willing to pay. If you are willing to pay for it in terms of inconvenience or cost in this way you can put it into effect very promptly. If the public is not willing to go through the bother of inspections in those periods which we believe to be critical then that is something else.

Mr. DADDARIO. Dr. Middleton, what does your experience tell you about that particular problem?

Dr. MIDDLETON. The motor vehicles that are sold nationally beginning in the fall of 1967, the 1968 models, the certificates of conformity awarded to the automotive industry for new vehicles, and Dr. Hibbard is making a very critical distinction there—authority vested in the Department of Health, Education, and Welfare is for new motor vehicles and engines—these certificates are awarded based on the lifetime of the vehicle such that a car, authorized as being in conformity, is manufactured, based on the samples tested, and that it will last within the limits imposed.

That is to say that the test procedures, the durability testing, and the amount of maintenance required are such that there is every assurance that these vehicles will be in compliance, and by way of some information on this, perhaps, we can give you some facts.

Let me say that in the testing of motor vehicles—I am trying to find that information.

Mr. DADDARIO. Why not give us your guess as you remember it at this point?

Dr. LUDWIG. The surveillance tests that have been conducted over the several years since cars with devices, which have been required in California since 1966 and 1967, would indicate that they are exceeding slightly the 275 parts per million and the 1½ percent CO.

Whether this is 285 and 1.55 or something like this I cannot recall exactly.

Mr. DADDARIO. You mean better than?

Dr. MIDDLETON. No, do not meet.

Dr. LUDWIG. Do not meet the standards. They are slightly above the standards after 1 or 2 years of deterioration.

It is difficult to extend this into the future because the only way you can get car owner mileage on automobiles is to wait to see what happens in the third year.

Mr. DADDARIO. It would be difficult for the owner to come to a judgment as to whether or not his vehicle is meeting the standard or not.

Dr. MIDDLETON. These vehicles are actually run 50,000 miles for durability tests. Every 4,000 miles they are measured.

From this we have a decay factor which tells us whether this system will last for the lifetime of the vehicle, expected to be 100,000 miles.

This is the data that I think will be of interest to you.

From the present certification data for the 1968 models we have found that 25 percent of the 1968 model year vehicles to be sold have been certified at less than 180 parts per million—our present standard is 275 hydrocarbon—and 1 percent CO. Our present standard is 1½. There is 25 percent capability, so there is technical capability of being better than now.

As to the durability and how well these cars last in the hands of private ownership let me point this out—90 percent of these same cars, 1968 models, to be sold have been certified with emission levels that are 225 parts per million hydrocarbons, 50 parts per million below the standard, and 1¼ percent CO. So that these cars in fact, with the test procedures prescribed, do meet these standards for the lifetime of the car with the kind of maintenance that the motor vehicle producer normally expects.

That is to say that there is not the need with the 1968 models—perhaps Dr. Hibbard clarified this—new systems, new cars with the new systems, there is assurance that these systems will last the lifetime of the car with minimum maintenance, normal maintenance.

To be assured that this is the case the Federal Government and the Congress has authorized us to develop inspection stations. This will be done in conjunction with the Department of Transportation in conjunction with the Highway Safety Act, so that we can be assured States will have inspection systems to see that these cars, in fact, are maintained adequately.

In addition we will have our own surveillance techniques in several areas to see if in passenger car use these are maintained.

The difficulty here is that even though this is real, possible, and now is in effect, an average car lasts 10 years and goes 100,000 miles. We speak rather bravely about how well we are controlling motor vehicle pollution. We are controlling one-tenth a year. At that we are curtailing only about 55 to 60 percent of the total emissions. Therefore much more needs to be done than now is being done.

One then is tempted, as Dr. Hibbard suggests, to deal with the used car and what systems are in vogue there. This may be a much more complicated matter because it means taking your car, mine, which is not now equipped——

Mr. DADDARIO. Mine is not a 1968.

Dr. MIDDLETON. And going somewhere and having equipment put on which is many hours of labor and special equipment.

The feasibility, even though you have the technical skill, for putting these on used cars seems remote.

Mr. DADDARIO. The impetus you have given to the need in this direction already has caused development of certain mechanical capabilities. Wouldn't you foresee that because of the market potential here, that you will and can stimulate development of some mechanisms which ought soon to be available in the consumer market for used cars?

Dr. MIDDLETON. Whether this can be developed for used cars in the time frame we would like to see is a question.

Certainly innovation typically comes from outside the particular industry. We have many people who have ideas. The patentable idea of Du Pont, which Dr. Hibbard mentioned, is one of those. Whether this device can be applied to all populations of cars because of the

nature of the manifold exhaust system and the specific dimensions of it on a broad scale is an issue to be settled.

I am suggesting that the applicability of our known effective control system to used cars seems almost impossible, but if we can do this on a lab scale and check it out on existing cars then there may be further technical improvements to allow broad-scale application.

Dr. HIBBARD. I think this is the crux of the problem. For example, even with a 1968 car the first 50,000 miles of it will be driven with good maintenance.

Probably the second 50,000 miles will be driven with significantly less maintenance because it becomes substantially a different kind of car.

Of the large number of cars that are now on the highways, a significant number are in the second category. Really, then, the major inroad to the problem goes back to what we can do—with the cars that are on the road. I see no alternative than the one I mentioned before. You have to decide what you are willing to pay for it. Will you force these people to either fix up their cars or take them off the roads?

Will you insist on a series of fairly careful inspections? You cannot tell by looking.

For example, these concentrations of various exhaust components are not something you can determine by looking at the exhaust. These are more subtle. Therefore a car can be on the road having no apparent exhaust effluent and yet be pouring out CO without anybody knowing it. This is what I meant.

Mr. DADDARIO. I have already kept all of you far beyond the time I should have.

I am going to pose one further question. I will not ask you to answer it here but I will ask you to provide the answer for the record.

The 1967 Air Quality Act gives the Secretary of Health, Education, and Welfare authority to prescribe standards for auto emissions which in his judgment cause pollution. This is section 202(a). But in the case of other sources, criteria and recommended control techniques must be published before standards are set.

In the case of carbon monoxide, if we do not bypass the criteria set by Federal standards and assuming the Federal Government is following California's lead, what is the basis for that State's choice of carbon monoxide emission limitations?

Please provide the answer.

Dr. MIDDLETON. Very simply provided.

(Information requested is as follows:)

BACKGROUND INFORMATION ON PROCEDURES USED IN DEVELOPING POLLUTION CONTROL STANDARDS FOR MOTOR VEHICLES—CALIFORNIA

The State of California established its initial ambient air quality and motor vehicle emission standards in December 1959. They were revised in October 1964. California's standards were based on evaluation of available evidence reflecting the relationship between pollutants and their adverse effects on health, vegetation, and visibility. This was required by State statute. Section 426.1 of the California Health and Safety Code provides: "The standards shall be so developed as to reflect the relationship between the intensity and composition of air pollution and the health, illness, including irritation to the senses, and death of human beings, as well as damage to vegetation and interference with visibility." This language refers to the establishment of air quality standards. Section 426.5,

which refers to maximum allowable standards of emissions of exhaust contaminants from motor vehicles, states that these emission standards must be "compatible with the preservation of the public health including the prevention of irritation to the senses, interference with visibility and damage to vegetaton." Provision is made in these statutes for revision of the standards. A copy of "California Standards for Ambient Air Quality and for Motor Vehicle Emissions" is enclosed to indicate in more detail the factors considered in establishing the standards and the justifications for the specific values established.

California's motor vehicle standards were derived from the State's air quality standards and data concerning motor vehicle emissions[1]. The emission standards set in 1959 were calculated from the following elements[2]:

1. Determination of the total emissions from all sources and the concentration emitted by the vehicle, and extrapolation of the data to a reasonable time period in the future. The year 1970 was selected.

2. Evaluation of current levels of atmospheric pollutants, those expected in 1970 and levels in the air quality standards which describe the relationship of air pollution effects and concentrations.

3. Calculation of the necessary reduction of pollutant emissions to maintain the desired air quality. This procedure indicated that motor vehicle hydrocarbons should be reduced by 80 percent and carbon monoxide by 60 percent.

In October 1964, the State of California revised its standards for emission of hydrocarbons and carbon monoxide from motor vehicles using data on vehicular emissions that had been developed since 1959 and using 1980 as the target year in which to restore smog-free air. These new standards were applicable, generally, to 1970 model year vehicles and were considerably more restrictive than the standards originally promulgated in 1959.[3] Recent estimates of the California Department of Public Health indicate that even more restrictive standards will be required if clean air is to be maintained in the years 1990 and 2000.[4]

FEDERAL GOVERNMENT

The Clean Air Act Amendments of 1965 directed the Secretary of Health, Education and Welfare to prescribe standards applicable to air pollutant emissions from new motor vehicles which, in his judgment, cause or contribute to, or are likely to cause or contribute to air pollution which endangers the health or welfare of any persons. The Secretary was directed to give appropriate consideration to technological feasibility and economic costs of vehicle emission control. In the Clean Air Act of 1963, the Secretary was directed to compile and publish air quality criteria whenever he determines that there is a particular air pollution agent (or combination of agents) in the air producing effects harmful to the health or welfare of people.

In the normal course of carrying out responsibilities specified in the Clean Air Act and the original Federal air pollution control law of 1955, the Department had been conducting a variety of research projects to determine the effects of air pollutants on health and welfare and had been supporting the work of others in this field through grants and contracts. Consideration of the results of this work, along with the results of work done by many investigators, both since 1955 and earlier had, by 1966, made it possible to develop reasonably good estimates of levels of air pollutants which would be necessary to prevent harmful effects on the public health and welfare. This information, along with data on existing pollution levels in a substantial number of communities clearly indicated that pollution levels associated with pollutants emitted by motor vehicles were in excess of desirable levels in many communities. All estimates of future pollution levels indicated that the situation would worsen rapidly because of the growth of urban communities and increased usage of vehicles, unless action was taken to control pollutant emissions from vehicles. On the basis of all this information, and in consideration of then available means for reducing emissions from vehicles, and their

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[1] Technical Report of California Standards for Ambient Air Quality and Motor Vehicle Exhaust; California Dept. of Public Health, Berkeley, Calif., 1960.

[2] Maga, John A. "Prepared Discussion: The Rationale of Motor Vehicle Pollution Contriol" in Proceedings, National Conference on Air Pollution, Dec. 10–12, 1962. USDHEW, PHS, USGPO, 1963 (pp. 68–70).

[3] State of California, Dept. of Public Health, Bureau of Air Sanitation, "Clean Air Quarterly" *11*, March 1967.

[4] Calif. State Dept. of Public Health "Progress Report—Possible Future Motor Vehicle Emission Standards" presented to the California Motor Vehicle Pollution Control Board, May 10, 1967.

costs, standards were promulgated in March of 1966 for control of pollutants from certain motor vehicles, beginning with the 1968 model year.

Since 1966, the Department has continued and accelerated its work on determination of the adverse effects of air pollutants on health and welfare, means for control of pollutants from motor vehicles, measurement of pollution levels in a variety of communities, estimation of probably future pollution levels, and development of air quality criteria. Such criteria are being prepared for carbon monoxide, hydrocarbons, and nitrogen oxides. By the later part of 1967, sufficient knowledge had been acquired to provide a reasonable basis for selection of air quality goals for community atmospheres and to relate these to presently existing and probable future pollution levels. The air quality goals used were generally consistent with those recommended by the Advisory Panel on Electrically Powered Vehicles to the Commerce Technical Advisory Board of the U.S. Department of Commerce in a report supported by nine Federal agencies[5, 6]. On the basis of all available information, it was determined that the motor vehicle emission standards promulgated in 1966 would not provide the degree of emission reduction needed to ensure air quality in keeping with the selected air quality goals. Therefore, after consideration of technological feasibility and economic costs, revised vehicle emission standards were proposed by the Secretary of HEW in the Federal Register on January 4, 1968. When adopted and implemented, these standards will provide for important reductions in emissions and pollutant levels in the ambient air. However, in view of the continuing growth of urban centers and vehicle usage, it is expected that even more restrictive standards will be needed in the future. Further developments in emission control technology will be needed.

California Standards for Ambient Air Quality and for Motor Vehicle Emissions

A compilation of standards set by the California State Department of Public Health between December 1959 and October 1965

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Sections of the Health and Safety Code.
Ambient Air Standards.
Motor Vehicle Emission Standards:
- **Definition of Terms;**
- **Exhaust Emissions;**
- **Crankcase Emissions;**
- **Fuel Tank Emissions;**
- **Carburetor Hot Soak Emissions;**
- **Smoke Emissions.**

Sections of the Health and Safety Code Relating to the Enactment of Standards for Ambient Air Quality and for Motor Vehicle Emissions

§ *426.1 Standards for quality of air*

The State Department of Public Health shall, before February 1, 1960, develop and publish standards for the quality of the air of this State. The standards shall be so developed as to reflect the relationship between the intensity and composition of air pollution and the health, illness, including irritation to the senses, and death of human beings, as well as damage to vegetation and interference with visibility.

The standards shall be developed after the department has held public hearings and afforded an opportunity for all interested persons to appear and file statements or be heard. The department shall publish such notice of the hearings as it determines to be reasonably necessary.

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[5] U.S. Dept. of Commerce "The Automobile and Air Pollution—A Program for Progress, Part I." Report of the Panel on Electrically Powered Vehicles, R. S. Morse, Chairman. Oct. 1967. (USGPO).

[6] U.S. Dept. of Commerce "The Automobile and Air Pollution—A Program for Progress, Part II." Report of the Panel on Electrically Powered Vehicles, R.S. Morse, Chairman, Dec. 1967. (USGPO).

The department, after notice and hearing, may revise the standards, and shall publish the revised standards, from time to time. (Added Stats. 1959, c. 835, p. 2885, § 1, effective June 8, 1959.)

§ 426.5 Maximum allowable standards of emissions of exhaust contaminants from motor vehicles; determination; public hearings; notice; revision

It shall be the duty of the State Director of Public Health to determine by February 1, 1960, the maximum allowable standards of emissions of exhaust contaminants from motor vehicles which are compatible with the preservation of the public health including the prevention of irritation to the senses, interference with visibility and damage to vegetation.

The standards shall be developed after the department has held public hearings and afforded an opportunity for all interested persons to appear and file statements or be heard. The department shall publish such notice of the hearings as it determines to be reasonably necessary.

The department after notice and hearing may revise the standards, and shall publish the revised standards, from time to time. In revising the standards the department shall, after February 1, 1960, take into account all emissions from motor vehicles rather than exhaust emissions only.

Whenever the department revises the standards it shall submit a copy of such revised standards to the Legislature if the Legislature is in session, or to the Senate Fact Finding Committee on Transportation and Public Utilities and the Assembly Interim Committee on Transportation and Commerce if the Legislature is not in session, and such revised standards shall not become effective until the 31st day after such submission. (Added Stats. 1959, c. 200, 2091, § 1, as amended; Stats. 1960, 1st Ex. Sess., c. 36, p. 380, § 1; Stats. 1965, c. 2031, p. —, § 1 urgency, eff. July 23, 1965.)

AMBIENT AIR STANDARDS

In establishing the air quality standards which follow, the State Department of Public Health aimed at providing a sound basis for efforts to control or abate sources of atmospheric pollution. With the great variety and wide distribution of emission sources, air pollution control may indeed be costly, and minimum levels of some pollutants are inevitable. It was important, therefore, to estimate at what level certain specified effects begin to occur for the various pollutants. These estimates are the basis for the standards.

It was agreed from the outset that any standards set must be based on sound data and concurred in by scientists in the air pollution and related fields. The standards relating to human health and well-being were based on the groups of persons in the population who are most sensitive to air pollution effects provided such groups be definable in terms of age and medical status.

The following possible effects of community air pollution on sensitive groups of people were recognized:

1. Acute sickness or death.
2. Insidious or chronic disease.
3. Alteration of important physiological function.[1]
4. Untoward symptoms.[2]
5. Discomfort from air pollution sufficient to lead individuals to change residence or place of employment.

The following effects of community air pollution upon sensitive types of crops were also recognized:

1. Acute damage leading to unmarketability.
2. Insidious or chronic effects, leading to impaired yield.
3. Alteration of fundamental biochemical processes without overt damage.

The effects of air pollutants vary both in kind and in severity. The seriousness of the effect determines the urgency of control. A graded set of standards was established which recognized this relationship. Three levels of air pollutants were defined as follows:

I. "Adverse" Level. The first effects of air pollutants are those likely to lead to untoward symptoms or discomfort. Though not known to be associated with the development of disease, even in sensitive groups, such effects are capable of

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[1] By important physiological function is meant function such as ventilation of the lung, transport of oxygen by hemoglobin, or dark adaptation (the ability to adjust eye mechanisms for vision in partial darkness).

[2] By untoward symptoms is meant symptoms which in the absence of an obvious cause, such as air pollution, might lead a person to seek medical attention and relief.

disturbing the population stability or residential or work communities. The "adverse" level is one at which eye irritation occurs. Also in this category are levels of pollutants that lead to costly and undesirable effects other than those on humans. These include damage to vegetation, reduction in visibility, or property damage of sufficient magnitude to constitute a significant economic or social burden.

II. "Serious" Level. Levels of pollutants, or possible combination of pollutants, likely to lead to insidious or chronic disease or to significant alteration of important physiological function in a sensitive group, define the "serious" level. Such an impairment of function implies a health risk for persons constituting such a sensitive group, but not necessarily for persons in good health.

III. "Emergency" Level. Levels of pollutants, or combination of pollutants, and meteorological factors likely to lead to acute sickness or death for a sensitive group of people, define the "emergency" level.

"The net effect of air pollutants depends on a number of modifying factors. It cannot be predicated reliably from the mere specification of a concentration of a pollutant at one place at one time. It is known that particle size may modify the toxicity of inhaled toxic substances; moreover, the mere presence of particles, whether or not in themselves toxic, may strongly intensify the irritant action of gases such as sulfur dioxide. In some cases, present knowledge was sufficient to take some of these factors into account in setting standards. In others, more information will be required before standards can be set.

It was necessary in some instances to use indirect indicators in order to specify pollutant levels. For example, reliable analytical methods have been widely used to measure levels of "oxidant." Data from such measurements provide useful correlations with eye irritation, visibility and crop damage, despite the fact that "oxidant" does not directly measure the specific substances that produce these effects. Until the specific substances have been identified and adequate procedures for their measurement developed, "oxidant index" will be used to define these effects at the advese level. In the future it may be practical to utilize a biological indicator of air pollution.

Standards set for single pollutants alone are not necessarily applicable to combinations of pollutants, nor to physiological effects under unusual weather conditions, or to pollutants occurring in aerosol form or when in combination with aerosols. These factors may complicate the effects of single pollutants. In addition several pollutants may have similar effects. For these reasons no single level of a given pollutant ordinarily without effect at that level should be interpreted as a guarantee that levels below that point are safe or free from effect.

The standards of air quality are not intended to provide a sharp dividing line between air of satisfactory quality and air of unsatisfactory quality. The numbers represent the approximate levels at which certain definite effects begin to occur. It follows that pollution levels below those shown in the standards should not ordinarily produce the stipulated effects defined at each level.

In addition to the above matters, the following technical factors were also considered in setting standards: (1) methods of measurement of the pollutant, (2) criteria for selection of the most susceptible group in the community, and (3) time of exposure to the pollutant.

Two time-periods were considered: a time-weighted hourly average and an average for an eight-hour period. Concentrations and time periods given in the table refer only to levels for which data are felt to be reliable and suitable for application without excessive assumptions. The footnotes to the table indicate the substances which need additional data before they can be entered in the table of standards.

The entry, "Not Applicable", indicates that under conditions of community air pollution it is extremely unlikely that the defined effects occur.

It is the intent of the Department to adopt standards for additional substances in the future.

The values entered here are determined on a substantially different basis than the industrial exposure standards. These values are, therefore, not appropriate for application in industrial hygiene.

The bases upon which standards are set are indicated by items enclosed with parentheses.

The Department will interpret these standards to those agencies responsible for air pollution control. In interpreting these standards, the sites and conditions of air sampling should be so chosen as to realistically represent the exposures of persons and property which might be affected.

TABLE OF STANDARDS FOR AMBIENT AIR QUALITY

Pollutant	Adverse level [1]	Serious level [2]	Emergency level
Photochemical pollutants (hydrocarbons, ozone, oxidant, and photochemical aerosols).	Oxidant index, 0.15 p.p.m. for 1 hour by the potassium iodide method (eye irritation, damage to vegetation, and visibility reduction).	([4 5])	([4 6]).
Nitrogen dioxide	0.25 p.p.m. for 1 hour (coloration of the atmosphere during daylight hours).	3 p.p.m. for 1 hour (bronchoconstriction).	([7]).
Carbon monoxide	Not applicable	30 p.p.m. for 8 hours, or 120 p.p.m. for 1 hour (interference with oxygen transport by blood).	([8]).
Sulfur dioxide	1 p.p.m. for 1 hour or 0.3 p.p.m. for 8 hours (damage to vegetation).	5 p.p.m. for 1 hour (bronchoconstriction.	10 p.p.m. for 1 hour (severe distress in human subjects).
Hydrogen sulfide	0.1 p.p.m. for 1 hour (sensory irritation).	([9])	([10]).
Sulfuric acid	([11])	([11])	([12]).
Ethylene	0.5 p.p.m. for 1 hour or 0.1 p.p.m. for 8 hours (damage to vegetation).	Not applicable	Not applicable.
Hydrogen fluoride	([13])	([14])	Do.
Lead	Not applicable	([15])	([15]).
Particulate matter	Sufficient to reduce visibility to less than 3 miles when relative humidity is less than 70 percent.	Not applicable	Not applicable.
Carcinogens	Not applicable	([16])	Do.

[1] Level at which there will be sensory irritation, damage to vegetation, reduction in visibility, or similar effects.
[2] Level at which there will be alteration of bodily function or which is likely to lead to chronic disease.
[3] Level at which it is likely that acute sickness or death in sensitive groups of persons will occur.
[4] Hydrocarbons are a group of substances most of which, normally, are toxic only at concentrations in the order of several hundred parts per million. However, a number of hydrocarbons can react photochemically at very low concentrations to produce irritating and toxic substances. Because of the large number of hydrocarbons involved, the complexity of the photochemical reactions, and the reactivity of other compounds such as nitrogen dioxide and ozone, it is not yet possible to establish serious and emergency levels for hydrocarbons. From the public health standpoint, the concentration of those hydrocarbons which react photochemically should be maintained at or below the level associated with the oxidant index defined in the adverse standard.
[5] Ozone, at 1 p.p.m. for 8 hours daily for about a year, has produced bronchiolitis and fibrositis in rodents. Extrapolation of these data to man is difficult. Functional impairment data have been reported; at 1.25 p.p.m. some effect is observed on residual volume and diffusing capacity. The variability of the tests was not reported. Additional data would be needed before a standard is set.
[6] A value of 2.0 p.p.m. of ozone for 1 hour may produce serious interference with function healthy persons and the assumption is made that this might cause acute illness in sensitive persons.
[7] Nitrogen dioxide, at concentrations above 2.5 p.p.m., causes acute damage to sensitive plants. 1 p.p.m. for 8 hours will produce significant growth reduction, expressed as fresh and dry weight, with no visible lesions of damage. High levels (150 to 220 p.p.m.) in short exposures produce fibrotic changes in the lungs of man that may end fatally.
[8] Given certain assumptions concerning ventilatory rates, acute sickness might result from a carbon monoxide level of 240 parts per million for 1 hour in sensitive groups because of inactivation of 10 percent of the body's hemoglobin. In any event it is clear that when a population exposure limit has been set for carbon monoxide, because of exposures from other sources, community air pollution standards should be based on some fraction of this limit.
[9] Hydrogen sulfide is not known to produce chronic disease in humans but there may be durable sequelae from acute exposures. The disagreeable odor may interfere with appetite in sensitive groups of persons at about 5 parts per millioni At high concentrations loss of the sense of smell occurs. This has been reported at 100 parts per million for exposures lasting 2 to 15 minutes. Conjunctivitis and mild respiratory tract irritation have been reported at levels of 50 to 100 parts per million for 1 hour.
[10] Acute sickness and death with neurotoxicity may occur at concentrations of several hundred parts per million. It is very unlikely these levels will occur in community air pollution.
[11] A sulfuric acid mist level of 1 mg./M^3 with an average particle size of 1 μ will produce a respiratory response in man. It is not possible to generalize from this for all air pollution conditions, because under natural conditions, particle size will vary. Only with large droplets would sensory irritation be produced without other physiological effects.
[12] A level of 5 mg./M^3 of sulfuric acid mist for a few minutes produces coughing and irritation in normal individuals. Presumably, it could cause acute illness in sensitive groups of persons in a period of 1 hour.
[13] Hydrogen fluoride and other airborne fluorides settle upon and some are absorbed into vegetation. When forage crops containing 30 to 50 p.p.m. of fluoride measured on a dry-weight basis are regularly consumed over a long period the teeth and bones of cattle may show changes, depending upon age, nutritional factors, and the form of fluoride ingested. Such changes may or may not have any economic effect. Fluorides at these levels do not necessarily cause injury to the forage plants themselves. However, injury may be produced in certain species of vegetation upon long-term exposure to low levels of atmospheric fluorides.
[14] The irritating properties of hydrogen fluoride in experimental human exposure have been manifested by desquamation of the skin, at concentrations of 2 to 5 p.p.m. Mucous membrane irritation also occurs from hydrogen fluorides but quantitative data are not adequate to support a standard.
[15] It is clear that lead levels should be set on the basis of average values for long periods. While data are abundant concerning human response to 8-hour-a-day, 5-day-a-week exposures, data are insufficient for the effects of the continuous exposure inherent in community air pollution. While laboratory studies will be pursued with vigor, it becomes very important that local agencies collect data on existing lead levels. Since lead exposures are from multiple sources, community air pollution standards should be based on a portion of the total limit for population exposure.
[16] Carcinogens include a few organic compounds such as some polycyclic hydrocarbons and some metals such as arsenic and chromium. Studies on effects of such substances are currently underway, but there are not sufficient data at present to set standards. In the meantime, it is recommended that concentrations of carcinogens in air should be kept as low as possible.

Motor Vehicle Emission Standards

Motor vehicles are a major source of air pollution in the large metropolitan regions of California. Their exhaust contains large quantities of hydrocarbons, oxides of nitrogen and carbon monoxide. Hydrocarbons are also emitted from the crankcase, fuel tank and carburetor. Controlling the emissions of these contaminants from motor vehicles is an essential step in the control of photochemical smog.

Recognizing that control of motor vehicle emissions is a vital part in a total program to improve air quality in California, the State Department of Public Health established a set of standards for the various motor vehicle emissions. These standards provide a technical basis for control programs. The standards define acceptable limits for emissions from an "average" vehicle.

Essentially, the Department based the standards on conditions in Los Angeles. Since air pollution in Los Angeles is known to be the most severe in the state, measures that would provide satisfactory air quality there would be adequate for other regions in the state.

Hydrocarbons and oxides of nitrogen are directly involved in the photochemical reactions in the atmosphere that result in smog. Nitrogen dioxide can also be injurious to health, cause vegetation damage, and impart an undesirable color to the atmosphere.

Carbon monoxide does not participate in the smog reaction, but it is a toxic substance. At sufficiently high concentrations, it can cause sickness. Since more than 95 percent of the carbon monoxide in the atmosphere of Los Angeles is of vehicular origin, control of its emission from motor vehicles should effectively reduce the atmospheric concentration of this contaminant.

The smoke standard was established to provide a guide-line for controlling the local nuisance effect of vehicle smoke.

Definition of Terms

Exhaust Emissions.—Exhaust emissions are defined as substances emitted to the atmosphere from any opening downstream from the exhaust manifold of a motor vehicle engine.

Crankcase Emissions.—Crankcase emissions are defined as substances emitted directly to the atmosphere from any opening leading to the crankcase of a motor vehicle engine. Crankcase gases which are conducted to the engine intake or exhaust systems are not included in the definition of crankcase emissions, but are defined as exhaust emissions.

Carburetor Emissions.—Carburetor Operating Losses: Carburetor operating losses are defined as the vaporized fuel emitted from the carburetor of a motor vehicle engine to the atmosphere while the engine is operating.

Carburetor Hot Soak Losses: Carburetor hot soak losses are defined as the vaporized fuel emitted from the carburetor of a motor vehicle engine to the atmosphere during the hot soak period, i.e., the period which begins immediately after the engine is turned off.

Fuel Tank Emissions.—Fuel tank emissions are defined as the vaporized fuel which escapes to the atmosphere from the fuel tank of a motor vehicle, except during tank filling.

Exhaust Emissions

The standards of emissions of motor vehicle exhaust contaminants are:

Hydrocarbons—275 parts per million by volume as hexane (0.165 mole percent carbon atoms).

Carbon Monoxide—1.5 percent by volume.

Oxides of Nitrogen—350 parts per million by volume as nitrogen dioxide.

However, effective January 1, 1970, the standards of emissions of motor vehicle exhaust will be:

Hydrocarbons—180 parts per million by volume as hexane.

Carbon Monoxide—1.0 percent by volume.

Oxides of Nitrogen—350 parts per million by volume as nitrogen dioxide.

Exhaust gas concentration shall be adjusted to a dry exhaust volume containing 15 percent by volume of carbon dioxide plus carbon monoxide. However, effective January 1, 1970, the exhaust gas concentration shall be adjusted by the ratio of $15/[\frac{1}{2}(\%CO)+\%CO_2+10(\%\ \text{Hydrocarbon})]$.

Hydrocarbons are defined as the organic constituents of vehicle exhaust as measured by a hexane-sensitized nondispersive, infrared analyzer or by an equivalent method.[1]

Carbon monoxide shall be measured by a nondispersive infrared analyzer or by an equivalent method.

Oxides of nitrogen shall be measured by the phenoldisulfonic acid method or by an equivalent method.

The standards refer to a composite sample representing the driving cycle described as follows:

TABLE I[1]

Condition	Rate of speed change miles per hour per second	Percent of total time	Percent of total sample volume
Idle		15.0	4.2
Cruise (miles per hour):			
20		6.9	5.0
30		5.7	6.1
40		2.7	4.2
50		.7	1.5
Acceleration (miles per hour):			
0 to 60	3.0	1.1	5.9
0 to 25	2.2	10.6	18.5
15 to 30	1.2	25.0	45.5
Deceleration (miles per hour):			
50 to 20	1.2	10.2	2.9
30 to 15	1.4	11.8	3.3
30 to 0	2.5	10.3	2.9
Total		100.0	100.0

[1] If other test cycles are used, they must represent urban driving and the emissions must be relatable to the composite sample from the driving modes described in table I.

Crankcase Emissions

The standard for motor vehicle crankcase emissions is: Hydrocarbons—0.1 percent by weight of the supplied fuel. The standard refers to a composite sample representing the modes of engine operation described as follows:

Mode of operation	*Percent of total time*
Idle	19
30 mph—16 inch mercury manifold vacuum	37
30 mph—10 inch mercury manifold vacuum	11
30 mph—2 inch mercury manifold vacuum	8
Deceleration	25

Fuel Tank Emissions

The standard for fuel tank emissions is: Hydrocarbons—6 grams per day.[2]

Carburetor Hot Soak Emissions

The standard for carbuertor hot soak emissions is: Hydrocarbons—2 grams per soak.[3]

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[1] Some hydrocarbons, for example methane, ethane, propane, n-butane and acetylene, are not considered sufficiently reactive to produce photochemical smog effects. The Department is working on methods which measure the reactive organic compounds in exhaust and will restate the hydrocarbon standard in terms of reactive hydrocarbons when methods and data satisfactory to the Department are developed.

[2] The standard refers to emissions in a 24-hour day when the minimum temperature is 60°F. and the maximum is 90°F., and when the fuel tank is between one-fourth and one-half full, averaging three-eighths full. The standard was developed from data obtained when fuels averaging a Reid Vapor Pressure of approximately 9 were used, and when hydrocarbon emissions were collected in condensing traps at dry ice temperature. Equivalent methods and other conditions may be used if approved by the Department of Public Health.

[3] The standard refers to emissions from the carburetor of an automotive engine operated to an equilibrium coolant temperature of 180° F. minimum and when the ambient air temperature is from 85 to 95° F. minimum. The soak duration is one hour. The standard was developed from data obtained when fuels averaging a Reid Vapor Pressure of approximately 9 were used in the test vehicles, and when hydrocarbon emissions were collected in condensing traps at dry ice temperature. Equivalent methods and other conditions may be used if approved by the Department of Public Health.

SMOKE EMISSIONS

The standard for smoke emitted from a motor vehicle is:

a. The shade, or the equivalent opacity of the shade,[1] designated as No. 1 on the Ringelmann Chart; [2] or

b. The shade, or equivalent opacity of the shade, designated as Ringelmann No. 2, if the smoke is for a period not exceed five seconds at a time.

ADDITIONS TO TITLE 17, CALIFORNIA ADMINISTRATIVE CODE—ADOPTED BY THE CALIFORNIA STATE BOARD OF PUBLIC HEALTH, JUNE 10, 1966

ARTICLE 2. STANDARDS FOR MOTOR VEHICLE EMISSIONS

30570. Exhaust Odor and Irritation

The standards for exhaust odor and irritation are:

(a) The average intensity of odor as determined by subjective appraisal shall be less than the intensity from diesel vehicles with horizontal exhaust pipes representative of the diesels in use in 1966 and whose odorant concentrations have been reduced by at least 80 percent.

(b) There shall be no detectable eye, nasal or throat irritation to at least 75 percent of the panel.

(c) Exhaust odors that are different in quality from characteristic diesel odor shall be less objectionable to the panel than the odor from diesel vehicles with horizontal exhaust pipes representative of the diesels in use in 1966 and whose odorant concentrations have been reduced by at least 80 percent.

(d) The conditions for the appraisal are:

1. The odor and irritation panel shall consist of not less than 10 persons.

2. Appraisal of odor and irritation shall be made on a vertical plane ten feet distant from the exhaust outlet to either side of the motor vehicle parallel to the longitudinal axis. For vehicles with more than one exhaust outlet, the appraisal shall be made on a vertical plane parallel to the longitudinal axis at a horizontal distance ten feet from the midpoint of the exhaust outlets.

3. The exhaust gas shall be evaluated during the modes of idle and full throttle acceleration.

4. Other methods of odor appraisal or measurement may be used if approved by the Department of Public Health.

ADDITION TO TITLE 17, CALIFORNIA ADMINISTRATIVE CODE—ADOPTED BY THE CALIFORNIA STATE BOARD OF PUBLIC HEALTH, OCTOBER 21, 1966

ARTICLE 2. STANDARDS FOR MOTOR VEHICLE EMISSIONS

30520. Exhaust Emissions. (a) The standards of emissions of motor vehicle exhaust contaminants are:

1(Vehicles with engine displacement of 50 to 100 cubic inches: Hydrocarbon—410 parts per million by volume as hexane. Carbon Monoxide—2.3 percent by volume.

(2) Vehicles with engine displacement of 101 to 140 cubic inches: Hydrocarbons—350 parts per million by volume as hexane. Carbon Monoxide—2.0 percent by volume.

(3) Vehicles with engine displacement above 140 cubic inches: Hydrocarbons—275 parts per million by volume as hexane. Carbon Monoxide—1.5 percent by volume.

(4) Oxides of Nitrogen—350 parts per million by volume as nitrogen dioxide, for all engine displacements.

However, effective January 1, 1970, the standards of emissions of motor vehicle exhaust are:

Hydrocarbons—180 parts per million by volume as hexane.

Carbon Monoxide—1.0 percent by volume.

Oxides of Nitrogen—350 parts per million by volume as nitrogen dioxide.

(b) Exhaust gas concentrations shall be adjusted to a dry exhaust volume containing 15 percent by volume of carbon dioxide plus carbon monoxide. How-

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[1] Equivalent opacity is defined as the obscuration to an observer's view produced by smoke of any color that is equal to an obscuration by smoke of a shade specified in the Ringelmann Smoke Chart, published by the U.S. Bureau of Mines.

[2] As published by the U.S. Bureau of Mines, Information Circular 7718, August, 1955.

ever, effective January 1, 1970, the exhaust gas concentrations shall be adjusted by the ratio of $15/[\frac{1}{2}(\%CO)+\%CO_2+10(\%\ Hydrocarbon)]$.

(c) Hydrocarbons are defined as the organic constituents of vehicle exhaust as measured by a hexane-sensitized nondispersive infrared analyzer or by an equivalent method.[1]

(d) Carbon Monoxide shall be measured by a nondispersive infrared analyzer or by an equivalent method.

(e) Oxides of nitrogen shall be measured by the phenoldisulfonic acid method or by an equivalent method.

(f) The standards refer to a composite sample representing the driving cycle described as follows:

TABLE I.[1]

Condition	Rate of speed change miles per hour per second	Percent of total time	Percent of total sample volume
Idle		15.0	4.2
Cruise (miles per hour):			
20		6.9	5.0
30		5.7	6.1
40		2.7	4.2
50		.7	1.5
Acceleration (miles per hour):			
0 to 60	3.0	1.1	5.9
0 to 25	2.2	10.6	18.5
15 to 30	1.2	25.0	45.5
Deceleration (miles per hour):			
50 to 20	1.2	10.2	2.9
30 to 15	1.4	11.8	3.3
30 to 0	2.5	10.3	2.9
Total		100.0	100.0

[1] If other test cycles are used, they must represent urban driving and the emissions must be relatable to the composite sample from the driving modes described in table I.

Mr. DADDARIO. I expect we could continue here for some time but we will have a whole series of questions for you. We would appreciate your getting them to us. If there are any problems I am sure we can have our staff work them out.

Dr. MIDDLETON. Thank you very much, sir. I enjoyed being with you.

Mr. DADDARIO. I appreciate ever so much your cooperation, and you all being here this morning.

(Dr. Hibbard's complete prepared statement is as follows:)

PREPARED STATEMENT OF WALTER R. HIBBARD, DIRECTOR, BUREAU OF MINES, U.S. DEPARTMENT OF THE INTERIOR

My name is Walter Hibbard, and I am the Director of the Bureau of Mines, U.S. Department of the Interior. A biographical summary is available for the record if you so desire.

I am pleased to have the opportunity to participate in these hearings and to outline for you the activities of the Bureau of Mines that are directed toward resolution of the technical problems facing the Nation in its efforts to abate environmental pollution.

Our mission and responsibility in this important problem area is for research on the control, at the source, of pollutants produced as a result of the production, processing, handling, and utilization of the Nation's mineral and mineral fuels resources. Authority for conducting such research derives from the Bureau's organic act which states that scientific and technologic investigations shall be

[1] Some hydrocarbons, for example methane, ethane, propane, n-butane and acetylene, are not considered sufficiently reactive to produce photochemical smog effects. The Department is working on methods which measure the reactive organic compounds in exhaust and will restate the hydrocarbon standard in terms of reactive hydrocarbons when methods and data satisfactory to the Department are developed.

conducted on the extraction and utilization of mineral substances with a view to conserving resources through the prevention of waste, increasing safety, and on behalf of the Government to investigate mineral fuels.

At the present time, we are committed to research designed to provide feasible, economic methods for abatement of the ever-growing air pollution problems of this country. Although this research is being performed largely in cooperation with the Public Health Service, significant amounts of direct program funds of the Bureau are applied to research programs that originate as a result of efforts to conserve our natural resources. These programs also make a marked contribution towards the pollution abatement program. The two most active areas under investigation cover the control of fumes resulting from combustion of gasoline and diesel fuels in automotive engines and the control of sulfur oxides emissions from the combustion of fossil fuels.

The type of pollutants discharged from motor vehicles differs appreciably from those from industrial installations. Gasoline and diesel fuel are normally very low in sulfur. The exhaust gases are generally high in unburned and partially burned hydrocarbons, oxides of nitrogen, and carbon monoxide. Both automotive and diesel exhaust research is in progress in Bureau laboratories. This research stresses the relationship between types of fuel, combustion system characteristics, and the pollutants emitted. Work is also being done to identify and minimize those constituents of the exhaust that are most active in producing smog.

Just last month, engineers at our Bartlesville, Okla., Petroleum Research Center demonstrated the technical feasibility of equipping an automobile with control devices that will lower the concentration of pollutants emitted well below what the Commerce Department's Report of the Panel on Electrically Powered Vehicles considered as commercially feasible by 1970.

The demonstration involved equipping a 1967 stock model of popular make with devices called exhaust manifold reactors, which were developed by a domestic company interested in the problem of controlling automotive exhaust emissions. Use of the exhaust manifold reactors permits mixing additional air with the exhaust gases, thereby changing their chemical properties.

By applying these devices, the research group at Bartlesville has thus far been able to achieve these results:

(1) Emission of total hydrocarbons from the exhaust of the car has been reduced to less than 70 parts per million (ppm), compared with an average of 900 ppm in the exhausts from cars without pollution controls.

(2) The concentration of reactive hydrocarbons (those that form smog) has been reduced to less than 50 ppm. The Bureau believes that this concentration probably is less than 30 ppm, but further analytical studies are necessary to confirm this finding.

(3) Carbon monoxide has been reduced to less than 0.7 percent of the total exhaust mixture, compared with an estimated 3.5 percent for cars not equipped with pollution controls.

(4) Oxides of nitrogen have been reduced to 400 to 600 ppm, compared with concentrations that range from 1,000 to 2,000 ppm for conventional cars.

The following table compares the pollutant concentration recorded in extended tests of the Bureau's demonstration car with those considered commercially feasible by 1970.

	Bureau of Mines vehicle	Considered commercially feasible by 1970 [1]	1970 California standards
Total hydrocarbons	70 p.p.m	275 or 180 p.p.m	180 p.p.m.
Carbon monoxide	0.7 percent	1.5 or 1 percent	1 percent.
Nitrogen oxides	400 to 600 p.p.m	350 or 600 to 800 p.p.m.	350 p.p.m.

[1] Source: "The Automobile and Air Pollution." Report of the Panel on Electrically Powered Vehicles, U.S. Department of Commerce, October 1967.

It is particularly noteworthy that with its low hydrocarbon and carbon monoxide emissions the Bureau's demonstration car has exceeded both what is considered commercially feasible by 1970 and the standards proposed for California in that year. Only with respect to nitrogen-oxide levels have we missed the lowest mark established, and even there our work has refuted the pessimistic view that nitrogen oxides can be reduced below a certain level only if we are willing to accept higher levels of other contaminants.

Bureau of Mines responsibilities for the conservation and efficient utilization of fossil fuels places this agency in a unique position to take a responsible part in the overall Federal program on air pollution abatement. Therefore, our staff, in cooperation with the Public Health Service, is making every effort to find a feasible solution to the control of pollutants at the source of their production. We believe that a total systems approach to the problem is required if the problems of air pollution are to be solved without severe economic and social effects on the Nation as a whole.

Most air pollution ordinances that have been adopted or are being considered by cities, counties, states, etc., contain provisions limiting the sulfur content of fuels burned in stationary heating and power plants. This type of limitation is the only currently feasible method of effecting substantial and immediate reduction of emissions of sulfur oxides to the atmosphere.

Nevertheless, widespread adoption of such provisions would have a significant impact on the availability and cost of low-sulfur fuels. For example, over 90 percent of coal containing 1 percent or less sulfur is produced in the Appalachian area, which contains about 8 percent of total reserves of such coal. Furthermore, these low-sulfur coals are, (a) in great demand by metallurgical plants, both in the U.S. and in foreign countries, (b) priced substantially higher at the mine than high-sulfur coals, and (c) produced somewhat farther from the areas considering their use for air-pollution control purposes than are the higher-sulfur coals currently being used.

Accordingly, the Bureau recently embarked on a special cooperative project to determine the location, quality and availability of low-sulfur coals for energy production.

The combustion of fossil fuels in powerplants and for space heating is a principal source of air pollutants, particularly sulfur and nitrogen oxides. The Bureau of Mines is engaged in research that we believe will lead to practical and economically feasible methods for: (1) desulfurization of fuels and (2) the removal of sulfur oxides from stack gases before being released to the atmosphere and the subsequent recovery of the sulfur resulting from the combustion of these fuels, thus reducing the critical shortage of sulfur that now exists on a world-wide basis. It is estimated that more than 23 million tons of sulfur dioxide are discharged into the atmosphere annually from the combustion of fuels for heat and power purposes and from industrial operations such as the metallurgical processing of sulfide ores.

One of the most promising methods for the recovery of sulfur from stack gases is the alkalized alumina process, which the Bureau invented and then developed in conjunction with the U.S. Public Health Service.

The process consists of four steps:

1. *Absorption.*—Alkalized alumina is contacted by the flue gas to remove sulfur oxide.

2. *Regeneration.*—The alkalized alumina containing the sulfur oxide is treated with a reducing gas to convert the sulfated alumina to its original state for recycling in the process. Simultaneously, the sulfur oxide is converted to hydrogen sulfide.

3. *Production of reducing gas.*—A gas generator is required to supply the gas essential to step two above. The reducing gas may be derived from either coal or natural gas or heavy hydrocarbons.

4. *Sulfur production.*—Hydrogen sulfide is converted to elemental sulfur. Steps one and two are novel to the alkalized alumina process; steps three and four are borrowed from other existing commercial-scale operations.

Operated on the basis of 90 percent removal of sulfur oxide from stack gases obtained from the combustion of 3 percent sulfur coal, the process should produce one ton per day of byproduct sulfur for each 4.3 megawatts of power generated.

Research on the alkalized alumina process has proceeded through laboratory bench-scale experiments using simulated flue gases, to a small scale pilot plant study. This now has been followed by operations in an intermediate sized pilot plant capable of handling 55,000 cubic feet of stack gases per hour. Completely instrumented for automatic control, this latest unit is designed for operation over extended periods on a 7-day a week, 24-hour a day schedule.

On the basis of results obtained to date, the process appears promising, both technically and economically. Latest estimates, however, indicate that the system will not be ready for industrial application before late 1970 or early 1971 *at the present level of effort.* Normally, it would be recommended that any further development await the outcome of the present pilot plant research program. However, because of the urgency of the situation and since this process is the most promis-

ing, we believe steps should be initiated immediately to design and build a plant to desulfurize a gas stream equivalent to that from a 30 megawatt power plant. There has been sufficient indication of interest from industry that it may be possible to build such a plant as a cooperative venture between industry and Government.

Before concluding my statement, I would like to refer briefly to two additional problem areas of air pollution, which, although of comparatively limited scope, are nonetheless significant.

The first involves mine tailings. These are the materials rejected during the processing and concentration of minerals from ores. There are hundreds of millions of tons of such tailings throughout the country that are the frequent source of the air-borne material of dust storms. Locally, this type of pollution disposal can reach annoying proportions.

The Bureau is working on several techniques that can be broadly applied to the majority of problems of tailings piles. Many piles are composed of relatively barren material. In these piles, the originally desired mineral has been efficiently extracted and there are no accompanying minerals worth removing. For these tailings, the only solution is disposal in an unobjectionable manner and we are investigating two methods of doing this. One involves chemical treatment for temporary stabilization, followed by fertilization and seeding with selected seeds to provide a permanent cover of vegetation that will minimize or prevent wind and rain erosion and the accompanying air and water pollution. The scenic blight caused by barren tailings dumps is also minimized by this procedure. The other approach involves injection of slurried tailings into underground strata. This technique has been shown to be technically feasible even for relatively coarse material, and the economics are now under investigation.

The other problem area that has been generally recognized for some time involves the pollution of the atmosphere within underground mines. In recent years the Bureau has attacked the control of airborne quartz that, when inhaled in excessive quantities, causes silicosis, and has undertaken an extensive survey of dustiness levels in bituminous coal mines where a chest disease known as coal miners' pneumoconiosis is found as part of a joint program with the Public Health Service. More recently in response to the growing concern with respect to the occurrences of lung cancer among uranium miners, we have surveyed 175 mines to evaluate the level of alpha radiation from radon daughters to which the men have been exposed and made recommendations for ventilation improvement, wherever we could, to reduce their exposure. Seventy-five of the mines were subsequently resurveyed. In those mines, the proportion of the men receiving less than 1.0 Working Level Day of exposure increased from 38.4% to 65% in the interim. One Working Level Day corresponds to the present requirement promulgated by the Department of Labor under the Walsh-Healey Act.

In conclusion, I would like to stress that the problems of environmental pollution, including pollution of the atmosphere, are, to a large degree, a byproduct of our economic progress, as well as past neglect and apathy. And these problems can be expected to increase in importance as our technology and standard of living continue to grow. It is unfortunate indeed, that our scientific knowledge of the causes and character of environmental pollution is more extensive than the technology to handle the waste products of our industrial civilization. Nevertheless, we believe that through continued research and engineering development, it will be possible to solve the problems confronting the Nation effectively and economically. The Bureau of Mines recognizes its responsibilities for the control of pollutants produced as a result of the production, processing, handling, and utilization of the Nation's mineral and mineral fuels resources and will continue to work for technically and economically feasible solutions to the problems arising therefrom.

Thank you for the opportunity to appear before you today, Mr. Chairman. I am at your service to answer any questions that may have occurred to you or the committee members.

ADDITIONAL STATEMENT BY DR. BLOMQUIST

In the testimony cited by Mr. Daddario, Dr. Bennett said: "The problem is not that we lack evidence that some of these pollutants do affect health. We are lacking evidence that they actually cause disease. There is abundant evidence

that an individual suffering from chronic disease has aggravated symptoms. There is abundant evidence that they cut down on performance of otherwise healthy individuals when they exert themselves. There is abundant evidence that they are harmful to plants. On the other hand, the area in which we are almost totally lacking in knowledge is what the effect will be of exposure to relatively low concentrations of materials over a period of 10, 20, or 30 years."

Dr. Bennett said, in short, that air pollution is indeed known to be a health hazard, and that what remains to be determined is exactly how serious a hazard it is. I am basically in accord with this view, though I do not agree in detail with everything Dr. Bennett said. I believe he and I are very concerned with determining at what level of a given pollutant or combination of pollutants injurious effects begin to take place, effects which culminate in increased morbidity and mortality years later.

In my opinion, it is overly conservative to say that we are "almost totally lacking" in knowledge of the effects of long-term exposure to relatively low levels of pollution in the air. There is already a substantial fund of scientific knowledge which indicates, without doubt, that long-term exposure to ordinary levels of air pollution in urban communities is associated with the worsening and, quite possibly, even with the initiation of chronic respiratory diseases such as asthma, bronchitis, and emphysema.

I submit that much of the speculation and controversy about whether or not air pollution causes disease is irrelevant to the significance of air pollution as a public health hazard. We are accustomed to thinking that a disease state is brought about by a single cause—a carryover from a period in public health history when virtually total emphasis was placed on *the* bacterial or viral agent which had to be identified before a communicable disease could be recognized and dealt with. That there is frequently a simple association between an infectious disease agent and the acute disease reaction which it provokes is an observation that has been and still is important in public health work. But we have learned that it is not the master key that unlocks all the secrets of disease and health. The idea that one factor is wholly responsible for any one illness is patently too simple to provide all the answers we need to deal with the chronic diseases which are a growing problem today.

Chronic bronchitis is a good example. It develops over a long period of time and can become crippling through a combination of many factors—air pollution, smoking, repeated and recurring bouts with infectious agents, occupational exposures—all affected, perhaps, by an hereditary predisposition. What then is *the* cause of chronic bronchitis? The answer is obvious. There is probably no single cause, but there is sufficient evidence that air pollution can and does contribute to its development. This is what really matters, whether we choose to consider it *the* cause, one of several causes, or simply a contributing factor.

Mr. DADDARIO. This committee tomorrow will hear from Dr. Robert Ekhart, who will be representing the American Petroleum Institute, and Dr. Harold MacFarland of Hazleton Laboratories.

We shall adjourn until tomorrow morning at 10 o'clock at this same place.

(Whereupon, at 12:45 p.m., the committee adjourned, to reconvene at 10 a.m., Friday, January 19, 1968.)

ENVIRONMENTAL QUALITY

FRIDAY, JANUARY 19, 1968

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
SUBCOMMITTEE ON SCIENCE, RESEARCH, AND DEVELOPMENT,
Washington, D.C.

The subcommittee met, pursuant to adjournment, at 10 a.m., in room 2325, Rayburn House Office Building, Washington, D.C., Hon. Emilio Q. Daddario (chairman of the subcommittee) presiding.

Mr. DADDARIO. This meeting will come to order. Today we continue our inquiry into the status of scientific knowledge and research management in support of our national goals for environmental quality, achieving and maintaining satisfactory air quality impacts most forcefully on our energy industries, electrical power generation, space heating, industrial processing, and transportation burned fossil fuel with the oxygen of the air and thereby encounter the problems of returning that air to the community atmosphere without degrading its quality. The air we breathe is the same air which flows through furnaces and engines. How can we continue to keep these two uses compatible one with the other?

Our witnesses today represent the oil and coal industries as medical and environmental health experts. The adversary nature of their position vis-a-vis the Public Health Service officials is a valuable mechanism which should help achieve the optimum cost benefit relationship in pollution control.

This subcommittee believes it necessary to secure diverse information sources and advice in complex matters of science policy. Therefore, we welcome the testimony today as a further contribution on the criterial establishment problem. The Air Quality Act of 1967 provides for appropriate advisory committees to the Secretary of Health, Education, and Welfare, which shall include medical and scientific personnel and industrial experts.

The clear intent of the Congress is that air quality criteria shall reflect an honest appraisal of all available facts.

I repeat, therefore, my concern is that the new law cannot function unless criteria are agreed upon which can be practically implemented.

The responsibility for environmental science to achieve this is planned. Dr. Robert Eckardt is representing the American Petroleum Institute. He is accompanied by Mr. Gammelgard. We appreciate the help they have given this subcommittee in the past, and today they are also joined by Dr. Harold MacFarland of the Hazelton Laboratories.

Gentleman, we are pleased you are here with us today and appreciate your coming and are anxious to hear what you have to say.

Dr. Eckardt, if you would proceed, please.

(Dr. Eckardt's biography follows:)

ROBERT E. ECKARDT, MD

Age.—Born May 1, 1916.

Secondary School.—Great Neck High School, Great Neck, N.Y.

College.—Antioch College—Yellow Springs, Ohio: B.S. with honors in chemistry—1937.

Graduate School.—Western Reserve University—Cleveland, Ohio: M.S. in biochemistry—1939—Thesis—"Nutritional Cataract with Special Reference to Galactose Cataracts in Rats," Ph. D. in biochemistry—1940—Thesis—"Vascularization of the Cornea in Riboflavin Deficiency."

Medical School.—Western Reserve University—Cleveland, Ohio: M.D.—February, 1943.

Internship.—Straight medicine—New York Hospital: March 1943–January 1944.

Residency.—Straight medicine—New York Hospital: January 1944–October 1944 and June 1947–July 1948.

Hospital Appointments.—Assistant Attending Physician in Medicine, OPD—New York Hospital: 1948 to 1967. Attending Physician to Outpatients: 1967 to Present. Associate Attending in Medicine—University Medical Center—University Hospital: Sept. 1, 1962 to Present.

Medical School Appointments.—Instructor in Medicine—Cornell: 1948–1967. Clinical Assistant Professor of Medicine—Cornell: 1967 to Present. Assistant Clinical Professor of Industrial Medicine—NYU—Postgraduate Medical School: 1952–1967. Associate Clinical Professor of Environmental Medicine—NYU: 1967.

Licenses.—Diplomate—National Board of Medical Examiners New York State—by reciprocity with National Board: 1947. New Jersey—by reciprocity with National Board: 1951.

Specialty Certification.—Diplomate—American Board of Internal Medicine: 1950. Diplomate—American Board of Preventive Medicine (Occ. Med.): 1955. Appointed to the Executive Board: 1967.

Membership in Professional Societies.—American College of Physicians: Associate: 1950–1954; Fellow: 1954.

American Medical Association: Committee on Occupational Toxicology: Member, 1965; Chairman, 1968.

Union County and New Jersey State Medical Society.

Industrial Medical Association: Director, 1954–1956; President, 1960–1961.

American Industrial Hygiene Association: Director, 1953–1955.

Fellow, N.Y. Academy of Medicine: Sec'y. Occ. Health Section, 1967–1968; Member, Education Committee, 1968.

Fellow, American Academy of Occupational Medicine.

Member, New York Academy of Sciences, 1951.

Member, The Scientific Research Society of America, 1952.

Permanent Commission and International Association on Occupational Health: Secretary-General: XIIIth International Congress, N.Y., 1960; Elected a Member of the U.S. Delegation, 1960; Membership Committee, 1963 to Present; Chairman, U.S. Members, 1967 to Present.

American Public Health Association.

Air Pollution Control Association.

Membership in Associations.—American Petroleum Institute.

STATEMENT OF R. E. ECKARDT, M.D., DIRECTOR OF THE MEDICAL RESEARCH DIVISION OF ESSO RESEARCH & ENGINEERING CO., LINDEN, N.J.; ACCOMPANIED BY P. N. GAMMELGARD, VICE PRESIDENT, CONSERVATION AND MANUFACTURING, AMERICAN PETROLEUM INSTITUTE

Dr. ECKARDT. Thank you, Mr. Chairman.

On behalf of the institute and its member companies, I should like to thank the committee for this opportunity to present our industry's views concerning the problems that may be encountered in implementing the newly passed Air Quality Act of 1967. We believe your

committee is acting most appropriately in trying to ascertain what those problems are likely to be.

In the Air Quality Act, Congress wisely recognized the need to take economic and technologic factors into account in the setting of air quality standards. Thus it provided for consultation between the Secretary of HEW and appropriate technical advisory committees in establishing air quality criteria for use as guidelines by the States in setting standards.

We believe that standards that go beyond protection of public health ought properly to be based on a realistic assessment of the technologic feasibility and economic effects of compliance. In other words, the benefits of more stringent control than that needed to protect health should be commensurate with its cost.

Mr. DADDARIO. Dr. Eckardt, when you say it should be commensurate with its cost, do you mean that, or do you mean that establishing a criteria so that there can be a judgment as to what it will cost, recognizing health and aesthetics and everything else. Then the public can come to a decision what it is willing to pay rather than to assume that somebody in a committee will arbitrarily come to that judgment.

Dr. ECKARDT. That is right.

I would say this is precisely what we mean, that good cost figures should be available.

Because our industry possesses considerable expertise in air quality matters, we look forward to making a meaningful contribution to the scientific deliberations that must precede establishment of air quality criteria and standards.

To better enable our industry spokesmen to participate impartially and effectively in these deliberations, the American Petroleum Institute has arranged for a number of eminent medical and scientific experts to review all previous experimental work pertinent to the establishment of air quality criteria. We have also asked that they give us their independent views as to what might be considered reasonable air quality standards under various conditions—standards that would provide for the protection of health.

Mr. DADDARIO. Could you explain a little bit about how that works? When did they start, how many people are involved?

Dr. ECKARDT. This started about 3 or 4 months ago. The concept arose within our industry. We are collecting together, I would estimate, approximately 20 people. Presumably each individual would be an expert in an area of air pollution. Perhaps in relationship to one or another of the pollutants involved.

Mr. DADDARIO. How many people are you talking about?

Dr. ECKARDT. About 20.

Mr. DADDARIO. Are they doing this on a consultant basis?

Dr. ECKARDT. On a consultant basis, yes, sir.

Mr. DADDARIO. How much money and time is involved, or is this something you will work out as you go along?

Dr. ECKARDT. This is entirely their decision to make. We contacted the experts and asked them what they thought it would take to do the job that we were asking in terms of time and money.

Mr. DADDARIO. You are in the process of working it out. Do you have any idea as to when you might expect to get some results?

Dr. ECKARDT. We are hoping to get some early this spring.

Mr. DADDARIO. Mr. Bell.

Mr. BELL. Dr. Eckardt, in areas like Los Angeles County they have requirements to alleviate the pollutants that may come out of your refineries. Could you tell me what that is and how much it costs?

Dr. ECKARDT. I presume Mr. Gammelgard can answer this better.

Mr. GAMMELGARD. The industry in the Los Angeles Basin has taken a great number of measures, such as floating roof tanks to prevent evaporation loss from tanks. This raises the cost of the tank by at least 50 percent over what it would cost for a conventional cone roof tank.

Mr. BELL. Is that the tank that prevents the evaporation of the liquid gasoline?

Mr. GAMMELGARD. Yes. The roof floats on the surface of the liquid. Electrostatic precipitators on catalytic cracking units catch the last bit of catalyst dust that would otherwise get into the atmosphere. There are covered oil and water separators, closed loading systems on the tank truck and tank car racks to prevent vapors going into the atmosphere. Smokeless flares are used, as are sulfur recovery units.

These are very expensive measures and Los Angeles is certainly one area of the country where they do have a key problem and where much money has been spent.

Mr. BELL. How much are you talking about in money for one refinery that would be in one of the major industries?

Mr. GAMMELGARD. I would guess in the Los Angeles area they have invested $75 million to $100 million in facilities to control pollution from the refineries in the Los Angeles Basin. (Figures checked later and found to be $87 million capital investment and $100 million operating and maintenance costs for the period 1948–1965 inclusive.)

Mr. BELL. That is the total figure for all the refineries.

Mr. GAMMELGARD. In the Los Angeles Basin only.

Mr. BELL. Are you talking about major oil refineries or independents, too?

Mr. GAMMELGARD. All of them.

Mr. DADDARIO. Do you have any estimate as to what you save by preventing the evaporation? It seems to me it serves that purpose as well.

Mr. GAMMELGARD. There are some savings in the use of floating roof tanks for the lighter products like gasoline, but it is not exactly the type of investment you like to make because the payoff is pretty long.

Mr. DADDARIO. But there is some writeoff.

Mr. GAMMELGARD. Yes, there is.

Mr. BELL. When you have shutdowns for cleanup and repairs of the refineries and you are getting the coat off the tanks and conning towers, there is no falloff from that, is there?

Mr. GAMMELGARD. No.

Mr. DADDARIO. Mr. Mosher.

Mr. MOSHER. Dr. Eckardt, so far in your testimony you seem to be making a distinction between those standards that would provide for the protection of health and those that go beyond the protection of public health. Do you want to give us a suggestion of what the potential standards are that might be required that go beyond the protection of health? What are you thinking of there?

Dr. ECKARDT. I am thinking of material damage, plant damage, agricultural damage, corrosion of buildings, reduced visibility, all of the nonhealth factors that may be associated with air pollution.

Mr. MOSHER. I thought it would be helpful for clarification. You are making that distinction so far very definitely?

Dr. ECKARDT. Yes.

Mr. DADDARIO. Will you proceed, please?

Dr. ECKARDT. In addition, in June of this year, the institute will join with the Air Pollution Control Association, the American Industrial Hygiene Association, and the Industrial Medical Association in cosponsorship of a symposium on air quality criteria.

Parenthetically, I might add here that the National Center on Air Pollution Control has been invited to participate in this symposium to any extent that they desire.

This symposium will be held in New York City. Its purpose will be to provide an opportunity for medical and environmental scientists, from both the public and private sectors, to review the present state of knowledge concerning the effects of air pollution—and to air their views concerning what would constitute reasonable air quality criteria in the light of present knowledge.

As this committee undoubtedly knows, air quality criteria are not themselves prescriptions for air quality. They are scientific judgments, based as far as possible on available data.

Ideally, such data would convincingly relate specific time concentrations of pollutants, or combinations of pollutants, to specific effects on man and his environment.

In practice, however, this may not be so simple because the toxicologist has learned that curves relating time-dose to effect are not linear. This is because the effects at high concentrations and short exposure times often differ qualitatively from the effects produced by low concentrations over prolonged exposure.

Moreover, very few efforts have ever been made to develop appropriate data relating long-range, low-dose exposure to air pollutants with specific effects on health. Thus, any criteria issued at this time with regard to such long-term, low-dose effects must necessarily be regarded as speculative and should be so labeled.

An excellent illustration of this is the fact that during the past year no fewer than three separate sets of criteria for sulfur oxides have been issued—one by the U.S. Public Health Service, one by the State of Pennsylvania, and one from Holland. The figures arrived at by each group were different, even though many of the same source data were used and the approach and concern were presumably quite similar.

Mr. DADDARIO. Dr. Eckardt, how do they differ? Are they more or less stringent? Why do you call these three to our attention beyond the fact that there were three sets of criteria developed in this way? What is so important about it?

Dr. ECKARDT. The importance of this is the level at which effects are attributed. In the air quality criteria by the PHS basically they are talking about a tenth of a part per million for SO_2 on a 24-hour basis. The State of Pennsylvania proposes 0.25 parts per million on a 24-hour basis. The report from Holland, as I remember the figure, is three-tenths part per million on an 8-hour basis. These levels are those

to which they feel we are going to have to control air pollution and they differ. This obviously means that the control that you have to put in will differ in order to get a specific level.

Mr. DADDARIO. Are your objectives determined through these experts you are bringing together, or is one of your objectives to see if there can be a reconciliation between these various levels of criteria?

Dr. ECKARDT. Yes, sir.

Mr. DADDARIO. Are you suggesting because of the high concentration and the short period of time which brings about some of these dangerous episodes that it is a special kind of problem and has to be looked at in a different way than the long-term, low-concentration problems?

Dr. ECKARDT. I think this is true. To me the most pressing problem is the acute episode I think we have the ability to control it today. The long-term one we are not so sure about.

Mr. DADDARIO. That is encouraging. You believe that the episodes can be controlled. Is this because of advanced meteorological capabilities?

Dr. ECKARDT. Yes, sir.

Mr. DADDARIO. Will you go into that a bit as to why you are optimistic?

Dr. ECKARDT. Yes. I think the reason they can be controlled are two in nature: One, we have more advanced meteorological data and two, we have more advanced knowledge of what the levels are in various cities, which we have not had before. As an example, New York City up until the time that Austin Heller came there as air pollution commissioner basically was measuring its SO_2 levels at one station. Now they are measuring out of ten telemetered stations which print out the results in a central office where somebody can keep good track of them. They know much more rapidly what is going on in New York today than they ever did before. The same thing is going on in Chicago where they have eight telemetered stations, and the data can be looked at at 15-minute intervals, if you wish, because the sampling keeps repeating itself every 15 minutes.

Mr. DADDARIO. How does the medical man who is an expert on the effects of these pollutants in such concentrations come to a judgment how the weather conditions, in fact, change that situation, either for better or worse?

What capability does he have as a medical man to feed into this the judgments necessary so that we have some assurance that he is right, these disciplines being so different one from the other.

Dr. ECKARDT. Unfortunately at the present time this has not been developed to accompany concurrently the analytical data being telemetered into the stations. I happen to serve on the medical advisory committee in New York, and one of the things that we are considering now is a mechanism by which we can feed the medical data into the central station the same way we are now feeding in analytical data.

Mr. DADDARIO. Will you tell us a little bit about that? What does it involve?

Dr. ECKARDT. I cannot tell you this right now because the plans have not yet been worked out. I do not know what will utimately develop. But presumably it will consist of a system whereby admissions to hospitals, admissions to emergency rooms in hospitals in the

city, hopefully perhaps reports from private physicians who see people that they think are affected by air pollution will be sent into a central location where this data can be collated with the air pollution analytical data.

Unfortunately, up until now we have had to go back and analyze what happened in retrospect during an episode. For instance, after the famous November 1966 episode that Mr. Ryan talked about yesterday, the report on the health effects of that only appeared in the December 1967 Archives of Environmental Health. It took them 1 year to analyze the health effects data.

Mr. DADDARIO. What you are doing is establishing a whole series of denominators which will begin to develop an understanding on both sides. Both the weather people and the medical people will be able to put these together in a meaningful way.

Dr. ECKARDT. We hope so.

Mr. DADDARIO. Mr. Bell.

Mr. BELL. Dr. Eckardt, you say on page 4, "Thus any criteria issued at this time with regard to such long-term, low-dose effects * * * must be regarded as speculative."

How long would it take you to develop such criteria? Do you have have any length of time figured on that?

Dr. ECKARDT. I am not sure that we will ever have complete data to be any more than speculative about this. I think we are going to have to feed one element in and attempt to develop air quality criteria and that is judgment. I do not know how you define it. Maybe judgment is not speculative, but it is not a hard-and-fast number analysis. You are going to have to feed into this very competent medical judgment which is going to have to take into account judgments which probably cannot be fed into a computer.

Mr. BELL. What is the time period on that?

Dr. ECKARDT. You mean how long will it be before criteria are developed?

Mr. BELL. Yes.

Dr. ECKARDT. I would think they can be developed in accordance with the timetable that Dr. Middleton talked about yesterday. He proposed that perhaps by the end of this fiscal year they would have three air quality criteria issued.

Mr. BELL. I see.

Dr. ECKARDT. I have talked with them and I know they plan two additional ones, probably by the end of 1968.

Mr. DADDARIO. Dr. Eckardt, these three reports you are talking about, the Public Health Service has 0.1 part per million, State of Pennsylvania, 0.25, Holland 0.3. What does this really mean? As you look at it, what does it mean in the difference in abatement cost to meet each of these proposed criteria? What does it show us if we are to look at one as against the other?

Dr. ECKARDT. I will attempt to answer that. I do not know whether I can do it adequately.

Mr. DADDARIO. Why don't you give us an explanation and then we can go over it and refine it for the record later if you wish.

Dr. ECKARDT. Yes. A few years ago the Public Health Service issued some suggestions as to how Federal installations in the cities of New York, Philadelphia, and Chicago should try to meet their respon-

sibilities in air pollution control. The proposition was that New York City would need 0.3-percent sulfur fuel. Philadelphia would need 0.6-percent sulfur fuel, and Chicago, 0.6-percent sulfur fuel. Previously, New York had proposed that they wanted to go to a 1-percent sulfur fuel. I am not a refining expert and perhaps if I make a mistake here Mr. Gammelgard can correct me, but my understanding is that to go from 1-percent sulfur fuel to 0.3-percent sulfur fuel in a single refinery might represent an increase in capital investment in refining equipment of the order of $50 to $100 million; the total investment running between $150 and $200 million, with an additional $50 or $100 million if you have to go from 1 percent to 0.3. Would this be a fair figure?

Mr. GAMMELGARD. In that ball park; yes. We are talking about desulfurizing heavy black fuel. The cost of desulfurizing home heating oils Nos. 1 and 2 is much lower. But the heavy black fuel is harder to desulfurize. It has more sulfur in it by far than the lighter fuels to begin with and it takes a lot more hydrogen and a lot more severe processing to get the sulfur out. If you start with two and a half or three and a half percent sulfur and you go down to 1 percent, one set of economics applies. If you want to get down to three-tenths of 1 percent, it really adds to the cost. I would say it probably would double the cost to go down to 0.3-percent sulfur.

Do I make myself clear? We are probably talking over a dollar a barrel in added cost to get down to three-tenths of a percent sulfur.

Mr. DADDARIO. Carry that a bit further so that we get it down to terms we understand. A dollar a barrel. How does that affect heating costs in the ordinary home? Can you bring it down that far?*

Mr. GAMMELGARD. Residual fuel would not be used in the ordinary home.

Mr. DADDARIO. Let us say a factory or apartment building.

Mr. GAMMELGARD. This would be big apartment buildings and public buildings. In the New York harbor barge market, the 2.2-percent sulfur residual fuel currently being sold there is probably selling for around $2.25 per barrel. If the customer would have to pay another dollar a barrel to get down to 0.3 percent or if he has to pay 50 cents more per barrel to get down to 1 percent, the effect on heating costs would be in a direct ratio from the current level of around $2.25 to either $2.75 or to $3.25, as the case might be. These economies, as I have said, do not hold for home heating oils because they can be desulfurized much more easily and at a much lower cost.

Mr. BELL. What effect would this have on your industry as compared with a competitor such as gas? Would it drive your type of fuel oil out of business as far as competing adequately with gas as a source of heat?

Mr. GAMMELGARD. It could well do that if you are talking about residual fuel made from domestically produced crude. The same economics do not hold for foreign-produced crude. The economics change. If you are talking residual fuel from domestic crude in a midwestern refinery, you might price yourself right out of competition with either gas or coal.

If you cannot sell the residual fuel oil due to sulfur specification problems, you could then hydrocrack this fuel into lighter products—which would probably be the route a lot of domestic refiners operating on domestic crude would take.

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*See Appendix B, page 555, for additional information obtained from Consolidated Edison Company of New York, Inc.

Mr. BELL. You also sell a great deal of the heavy fuel oil to vessels, don't you, ships and trucks and trains and so forth.

Mr. GAMMELGARD. Yes, though trains are pretty much out of that market. They are practically all diesels now; vessels, yes.

Vessels out in the ocean are not an air pollution problem and they can burn high-sulfur residual, and may do that. They have a problem when they get into a port like New York where they have to burn a low-sulfur fuel while in port.

Dr. ECKARDT. I think one of the things we have said here applies strictly to the petroleum industry. What the costs of controlling sulfur for the coal industry are I am not in a position to say, and I am not sure that anybody is because it seems at the moment the only way you are going to do this is to desulfurize the stack gases. I am not sure we have any valid estimates of how much this would cost at the present time.

Mr. BELL. In many areas you are not allowed to stack gases, isn't that true?

Dr. ECKARDT. I beg your pardon?

Mr. BELL. Are you still allowed to stack gases?

Dr. ECKARDT. Yes.

Mr. BELL. I thought there was some restriction on that.

Mr. GAMMELGARD. Mr. Bell in some areas you are not permitted unrestricted sulfur oxides coming out of a stack. Some of the regulations are written in such a manner as to say you must burn a half percent maximum sulfur fuel or you may alternatively desulfurize the stack gases to the same amount of sulfur dioxide coming out the stack as you would have to put out by burning a half percent sulfur fuel. There are two ways to go.

Mr. DADDARIO. Continue, please, Dr. Eckardt.

Dr. ECKARDT. Nevertheless, we do feel strongly that the public interest will best be served if it is recognized that such judgments are based on scant or inconclusive evidence. As new evidence is developed, a reassessment, and possibly new judgments, will have to be made.

Once a judgment has been reached, however, it should be possible to determine what course of action will best serve the public interest in a given situation. It must be recognized, however, that the public interest may not be served well if we fail to give proper weight to economic and technologic factors.

For example, recently reported studies of the population residing in the Nashville, Tenn., area reveal a very close correlation between socioeconomic status and health, whereas the correlation between relative exposure to air pollution and health in the same population sample was far less consistent. This is not to say that air pollution may not be health related, but socioeconomic status unquestionably plays a more significant role in public health than does air pollution.

For the reasons I have just given, we would favor a procedure—regardless whether it is applied at the regional, State, or local level—whereby proposed standards be published far enough in advance of final hearing and adoption to permit affected parties to determine what their control requirements and cost of compliance will be. This would permit an assessment of benefits versus costs at final public hearing before adoption of standards and rigid timetables for compliance.

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Such a policy would also serve to eliminate much of the apprehension affected parties might feel if confronted with regulatory proposals whose economic consequences they did not have time to assess. Moreover, it would give them the time to determine how much leadtime would be required and whether compliance is, in fact, possible.

For example, a study was recently made for the American Petroleum Institute by the Bechtel Corp. to determine the cost of equipping refineries in the Caribbean area to produce extremely low sulfur content fuel oil for their eastern seaboard markets. The study showed that the required investment in new refining facilities would total more than three quarters of a billion dollars.

Obviously, the leadtime required to complete such a huge capital investment program is significant and should not be ignored in setting deadlines for delivery of extremely low sulfur content fuels.

Mr. DADDARIO. How much time are you talking about? The present law is 15 months after the criteria has been established. Do you disagree with that figure?

Dr. ECKARDT. I would say to design—from the time you reached the decision to put in desulfurization facilities, put it on the design board, go ahead and construct it and get it into operation would be of the order of 3 to 4 years.

Maybe Mr. Gammelgard would disagree with this.

Mr. GAMMELGARD. I would lower it and say 2 to 4 years.

Mr. DADDARIO. Shouldn't we assume that during the period of time when this criteria is being established that you are somehow keeping pace with it? I don't understand, Dr. Eckardt, that the criteria could come to you as a complete surprise. Somewhere along the line, with all these mechanisms you are presently developing—the fact that you are keeping in touch with the regulatory agencies—your activities must be taking place, simultaneously and in lockstep, with the development of the criteria I would think.

Dr. ECKARDT. I have learned this from talking with some of my technical people: The problem is that targets have been moving. In New York they had a time schedule for reduction of sulfur content of fuel. They started at 2.5 percent and now they are supposedly at 2.2 and they ultimately in the 1970's will get to 1 percent.

We then had an abatement conference in the New York area where they proposed that fuel content go to three-tenths of a percent by 1969, I believe, were the recommendations. Now, this makes it very difficult to keep up with. We were trying to keep pace with the previous schedule and now a new one comes in and you can't keep up with it. We couldn't possibly meet the 1969 recommendation of three-tenths percent sulfur through desulfurization facilities.

Mr. DADDARIO. What is it that prevents you from keeping up? As the targets move—as we could expect them to, as the people desire higher standards—what does cause you problems? Is there a liaison problem here, so that you aren't in fact able to establish a relationship with those people who are establishing criteria? Or is it that they, not being professionally competent, are establishing a criteria beyond their ability or your ability to achieve? You know about it, but there is nothing presently available from a technical point of view so that you could adhere to it whether you wanted to or not? Where does the problem come from?

Dr. ECKARDT. I think the problem comes in that we don't know where the level is going to be set. I think the example is evidenced by the fact that three different people came up with three different criteria.

Mr. DADDARIO. By "level" do you mean there is no level which can be set which you now are capable of meeting?

Dr. ECKARDT. There is some level, yes.

Mr. DADDARIO. Is this part of the problem?

Dr. ECKARDT. I think this is right, yes.

We had a conference with the Public Health Service prior to the issuance of these (indicating) and we proposed that rather than come out with these recommended levels at this time that perhaps we come out with an intermediary level until such time as the leadtime to produce what they felt really was necessary would be obtained.

Mr. DADDARIO. Are you able to discuss why this recommendation was not followed?

Dr. ECKARDT. I don't understand that. I don't know why, frankly.

Mr. DADDARIO. But your request for an intermediary standard was so that you could develop the technical capability in order to put your shop in order and to meet that particular criteria. Once achieved, you could then begin looking for higher goals.

Mr. GAMMELGARD. That was part of it, I might add, Mr. Chairman. The other part was that with inadequate monitoring in New York City they didn't know what was in the atmosphere in New York City as a whole—just a couple of points. By bringing the sulfur down from around 2.5 percent in the residual fuel oils used in the powerplants and other big buildings, down to some intermediate level, then establishing a good monitoring system, which Austin Heller is now doing—you might find by going to 1 percent you would achieve a satisfactory level of sulfur dioxide in the atmosphere. To require going from 2.5 down to three-tenths in a couple of years could result in sulfur dioxide levels lower than the one-tenth part per million recommended by PHS.

Mr. DADDARIO. Then your problem involves the techniques necessary to know what ought to be done, and then the ability to have the time within which you could acceptably and technically meet those requirements.

Mr. GAMMELGARD. Exactly.

Mr. MOSHER. In the book supplied by U.S. Public Health Service, what are the time requirements with regard to the one-tenth part per million?

Dr. ECKARDT. This is not a regulation, but a criteria. We are concerned about the mechanism by which criteria would be adopted into standards which would then come under regulations.

Mr. MOSHER. You are not under any specific time compulsion?

Dr. ECKARDT. Under this document, no, but in Pennsylvania, yes.

Mr. BELL. Dr. Eckardt, you said the Bechtel Corp. was doing a study in which the cost of equipping the refineries in the Caribbean areas to produce low sulfur content oils would cost in the area of three-quarters of a billion dollars. What was the level you were trying to reach in that study?

Mr. GAMMELGARD. That was getting down to a level of approximately a half percent. Hopefully maybe a little lower than that.

Mr. BELL. Actually that may not even be a requirement as far as the eastern seaboard is concerned? You may be getting 2 percent or 1 percent?

Mr. GAMMELGARD. With the rules that are currently under study in New York and New Jersey, it looks like the three-tenths, and the .37 they are talking about, is more realistic as to what their goal is than 1 percent.

Mr. DADDARIO. Mr. Gammelgard, when will New York City have what you would expect to be a good monitoring system? They are developing it at the moment, as I understand it, but when will they achieve it?

Mr. GAMMELGARD. I believe that they expect to have it by the end of this year. I think his goal is 36 stations with a grid covering the five boroughs.

Mr. DADDARIO. Taking New York as one area, where do we stand in our other cities?

Mr. GAMMELGARD. Chicago has an excellent system which went in about 4 years ago in which they girded the entire city and then telemetered in from some of the key stations—not all of them, because telemetering is expensive. They know what the air in Chicago contains. There are eight telemetered stations measuring wind velocity and direction plus SO_2 and they soon will add devices to measure particulates.

I am quite certain Los Angeles has a good grasp on what is in their atmosphere. I don't know what their monitoring system is, but very few cities have a sufficient number of stations to really know what is in their atmosphere.

The Government CAMP system, or continuous air monitoring program, usually consists of one station per city, and this is not a good indication of what is in the atmosphere of a big city.

Mr. DADDARIO. Are the techniques which are being developed to set up these stations, even though the weather conditions are different in certain places, are they systems mutually compatible so that the lessons being learned in those cities where we are doing a good job, such as Chicago, can be transferred quickly and without too much cost to these other cities?

Mr. GAMMELGARD. Yes.

Mr. DADDARIO. Do you have any idea as to what the size of the city ought to be to necessarily compel it to have a good monitoring system?

Mr. GAMMELGARD. I think it would probably depend on what the air pollution problem seems to be in the city. Certainly some cities have a much lesser problem, obviously, than others.

Mr. DADDARIO. But it would be wise for most cities of size to take a look at this and to come to some judgment about what they do need.

Mr. GAMMELGARD. I think so, like your Clevelands, Toledos and Detroits. They certainly should have their air system adequately monitored.

Mr. DADDARIO. Which they presently do not have?

Mr. GAMMELGARD. They don't in my opinion.

Mr. MOSHER. You say there is a need for more than one monitoring location in each city?

Mr. GAMMELGARD. Yes.

Mr. MOSHER. Can you put this in terms of square miles or number of population? How about a city of 80,000, would one monitoring spot be all right for small cities such as that, or does this depend on what the industrial situation is there, and the location of the industries? Is that what determines it?

Mr. GAMMELGARD. Not only industry, but other sources, too.

I would say, for example, Tulsa is one of the cleanest cities in the country and I think if they had one well-located station they couldn't justify putting in a dozen stations or even a half dozen.

Mr. MOSHER. So this is an individual decision depending on the character of the city?

Mr. GAMMELGARD. Yes. As I recall the Chicago system, just the monitoring stations, the equipment itself costs something like $135,000, so you are not talking about peanuts for a good system.

Mr. DADDARIO. What responsibility do you have, taking into consideration that we are in the process of establishing criteria to improve things, to anticipate what some Government agency may require you to do by taking the situation as it presently exists, and doing what is necessary to improve it, without any compulsion?

Dr. ECKARDT. We are attempting to anticipate this and proceed accordingly.

Mr. DADDARIO. We could expect, then, that industry will be making such efforts?

Dr. ECKARDT. I think they will, yes.

Mr. GAMMELGARD. I'd like to point out, Mr. Chairman, that since the end of World War II, all of our lighter products, gasoline, kerosene, No. 1 and No. 2 heating oils and diesel fuels, have all been desulfurized to a much greater degree than they were at the end of World War II so that the sulfur content has dropped by more than 50 percent in that 20-year period in the light products. There is practically no sulfur in gasoline today, but desulfurizing heavy residual fuel, which is our remaining problem, is very expensive and as the point was made, you can price yourself out of the market if your competing fuels still stay at the present level.

Mr. DADDARIO. You finally answered Mr. Bell's question.

You would expect, then, that the same research which has allowed you to do a better job with certain fuels will continue to go on, I would expect, at an accelerated pace, to the point where you can do the same thing with these other fuels that presently cause you this problem?

Mr. GAMMELGARD. Yes.

Mr. DADDARIO. It is not that you are ignoring the situation. You recognize that it exists and you are trying to do something about it.

Mr. GAMMELGARD. In the year 1966 the oil companies in this country spent over $4 million on research to develop or to improve the desulfurization processes for residual fuel.

Mr. DADDARIO. Do you have any judgment, Mr. Gammelgard, as to what research effort is going to be required in order to do a much better job in this area? As you look at it, do you have an estimate as to what time period will allow you to improve this sulfur content?

Mr. GAMMELGARD. We have the technical feasibility now to desulfurize residual fuel oils. One of the major companies operating in this country and in South America made an investment several years ago on the strength of the New York City 1964 code which at that time scheduled a stepwise reduction to a 2.2 percent maximum sulfur by October 1969. Before the facilities were even completed, the ground rules and the target had changed so that this facility was practically useless to them. More recently the target and the date for achieving it

have again been changed and they will require an additional investment to meet the new goals—which is a pretty wasteful way of doing it.

One of the other major companies recently announced that they are going to invest $120 million in their big refinery in Venezuela to desulfurize their residual fuel for the east coast market and I presume they are planning to bring the sulfur down well below 1 percent. That is a big investment.

Mr. DADDARIO. This is an answer to a question I previously asked. Your ability to improve the situation is somewhat encumbered by the fact that you might make the necessary capital investments to reach a certain standard, and then find that that will not accomplish what the regulatory agencies want. It puts you in a position where you have a plant which is brand new and is perhaps not even used?

Mr. GAMMELGARD. Yes.

Mr. DADDARIO. A plant which is now obsolete though better than what you have and still unable to meet the requirements. We would like to have some understanding as to that before you make such capital investment.

Mr. GAMMELGARD. That is right.

Mr. DADDARIO. There is already at least one incident, and others, where such investments have been made to meet an improved criteria which you have already been advised is inadequate?

Mr. GAMMELGARD. That is correct. I know of one such company.

Mr. DADDARIO. Is it possible that you can get the background of that situation so that we may have it for the record, Mr. Gammelgard?

Mr. GAMMELGARD. I believe so. I will ask them, certainly.

Mr. BELL. Where is the gravity of a black oil where you have a considerable problem with sulfur and the higher oils or lighter oils where you don't have, such as you just described? What gravity is that?

Mr. GAMMELGARD. A typical No. 6 is around 12° A.P.I. gravity, just a little bit lighter than water.

Mr. BELL. You are talking about real heavy oil?

Mr. GAMMELGARD. Real heavy. With a high B.t.u. content per gallon. Much higher than gasoline or propane.

Mr. BELL. As far as most of the companies are concerned, the overwhelming amount of oil they sell then is really the higher gravity oil?

Mr. GAMMELGARD. That is correct.

Mr. BELL. You are really talking about the bottom of the barrel at the refinery. In other words, you have a breakdown for lower ends in your fuels; is that what you are saying?

Mr. GAMMELGARD. Yes.

Mr. DADDARIO. Proceed, please, Dr. Eckardt.

Dr. ECKARDT. It should also be noted that once an air quality standard has been adopted the question of how best to achieve it still must be answered. Because of variations in meteorologic and topographic conditions, types, and concentrations of industry, prevailing fuel use patterns, and other factors, translation of air quality goals into specific control measures—or emission standards—is a complex task.

If pollution is to be controlled—as we believe it should be—on a cost effectiveness basis, there is a real need for research into methods of determining what combination of control measures can do the best job at the lowest overall cost to the community.

Unless such research is undertaken there will inevitably be a tendency for one jurisdiction merely to copy the actions of another, whether appropriate or not. The result could be wasteful expenditures in some areas and inadequate control in others.

Meanwhile, the development of better methods for determining what specific control measures are needed to accomplish specific air quality objectives should be an item of the highest priority. Otherwise, our air pollution control efforts may fail to produce the desired effect on air quality.

In concluding, I should like to make one observation concerning an aspect of the Air Quality Act which we may tend to overlook. Under the abatement conference procedure established back in 1963, which also carries over into the new law, the Federal Government still can and does recommend specific control measures for pollutants on which no criteria have been issued. Certainly the control measures recommended and adopted under these abatement procedures ought to be subject to the same tests of economic and technologic feasibility.

I want to thank the committee once again for the opportunity to appear here today.

That concludes my statement.

With your permission, I would like to address myself to a question asked yesterday of Mr. Ryan. I see he is not here today. I don't think he got a good answer and I think I can give a little better one.

Mr. DADDARIO. Will you restate the question and tell us your answer?

Dr. ECKARDT. He inquired yesterday about what action was taken by New York City during the November 1966 air pollution episode and I got the impression that he left here and maybe the committee felt that no action was taken. This was not true. In fact, three steps were taken in New York. Consolidated Edison was asked to use the lowest possible sulfur content fuel they could. Incineration in apartment houses, and the city incinerators was stopped and people were asked voluntarily not to drive into the city.

Then another corollary question he asked was, does New York have a plan? Well, this is part of it, but there is an additional plan that is available in New York for action if they have another air pollution emergency. I happen to serve on the Medical Advisory Committee for the Air Pollution Control Authority up there and they have recently asked us to review this plan and in essence we approved it, from a medical standpoint, with one exception, and an interesting one, and that was that they had recommended that the heat in apartment buildings not be permitted to exceed 60° Fahrenheit. We, on the medical advisory committee, thought that this was too low a temperature and would probably cause more hardship and perhaps more deaths than the air pollution itself, so we recommended this be raised to 68° Fahrenheit. But other than this one recommendation, the plan was approved and so far as I know it is in effect in New York City.

Mr. DADDARIO. Dr. Eckardt, having brought up the question of a serious episode coming about, let's say one even more serious than the Thanksgiving episode 2 years back, should there not be a plan which can take effective action? Should there not be, for example, the ability to prevent unnecessary traffic in New York and have some way to enforce this?

We ought to be able to do much more than to say to people, "We would like you to do this" if in fact it could cause great harm to a great number of people.

Dr. ECKARDT. In effect, the plan developed by New York, depending upon the levels of air pollution measured, goes from voluntary action to mandatory action.

When the mayor of the city of New York declares a state of emergency, they can prevent traffic from coming into the city because you have to cross a bridge or a tunnel or something to get into New York City and I know during one of the heavy blizzards that they had in New York, as a New Jersey resident, I was not able to get into New York with my automobile because they would not let you through the Lincoln Tunnel, or the Holland Tunnel.

Mr. DADDARIO. Does your knowledge of that situation give you the ability to answer as to whether or not the mayor does have the ability to declare a state of emergency in the case of air pollution, or does the law confine him to certain other things such as snowstorms? Has the necessary step been taken so that he might declare a state of emergency for this purpose and would not the state of emergency under this set of facts compel him to do different things? I would imagine there would need to be hospitalization of certain people. Perhaps even moving them from a city.

Dr. ECKARDT. All of this is incorporated into the plan. I don't know the legal implications because I am not a lawyer and whether this would hold up in court, but my understanding is that he does this under a general type of law declaring a state of emergency and then under this he can make the individual adhere to certain regulations which he issues.

Mr. DADDARIO. It may be that the plans to meet such emergencies seem to be more tenuous than real and that they would necessitate a great deal of improvisation. We are not going to come to an answer about that now. But certainly it does call upon us to follow through, as Mr. Gammelgard has said, to have monitoring capabilities which are adequate, and then to take other steps when the situation requires it. Otherwise the monitoring system would be unnecessary.

Dr. ECKARDT. My understanding, Mr. Chairman, is that in Chicago, Mr. Stanley, who is head of their air pollution control department, has what he calls a "hot line" to the utility companies and when the air levels on his telemetered monitoring stations get to a level where he feels something should be done about it, then he calls the utilities and suggests that they change also to a lower sulfur fuel.

Mr. BELL. Dr. Eckardt, to what extent is the American Petroleum Institute, which includes most of the large oil industries in the Nation, involved in gas production as compared to fuel oil?

Dr. ECKARDT. I don't really know. Would you like to answer?

Mr. GAMMELGARD. I will make a general answer to that, if I may.

In the production of crude oil almost invariably gas is produced along with it, to a widely varying extent. The gas-oil ratio can be all over the map. So we in the oil business are involved in gas production too. However, well over half of the natural gas produced in this country comes from gas wells which produce no crude oil.

Mr. BELL. As I understand your testimony earlier, it would indicate to me that gas is less a source of a pollutant than is fuel oil, is that right?

Mr. GAMMELGARD. In comparison with a 1 or 2 percent sulfur residual fuel oil, yes, that is correct.

Mr. BELL. To explore that further, would it not cost you less to make your gas controls, whatever they need to be, than to make the necessary changes in the fuel oil to eliminate your sulfur.

Mr. GAMMELGARD. There is a limit, of course, to the gas reserves in the country and if the gas reserves are used to, say, fuel all the powerplants in the country, with the big increase in demand that is forecast for power in this country, I think we would seriously dip into our reserves. Secretary Udall a year ago was very concerned and said publicly, that the reserve ratio, that is, the number of years supply of gas to current annual consumption, is steadily dropping and he doesn't want to see it drop because if that continues too long we will run out of gas.

Mr. BELL. Aren't we in the same position as far as production of any kind of oil is concentrated? Do we have unlimited amounts of resources of oil?

Mr. GAMMELGARD. No, we do not, but when I refer to the reserve ratio I am tying it to the known reserves of crude oil to the current consumption of crude oil. That ratio has not been dropping in the same manner. The gas reserves to consumption ratio has been dropping, and I think it is currently about 16.5 to 1. Secretary Udall wants this down-trend reversed.

Mr. BELL. As I understand it, earlier you said there is always a certain amount of gas, and in many cases there is too much gas over oil. When you find a new field you also find gas with oil.

Mr. GAMMELGARD. Some of that gas is used to repressure the formation so as to eventually produce more of the crude from the formation and it is not sold as gas to consumers.

Mr. BELL. Eventually, when you get the crude out, you then get the gas out too.

Mr. GAMMELGARD. Yes.

Mr. BELL. You can probably see what I am coming to. If gas is less of a pollutant, and if all of the oil companies produce as much gas as they do oil and maybe more, why wouldn't it be a good direction for the oil companies to start moving toward the production and sale of gas and thus eliminate the pollutant problem, the costs and so forth. This would be the direction you could go and save yourself a lot of money.

Now, is this a practical suggestion?

Mr. GAMMELGARD. I think that is what has actually been happening. If you examine the last 10 years, the annual increase in gas consumption in this country has exceeded the annual increase in petroleum liquid products. Gas consumption has grown at a substantially higher rate than the growth of the liquid petroleum products.

Mr. BELL. In other words, you are saying the gas is taking over your competition? Is that also true?

Mr. GAMMELGARD. It is taking over some of the markets formerly served by other fuels, such as coal and oil. Large scale substitution of gas for residual fuel in the east coast market would have a very serious impact on the economies of friendly Caribbean nations now supplying fuel oil to this market.

Mr. BELL. In other words, the sale of gas is becoming a little bit more competitive, as it is right now, even without your economic changes in sulfur content. It is still becoming more of a competition to you in the sale of your products, is that right?

Mr. GAMMELGARD. That is correct, but I would like to also point out that gas is not a nonpolluting fuel. Combustion of gas makes nitrogen oxides the same as other fossil fuels do.

Mr. BELL. You did give me some tremendous figures involving the cost of sulfur elimination. You did not give me any such figures relating to the elimination of pollutants in gas, so I am assuming that it is less expensive to eliminate pollutants in gas. I think you testified to that effect.

Mr. GAMMELGARD. Yes, that is right.

Mr. BELL. Then the only argument I can see that you have is that you might run out of gas, but you won't run out of heavy oil.

Mr. GAMMELGARD. I don't think we will run out of crude oil.

Mr. BELL. That is a debatable point.

Mr. GAMMELGARD. Some day, of course.

Mr. BELL. The other point would be, why wouldn't the industry be wise to think in this direction?

Mr. DADDARIO. I think you have answered that question.

Mr. Brown.

Mr. BROWN. No questions

Mr. DADDARIO. I would then like to go to Dr. MacFarland's statement.

(Dr. MacFarland's biography follows:)

DR. HAROLD N. MACFARLAND

Education.—University of Toronto: B.A., 1941; University of Toronto: M.A., 1942; University of Toronto: Ph. D., 1949.

Present Position.—September 1965 to present. Director, Inhalation Division, Hazleton Laboratories, Inc.: Directs the overall research and applied programs for the Inhalation Division encompassing the fields of respiratory physiology and pharmacology, inhalation toxicology, industrial hygiene and air pollution.

January 1965 to present. Vice President and Director, Resources Research, Inc. (subsidiary of Hazleton Laboratories, Inc): Assists in corporate planning for Resources Research, Inc.; provides toxicological interpretation of air pollution findings; acts as liaison between RRI and Hazleton Laboratories, particularly with respect to performance of research in air pollution involving biological effects.

Experience.—1962–1965. Senior Toxicologist, Hazleton Laboratories, Inc.: Research coordination and development in environmental health; toxicological consulting in the field of military industrial chemicals.

1952–1962. Department of National Health and Welfare, Ottawa, Canada: Assistant Chief, Occupational Health Laboratory (1952–1954); Head, Research Group, Occupational Health Division (1954–1959); Senior Scientific Officer, Biological Unit, Occupational Health Division (1959–1962): Evaluation of pesticide hazards in orchards; supervision of problems in air and water pollution; experimental therapeutics in pulmonary edema; evaluation of hazards from thermodecomposition of plastics; fundamental studies on respiratory function; toxicological and pharmacological evaluation of pulmonary irritants; statistical design and evaluation; design of equipment for studies with airborne toxicants.

1949–1951. Chief, Toxicology Section, Defense Research Medical Laboratories, Department of National Defense, Ottawa, Canada: Toxicology of fluorine compounds, toxic gases and anticholinesterase agents; chemical warfare.

1941–1949. Department of Physiological Hygiene, University of Toronto, Canada: Research Assistant (1941–1943); Research Fellow (1943–1947); Senior Research Fellow (1946–1947); Lecturer in Industrial Hygiene (1947–1949). Synthetic organic chemistry; metabolic studies of foreign organic compounds; experimental therapeutics in heavy metal poisoning; toxicology of organic compounds, heavy metals and airborne toxicants.

Professional Memberships.—

Air Pollution Control Association (company representative);
American Association for the Advancement of Science;
American Public Health Association;
American Industrial Hygiene Association;
Canadian Federation of Biological Societies;
The Canadian Physiological Society;
The Pharmacological Society of Canada (charter member);
Society of Toxicology (charter member);
Consultant, Threshold Limits Committee, American Conference of Governmental Industrial Hygienists;
Member, Z–37 Committee of American Standards Association;
Certification from the American Board of Industrial Hygiene in the Toxicological Aspects of Industrial Hygiene;
Member, Editorial Board, Toxicology and Applied Pharmacology.

STATEMENT OF DR. HAROLD N. MacFARLAND, HAZLETON LABORATORIES, INC.

Dr. MacFarland. Mr. Chairman and gentlemen, I thank you for the opportunity to present testimony to this committee.

My primary purpose today is to describe to you two large experimental investigations having to do with the biological effects of air pollutants which are presently being conducted at Hazleton Laboratories, Inc. Hazleton Laboratories is an independent life sciences research firm which performs contract research for Government and industry. Its laboratories are located just a few miles from here, near Falls Church in northern Virginia.

In the last 2 days the need for additional knowledge in order to determine meaningful criteria and to set objective standards for air pollutants has been emphasized more than once. Specialists in this field have been aware for many years of the deficiencies that exist in our knowledge, but it has been only comparatively recently that adequate funding has become available to undertake the rather extensive investigations that are required.

What are the deficiencies and what needs to be done? Examination of existing experimental studies on the biological effects of air pollutants reveals a pattern which is readily understandable. The first investigators—toxicologists, physiologists, and scientists from cognate specialties—examined some of the simple gaseous pollutants, such as sulfur dioxide, in short-term or acute studies. In order to increase the chances of seeing biological responses, they worked with very high concentrations of these agents. And since one tends to do the simple and inexpensive thing first, these early trials were performed with small laboratory rodents as the test species. The measures of response in these animals were also simple and obvious—gross pathological damage and death. Although it was appreciated that human populations are scarcely ever exposed to just a single pollutant, investigators nonetheless usually only looked at single pollutants and almost no work was done with mixtures of pollutants.

But what is the real problem that confronts us? We want to know the effects of pollutants, particularly mixtures of them, on human subjects undergoing very long-term exposures to quite low concentrations. So, it would seem that the work that had been done was just the opposite of what was needed. And, to add the coup de grace, enough was known about the effects of air pollutants on human populations to realize that certain predisposed individuals—the respiratory cripples, asthmatics, chronic bronchitics and cardiopulmonary cases—were especially liable to adverse effects. But there were no analogous experimental studies on such special types of population; that is, animals in which a functional impairment had been established before exposing them to pollutants.

We approached representatives of the coal-burning electric power utilities a few years ago with the suggestion that biological studies be undertaken in which many of the defects seen in earlier work would be overcome by means of adequate experimental design. In due course, the Edison Electric Institute and the National Coal Association, with minor contributions from two or three other sponsors, authorized a five-and-a-half-year series of investigations at a cost of $2.2 million. A recent analysis indicates that the program will actually require 7 years to complete and the total cost will be $3.3 million. The work on this program commenced in June 1966, a year and a half prior to the adoption of the Air Quality Act of 1967.

Mr. DADDARIO. Has that 7-year and $3.3-million proposal been approved? Do you have the funds for it? Are you going ahead with it?

Dr. MACFARLAND. We haven't the funds for it yet.

Mr. DADDARIO. You have the funds for the 5-year study at $2.2 million, but do you expect the same people would support the additional expenses?

Dr. MACFARLAND. We have hopes of getting an additional sponsor now to provide the remaining $1.1 million that we need. In the months preceding the authorization of this contract in June 1966, we had approached the U.S. Public Health Service to see if they would contribute to the financial support of this project. They refused. More recently, particularly with the enactment of the Air Quality Act, we believe there is a possibility now that they may be prepared to reconsider their earlier decision. So we have started to approach them with a view to seeing if they might provide the additional $1.1 million that will be needed to complete the program.

Mr. DADDARIO. Was the Public Health Service refusal based on financial reasons or was it based on their disagreement with the way in which the studies would take place?

Dr. MACFARLAND. I think for financial reasons. The history of the development of this project, and the design of the experiments is a rather long and involved one, and the opinion of experts in the field was solicited many times before the project took its final form. Among the experts whose opinions were sought were some from the Public Health Service, so that when the final proposal was prepared it carried the imprimatur of the Public Health Service. They had no objections from a technical point of view. I assume, then, it was a financial limitation that resulted in their refusing to help at that time.

Let me give some of the details of the design of this study. The pollutants selected for examination are sulfur dioxide, a gas; sulfuric

acid mist, a droplet aerosol; and fly ash, a particulate aerosol. These are the three most conspicuous pollutants emitted from the stacks of coal-burning powerplants. Graded levels of these substances, spanning the range of concentrations that have actually been measured in polluted urban atmospheres, are being employed. Exposures are being conducted in large chambers operated on an around-the-clock basis so that the daily exposure exceeds 22 out of the 24 hours, 7 days a week, for uninterrupted periods of a year or a year and a half. Two species of animals are under test, guinea pigs, which get the 1-year exposure, and monkeys, which get the year and a half. The greater emphasis in the work attaches to the primates, and it is rather easier to extrapolate from the monkey to man than to make the jump from a mouse to man. Guinea pigs were included in order to provide a connecting link with some of the earlier published studies. In the various trials which make up the complete program, the animals are being exposed not only to the single agents, but also to some of the binary and ternary mixtures of them. It is not feasible to examine all of the theoretically possible combinations, but an adequate and representative number of them have been selected.

Let us turn now to a most important consideration—the measures of response in the animals. In a biological study of this magnitude and duration, it is customary to perform certain conventional or routine tests. Thus, basic hematological and clinical parameters, X-rays, electrocardiograms, and growth data will be collected throughout the study. However, we do not anticipate that any striking changes will be seen in these variables, although we may be surprised.

Our interest is focused intensively on the results being obtained from a battery of very advanced and highly sensitive pulmonary function tests. These include measures of the mechanical, ventilatory, and diffusional characteristics of respiratory function. With the aid of an online computer facility, about 3 dozen primary and derived parameters are obtained. The tests are performed on all animals on a scheduled basis prior to, during, and at termination of the exposures. It is possible to apply these tests on this repetitive basis because they are what we call nondestructive, that is to say, the animal under examination requires no anesthetic, operative procedures or other techniques which would interfere with the test or preclude its repeated performance. It is only at the termination of the year or year and a half of exposure that we add one or two final tests that will render it necessary to sacrifice the animal after conducting them. At this point, a thorough gross and microscopic examination of all major tissues and organs of the animal completes the experimental phase of the investigation.

Although this program was authorized a year and a half ago, it is too early yet to speak of the results which are beginning to accumulate. When the results are available from each series of exposure trials, the final phase of the investigation may be entered into. This will be an evaluation and interpretation of the findings as they relate to the standards for the specific pollutants and their mixtures. The objectives of the study, then, are of a quite practical significance.

Mr. DADDARIO. Mr. MacFarland, what are the difficulties in extrapolating this information obtained through your animal studies to man? What do we learn? How far can we go? What do we then need to do? Where do your studies bring us?

Dr. MACFARLAND. This is a long and difficult question.

The experimentalist is always asked, How do you get from your animals to man? It must be admitted that all or nearly all work with experimental animals has as its ultimate objective something that applies to man.

Experience has shown that if you work with an organism or species which is far removed from man on the phylogenetic scale, if you work with a mouse rather than, say, with a dog, the danger of extrapolation that you will ultimately make is increased. It is, therefore, as a general rule, considered a little safer to jump from, let us say, a subhuman primate to man. What kind of results are we talking about and what is this jump? One of the things that may be of interest to you is the qualitative nature of the responses you are seeing. If you do examine the effect of something on a series of animals moving up the phylogenetic tree and you see much the same kind of effect occurring in each one of them, you will feel fairly confident that if man were exposed to the same thing he would exhibit the same signs and symptoms. You can appreciate that if you had only done the work with mice and then jumped to man that there is a possibility that there might be a striking species difference which would vitiate your extrapolation.

So there are these questions of the qualitative similarities that may or may not be present when you do this kind of work. There is also a question of the quantitative nature of the responses and the same sort of considerations apply.

Now, as to the next part of your question, suppose we had results in various species, including the primate, and we want to jump over to man, can we do this, or what other work is indicated? One of the things, of course, that one would like to think of as a theoretical possibility, perhaps, is: Could we do experiments on men? This question is not at all ridiculous and, in fact, we do do experiments on men.

One of the factors that will govern this is the nature of the kind of things we are working with and the nature of the effects they produce.

It is fortunate, in this sense, that the sort of pollutants that I have been talking about are not noted for their high toxicity. They are irritating materials and they do fall into a class where considering the possibility of doing human experiments is quite on the books. As a matter of fact, we have proposed to our sponsors in a tentative form a possible continuation of some of the work that we are doing in human subjects. However, there are difficulties. I mentioned at the beginning what we really want to know is the effect of very low concentrations of these pollutants over protracted periods of time. Well, you can put an animal in a chamber and conduct experiments on him for a quite high fraction of his total lifespan or, in fact, for his total lifespan, but you cannot do this with human subjects. So it is a little difficult at the moment to see how we can perform the necessary experiments on human beings. Short-term ones we can do, but short-term ones are not what we are really interested in.

I seem to have talked around this question, Mr. Chairman. I do not know whether I have answered your question.

Mr. DADDARIO. Well, we can get into it more deeply later. I do think this is important to us, however, so that we might know what time scale we are talking about and how, in fact, we can have confidence in criteria to be established through such laboratory techniques, recognizing they are extremely important. I do not assume that this is not an

important piece of work to be doing because it is; it is just that we ought to have it generally recognized what the limitations are, both to know what it can accomplish and what it cannot.

Dr. MACFARLAND. Yes.

In my opening sentence I referred to two large air pollution studies in progress at Hazleton Laboratories and I would like now to give a description of the second program. You will be pleased to learn that this can be done rather briefly and without quite so much detail.

By way of background on the second study I will remind you that there have been a few air pollutant visitations sufficiently severe to be labeled "disasters." The London smog of 1952 is the most well known of these disasters and some 4,000 excess deaths were attributed to it. Monitoring stations were in operation during that "killer smog" and levels of sulfur dioxide and suspended particulate were measured. The maximum sulfur dioxide concentration, recorded briefly at one station, was 1.34 parts per million; the peak level of suspended particulate matter was 4.46 milligrams per cubic meter. To the air pollution control officer, the increase in the concentration of both these pollutants over background levels was the salient observation; but, to the toxicologist, the absolute value of the concentrations, vis-a-vis the mortality incidence, appeared anomalous. It is true that those who succumbed were, for the most part, not healthy adult men but, rather a group suffering from preexisting cardiopulmonary insufficiency, or else were very young or very old. But, even allowing for these facts, it is still difficult to see how such toxicologically low levels of sulfur dioxide and suspended particulate matter could elicit such a drastic response as death in 4,000 victims.

Some theories have been advanced which, if true, might explain the observations just cited. One of the more promising ones has to do with what is called a synergistic effect. This is an enhanced response to a mixture of pollutants greater than would be expected from the sum of the responses to each component when acting singly. You can probably anticipate what a review of the literature on synergistic effects among mixtures of common air pollutants is going to reveal. Very few studies have been performed. Those that have are of a short-term, acute nature, employing unrealistically high concentrations of pollutants, and they have been conducted exclusively in small rodents.

In 1966 we suggested to members of the American Petroleum Institute that a study of synergistic effects, in which the deficiencies noted above had been corrected, was worthy of support. In January 1967 the American Petroleum Institute authorized our proposal for a 3½-year program, costing $1.6 million. The details of the design and the battery of test procedures are quite similar to those in use in the power utilities program. Again, the main test species is the primate, although a limited amount of work in rats is also being performed. The main points of difference should be mentioned. The pollutants under examination are the gases sulfur dioxide, carbon monoxide, and nitrogen dioxide, and two particulates, lead chlorobromide and calcium sulfate. Lead chlorobromide is the main lead compound found in the exhaust of automobiles using leaded gasoline as fuel.

Calcium sulfate typifies the ubiquitous "particulate sulfate" found in urban atmospheres. The effects of these five materials acting singly are being determined in several trials, but the bulk of the work will

be performed on a selection of the various gas-gas and gas-particulate combinations. At the end of the study the computer will help us perform the rather complex statistical analyses of the data that will reveal whether or not synergistic actions have occurred and, if so, their magnitude. When we consider that human populations are almost invariably exposed to mixed pollutants, the potential value of the results that will be forthcoming from the American Petroleum Institute study is evident.

Mr. DADDARIO. Dr. MacFarland, getting back to the preceding page, the last sentence of your statement on page 5: "Even allowing for these facts, it is difficult to see how such toxicologically low levels of sulfur dioxide and suspended particulate matter could elicit such a drastic response as death in 4,000 victims." You are talking about those who have a predisposition to such a situation. Can we assume that a higher concentration of such pollutants could affect great numbers of people who do not have such predispositions, since the death of so many allows you to come to this conclusion?

Dr. MACFARLAND. Yes; it is undoubtedly true that a normal subject would be adversely affected if the concentrations were high enough. The question that remains, then, is: How high is high enough? And some of the types of experiments we are doing, hopefully, will give some indications in this direction.

Mr. DADDARIO. Would you assume because people have died from such concentrations whom you would not expect to, even though they have a predisposition, that you could take the next logical step and say that healthy people subjected to high concentrations would also die? If that is so, then we are talking about a very dangerous situation because you are talking about the possibility of death of an untold number of people who somewhere in this scale will be affected as these 4,000 were?

Dr. MACFARLAND. I think this may be possible. The difficulty here is that we are talking about something where we simply do not know the answer at this point. We have not enough knowledge. Many people cannot even smell a concentration of sulfur dioxide of one and one-third parts per million. This particular visitation lasted about 5 days. Now, it is inconceivable on toxicological evidence that a person could not stand one and a third parts per million of sulfur dioxide for 5 days. Let me bring in something that may illuminate this a bit.

I sit on a committee which is concerned with the establishment of threshold limit values. These are numbers to be used in industries which produce airborne hazards and they purport to be a sort of maximum allowable concentration that a normal working man can be exposed to for 8 hours a day, 5 days a week, for a working lifetime of 40 to 50 years without adverse effect.

Now, what is the threshold limit value, this industrial standard, for sulfur dioxide? The value currently used is five parts per million. This standard has been in existence for many years and there simply is no evidence to indicate that it is too high, We do not anticipate that this number will be revised downward on the basis of any evidence presently available. So then if this number is a valid one, and it must be admitted that the reliability of these numbers in the threshold limit value list varies from number to number, depending on the evidence that lies behind them, but if we accept the five parts per mil-

lion then this standard purports to say that a man can be exposed 8 hours a day to five parts per million for 5 days a week, for 40 to 45 years. Now, maybe this will help you to get an impression of the kind of thing that makes me say that one and a third parts per million of sulfur dioxide is toxicologically a pretty low concentration, particularly when the one and a third was only a peak value seen very briefly at one station, while the average concentration was below this and the whole duration of this episode was about 5 days.

So, there is some kind of a quantitative anomaly between what are really, toxicologically speaking, low levels of these things as compared with the very drastic outcome, 4,000 people dying, which is a pretty severe response.

Mr. DADDARIO. Dr. MacFarland, I think this has some bearing on it. The New York Times this morning has an article on emphysema and the effect of air pollution. I would like to pass these to all of you just so that you can take a look at them, in case you have not seen the article. The article says:

> Emphysema, the lung disease that often suffocates its victims, strikes earlier and pushes them faster toward death in air-polluted industrial cities than in nonindustrial, unpolluted communities, experts said here this week.

It goes through to prove these points and concludes then by saying:

> There was more emphysema in St. Louis than Winnipeg, it was evident at an earlier age and appeared to progress more rapidly.

It goes on:

> The importance of environmental pollution is suggested by the fact that the incidence of severe emphysema in smokers is four times as high in St. Louis as it is in Winnipeg.

Taking what you have said and extrapolating this into the overall situation, it indicates that there are varying degrees of severity, that people with a predisposition, with a disease such as emphysema, can be more affected in an industrial area. I would think that people who do not have thep redisposition are also in a more dangerous situation as a result of finding themselves in a highly industrialized area where high pollution percentages exist.

Dr. MACFARLAND. Yes, but this needs to be analyzed a little further. The people who succumb, or the bulk of the people who succumb in this kind of disaster, are the respiratory cripples. These people have one foot through the door anyhow.

Mr. DADDARIO. So do we all.

Dr. MACFARLAND. It takes a very little to push them over. If you were to place a normal individual, a person with adequate pulmonary function, we will say, into this kind of an atmosphere, this is not going to bother him at all. Suppose that a normal person lives in this kind of atmosphere over a long period of time—suppose he grows up in this industrial area and he begins to develop the early changes, which if they go on to completion, will lead to emphysema and other respiratory diseases. He is not a normal, healthy individual, he has already suffered the beginnings of a process that will result in overt disease ultimately. If you put this man in a heavily polluted atmosphere such as may occur in one of these incidents, you would anticipate that he would tend to be adversely affected more

severely and sooner than a stranger who just happened to be visiting this city at the time and who was completely normal.

Mr. BROWN. Mr. Chairman.

Mr. DADDARIO. Mr. Brown.

Mr. BROWN. May I just interject a thought here. I think what you said is absolutely correct, Doctor, but don't we also need information as to the extent or degree to which these so-called pulmonary cripples have been created by these same conditions at a lower level prior to the episode? Obviously we do not have this information? But if there is any basis for this assumption that the pulmonary cripples are more susceptible to an episodic situation—and this is created by the same kind of conditions—then the episode merely adds the final touch to something that has been created by the lower conditions over a period of many years. Therefore, what I am asking is: Don't we need considerable information about the degree to which the cripples themselves may have been created by the lower concentrations of some of these contaminants over a long period of time?

Dr. MACFARLAND. Yes, indeed we do need this information, and much has been done to try and garner this information. It is done in part by epidemiological techniques of looking over the history of what has happened, looking at the medical records and trying to correlate these with occurrences of elevated pollutant levels.

Again from an experimental point of view, it is rather difficult to envisage how could you try to simulate this kind of situation in human subjects. It can be done with experimental animals. The trouble is that this is going to be a costly and long term program.

Mr. BROWN. The whole point of this New York Times article seems to be an environment in which the pollution exists compared with an environment in which the pollution does not exist. It will exist at these very low levels—was not St. Louis one of the cities mentioned?

Mr. DADDARIO. Yes.

Mr. BROWN. St. Louis has never had an incidence of severe pollution comparable to the London incidence. The evidence seems to be quite clear that the incidence and severity of emphysema is substantially greater there than in any area such as Winnipeg where the pollution does not exist. Isn't this the kind of pollution you are talking about?

Dr. MACFARLAND. Yes, this kind of evidence is usual. It provides directives for us, and I do not see that there is any argument about the validity of this kind of thinking.

Mr. DADDARIO. I bring it up only because it seems to logically follow from your testimony. How do you view it? Because there is such a base of information and so many points of reference that you have to take into consideration, recognizing how difficult it is, it is information such as this which does have a tremendous effect on the public generally. They read into it almost what they want to. It is therefore more important that we, as we analyze this information, develop a mechanism through which confidence can be built.

Dr. Eckardt, do you have a point here?

Dr. ECKARDT. I simply want to comment about the disease emphysema a bit.

The medical profession today really does not understand what causes emphysema but they do know there are several factors that contribute to it. We do know, for instance, that the asthmatic who suffers from pollenosis over many, many years may develop emphysema. It is conceivable, although I am not saying this is the case, that the pollen count in St. Louis is quite different from that in Winnipeg. Another factor that we know is of importance in emphysema production is genetics. The best example I know of is this isolated island in the middle of the South Atlantic called Tristan Da Cunha, where there was a population isolated since the time of Napoleon which reached a peak population of about 250 people in about 1960 or 1961. At that time this island threatened to erupt volcanically and these people were removed and brought back to England ultimately and examined. Over 50 percent of these people suffered from chronic bronchitis or emphysema. This is a highly inbred population, again suggesting that there is a genetic factor in the production of emphysema.

Finally, in a recent epidemiology meeting that I attended in New York in December of 1967, Dr. Patrick Lawther from England indicated that there is something in the particulate pollutant from a city which stimulates the growth of an organism called Hemophilus influenzae. This same organism is found clinically by the physician. It will be found probably in small numbers in anybody's throat culture, but it is found in large numbers in people who are suffering from acute bronchitis. We in the medical profession feel that this organism may be in some way related to bouts of acute bronchitis which also, we feel, are related to the production of chronic bronchitis and, ultimately, emphysema.

Now, this growth-stimulating factor present in the particulate matter from urban communities—and I presume that this was London though he did not elaborate on it—is also present in cigarette smoke and certain phenols have the same effect. It does not stimulate certain other organisms that do not seem to be related to bronchitis. The organism that he specifically mentioned was staphylococcus. The point I am trying to make here is that the factors we are trying to control in air pollution, even if they are related to chronic bronchitis and emphysema may not be known. We might well clear up the industrial pollution in these cities as suggested—the New York Times article is suggestive that this is related to industrialization—we might clean these up but we might not influence the incidence of emphysema one bit because of the other factors that might be involved, such as the pollenosis, perhaps materials in the air not related to or ordinarily considered pollutants and because of genetic differences between the population. I am sure there are genetic differences between the people who live in St. Louis and those who live in Winnipeg.

Mr. DADDARIO. Dr. MacFarland, I think we should proceed.

Dr. MACFARLAND. Yes.

Gentlemen, I believe that programs such as the two which formed the subject of my testimony will help to fill some of the gaps in our knowledge of the nature of the action of pollutants and the concentrations at which they occur, and thus contribute to the solution of the problems that concern us all—the development of meaningful criteria from which scientifically objective standards of air quality may be derived.

Mr. Chairman, you have intimated to several of the witnesses that you may invite them to pay a return visit to this committee. May I, on my part, extend to you and the members of the committee, taken singly or in mixture, an invitation to visit at your convenience the Inhalation Division of Hazleton Laboratories to see the programs I have described in progress.

Mr. DADDARIO. Considering the fact that you are looking for human subjects, that might be an ominous invitation.

Mr. Brown, do you have some questions of Dr. MacFarland?

Mr. BROWN. No.

Mr. DADDARIO. Dr. Eckardt, your last statement indicates to me that there is some question about the quality of air we should be striving to achieve. When you relate diseases to the effect that air quality may have in the initiation of these diseases, or the effect that they could have on the diseases already existing, I wonder if you have any view or theory about this? How do you, in fact, separate it? Or should it in fact be separated, recognizing that emphysema most likely does arise in a multitude of ways and recognizing, too, as I understand the New York Times article, it does not indicate that industrialization's pollutants cause emphysema but that it has a greater effect on those already having it? Then that gets us to the development of a capability to get air quality to the highest possible level we can, regardless of our lack of ability, lack of knowledge about the causes, effects and initiation.

Dr. ECKARDT. I am not sure just what the implication of this study is, not having read the original one, but I personally feel that air pollution is going to be controlled; it should be controlled, but it probably will not be controlled on the basis of health. I often like to make the example of the use of the sanitary toilet and sanitary sewers. This primarily arose because people got sick and tired of the stench of human excrement in the streets and they wanted to do something else with it, put it some place else. I personally think air pollution has a stench at times, it looks bad, and I think we are going to control it on this basis. I like to go back to when I was a boy traveling between Long Island and New York City past what now is the old New York World's Fair site and La Guardia Airport. Both of these areas were huge burning garbage dumps. As we used to go through Flushing at that time, we invariably as children used to go through holding our nose because it stenched so bad. This has been cleared up and not because it was a health effect, but because people apparently got sick and tired of this stench. I think basically we are going to clean up our cities, unrelated to health effects, and even before we find out whether or not there are health effects, other than the acute episodic health effects. I think we are going to clear them up, every city, to a certain degree, but I am concerned that this is going to have no effect on the health of the people of the United States even though we do clear them up, because I am not convinced, other than the episodic area, that health effects have clearly been demonstrated for low level, long-term air pollution levels.

This does not mean to say you do not clear it up for other reasons. I think you can clear up air pollution as a public nuisance. I think, for instance, in my town they have decided that they do not want people to burn leaves.

Now, I get nostalgic when I smell burning leaves, again because of my boyhood, I suppose, but some people do not like it. I do not think this has been demonstrated to be a health effect, but they do clean it up. They find other methods of disposing of leaves and I think we will do the same thing; as our technology improves, we will improve our air pollution control and clean up our cities, unrelated to health effects.

Mr. DADDARIO. Will you theorize a little bit on this, Dr. MacFarland?

Dr. MACFARLAND. I agree with Dr. Eckardt that this is probably how it will go. I agree, too, that the direct cause-and-effect relationship between low levels of pollutant and health effects has certainly not been convincingly demonstrated at the present. I believe, however, that in time, as the evidence comes in from studies such as the ones I have described, and others, that the evidence will become clear that there is a relationship and it will, hopefully, define just what sort of a concentration we are talking about. Is it true that if a man is exposed all his life to a tenth of a part per million of sulfur dioxide that he runs such-and-such a percentage increased risk of emphysema? Or should the figure be at 0.5, or at 1, or at 1.5? I think this kind of information will gradually accumulate and I think it will be found that there are, indeed, some levels at which health effects ultimately will be manifest.

Dr. ECKARDT. Let me say I do not disagree with this statement. I am only disagreeing, at present levels of air pollution in our major cities, I do not think there are chronic health effects.

Mr. BROWN. May I comment?

Mr. DADDARIO. Mr. Brown.

Mr. BROWN. I want to make a remark which I do not want to be construed as in any way bearing on the present witnesses. But several years ago I conducted a hearing on the effects of lead additives in gasoline and possible health effects upon populations as this concentration increased. We had some very able scientific witnesses there who, at the end of the time, left me almost convinced that the more lead we got in the atmosphere the healthier it would be.

Mr. DADDARIO. You did not believe that?

Mr. BROWN. No. It runs against the grain of what you might call just normal human logic. But science does run against the grain of conventional, normal human logic. I think that there is a very sound point which has been made here. I offer the possibility and ask for comment on the history of certain types of human disease resulting from biologic agents in which the process of human adaptability has seemed to be able to develop immunities and even strength as a result of this. I am not saying that the increased intake of pollutants is going to make people live longer, but in the nature of science and the human being, I suppose there is always this possibility that could occur. We seem to have, for example, in Vietnam evidence that the natives over there have learned to develop immunities to certain types of malaria, which immunities we do not have over here. What you are saying about low-level pollutants in the atmosphere of cities, is conceivable that we could develop immunities to these things and that we would not have a long-term health effect. Basically, we would seek to eliminate them ultimately for other reasons such as they are not esthetic or they represent a waste in the production proc-

ess. Is this the sort of thing that you are trying to point to here? Do you find any sympathy with what I am saying?

Dr. ECKARDT. I am not sure that there is an immunity developed to air pollutants in the sense that we know of immunity to bacterial agents. This is a different process to me. I am not convinced that you could develop an immunity to air pollutants. I do know one small piece of information that was told to me by a man who has been working with lead, who was doing tissue culture. This happens to be Dr. Leonard Goldwater, now on leave of absence from Columbia Medical School. He said he had a tissue culture individual working for him. That person used extremely pure ingredients in the culture medium and they would not grow until they added miniscule quantities of lead to the culture material. Then the tissue cultures grew. This type of thing suggests that there may be some—and I am certainly not advocating this—but there may be some level of pollutant that is not necessarily bad for us. I would not want to try to put my finger on this level right now, certainly.

Mr. BROWN. The thing that strikes me from what you have said and for many other reasons, a much broader research concept than we probably have is envisioned so far for this whole problem. I think we need extensive monitoring systems and extensive reporting systems on the incidence of disease throughout this country and in areas where there are no pollutants, for example, merely to set standards by.

Dr. ECKARDT. I agree with this.

Mr. DADDARIO. Of course, Dr. Eckardt, we have been defining this as against man. We must add plant and animal life to our determinations as criteria are established, because this is an important aspect of this whole thing. If in fact we can, one way or the other, establish that there are certain causes and effects in these areas and can prove it in a way so that confidence can be developed, our programs would be better supported. There is concern that there is danger to health. There is question as to whether there is or is not. Because we are in this ambivalent position, we are not really able to get these kinds of programs going as soon as we should. Those dumps you were talking about could have been cleared up a long time earlier if in some way action could have been focused, and probably should have been. We ought not to wait until you finally reach the point where it gets overwhelming. We in this committee feel a great responsibility in the legislative process of seeing if we can anticipate these problems, taking into consideration the very great danger that can come, and see if we can then be of help in solving them sooner rather than later.

Dr. ECKARDT. I agree. I think we will clean up our cities. I do not think there is any doubt of this.

Mr. DADDARIO. The hour has gone by again. This is a subject which could keep us going throughout the balance of the day, but we will be in touch. We will see if we can take you up on your invitation some time, Dr. MacFarland.

Dr. MACFARLAND. It was meant seriously.

Mr. DADDARIO. I understand that. Thank you.

This committee will adjourn until Wednesday, January 31, at 10 o'clock, in this place.

(Whereupon, at 12:14 p.m., the subcommittee recessed, to reconvene at 10 a.m., Wednesday, January 31, 1968.)

ENVIRONMENTAL QUALITY

WEDNESDAY, JANUARY 31, 1968

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
SUBCOMMITTEE ON SCIENCE, RESEARCH, AND DEVELOPMENT,
Washington, D.C.

The subcommittee met, pursuant to adjournment, at 10:09 a.m., in room 2325, Rayburn House Office Building, Washington, D.C., Hon. Emilio Q. Daddario (chairman of the subcommittee) presiding.

Mr. DADDARIO. This meeting will come to order. I would like all of our witnesses at this time to come forward, if you would: Dr. Weinberger, Dr. Pecora, who will be accompanied by Mr. Frank Clarke, and Mr. Everts. If you want to break in from time to time, gentlemen, you may do so.

Our hearings on environmental quality resume today with a discussion of water pollution. The concern of this subcommittee is that scientific and engineering resources be employed in a timely manner to assure a firm basis for administrative actions.

Water quality laws have preceded air pollution abatement by several years. States have now proposed standards for approval by the Federal Government. The adoption of these standards and the subsequent enforcement of abatement action will depend on the same sort of criteria which we have been studying in air pollution. The experience with the sequence of descriptive criteria leading to prescriptive standards under the water laws may be a valuable guide to research strategy for cleaner air.

The testimony we have received so far strengthens my feeling that improved waste management has been delayed because of wrangling arguments over the effects of contaminants in the environment and an inability to compare costs of abatement with benefits to air or water quality.

In water, as in air, the average citizen, industry, or local government has no trouble in reaching a decision to eliminate gross and obvious contamination. Floating matter, suspended particles, oil slicks, and foul smells in surface waters are being dealt with as quickly as facilities can be installed in most areas. Although further engineering development may increase capacity and efficiency in sewage and industrial waste treatment plants, abatement is not awaiting research results.

However, there is less certainly in dealing with subtle effects such as persistent chemicals in industrial effluents or the warm waters from a powerplant condenser. Particular problems, including mine drainage and eutrophication of lakes and estuaries add to the complexity of the overall water quality program.

With air, the primary criterion is that for breathing by human beings. Water for drinking purposes can be obtained from the most polluted source, although distillation may be necessary. But water has so many valuable uses that a spectrum of criteria has developed. A given stream may be consciously dedicated to a combination of compatible uses—but only if cause and effect relationships are known.

The Federal laws for water pollution began with the objective of simply keeping out debris which would obstruct boating and shipping. Today, the uses for which surface waters are preserved range from sport fishing and water contact sports to industrial processing, agricultural irrigation, and pumped storage for electricity generation. Criteria differ for each use. I expect these hearings to show our capability in achieving an optimum use of our water supplies.

Our first witness today is Dr. Leon W. Weinberger, Assistant Commissioner for Research and Development, Federal Water Pollution Control Administration, Department of the Interior. Dr. Weinberger was very helpful to us in our hearings in 1966.

He has been of help to us informally over the course of years, and always generous in donating his time and advice to our committee. We thank you and welcome you here again today.

(Dr. Weinberger's biography follows:)

DR. LEON W. WEINBERGER

EDUCATION

B.S. in civil engineering from the Cooper Union, New York, N.Y.
M.S. in sanitary engineering from Massachusetts Institute of Technology
Sc.D.—Massachusetts Institute of Technology

PROFESSIONAL AFFILIATIONS AND HONOR SOCIETIES

Fellow, American Society of Engineers
Water Pollution Control Federation'
American Geophysical Union
American Water Works Association
Member of Society of the Sigma XI
Who's Who in Engineering
American Men of Science

PROFESSIONAL HISTORY

1966–Date—Assistant Commissioner for Research and Development, Federal Water Pollution Control Administration, Department of the Interior.

1963–1966—Chief, Basic & Applied Sciences Br., Division of Water Supply & Pollution Control, PHS, U.S.

1949–1963—Assoc. Professor of Civil & Sanitary Engineering, Case Institute of Technology—Dir. of Sanitary Eng., Research Laboratory.

1949–1962—Consultant in water supply, waste water disposal, and stream pollution to city, State, and Federal governments, and to more than 20 industries.

1947–1949—Research Assistant and Research Associate, Massachusetts Institute of Technology.

1943–1946—U.S. Navy Civil Eng. Corps. (Seabees).

1943—Eng. Draftsman—Designer—North American Aviation.

Participates in numerous international, national, professional, and technical advisory committees, including the following:

World Health Organization (WHO)
United Nations Educational, Scientific, and Cultural Organization (UNESCO)
Organization for Economic Cooperation and Development (OECD)
National Academy of Sciences (NAS)
Office of Science and Technology—Federal Council for Science and Technology (OST/FCST)

STATEMENT OF DR. LEON WEINBERGER, ASSISTANT COMMISSIONER FOR RESEARCH AND DEVELOPMENT, FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, DEPARTMENT OF THE INTERIOR

Dr. WEINBERGER. Thank you, sir. Mr. Chairman and members of the committee, I am pleased to appear before you to discuss research, development, and demonstration, R.D. & D., in water pollution control.

I will submit the formal statement for the record, if I may, Mr. Chairman, and abstract this full statement, and respond then to any questions.

Mr. DADDARIO. Proceed, if you will, please.

Dr. WEINBERGER. In my introductory statement I made reference to the second D of R.D. & D., because demonstration, as far as we are concerned, is one of the most important facets of our program in the prevention and control of water pollution.

In my statement I cover the following items: Role of R.D. & D. in water pollution control; cost and benefits of water pollution control; research and development programed planning; research priorities; industrial participation in research and development; allocation of research resources; some major water pollution problems; the scientific and technical bases for water quality standards; advanced waste treatment and progress; industrial pollution control progress; eutrophication and water quality criteria and use of water.

An effective water pollution control program consists of a number of elements; namely, scientific and technical answers and solutions, economic resources to construct and operate pollution control facilities, a strong enforcement and program implementation effort, adequate planning and administration, and competent manpower. Research and development is needed to provide new and improved analytical tools, scientific knowledge, and engineering controls. I, of course, do not intend to minimize the importance or role of research and development; however, we should recognize that many of the water pollution problems facing our Nation today can be alleviated by the application of existing technology. In fact, in the immediate future, the most significant progress will be made in this way. Through research and development, we will find solutions where none now exist, we will better define the effects of impurities on water uses, we will improve the effectiveness of available solutions, and we will reduce the costs of waste treatment systems. Gentlemen, I have complete confidence that we will find solutions—acceptable solutions, in my opinion—to all our pollution problems.

The solutions will be satisfactory from a scientific and technical point of view, but they will cost money. Although you may believe that it is obvious that pollution control will cost money, there are apparently many polluters who are unwilling to recognize any solution as acceptable unless it is a zero-cost solution. We shall seek these zero-cost solutions—indeed, in some instances, through wastes recovery or byproduct development, a profit may be realized—but we must be willing to pay for pollution control. What is meant by an economically acceptable solution is certainly to be the subject of considerable debate. Conventional cost-benefit analyses are not totally applicable because

we are not able to define in a quantitative manner all the benefits of water pollution control nor assess the total damages resulting from water pollution. Research into the socioeconomic aspects of water pollution control may provide us with some of these analytical tools—tools which will enable us to evaluate the "intangible" benefits.

Our knowledge of the costs and benefits associated with water pollution control is rapidly improving.

The Federal Water Pollution Control Administration has just completed a study entitled "The Cost of Clean Water." This is in response to section 16(a) of the Federal Water Pollution Control Act, as amended, which directs the Secretary of the Interior to conduct a comprehensive analysis of the national requirements for and the cost of treating municipal, industrial, and effluent to attain water quality standards established under the act. The first analyses have just recently been completed as they were due for submission to the Congress in January, this month. These studies are extremely important because, although there is widespread agreement that water pollution is a significant, growing problem which must be dealt with, there are no firm estimates as to what the national requirements are, or what it will cost the Federal Government and other affected units of Government to achieve a satisfactory abatement level. Various cost estimate studies of municipal and industrial needs have been conducted in the past but they have not been sufficiently comparable in geographical coverage, time phases covered, cost criteria, types of facilities included, or in cost estimate technique to provide a fully meaningful guide to the national requirements and costs involved.

The cost of clean water study represents the initiation of what will be a continuing evaluation, aimed at developing more accurately the national costs of pollution control. Although it has not been possible to arrive at a completely definitive estimate of required costs, it is believed that the present study provides a more comprehensive cost estimate than has previously been developed and a sound base of information upon which to build future analyses. This estimate is expected to improve in accuracy with each yearly updating.

Mr. Chairman, the first volume of this report has been printed and copies can be made available to the committee and, as subsequent volumes become available, they will, of course, be provided to members of this committee and all Members of Congress.

Mr. DADDARIO. Do you have sufficient copies so that they could be distributed here?

Dr. WEINBERGER. Sir, I do not have sufficient number of copies for this, but I will see that we get them to you as quickly as we can.

Mr. DADDARIO. Fine.

As I understand it, Dr. Weinberger, the estimate for waste treatment, sanitary sewers and water cooling requirements, for fiscal years 1969 to 1973 is somewhere between $26 and $29 billion.

Dr. WEINBERGER. Yes, sir. I would like to start dwelling on the research and development program and planning.

I have taken figures 1, 2, and 3 out of the report, made it available to each member of the committee as a separate item.

(See charts in Dr. Weinberger's prepared statement appearing at conclusion of his testimony.)

Figure 1 (p. 193) illustrates the program structure and elements of the research and development program of the Federal Water Pollution Control Administration. It represents the framework within which we can plan our program, establish goals and determine needed resources to achieve goals, allocate available resources, and evalute the effectiveness of ongoing research. Subprograms 11, 12, 13, 14, and 15 contain the elements dealing with specific sources of wastes. One note, it includes such matters as mine drainage, oil production, animal feed lots, irrigation return flow, various industrial wastes, various sources of municipal wastes. Subprogram 16 is a general category containing the elements of pollution identification, fate and persistence of pollutants in the environment, water quality control, eutrophication, water resources planning and resource data, cold climiate research, and basic research; subprogram 17 contains the elements dealing with waste treatment; and subprogram 18 is the research on water quality requirements or effects of water pollutants on all water uses.

One of the purposes of introducing figure 1 is to indicate the scope of our research and development effort, ranging all the way from identification of pollution to various means for solving problems caused by pollution. The element 1608—water quality control encompasses pollution control techniques such as recovery and reuse, product modification, process change, elimination, dispersion, dilution, detention, diversion, and even environmental treatment, that is, treatment of wastes in streams. This structure for categorizing our research and development was established last year and we believe will facilitate interagency coordination and cooperation. The categories are compatible with those established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

The research program of the Federal Water Pollution Control Administration is directed primarily to the solution of water pollution problems.

In planning research, a major tack is to establish priorities of research within available resources and the directives provided by legislation. In our program, priorities are based on the needs, recommendations, and ongoing research of the following:

1. FWPCA regional directors and their staffs. They are knowledgeable of the problems as they exist or may develop in their respective regions (river basin);
2. FWPCA program directors at headquarters;
3. Other Federal agencies;
4. State and local agencies;
5. University professors and researchers;
6. Consultants and advisory groups;
7. Committee on Water Resources Research; and
8. Industrial groups.

The setting of research priorities and the allocation of research resources is still, to a considerable extent, based on a subjective analysis. The analysis, however, has considerable merit when carried out by competent, knowledgeable people who have available to them the information obtained from answers to the following series of questions.

I will not read the questions. Let me suggest that the type of question we are talking about which helps us establish our priorities is as

follows: What are the problems in water pollution or water quality control? Having identified the problems, what answers and solutions do we need? When do we need these answers? What answers and solutions are already available? Who has or should have the responsibility for seeking answers? What are the chances and incentives for obtaining better answers? When will the research, development, and demonstration be completed? On the basis of answers to these questions, gentlemen, it is possible to establish priorities which can be assigned to the various elements which I have indicated on figure 1.

The implementation of approved program plans consists of a number of aspects and I have listed these in my report.

The allocation of resources: The research and development program of the FWPCA is conducted through both in-house and extramural support. The in-house effort is conducted at our major laboratories and field sites.

It is obvious that to have a successful research and development program, in addition to the competence available in the Federal Government, the best scientific and engineering talent in the Nation, including that available in the university and private research institutions, industries, and in State and municipal organizations, must be included in the national effort to control water pollution.

Mr. DADDARIO. Dr. Weinberger, when you talk about the best scientific and technical manpower available, how about the manpower presently existing which has the responsibility to maintain the waste treatment plants now in existence? I have a letter from a Mr. Charles Pitkat, of Connecticut, who works at the Vernon waste treatment plant. He and a group of people who work at these plants get together on occasion and try to help each other out from the standpoint of skills and abilities to do a better job. He says, and I quote:

> One place that you can improve treatment is in the operator field. We need much more training than is now available. With all the talk going on about making police professionals or technicians, why cannot an operator have this same interest? Because of the background of operators, such as basic education, age, available time and the like, it is extremely hard to have us qualify to become a professional engineer. Yet, there is nothing available that would enable us to go to, say, three or four years of night school and end up as an accepted technician in this field. Professional people are reluctant to talk to or deal with nonprofessional people. If you look around in the design end of treatment plants, I would say you will find not one engineer concern who has someone who operated a plant on his staff. And yet we are the people who have the actual contact and control of their design.

I bring that up because we talk about scientists and technicians, yet when we had the hearings some time ago it showed quite clearly that many of our waste treatment plants were not operating at their full capacity for no other reason but that the people who were working on them just did not have the capability to maintain them at the highest possible level. Therefore the plants were not doing as good a job as they ought to do.

There was a desire on the part of these people to be able to do more. It was suggested, as I recall it, that perhaps we create an itinerant group of technicians who could go from waste treatment plant to waste treatment plant. They would help make assessments and tell these people what could be done to improve the plants, and by so doing reduce the waste and pollution problem which presently exists.

You talk about scientists and technicians, and yet you leave out the people who turn the switch and who see these things deteriorate around them—people who want to do a better job and cannot.

Dr. WEINBERGER. Mr. Chairman, our agency has last month submitted a report on manpower and training. Again, I would be very happy to make copies of that report available. This report agrees with the chairman completely, that one of the big gaps in our pollution control effort is an effective treatment plant operation. As a matter of fact, in the projections of manpower needs, the greatest need was indicated in the treatment plant operator category. Within our program, we are initiating within the month a technical training program which will supplement our professional training program. The purpose of the technical training program is to help develop institutions or curriculums or courses very much along the line that the chairman has suggested as one of the ways of doing this. We have a number of proposals which we are currently reviewing to help establish perhaps 2-year courses, junior college courses, specialized technical courses, to supplement some of the limited work going on right now at various States and which we are doing in-house.

Mr. DADDARIO. Dr. Weinberger, is it possible to put together some competent teams and have them review the procedures that are going on in certain plants? They could develop a checklist and give the people who are there some information as to what can be done at the moment while such a program of training is going on. Is this something that we should do or not?

Dr. WEINBERGER. Yes, sir; we should do it. It has again been done to a somewhat limited extent. There are some of the manuals, a number of programs, night courses, courses available in some of the high schools, at some of the universities, for operators to receive some of the training. There have been some instruction manuals prepared. One of the areas of research that I dwell on relates to this from the point of view of research and development. One of the things that we are attempting to do is to come up with procedures so that a plant can be operated in a more effective way. It is much more than just the matter of trained manpower. I made the statement that if there is a gap between the research man and the practitioner or the designer, then there is a chasm between the designer and the operator.

Mr. DADDARIO. Which is the point this gentleman makes in his letter to me.

Dr. WEINBERGER. And there are at least two things: what the chairman has suggested is certainly a very critical matter. The second one which we would hope to accomplish through R. & D. is to make it possible to operate our treatment facilities with better control devices, better instrumentation.

Mr. DADDARIO. Are you talking about those plants we will be building or plants presently existing?

Dr. WEINBERGER. Presently existing, sir. There is no reason, with the advances being made in control technology and instrumental methods, why some of these plants cannot be updated so that we can operate these on the basis of their design, at least, which will result in a very significant step forward in pollution control.

Mr. DADDARIO. The updating, however, involves some assessment as to where it is now and what needs to be done. This is a gap that,

if filled, could lift up the whole level of this particular effort and immediately cause some improvement, in fact, considerable improvement.

Dr. WEINBERGER. Yes, sir; unquestionably.

Mr. DADDARIO. Your hope is that we will be developing an ability to make such an assessment so that each community can, in an expeditious way, come to a determination as to where it stands or what can be done, and what it will cost, and how much more improvement will come about as a result.

Dr. WEINBERGER. Yes, sir; this is certainly one of the administration's goals, to accomplish this.

Mr. DADDARIO. Fine, Doctor.

Mr. Fulton?

Mr. FULTON. The question to me is: Maybe we are starting at the wrong end. Instead of being under the apple tree trying to catch the applies with our apron, why don't we go in from the constructive side, that is, the best use of water and air supplies, both for current use and for longtime purposes? Why don't we start like that instead of talking pollution? It should take in the whole field.

Dr. WEINBERGER. I certainly do not have any comment to make other than to agree with Mr. Fulton, that in looking at water pollution, water pollution is obviously part of a much larger water resource problem. The whole matter of effective utilization of all of our waters and water resource planning is one of the activities that is being undertaken by the executive branch through Water Resources Council, among other agencies. So that the need for an overview of our total water program is certainly in order.

Mr. FULTON. Instead of just putting our programs for 17 States on reclamation, why don't we in Congress have the programs for all States with an overall purview of the best use of the U.S. resources? You see, we limit, in the Federal program, reclamation to only 17 States. That takes in half of Texas and then goes on west but it does not affect the need of any State east of the Mississippi River.

Dr. WEINBERGER. I could not comment on reclamation.

Mr. FULTON. This is a trap. I am from Pennsylvania.

Dr. WEINBERGER. I was going to comment——

Mr. DADDARIO. Did you have to be advised that that was a trap?

Dr. WEINBERGER. No.

Mr. FULTON. I could see his light touch, he was feathering it a little bit.

Dr. WEINBERGER. I hope not. I was going to comment by saying that insofar as the water quality control aspects, the responsibility given to us by the Congress touches all of the States of the United States.

Mr. FULTON. My point is maybe we should have an overall view which includes these problems wherever they are rather than putting them just geographically by States or taking the end result of the problem, such as pollution.

Dr. WEINBERGER. I would say personally, I think the need for an objective assessment of our water resources and water utilization is certainly in order. I say this, having served on a committee of the National Academy which issued a report on alternatives in water management, which deals with the subject and dwells on the subject.

Mr. FULTON. I believe we have to watch that we keep the language so that the average person, such as we, Congressmen, can understand it. When you, Dr. Weinberger and your fellow scientists, and the chairman of the committee, Mr. Daddario, use words like eutrophication, wouldn't it be better just to call it clogging a lake through overenrichment? When I hear the word "eutrophication" I wonder whether it is building up or down, making hotter or colder. You see, I cannot tell just from the word what it means. I would imagine most of the people in the audience cannot.

Mr. DADDARIO. Doctor, the reason I put that word into my opening statement this morning was to see if I could get a reaction from Mr. Fulton. It was sort of a trap. The other day when that same word came up he went into the very root of it for some 5 or 10 minutes and I thought that he made a very good case. So I used it this morning.

Mr. FULTON. Having gone to Harvard, it gets to be difficult at times when they throw things out like that. I wrestled with them like a dog.

Dr. Weinberger, I was very intrigued by your extra "D" in R.D. & D. I must say I had hoped you would get better results from the Federal Water Pollution Control Administration because there you only have one "D." So could I make a suggestion to the Department that they correct that and give you the extra "D." You seem to want it.

I could point out to you that Abraham Lincoln had a story about Mary Todd, his fiance, later Mary Todd Lincoln. He said to her one time in an argument that actually while she had two "d's" in "Todd," God, for a long time, had been satisfied with one. So I hope you will be satisfied with one "D."

Mr. DADDARIO. We could carry that a step further, following Mr. Fulton's story: The "D" could be classified under "Divinity."

Seriously, however, a recent ruling of the Second Circuit Court of Appeals stated that the Federal Power Commission should not have licensed Consolidated Edison to build a Storm King Mountain plant without considering the total environmental impact, esthetic tranquility, et cetera. Do you know of any similar rulings? Are we now able to provide regulatory agencies with useful environmental information so that such determinations could be made? What implications, particularly in consideration of what Mr. Fulton said about taking a look at the whole thing, do you see in decisions of this kind which do include tranquility and esthetics?

Dr. WEINBERGER. Mr. Chairman, quite a bit of that information is available. We obviously need more. When the water quality standards program was established by the Congress we called together a group of experts to help us establish the criteria by which we could assess the various water uses.

The various water uses include not only municipal use, industrial, agricultural, propagation of fish and other aquatic life, but also water for esthetic purposes. These consultants, and I believe they were some 80 in number, reviewed the kinds of water that it would be desirable to have to protect all of these values. This has been issued in a report. I have a copy of it. I would be pleased to get copies to the members. It represents a rather thick document.

Mr. DADDARIO. This document which I now show you?

Dr. WEINBERGER. Yes, sir. It represents some of the best thinking, best available information dealing with the protection of our water for various uses. Some of the information is descriptive, some of it indicates we should be protecting the amenities, the senses of people, other recommendations are rather specific, scientific, quantitative, in such areas as toxicants, such areas as thermal radioactivity, and the like.

Mr. FULTON. Could I ask on that point?

Mr. DADDARIO. Have you finished?

Dr. WEINBERGER. Yes.

Mr. FULTON. The question comes up whether certain activities in various geographical areas are not socially destructive and should not be carried on. For example, the pollutants and the cost of cleaning up the pollutants might be more than the particular activity is either socially or economically worth.

In the case of rivers, how do we get around the fact that the Federal jurisdiction of rivers was originally limited to navigable rivers? That is, rivers used either for navigation by boats or logging, so that you had some small navigable rivers? How did the Government get jurisdiction? Would the Government have jurisdiction, for example, in the State of Pennsylvania where it is going to cost billions to clear up old mines, much more than was ever gotten out of them? Does the Government have jurisdiction, for example, in Pennsylvania and Ohio and other States to limit surface mining because it is going to cause so much trouble 1,500 miles down the Mississippi River? Should there be a limit? Can the Government move into such a field where we might just outlaw a whole industry as not being either economically or socially beneficial to the whole country?

I am on the Space Committee. When you see these new pictures of the earth from 200,000 miles out, we look like we are a sink. You can see the clounds twirling all over the earth, not just State by State. When we say we can come up with solutions, maybe that is a slightly inadequate statement.

So my point is basically, on jurisdiction, How do we approach this? Is this a new field or an extension of the old?

Dr. WEINBERGER. I do not think I am really competent to talk about all of the jurisdictional matters which you raise.

Mr. FULTON. You can put a statement in the record.

Dr. WEINBERGER. I will be happy to do that.

Mr. FULTON. Thank you.

(The information requested is as follows:)

The Water Quality Act of 1965, which amended the Federal Water Pollution Control Act to provide for the establishment of water quality standards for interstate waters or portions thereof and to make the discharge of matter which reduces the quality of such waters below the water quality standards established under the Act subject to abatement, specifically provides that "nothing in this subsection (Section 10(c) of the basic Act as thus amended) shall . . . extend Federal jurisdiction over water not otherwise authorized by this Act." The basic Act was amended by the Federal Water Pollution Control Act Amendments of 1961 to make the pollution of navigable waters, as well as interstate waters, which endangers the health or welfare of persons, subject to the Act's abatement authority.

The Act does not confer, not would we expect to exercise, arbitrary power to outlaw an industry as socially or economically undesirable. Its provisions respecting the establishment and implementation of water quality standards, and the abatement of pollution, are set about with safeguards against unreasonable action.

Mr. DADDARIO. There is no question, however, in your mind, Dr. Weinberger, but that these problems do affect the environment of this country. We do find a relationship to ocean currents and to climatic streams which can cause problems in places throughout the world. One has an effect on the other. It is simply a challenge to our laws to adjust ourselves so that we can overcome those problems and not allow ourselves to deteriorate because we place artificial barriers in front of the accomplishment of this end objective.

Dr. WEINBERGER. I do not think there is any question. I did not mean not to be directly responsive to Mr. Fulton, but there is jurisdiction, of course, so far as the effect of the activities in one State as they affect another, and many of the States in terms of the existing water quality standards have to themselves make some of the decisions Mr. Fulton is raising.

Mr. DADDARIO. We are coming into an entirely new set of nationwide and world conditions. Because we recognize that they will cause trouble, we are beginning to adjust ourselves in order to handle them. I can see where we are going to have difficulty, but certainly is not an impossible barrier.

Dr. WEINBERGER. No, sir. We, of course, on even the international phase, already have agreements as far as disposal of radioactive waste.

Mr. FULTON. Do you have the right in terms of Federal jurisdiction to ban coal mining in Pennsylvania because sulfuric waste causes pollution of the Lower Mississippi and colors the cotton grown by Mississippi?

Would you have the power to prevent the cotton from being colored, and therefore not salable, by the sulfur waste clear up in the Allegheny and Monongahela?

Dr. WEINBERGER. We will develop that for the record.

Mr. FULTON. Could you put a yes or no on that and we will go on?

Mr. DADDARIO. I would like to simply say again in this particular area, I do not know that it calls for a yes or no answer or that any Government agency has the power to do this. Rather, we as a society somehow must come up with a determination so that these derogatory or disastrous effects do not occur. Within the framework of our present free enterprise system we will make determinations which will overcome these problems because we must. It does not mean that the Federal Government will have the power. There is a whole wide stream of ramifications within which we can work.

Mr. FULTON. We may need a constitutional amendment to give the power to either the Federal Government, the States, or the local municipalities to proceed on this broad basis as a national policy for our U.S. resources.

Mr. DADDARIO. Dr. Weinberger, does not the general welfare clause, presently one of the foundation of our Constitution, give us a great deal of leeway in this particular area?

Dr. WEINBERGER. The Federal Water Pollution Control Administration at the present time does have and has exercised a certain amount of power in terms of protecting the welfare and well-being of our citizens.

Mr. FULTON. My point is, where does that power end or how far

does it extend in jurisdiction? I must say you are well represented by the chairman here.

Mr. DADDARIO. I am not trying to represent Dr. Weinberger. I am trying to represent my own ideas. This is not a matter in which the Federal Government alone is involved, and the solution of these problems does not come from the power of the Federal Government. Rather, it comes from the hopes and ambitions of our society. I think it is important that we, as a subcommittee, view these proceedings with objectivity and flexibility of mind. It is one of the basic criteria by which we must act.

Will you proceed, Dr. Weinberger?

Dr. WEINBERGER. I mentioned that the assistance of industry in the form of ideas, processes, products, and services will undoubtedly hasten the solution to some of the Nation's industrial pollution problems. Industry, for purposes of our R. & D., may be classified as follows:

1. Industries having a pollution problem.

2. Industries who have or expect to develop a commercial position in pollution control equipment, chemicals, instrumentation, processes, systems, or services.

3. Industries having a research and development capacity which has not been directed to pollution control.

4. Combinations of the above.

I would like to point out some of the factors which industry considers in participating in a federally supported research and demonstration effort.

There are a number of positive factors as far as industry is concerned and those are:

The fees associated with the contract.

The experience gained by their personnel.

The advances they may make in their technological position.

The publicity associated with contract awards.

The fact that financial risk is minimized.

An earlier demonstration of efficacy of results thereby establishing markets.

The negative factors that industry looks at are:

The time and effort of proposal preparation.

The time and effort of proposal negotiation.

The diversion of their competent personnel from other research and development activities.

Personnel who have gained experience at company expense working on a federally supported project would produce results available to competitors.

The contractor's art may be disclosed earlier than usual to competitors.

A noncontracting competitor can improve his competitive position with a minimum of contribution and a minimum of risk.

And, of course, any unfavorable publicity resulting from negative results.

By negative results, I do not mean poor research; I mean if the results do not come up with an improved solution.

Mr. DADDARIO. Dr. Weinberger, without our getting into an interminable discussion on the patent situation, under which of these sides

do you put Government patent policy in relationship to industry. Is it positive or negative, and under which of those subheadings?

Dr. WEINBERGER. I would say from the viewpoint of many of the industries I have talked with, it would be on the negative side. I might say that the patent policy——

Mr. DADDARIO. Then you would add another category to the negative side?

Dr. WEINBERGER. Yes, sir. This patent would be covered really in terms of the fact of disclosure of work being carried out, the rights to patents and the background patents which are all bound up in our patent policy.

Mr. DADDARIO. Let's not get into that.

Dr. WEINBERGER. On a number of other occasions I have mentioned the importance of demonstration and field evaluation. As a matter of fact, I believe I mentioned that when I appeared before this committee last time.

The Clean Water Restoration Act passed by the Congress in 1966 amended the Federal Water Pollution Control Act and makes it now possible for us to support large-scale field evaluation and demonstration projects. This program is approximately 1 year old but there is already ample evidence to indicate that the most significant contribution to the solution of water pollution by the development and application of new and improved technology will result from this program.

I have made available copies to the members of the committee of all of the grants we have made in this program for your review.

I would like to just quote something from an annual report that came to my attention just last week. This is the Pulp Manufacturers Research League, who in their 1967 annual report made the following references to grant support which they received from the Federal Water Pollution Control Administration:

> A fair estimate is that this League-Federal project will move ahead by as much as five years the time when pulp and paper mills will have a solid dollars and cents foundation upon which to base a yes or no decision for reverse osmosis. If this in-plant process proves as sound financially as it is already proved technically, the industry will have an effective and economical method for treating dilute effluents to a previously unattainable level of purity.

Mr. DADDARIO. Do you assume that a previously unattainable level of purity, which does not mean absoluately pure, is going to fall within criteria of purity which will satisfy you?

Dr. WEINBERGER. Yes, sir. I might comment on that because one of the approaches being taken by this particular project in so many other of our grants is leading to a recycle of water. If successful, many installations will have no liquid waste discharge by recovering the impurities and simply recycling the water, thereby perhaps having no liquide discharge or a minimal discharge.

Mr. RYAN. Do you anticipate that that process will be applicable, and, if so, when, to municipal sewage waste?

Mr. DADDARIO. If it is applicable.

Dr. WEINBERGER. Yes; if it is. I would say that the work on the applicability of reverse osmosis to municipal waste, although it is under intensive study by our program, and these are listed in a number of locations, the need to accomplish the desired results is not as

pressing for municipal waste—let me rephrase that. We have some alternate ways of accomplishing removal for municipal waste which show as of today more economic promise than reverse osmosis in a municipal plant installation.

Mr. DADDARIO. Proceed, Doctor.

Dr. WEINBERGER. Again referring back to figure 1, which indicates our total R. & D. effort, I would just like to mention some of the problems that stand out as being extremely high-priority items. These include municipal waste treatment, industrial waste treatment and control, improved methods for measuring effective pollutants, that is, water quality requirements including temperature effects, the disposal of impurities or solids removed from waste, mine drainage, irrigation return flows, agricultural land runoffs, storm and combined sewer discharges and lake, estuary, and ocean disposal of treated and untreated wastes.

I have discussed previously the problem of treatment and we have ample evidence to indicate that we can indeed treat waste waters to provide water of better quality than we started with. However, I would like to illustrate some additional areas of research and development that might be considered just under the subcategory of municipal pollution control. Some of these we have already talked about in my responding to questions.

One, improved procedures to accomplish more effective operation of plants; two, methods for increasing the capacity and performance of existing plants; three, improved design and construction procedure, including materials of construction.

Gentlemen, the biggest cost in pollution control is going to be in construction dollars and any improvements that we can make in reducing costs can significantly reduce our overall bill.

Work on design of treatment plants which would occupy a minimum of land area. Land is becoming more valuable, more critical. We have to consider design where land is used more effectively.

New systems for combining the waste water purification steps of the water cycle and perhaps a little bit into the future treatment systems which would result in valuable byproducts.

Mr. RYAN. Before we leave page 17, I would like to raise several questions regarding the treatment of municipal waste and specifically ask what level of treatment is attainable—let me ask that in terms of removal of waste—from municipal sewage.

Dr. WEINBERGER. Mr. Ryan, technology is available today for the removal of virtually all of the impurities which are introduced into our water resulting from municipal use of that water. In one of the summary sheets which I have, reference is made to a plant which is in operation in Tahoe on the Nevada-California border where extremely high degrees of removal are being accomplished. This is not very commonly employed, but I think Mr. Ryan asked what could be done. This is what can be done.

Mr. RYAN. What percentage is being removed in Lake Tahoe?

Dr. WEINBERGER. In Lake Tahoe there is better than 99-percent removal of the organic material. When I say better than 99 rather than 100 percent, our analytical techniques are inadequate in some of these cases to analyze all of the suspended material. Removal of such things

as phosphates in excess of 90 percent, virtually complete bacterial destruction. And I would be very happy to submit to the committee a specific breakdown on the results of that plant's operation, sir.

Mr. RYAN. And the costs?

Dr. WEINBERGER. May I supply that, Mr. Ryan? I do not have them with me right now.

Mr. RYAN. Yes.

(The information referred to is as follows:)

Lake Tahoe Water Reclamation Plant, Operation

Element:	*Removal (percent)*
BOD, mg./l	>99
COD, mg./l	>95
Phosphate, mg./l as PO_4	>99
ABS, mg./l	>90
Nitrogen	
Organic N, mg./l. as N	>95
Ammonia N, mg./l. as N, approximately	95
Calcium, mg./l. as Ca	Small increases due to the addition of lime.
Alkalinity, mg./l. as $CaCo_3$	
Sulfate	

COSTS

[Dollars per million gallons]

	Capital	Operating	Total
Lime treatment for phosphate removal	11	52	63
Ammonia stripping (95 percent removal)	6	9	15
Filtration	17	24	41
Carbon adsorption	18	12	30
Total	52	97	149

Note: Costs include phosphate, nitrogen, and organic removal plus recovery and reuse of lime and carbon.

Mr. RYAN. Let me ask you a question.

Last September there was a second session of the Conference on the Pollution of Interstate Waters of the Hudson River and Its Tributaries, and one of the recommendations and conclusions of that conference was that all waste prior to discharge into the waters covered by the conference should be treated to provide a minimum of 80 percent reduction of biochemical oxygen at all times.

Do you regard that as an unreasonable conclusion or recommendation?

Dr. WEINBERGER. I am hesitating, Mr. Ryan, in trying to respond correctly to your question. From a technical point of view, it is something which we can quite reasonably achieve. I do not have any question concerning whether we can achieve an 80-percent removal. I am not sure whether this is what Mr. Ryan is asking.

Mr. RYAN. Yes. I asked whether you considered the recommendation of the conference something reasonable from a technical point of view. Is it achievable?

Dr. WEINBERGER. Yes, sir; from a technical point of view it is certainly achievable.

Mr. RYAN. With today's technology?

Dr. WEINBERGER. Yes.

Mr. RYAN. It goes on to say:

It is recognized that this will require design for an average removal of 90 percent of biochemical oxygen demand.

Is that a fair statement of the case?

Dr. WEINBERGER. Yes, sir.

Mr. RYAN. In other words, to achieve 80 percent reduction it is necessary to design a plant for 90 percent removal?

Dr. WEINBERGER. To make sure we are always getting 80 percent. There are fluctuations in terms of the strength of the waste coming through a plant; there are operational variations. If we want to make sure that we get at least 80 percent, since there will be a fluctuation sometime, we will achieve 95 percent and other times it will be 85 and it could get down as low as 80 percent.

Mr. RYAN. Are there cases where the recommendations that have been made were higher than 80 percent minimum reduction?

Dr. WEINBERGER. Yes, sir.

Mr. RYAN. Where?

Dr. WEINBERGER. I would be pleased to get a copy of that for you, sir. I know this has been done. If I may, I will supply it for you.

(The information requested is as follows:)

DEPARTMENT OF THE INTERIOR FEDERAL WATER POLLUTION CONTROL ADMINISTRATION

HIGHER THAN 80 PERCENT BOD REDUCTION

Recommendations requiring higher than 80 percent reduction of biochemical oxygen demand are included in agreements reached by the Federal-State conferees in the following actions:

1. Penobscot River and Upper Penobscot Bay (Maine)

Recommendation

8. The abatement programs for the two poultry companies, Maplewood Packing Company and Penobscot Poultry, will be based on a 90% reduction of biochemical oxygen demand (BOD), 90% reduction of solids, and an effluent not to exceed 5,000 coliforms per 100 ml.

2. Moriches Bay and the Eastern Section of Great South Bay (Long Island, New York)

Recommendation

7. All the duck farms in the conference area:

(a) On or before August 1, 1967, shall submit to the New York State Department of Health final construction plans in approvable form, prepared by or under the direction of a duly licensed professional engineer, for adequate waste treatment facilities to remove at least 85 percent of the suspended solids and at least 85 percent of the biochemical oxygen demand, and a substantial portion of the phosphates thereof and therein shall be removed, and facilities for disinfecting such wastes and/or waste effluents to the extent that the final effluent shall at all times contain the chlorine residual of not less than 1 ppm after not less than 15 minutes contact time and a coliform count not greater than 100 per 100 ml in at least 90 percent of the samples in a series thereof, provided that at no time the coliform count of such organisms in said final effluents exceed 10,000 per 100 ml.

(b) On or before November 1, 1967, initiate construction of such facilities.

(c) On or before April 30, 1968, complete construction of such facilities.

(d) Thereafter maintain and operate such facilities in such manner that they at all times meet the performance criteria set forth above, and that the persons responsible for the maintenance and operation of such facilities set up an adequate trained and equipped staff in order thereafter to maintain and operate treatment facilities installed at duck farms at all times in conformance with requirements established by the New York State Department of Health.

3. Eastern New Jersey from Shark River to Cape May (New Jersey)

Recommendation

9. The New Jersey State Department of Health has adopted water quality standards for the waters of the conference area and has submitted the standards to the Secretary of the Interior for approval as Federal water quality standards under the provisions of section 10 of the Federal Water Pollution Control Act, as amended. These standards require that all wastes discharged to the Atlantic Ocean receive, as a minimum, treatment that will provide at all times 85 percent removal of BOD, and that all wastes discharged to the estuaries or tributary streams receive a minimum treatment at all times of 95 percent removal of BOD.

Mr. RYAN. In light of the conference recommendation for an 80-percent minimum reduction, and therefore design removal of 90 percent, is it consistent for New York City to propose a plant today with today's technology available which will achieve only a 70-percent removal at design capacity?

Dr. WEINBERGER. Mr. Ryan, that decision would not be based on let's say our technical ability to achieve greater removal. I am not familiar with all of the circumstances concerning what action New York State or New York City may have taken, but certainly the decision could not be on a basis of our technical ability to remove more than 70 percent or 80 percent of the impurities.

Mr. RYAN. New York City apparently intends to go ahead and construct a new plant which is designed to remove not 90 percent but 70 percent when construction is completed. But, as I understand it, that will go down to some 53 percent within a few years. How is this justifiable?

Dr. WEINBERGER. I can conjecture or surmise; but, if I may, I would much prefer to give you a written statement after I have had an opportunity to review this. I would again just make this one point: In the usual practice that we have today, when treatment plants are built they are frequently built on a stage basis. The first step in the design would be referred to as a primary treatment plant which might only remove 40 or 50 percent of the pollution load. On to that plant may be added, which is frequently done, a second-stage plant which can remove all the way from the 40 percent up to the 90 or 90-plus percent.

And in addition to that, when occasion arises, we can add a third step which is essentially what they have done at this place in Tahoe I referred to, where they have added on additional facilities to an existing plant. So that this may be one of the factors, but I will look into it and give you a reply.

Mr. RYAN. The fact is the 70 percent includes secondary treatment. It is not through primary treatment. It is through secondary treatment.

Dr. WEINBERGER. It sounds as if it would be some sort of accelerated treatment that would be intermediate between the primary removal and what could be accomplished by actual utilization of secondary capacity.

Mr. DADDARIO. It would appear wise, Mr. Ryan, if we were to allow Dr. Weinberger the opportunity to answer that question for the record so it could be more definite and precise.

(The information requested is as follows:)

Justification for the construction of a waste treatment plant constructed in New York City which will remove not 80 percent, but 70 percent when construction is completed, with the posibility of design capacity to decrease to 53 percent within a few years.

We understand this question refers to the North River treatment plant, which is expected to provide approximately 70 percent reduction of biochemical oxygen

demand (BOD) at present loading levels. This plant does not meet the recommendations of the water quality standards approved by Secretary Udall for New York's interstate waters or the Federal Enforcement Conference on the Hudson River. However, there are a number of reasons why construction of this facility is warranted.

The facility provides a resonably high level of treatment which will result in water quality enhancement. The plant was designed and land acquired prior to the effective dates of the Federal water quality standards and Federal Enforcement Conference recommendations, which specified higher levels of treatment than attainable at the North River facility under its present design and scope. Although this plant will not meet standards and conference requirements, it will be removing 70 percent of the biochemical oxygen demand of wastes, amounting to millions of gallons per day, which would otherwise be discharged raw to the river.

The facility will be part of a proposed system which, by the conference and standards deadline of 1972, should be providing treatment substantially in accordance with the standards and conference recommendations. The basic problem at this time is one of space on which to build a complete treatment facility which would remove 80 percent BOD at all times. The North River plant is designed to achieve as much treatment as possible within space and time limitations. The City of New York has recently acquired an additional 2.8 acres of land adjacent to the North River plant site on which to construct additional treatment facilities which will remove 70 percent BOD at design capacity (some twenty-five years hence), but which in earlier years of operation will achieve substantially greater treatment. Further, the City of New York has initiated the necessary administrative proceedings to acquire 4.9 acres of land for the purpose of constructing additional treatment facilities designed for 90 percent BOD removal to meet the Hudson River Conference recommendations and the water quality standards approved by the Secretary. The progress of the City in this regard will be regularly reviewed by the enforcement conferees, and every effort will be made to assure that the City meets the 1972 deadline.

Delay in constructing the treatment plant will result in increased cost to the City, the State and the Federal Government. Construction costs in New York City are increasing about 8 percent annually. Any delay in construction of the proposed treatmet plant will result in substantially increased costs to the City, New York State and the Federal Government. The North River project for both intercepter sewers and waste treatment plant has a present estimated cost of about $180,000,000, Each year's delay in going ahead with the project, whether caused by redesign or relocation, imposes an additional cost of about $15,000,000. Total redesign to upgrade the treatment levels of the North River plant would entail at least a three-year delay; the delay alone would cost $50,000,000.

Mr. RYAN. May I ask this question: What is the difference in the water quality which results from 90-percent removal compared to 70-percent removal, or 80 percent compared to 53 percent?

Dr. WEINBERGER. Let me try to answer that as briefly as possible. If we consider the 90 percent removal as contrasted with let's say 60 percent removal, then we would be introducing only one-fourth of the amount of impurities into the receiving stream. I am referring to what we would be discharging into the stream.

What effect this has on the stream would depend on the volume in the stream as well as the various use that stream is being protected for.

Mr. RYAN. Do you want to proceed or should we go into this further, Mr. Chairman?

Mr. DADDARIO. Mr. Ryan, you proceed until you are satisfied.

Mr. RYAN. I would like to come back to the question of the inconsistency of the Hudson River Conference recommending 80 percent reduction. Are you familiar with the New York State standards that have been approved by the Federal Government?

Dr. WEINBERGER. No, sir; I do not know whether that is one of the 15 that have been approved or not.

Mr. DADDARIO. Provide that for the record.

Dr. WEINBERGER. I will be happy to.

Mr. RYAN. Simply the inconsistency between the conference recommendation, which apparently is low compared to the state of technology anyway, and the initiation of a plant which would achieve at best 70 percent, and, according to my information, would go down to 53 percent in the next few years.

Dr. WEINBERGER. Mr. Ryan, I will be happy to go into that and, as I say, I think there are two different factors. That is why I hesitated originally in responding to your question. There is a question of available technology, I think, and the second question then is, In any particular installation, what is the required treatment to achieve your objective?

So when you asked the question initially, What is the best degree of treatment we can have? And I indicated it is substantially a complete removal of all impurities, we have not reached the point where this is being recommended for each and every community in the United States. So at the present time, one finds recommendations which provide for treatment facilities which do not necessarily remove all of the impurities that we can.

Do I make that clear?

Mr. RYAN. That is the difference between complete and 80 percent. We are now talking of the difference between complete and 70 percent going down to 53 percent.

Dr. WEINBERGER. In terms of the individual situation, and I will look into that.

(The information requested is as follows:)

DEPARTMENT OF THE INTERIOR FEDERAL WATER POLLUTION CONTROL ADMINISTRATION

Have water quality standards been approved by the Federal Government for the State of New York? What is the relationship between the Hudson River conference recommendation of 80 percent removal and the water quality standards as approved by the Federal Government in New York State?

Water quality standards have been approved by Secretary Udall for the interstate waters of New York under the Federal Water Pollution Control Act, as amended. These standards, which are presently being implemented by the State of New York, provide for a minimum of secondary treatment or the equivalent for all municipal and industrial discharges. "Secondary treatment" is generally defined by water pollution control officials as ranging from about 75 percent to about 95 percent reduction in biochemical oxygen demand.

The water quality standards anticipated reconvening of the Hudson River Enforcement Conference, A letter of August 4, 1967, from Dwight F. Metzler, Deputy Commissioner of the New York Department of Health, was included in the standards affirming the State's intent to implement the recommendations of all Federal enforcement conferences of which it had been a part, and indicating that the State would ". . . carry out its responsibilities as a conferee at the re-opening of conferences in the formulation, endorsement, or modification of the conclusions and recommendations of such conferences."

Cognizance of water quality standards was taken by the conferees at the second session of the Hudson River Enforcement Conference, and the recommendation in question reads:

> All wastes prior to discharge into the waters covered by the conference (a) shall be treated to provide a minimum of 80% reduction of biochemical oxygen demand at all times. It is recognized that this will require a design for an average removal of 90% of biochemical oxygen demand. *Or* (b) shall be treated, as approved by the State water pollution control agency, to the degree necessary to meet the water quality standards approved by the

Secretary of the Interior under the Water Quality Act of 1965. [Italics added.]

New York is implementing the treatment requirements called for in the water quality standards as necessary to protect the beneficial water uses and meet the water quality criteria. These requirements provide for significant enhancement of presently polluted waters. Where these requirements are below the 80 to 90 percent BOD reduction level, New York indicates that the affected treatmen facilities will be required to upgrade to this level as a second stage in the implementation program.

Mr. DADDARIO. When Dr. Weinberger answers your original question, Mr. Ryan, it appears that others such as this you are working on now will come. We will see to it, when the answer is submitted, our staffs do get together, and you will have an opportunity to ask additional questions so we can resolve this question.

Mr. RYAN. Thank you.

Mr. DADDARIO. Mr. Brown?

Mr. BROWN. I would like to make an observation or two and ask some questions.

For one thing, as far as the technology of water treatment is concerned, I think we are putting undue emphasis perhaps on the technology and not enough emphasis upon the economics. It seems to me the matter is primarily one of economics. Water treatment is probably one of the very few areas where we have had the technology since the invention of fire to produce practically pure water; namely, by evaporation. The question is whether we have the need and the resources to produce pure water in every situation.

I think undoubtedly the situation in New York to provide an additional level of purity beyond what they have apparently scheduled would require probably substantial capital investment and operating costs. The real problem is how much capital investment and operating costs are you willing to put up in order to secure a given degree of purity of water? I think these are the questions that need to be answered, basically, in connection with any discussion of water treatment.

The question I have is really a rather general one based upon an article I read within the last few weeks. I am not even sure where I read it. It was a discussion of a visit of a group of Americans to Russia and a trip down the Volga River. Having an interest in water pollution, I was struck by the fact that the article commented several times that the Volga was a relatively clean river, that they were able to swim in it, that the fishing resources were apparently as great as they ever had been, and that local sewage, what I guess would be municipal and industrial waste, was not permitted into the river.

Is it possible that in Russia and perhaps in other long-developed European countries they have achieved practices which are substantially superior to what we have here in the United States at this time in this field?

Dr. WEINBERGER. Mr. Brown, I have not seen this from personal visits to Western Europe. I think at the present time in most areas of water pollution control, our technology is further advanced than those countries and I think this is explainable due to World War II, when so much of their activity ceased. This is not to imply they would not be making additional contributions. But I do not know of any technology that has been developed or applied or under study in any part of the world that we have not looked at or are looking at.

Mr. BROWN. Would this necessarily be a question of advanced technology? Could it be just a simple matter of prohibiting industrial and municipal waste going into rivers as in the case of the Volga?

I do not know where it would go, but perhaps into the underground basin in some fashion which would preserve the purity of the river and ultimately it perhaps would pollute the land; I do not know. But it does not necessarily have to be a technology problem. It would be a standards problem.

Dr. WEINBERGER. I think it is also a matter of institutional arrangements. I think we get back to perhaps some of the points Mr. Fulton was raising in terms of the management of the waste, management of industry, management of location, the whole decision process of what you permit people to do and not do. There are some management practices, institutional arrangements in parts of Europe which we have looked at and, as you gentlemen are probably aware, the Ruhr and Emscher river systems have been extensively looked at because of the way in which the Germans manage those two rivers.

Mr. Brown. Do you know anything about the conditions of the Rhine? Is it a comparable situation to, say, the Hudson or something of that sort?

Dr. WEINBERGER. My simple answer would be to say the Rhine is polluted. I do not think we could make a comparison to the Hudson. I happen to think there are some parts of the Hudson which are much prettier than the Rhine and in better shape than the Rhine. On the other hand, one could say there are some parts of the Hudson that are more polluted than parts of the Rhine. But the Rhine is basically a polluted river.

Mr. BROWN. I think one of the general points I want to arrive at is the degree to which we are considering in our development in water pollution control the standards and achievements which have been reached in the rest of the developed world. Is this an input into our study? Do we have good comparative studies of what is going on in these other countries in terms of results as well as technology?

Dr. WEINBERGER. Reasonably well, Mr. Brown. I say reasonably well. This gets into our problem of information exchange. But we have a number of bilateral and multilateral agreements whereby we are able to get this information.

Mr. BROWN. There could be some very sound political reasons to get this. You know about 95 percent of our R. & D. money is justified on the grounds of a gap between us and the Russians. If you could show us a pollution gap, for example, you might be able to justify a very large increase in funds for the program. I have no further questions.

Mr. DADDARIO. Dr. Weinberger, is it not difficult to come to some assessment about all of this? As I understand it, our staff did some work in investigating some of these places. We think others are doing better than we are doing, and they think we are doing a lot better than they are doing.

You take the Rhine. It is polluted, as you say, but less polluted than people expect it to be. The reason for this is that they allow other rivers in the area to be more polluted and in that way take some of the strain off the Rhine. Therefore, they are shifting the problems around. In the final analysis, their situation is probably worse than ours.

Dr. WEINBERGER. Yes. They have one situation over there which has been looked into, studied, quoted, reported on, which is the situation involving the Emscher Cooperative. A solution is being applied there which I seriously question would be considered an acceptable solution in the United States. What they have done over there is, they have taken one river, the Emscher River, and have earmarked this as an open sewer. As a matter of fact, in talking to the engineering manager of that association, he has no hestitation in calling that a sewer rather than a river. And it is essentially the setting aside of one river to collect the waste for a particular watershed, trying to protect the Ruhr River in this case from pollution. And what they have done is, they have taken the entire river before it goes into the Rhine and put it through a treatment plant.

I do not think this is an acceptable solution in the United States. I have difficulty in picturing parts of our Nation being willing to have a river going by them which would be an open sewer. But again, this is an institutional arrangement that has been made over there.

Mr. BROWN. We would put it underground probably over here.

Mr. FULTON. Mr. Chairman?

Mr. DADDARIO. Yes.

Mr. FULTON. In Pennsylvania we have found that using underground mine passages and crevices as sewage sinks does not work and so we have proceeded to outlaw that practice.

Has there ever been a survey, Doctor, of how much the Federal Government is conforming to its good principles on the disposal of its waste and sewage?

I will give you a good example. Our big Federal building in Pittsburgh was being charged for our new sewage disposal system so much a month for disposal of waste. After paying it for a while, the Federal Government came back and said to the local people and the sewage authority in Pittsburgh: We are not going to pay it any more. The question was why? They said: Well, we, the U.S. Government, are not using the sewage disposal system of Pittsburgh, we are dumping it directly in the river. So the big Federal building was the biggest pollutant in our town.

Has it been cured now?

Dr. WEINBERGER. There is a very intensive and strong effort on the part of the executive branch to make sure that pollution from all Federal installations is brought under control.

Mr. FULTON. With the Chairman's permission, could you put a statement on it in the record?

Dr. WEINBERGER. We will be happy to do that.

(Information requested is as follows:)

CONTROL OF POLLUTION BY FEDERAL ACTIVITIES

To date, the fifty-eight volume publication, *Wastewater Disposal Practices at Federal Installations*, is the only comprehensive inventory of the wastes discharged into ground or surface waters from Federal activities. Published in 1962, this study was conducted by the Public Health Service, Division of Water Supply and Pollution Control (now the Federal Water Pollution Control Administration) and the General Services Administration. It reports conditions as of December 31, 1960.

While this study reports on sewage and industrial wastes (excluding cooling water), both waterborne and non-waterborne, discharged at 22,656 points, it

does not contain an exact count of the number of installations actually reported upon. The majority of installations included in the 1960 study reported two or more points of discharge for the wastes generated. Educated estimates place the number of installations covered between 7,000 and 8,000. In general, the scope of the report excluded those installations at which there was no activity which would be expected to generate a waste discharged to ground or surface waters. The 1960 study reported discharges of both adequately treated and inadequately or untreated wastes.

The Natural Resources Subcommittee of the Committee on Government Operations, House of Representatives, used the 1960 study as the basis of its 1964 and 1965 surveys of sewage and industrial waste disposal at Federal installations. (Copies of the reports of the surveys, House Report 1636, 88th Congress, 2nd Session; House Report 555, 89th Congress, 1st Session; and House Report 1644, 89th Congress, 2nd Session, are submitted for the information of the Committee.) For these reports, the committee selected from the 1960 study a total of 1,003 Federal installations that discharged waterbone sewage or industrial wastes (excluding cooling waters) "at a rate of 3,000 or more gallons per day, or non-waterborne wastes of 200 or more persons per day" or which had "received a notification from a Government agency that a pollution condition exists."

President Johnson, in 1965, issued an executive order, the strongest executive statement to date on the water pollution control responsibilities of Federal agencies, which became the basic policy of the entire Federal Government. The Executive Order, as superseded in 1966 by Executive Order 11288, requires the heads of Federal departments, agencies, and establishments to provide the leadership example in the national water pollution control effort. It requires the Secretary of the Interior to provide the necessary review, coordination, and technical advice and assistance to Federal agency heads, who are in turn, directed by Section 11 of the Federal Water Pollution Control Act to cooperate with the Secretary, and with State and interstate, and municipal agencies. In addition, the Order establishes general standards and procedures to facilitate Federal agency budgeting for water pollution control measures.

Program responsibility for the Secretary's functions is vested in the Federal Water Pollution Control Administration, whose Regional Offices have primary operating responsibility within their respective regions. FWPCA's responsibilities under Section 11 of the Act and the Executive Order include: assisting Federal agencies to clean up pollution from their facilities; reviewing proposed Federal water resources projects to determine their impact on water quality; helping other Federal agencies to include water pollution control standards in their loan, grant, and contract practices; and assisting other agencies to prevent pollution from Federal vessels.

To facilitate interagency cooperation and to provide a framework for coordination between Federal and non-Federal agencies, FWPCA has issued "Guidelines for the Prevention, Control, and Abatement of Water Pollution from Federal Activities," (copy submitted for the Committee's information). Through its programs of review and technical assistance, FWPCA has helped to develop water pollution control programs at Government military bases, hospitals, national parks, and forests, post offices, and Federal water resources development projects. Agreements on program procedures have been reached with the Forest Service, the Bureau of Public Roads, and the Corps of Engineers. Similar understandings are being worked out with the National Park Service, Bureau of Indian Affairs, Bureau of Outdoor Recreation, and the Department of Defense.

FWPCA has reviewed plans from 16 agencies for improving water pollution control at Federal installation. As a result of priorities recommended to the Bureau of the Budget, the FY 1968 Federal Budget included requests for $51 million to upgrade water pollution control at Federal installations.

The almost unlimited activities pursued under Federal loans, grants, and contracts offer a particularly significant means of exercising Federal leadership in this area. Section 7 of the Executive Order encourages all Federal agencies to include water pollution control standards in their loans, grants, and contracts. FWPCA has reviewed reports from 21 other Federal agencies detailing to what extent their loan, grant, and contract procedures should include such standards.

A Departmental Task Force has comprehensively reviewed the loan, grant, and contract practices of Interior and other agencies, and will propose pollution control requirements that could be made applicable to borrowers, grantees, and contractors. In addition, the Department has informed all its constituent agencies

that Interior is expected to set an example in this government-wide effort. The agencies have been directed to submit for FWPCA review all proposed regulations for water pollution control. This would apply to leases, licenses, and permits issued by the Department of the Interior as well as loans, grants, and contracts.

Current plans now call for control of pollution from all existing Federal installations within five years.

Mr. FULTON. The other point is on the historic use of certain waters. What effect does the historic use of waters have on the clearing up of pollution and waste? For example, on the Musatox you might have a person who would rather have birds, bees, or flowers. To what limits of the historic water doctrine are we bound because some areas may now be industrial with certain customary results of the industrial use of the water?

Dr. WEINBERGER. I will supply that for the record.

(The information requested is as follows:)

The Federal Water Pollution Control Act, in Section 10(a), makes the pollution of interstate or navigable waters, which endangers the health or welfare of any persons, subject to abatement. The historic use of any such waters for a certain purpose or purposes does not as a consequence convey any prescriptive right to pollute. Pollution resulting from the established use of such waters, which endangers the health or welfare of any persons, is fully subject to the abatement authority conferred by the Act.

Mr. DADDARIO. We are running a little behind time so we better speed things up.

Dr. WEINBERGER. Let me just conclude my presentation by referring to figures 2 and 3 which I think are the two most important figures to explain the scientific and technical basis for controlling water pollution.

Figure 2 (p. 194) which is labeled "Effects on Water Use by Pollutants" indicates that for any water pollutant that has an adverse effect on any water use, it is one probably of function of the time of exposure.

Let me consider for a moment and use for example a toxic material. We will consider a metal, copper, and its effect on fish.

The concentration in the water and the time that the fish is exposed to that concentration will produce certain effects. If the level is low enough it may produce no effect. If it is too high, and this would be to the right of the figure, there would be death of the fish. Between no effect and the death, there would be various other detrimental effects, including such things as the inhibition of reproduction, the fish may not be as large, it may actually result in certain behavioral aberrations. These can become quite important if the fish is unable to compete for food.

One of the major research efforts that we have underway is to determine the relationship between specific impurities under various water users. This will end up with a series of curves as illustrated by figure 2.

We must do this, not only for each individual pollutant but for combinations of pollutants. For example, again speaking of fish, and fish turn out to be a much better animal to do research with than man, there is the relationship between a heavy metal and let's say a pesticide or the thermal effects or any other impurity or pollutant going into our stream. But, nonetheless, through research and development we are trying to obtain this kind of information, and we must obtain this information, which indicates the relationship between concentration

and effect for various water use. These water uses will be not only for fish but for municipal purposes, industrial purposes, and agricultural purposes.

Figure 2 represents what concentrations you should have in order to protect a particular water use.

Referring to figure 3 (p. 195), it indicates what we are trying to accomplish through our waste treatment or control technology program.

Figure 3 indicates that cost to achieve final concentrations in waste treatment or through control.

What this chart indicates is that knowing your initial concentration in waste, what would it cost to treat, or using other methods of control, to reduce that concentration to any level.

With the information available from figure 2 and figure 3, the Administrator having responsibility for establishing water quality standards will be in a position of knowing what kind of water he must have to protect that water use and what it will cost him to accomplish that.

I would say there our entire research effort can be almost summarized by getting those two sets of answers. I might say there is one category that is extremely important, touched on very briefly. That would be research into socioeconomic bases, the policy-science basis for enabling the Administrator to take the scientific and technical information we have developed in figures 2 and 3 and make his decision as to what water use we are going to have in any particular location.

Mr. FULTON. Mr. Chairman?

Mr. DADDARIO. Yes.

Mr. FULTON. One of the chief pollutants is the detergents, cleaners, or soap mixtures of various kinds. What do you do to prevent this before you get this tremendous perpendicular column of heavy pollutants? Are you doing anything there?

Do you say to the manufacturer you cannot make this kind of a detergent because we know it is going to pollute the streams? What do you do then?

Dr. WEINBERGER. We do not have any legislative authority which would enable us to prohibit any manufacturer from manufacturing a product. However, we have called it to the attention of manufacturers when their products may cause a pollution problem.

The detergent industry about 3 years ago had brought to their attention that the type of detergent they were formulating was causing pollutional problems, that it would be very desirable if they had or were able to come up with a substitute product.

There was legislation introduced in the Congress. Before that legislation was enacted, industry voluntarily converted from one from of detergent to another, primarily for the purpose of reducing its pollutional impact.

Mr. FULTON. Is the present type of detergent a pollutant?

Dr. WEINBERGER. If the present type of detergent went into a river without treatment it would be a pollutant.

Mr. FULTON. Would it be feasible to put a tax on pollutants so that when the person buys the can of detergent he likewise pays for the cost of cleaning it up. What do you think of that?

Dr. WEINBERGER. This is certainly a possibility and one of the things that ought to be looked into in terms of meeting our overall cost and ways of accomplishing pollution control. It is an alternative.

Mr. FULTON. By putting the tax on the product that is going to cause the pollution, you then have a readymade antipollutant to clean it up.

Dr. WEINBERGER. I can see some difficulties, Mr. Fulton, because almost everything that we buy and everything that we use ends up being a pollutant. The food that we buy.

Mr. FULTON. You can certainly tax detergents and not food.

Dr. WEINBERGER. This is one of the problems in terms of what one——

Mr. FULTON. With that approach, the question is on what you can do with handling milk or beer. You can do a lot more things with beer through the governmental approaches, or on cigarettes, that you can not do with milk.

If we could pick some products that were known to be pollutants, or manufacturing processes that cause extreme pollution, why not tax them? The more the pollutant the bigger the tax.

Dr. WEINBERGER. I don't think Mr. Fulton is asking for any comment from me.

Mr. FULTON. Really I am. We are looking for methods. I would do it. Would you?

Dr. WEINBERGER. I would say that the question of incentives, both positive and negative, for providing the financial resources for accomplishing pollution control, this is certainly one of them that has to be explored with all the policy and public ramifications.

Mr. FULTON. My approach is not give them two carrots, by tax reductions, but add the tax on if they pollute. Do just the opposite. Don't try to ingratiate them. What do you think of that?

Mr. DADDARIO. I would think that that is a question Dr. Weinberger is not here to answer, Mr. Fulton. He could not say yes or no.

Mr. FULTON. This is your third rescue, Dr. Weinberger.

Dr. WEINBERGER. I appreciate the help from all of the members.

Mr. DADDARIO. Dr. Weinberger, taking your charts 2 and 3, however, recognizing what you are trying to accomplish, the fact is, as I understand it, 15 out of 50 States have submitted criteria for standards which you would approve. Do we really know what all of these graphs mean? Are these lines going to go really in this direction?

Considering the fact that the entire process of standard setting is occurring with very little knowledge of either the benefits or costs from controlling pollution; are we right or wrong? Are we doing too much or too little?

Mr. Brown raised a very good point. The economics of this could very well be a controlling factor. Do we know enough to point these criteria in the right direction?

I will quote from a statement by Jack W. Carlson, who is the senior staff economist with the President's Council of Economic Advisers.

He talks about the process of standard setting and goes on to say:

> Although the situation is lamentable, measurements take time and if some damage is obvious, though unmeasurable, some abatement is acceptable pending better determination of an appropriate level.

The whole thing gets kind of mixed up and because it is such a problem, we are thinking of spending some $26 billion in the next few years. Are we operating on such a shaky base. I would like your ob-

servation as to how do we handle this as we go along. Is our capability improving? Are we going to be stuck with this criteria only because we have come to some kind of estimated estimates to make these?

Are we going to remain flexible and change things around and be willing to admit mistakes if we need to?

Dr. WEINBERGER. Certainly, we have to be willing to modify some of these numbers when additional information is developed.

Let me comment on the validity or the amount of information that we have regarding the scientific base for setting these standards.

I think that we have a pretty good idea as to the maximum amount of these impurities that we can have in our environment. In other words, it is not that we have just an unrestricted range of values which we can tolerate. This is not really the issue. If one looks at some of the debates it may very well be as to whether the temperature should be 90° or 95°. It is not the question of whether it should be 90 or 110. So that I think that the information that we have begins showing that at certain concentrations we will have deleterious effects.

I think the problem in setting standards relates to making sure that we don't set the value too high because we don't fully understand all of the long-range effects and interrelationships among impurities.

I don't think there is anything inconsistent in establishing, if you will, a factor of safety which would say that we know that an organism will be destroyed at a certain concentration so let us apply a factor of two, three, four, or five since we don't fully understand what some of the more subtile effects will be.

Mr. DADDARIO. That is very fine, except there comes a great question of our ability to monitor so we know enough ahead of time. The problem is knowing enough ahead of time to be able to take the steps necessary to meet an emergency. Admitting that all of what you say is so, we still have to get the information to the people at the right time, and in sufficient time to enable them to do what is necessary to handle the emergency.

The ability to get an injunction to prevent automobiles from entering New York City, for example. It gets tremendously mixed up even though we have some idea about this criteria. Therefore, as we accept certain standards, are we also forcing the communities to develop the necessary steps? Are we developing the proper laws within which the courts can take action if the local officials refuse to?

Dr. WEINBERGER. I can respond very specifically to that.

The standards which are being set by the States and currently being reviewed and acted upon by the Secretary actually consist of two parts.

The standards consist of one part where the various criteria, the analyses, what measures we should take to determine the quality, are set forth. That is one part of the standards. The second part of the standards being submitted, or that have been submitted, involves an implementation program. Every State as part of its standards must come forward with an effective implementation program. The implementation program includes monitoring programs, insuring that they have proper legislation, insuring that they have the proper means for seeing that pollution control is carried out.

This is part of the standards setting.

90-064—68——12

Mr. DADDARIO. When you talk about safety factors, there is a safety factor upon which we can develop our existing knowledge. Do you put a cost-effectiveness price on that safety factor? Do you reach a point where not knowing what might happen we ought to be willing to pay something in order to prevent this from coming about?

Dr. WEINBERGER. The economics certainly come into play. There is no question but that when one develops control procedures that are inexpensive to carry out we do that even if we cannot demonstrate conclusively that this really results in improved water based on any physiological response. We have done that in the case of our present treatment technology for ordinary water.

So that let me try to give again an example of this, if I may.

Some of our earlier work indicated that a material killed fish. If at that time our techniques only really involved being able to determine the concentration which kills or does not kill a fish, that is pretty crude as a measure.

More recent work indicated that that same metal at one-tenth of a concentration made the fish sterile. This is the same, if you will, as killing the species outright.

If you will, if we had taken the initial value, we should have had at least a factor of 10, based on a lethal rate. Having reached now the figure of a tenth, the question is, with our limited knowledge how much lower than that should we go in the absence of scientific knowledge. We proceed very cautiously in requiring any lower value as a standard.

Mr. Chairman, I don't have the answers. There is obviously constant battle not only in water pollution but in any other field affecting health and well-being, welfare, constant battle as to how safe you must be, how safe can you afford to be.

Mr. DADDARIO. Dr. Weinberger, we don't ask you these questions because we believe you can give us a precise answer. There is much more that needs to be understood about it. We have to have more and better definitions from you people who are in fact going to handle all of this. This is why we ask these questions.

I would like to just go into this business——

Mr. RYAN. Could I ask a question?

Mr. DADDARIO. I have just one more question following this same line, and then I will recognize you.

As you apply your criteria, have you run into this situation? Or if you have not, what would you do if you do run into it. What would you do if you find a community or a State in a position where they do not have financial ability to handle this kind of activity? What do you do then to give them the hand necessary to develop their capital capability to handle these problems?

Take New York City, for example. If New York City were to say to you, "We would like to improve the percentage of removal that Mr. Ryan was talking about, but we just can't afford it. We can afford to get up to 70 percent, but not 85 or 90 percent." How do you give them a helping hand, or can't you?

Dr. WEINBERGER. The amount of help that we can provide is quite limited. We do have a construction grant program which is made

available to the States. There is a very limited amount of funds that can be moved from one area to another.

Mr. Chairman, we come back to the question that I mentioned when I started; that is, what is it that we can afford to pay? There was one enforcement action that we held where a city was required to put in waste treatment facilities. The city did not pass the bond issue. Steps were taken to bring the parties into court. Under those circumstances a bond issue was passed and the plant was built.

Again we get down to the point of what is it that the people will pay for these facilities?

A specific answer to your question is the amount of help that we can provide from a financial point of view which would be pretty much through our existing construction grant program.

Mr. DADDARIO. The possibility does exist that there will come a time, or could come a time, when the locality involved is not willing to meet these requirements and would develop a pollution problem which might in fact affect the entire area, or other States as well? The laws prevent you from doing one thing and you know the danger still exists.

Are we moving to the time when as these things develop, we will most likely have some national funds to meet those emergencies?

That gets us back to Mr. Fulton's question.

Dr. WEINBERGER. Yes, I think it goes back to our existing legislation. I think you gentlemen are all familiar with the appropriations in terms of providing additional funds for construction grants.

Mr. DADDARIO. These are things we certainly should keep in mind.

Mr. Ryan.

Mr. RYAN. Is it the intent of the Federal Government to enforce standards once they have been submitted and approved?

Dr. WEINBERGER. Yes, sir.

Mr. RYAN. That being the case, then I do not understand how the Federal Government could fund the construction of a plant which on the face of it will not meet those standards. In other words, if an exception is made in New York and you permit New York City to build a plant which on the face of it does not meet the standards approved for the Hudson River, through a conference and also through approval of the Secretary on standards, then you are openly encouraging defiance of your own regulations and standards approved by the Secretary.

How could the Department be in that untenable position: On the one hand saying we are going to enforce Federal standards which are 80 percent removal of BOD, and, on the other hand, approve 55-percent construction grant for a project which violates 80-percent removal of BOD standards?

There has to be some coordination within the Department so that you resolve this question. If you make an exception in New York, why not an exception in every one of the other 49 States?

Dr. WEINBERGER. Mr. Ryan, again as I indicated, I will try to elaborate on this. Unfortunately, I don't have the information on New York standards nor the particular Hudson conference, but I will be pleased to get it and present it in detail to you.

Mr. RYAN. Would you agree the Department would be in a very untenable position if it said it was going to enforce Federal standards and at the same time on the other hand approve and pay out Federal moneys for something that did not meet those standards?

Dr. WEINBERGER. I would——

Mr. RYAN. That is susceptible of a "Yes" or "No" answer.

Dr. WEINBERGER. I would suggest that if, indeed, we carried out a program which resulted in our encouraging violations of our own standards, this would not be a very good situation to be in.

Mr. RYAN. That is where the Department is today.

Dr. WEINBERGER. I will look——

Mr. RYAN. That is my statement.

Dr. WEINBERGER. All right, sir.

The information requested is as follows:

WASTE TREATMENT WORKS CONSTRUCTION GRANTS REQUIREMENT

When an application for a construction grant is received, it is reviewed to assure that the proposed project will meet all Federal requirements, including conformance with approved water quality standards. If a proposed project of itself does not provide the degree of treatment required by the standards, it will not be approved for a grant unless the applicant shows a firm intent to provide the required degree of treatment within a specified length of time.

Mr. DADDARIO. Mr. Fulton. One more question and then we will allow Dr. Weinberger to finish. I would like then, if possible, to have Dr. Pecora make his statement, which is relatively short, and Mr. Everts.

Mr. FULTON. My point is along the lines of the first comment.

Ten-percent pollution made the fish sterile, you said. What happened to the people in that locality? Was there any effect on the people if that occurred to the fish and was provable?

What is the effect on people of the varieties of pollution, both air and water, because we can show generally that there is a marked distribution pattern on the types of cancer, for example, lung, throat, kidney, liver, even on the breast cancer.

There is a remarkable correlation with the water systems and air pollution systems on types of cancer.

For example, sinus trouble or multiple sclerosis occurred amazingly along our river system and not in our mountain areas.

I would like a statement of what correlation we are trying to get among those particular factors for the record.

(Information requested is as follows:)

DEPARTMENT OF THE INTERIOR, FEDERAL WATER POLLUTION CONTROL ADMINISTRATION

CORRELATION BETWEEN WATER POLLUTION AND HUMAN DISEASE

Reorganization Plan No. 2 of 1966, which transferred from the Secretary of Health, Education, and Welfare to the Secretary of the Interior responsibility for the administration of the Federal Water Pollution Control Act, excepted from the transfer certain functions related to the public health aspects of water pollution. The plan directed that the two Secretaries present to the President an interdepartmental agreement for the implementation of the requirement that the Secretary of the Interior consult the Secretary of Health, Education, and Welfare on public health aspects of water pollution.

This "Interdepartmental Agreement Concerning Health Aspects of Water Pollution Control" directs that the Secretary of Health, Education, and Welfare be consulted on the following health-related matters: criteria for water quality standards setting based on health aspects of intended use for drinking water supplies, shellfish and other marine food production, bathing and other water contact activities; specific water related health problems, such as comprehensive water pollution control programs and water pollution research projects; and construction grant applications and requirements for the control of pollution from Federal installations where projects may adversely affect shellfish-growing areas.

In conformance with the Agreement, the Federal Water Pollution Control Administration is using Public Health Service Drinking Water Standards as the general basic requirements for protecting public water supply use of interstate waters, and is using Public Health Service Shellfish Sanitation Standards as the basic bacteriological requirements for protecting shellfish waters. The Federal Water Pollution Control Administration solicited the participation in the water quality standards-setting process of Public Health Service officials, who have served as representatives to the National Technical Advisory Committee on Water Quality Criteria. In addition, at the regional level Federal Water Pollution Control Administration Regional Directors have worked with the staff of the Public Health Service in the review of individual State water quality standards.

In carrying on a national program for the prevention, control, and abatement of water pollution, the Federal Water Pollution Control Administration gives major attention to the protection of human health. Our objective is the preservation and restoration of water quality for every legitimate use, including public water supply, recreation, and other uses which affect the health of man. The establishment of water quality standards, the enforcement function, and other major program activity is directed in large part to the protection of public health and welfare.

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE,
PUBLIC HEALTH SERVICE,
March 14, 1968.

Memorandum to: Dr. Leon Weinberger, Assistant Commissioner for Research and Development, FWPCA. Attention: Mrs. Seligson.

From: Deputy Director, Bureau of Disease Prevention and Environmental Control, PHS.

Subject: Material for Daddario Committee on "Effects of Water Pollution on Human Health."

In accordance with your request, there is forwarded herewith a draft of material for insertion in the recent Daddario Committee hearings on the above subject. Please excuse the delay in getting this material to you.

V. G. MACKENZIE,
Assistant Surgeon General.

EFFECTS OF WATER POLLUTION ON HUMAN HEALTH

Water pollution directly relates to man's health through:

1. Contamination of his drinking water,
2. Destruction of water contact recreational and work areas,
3. Contamination of his food sources, particularly marine food, and
4. By creating environmental areas which produce disease carrying insect vectors.

While the broad parameters of these effects are generally recognized, the increasing discharge of wastes to water resources is exposing man to an increasing degree to low levels of potential hazardous chemical intoxicants which may have a direct effect on his health. This problem is well illustrated by a review of the Public Health Service Drinking Water Standards which contain limits for microbiological, chemical, and radioactive contaminants. While efforts have been made to develop these standards in the light of man's total exposure through the mediums of air, water, and food to particular chemicals, lack of knowledge as to the long term chronic effects of these substances is notable by its absence. Without

such information, it is difficult, if not impossible, to establish minimum tolerance levels for inclusion in standards on potable water quality. Furthermore, the increasing contribution of industrial waste containing both inorganic and organic chemicals or unknown or undetermined composition also complicates the problem. Many of the chemical limits contained in the Drinking Water Standards relate to time-honored materials without appropriate recognition of new and exotic forms of chemicals which pass through both sewage and waste treatment plants and water supply treatment plants with little or no reduction.

The total body burden exposure is becoming increasingly important. It is essential that total intake of a given chemical by man be considered in establishing the respective limit for its presence in air, water, and food. An excellent example in this regard relates to lead in the environment which is present in water, air, food, and cigarette smoke. Relative judgments have to be made as to the appropriate levels in each of these categories in order to establish meaningful standards.

The lack of specific guidelines is well exemplified by the establishment of a limit for carbon chloroform extractables in the Drinking Water Standards. These are organic materials which can be removed by the use of activated carbon and the standard provides a gross measure of organic materials which may be present in the water supply. Laboratory studies have indicated that these materials are carcinogenic in nature. While still at an extremely low level of concentration in many of our municipal water supplies, studies are needed in order to identify the particular chemicals to permit the establishment of limits for various organic chemicals hazardous to health. The difficulties in trying to establish absolute limits for all chemicals which may be found in drinking water supplies are obvious. Nevertheless, a surveillance program is needed in order to provide better information on the types of chemicals which are increasingly finding their way into water supplies, both ground and surface. It is essential that a continuing review and appraisal of the Drinking Water Standards be maintained in order to keep abreast of the problem.

CHEMICAL EXPOSURES

The following specific examples highlight the importance of chemicals in our domestic water supply. Marked geographical differences have been noted in mans' morbidity and mortality rates. It is reasonable to assume that some of these rates might be related to the varying chemical composition of drinking water supplies. As noted above, potential carcinogenic and toxic substances are being found in water sources although currently at levels which are not believed to be hazardous. Some of these substances are incompletely removed by conventional water treatment methods. Distribution of death rates for malignant neoplasms of digestive organs, cirrhosis of the liver, and chronic and unspecified nephritis in certain metropolitan areas suggests that there could be an association with drinking water quality.

Specific examples of health problems to which answers are needed on the subject of contaminants in drinking water supplies may be listed as follows:

1. The increased incidence of cancer of the bladder in certain geographical areas of the country where the raw water supplies have received the municipal, industrial, and agricultural wastes of up-stream cities on the Mississippi-Missouri-Ohio river chain.
2. The potental toxicity of high nitrate concentration currently known to cause methemoglobinemia in infants.
3. The limits for lead in water supply in terms of whole body exposure and its potential as a cumulative poison in humans.
4. The fate of antibiotics, hormones, and similar materials in waste waters discharging to sources of water supply must be established.
5. Further exploration of the relationship of copper to arthritis.

The above are only a partial listing of the health-related problems of chemicals in drinking water supplies. While progress is being gained in securing municipal and industrial waste treatment facilites throughout the nation, these plants are not always effective in the removal of the dissolved inorganic and organic chemicals which are believed to have toxic potential to the human organism. Basic to all studies of the effects of chemical contaminants in water supplies is the need for

more precise and sensitive methods for the identification and measurement of both known and unkown contaminants. The increasing occurrence of pesticides in water supplies and their potential toxicity to man may require changes in water treatment practices.

BIOLOGICAL EFFECTS

While many of the classical communicable diseases such as typhoid fever, amoebic dysentery, bacillary dysentery, and gastroenteritis transmitted by water have been brought under control, waterborne epidemics are still occurring in this country. During the period 1946–1960, there were 228 waterborne disease outbreaks which resulted in 25,984 cases of illness. For example, a waterborne outbreak of salmanellosis in Riverside, California in 1965 resulted in some 18,000 cases of the disease.

In view of these continuing outbreaks, the question can logically be raised as to the reliability of time-tested safeguards and safety factors applicable to the production of potable drinking water. Substantive questions have been raised as to the adequacy of coliform organisms as a measure of safe water quality. It is known that viruses in water supplies react differently than bacteria. Until studies can be made to demonstrate the efficacy of the current water treatment practices, this question will remain. In light of the proposals to permit the reuse of treated sewage effluent, the adequacy of the coliform organism as the indicator of pollution must be critically examined. The standard bacteriological method requires approximately 18–24 hours for preliminary results which does not permit the degree of close control and surveillance required when sewage reuse is being proposed.

FOOD SOURCES

Another area in which water pollution has a health impact is in the food production and processing industry. This is best illustrated in the case of shellfish which are filter-feeders with almost unparalleled ability to extract and consume biological and chemical contaminants from polluted water. Since many shellfish are consumed raw, the ultimate effects of contaminated shellfish are self-evident. Considerable effort is required in order to preserve the quality of shellfish-producing waters. The relationship of water supply to the growing and processing of food is also well recognized. Fortunately, most of the processing does result in the production of a food that is safe. With the increasing use of land surface for the disposal of wastes, however, the situation may change. The use of water in food processing operation may result in concentration of the chemicals present and their retention in the food.

RECREATIONAL USE OF WATER

The pollution of water resources creates a hazard to individuals using such waters for body contact sports. Typhoid fever outbreaks have resulted from swimming in areas polluted by human sewage. Contamination of water by domestic or wild animals has resulted in outbreaks of leptospirosis in humans. It is essential that we develop new and improved indices of bacteriological quality for recreational waters. As a health related problem the destruction of the aesthetic qualities of water have a detrimental effect on the use of these waters for recreational and scenic purposes and population groups are denied the health related benefits therefrom. Fish taken from such waters may contain toxic levels of certain chemicals which have been concentrated in the flesh of the fish.

BREEDING OF DISEASE VECTORS

The improper management of water resources may provide areas for the breeding of insect vectors capable of transmitting human disease. Mosquito vectors of encephalitis appear to reproduce more prolifically in polluted water. The normal problem of insect vector control measures at water impoundments take on a more significant aspect in relation to this phenomenon.

Individuals involved in water contact occupations such as fish and boat washing operations are potential victims of schistosomiasis from pollution of their water environment with wastes from humans infected with the disease. More adequate

measures must be developed for the treatment of these wastes as well as for control of the snail which acts as an intermediate host in the life cycle of the parasite.

Proper control measures can be applied to prevent the gross production of such vectors of disease.

RADIOLOGICAL EFFECTS

The effects of radiation on human beings are viewed as harmful and any unnecessary exposure to radiation in the environment should be avoided.

The development of the nuclear industry has been attended by a small unavoidable increase of radioactivity in the environment. Above average levels of intake occur only in unusual situations where drinking water may contain naturally occurring Radium 226 in greater than average amounts, or from pollution of a water supply by industrial discharges of wastes containing radioactive materials.

CONCLUSIONS

In a recent report to the Secretary, Health, Education, and Welfare, "Strategy for a Livable Environment", June 1967, the statement was made that "50 million Americans drink water that does not meet Public Health Service Drinking Water Standards. Another 45 million Americans drink water that has not been tested by the Public Health Service." This represents a rather sad commentary on the state of surveillance of domestic water supplies in this country. The Task Force which prepared the report recognized the need for a new and larger approach to protect the public from environmental health hazards incident to water pollution and as it relates to drinking water supplies. A substantive question can be raised as to whether our present protective barriers are being strained to their ultimate limit without due regard for an examination of the future potential of the numeous problems in the water supply field as outlined above.

One other point. When you speak of the grants to the States for construction of facilities to prevent pollution or clean it up, it is really the understatement of the year when you say that funds are limited. The answer is that there are not any. There are too many applications to take care of even in part the proposals that have been made, or that Mr. Ryan is speaking about. You are so far down the list of applications that you just might as well give up to the Federal Government.

For example, in Pennsylvania we have figured that in a period of 5 years if we went after pollution of mine drainage alone, or surface mining, it would take $3 to $5 billion.

You just cannot do it. There are not funds; are there? You do not have funds; do you?

Dr. WEINBERGER. We do not.

Mr. FULTON. There are no funds in the Federal Government for this construction at the present time because the applications are tremendous and the funds are miniscule; is that correct?

Dr. WEINBERGER. Yes, sir.

Mr. FULTON. That is all.

Mr. DADDARIO. You would not agree it is a hopeless situation?

Dr. WEINBERGER. Absolutely not.

Mr. DADDARIO. Finish your statement.

Dr. WEINBERGER. Thank you, sir.

Mr. FULTON. The chairman had commented on your charts with the inference they either were completely no good, partially no good, or slightly no good.

Mr. DADDARIO. Those are your own conclusions, not mine.

Mr. FULTON. I think if you will read the record, the question then is: How did you make up your charts? What sources? How did you

make these figures that are now questioned, whether they are good enough even to rely on? Who made the charts and how were they collected?

Dr. WEINBERGER. I would want to comment on that.

Mr. DADDARIO. I think you should.

Dr. WEINBERGER. It is one point that I think is quite important that again we indicate.

The work in developing the cause-effect relationship has been pursued for many years. There are two Federal laboratories that were authorized by the Congress in 1962 specifically for the purpose of carrying out the necessary research to determine water-quality requirements.

One of these laboratories is at Duluth and the other is at Narragansett in Rhode Island. Both of these laboratories will be developing increased information on these cause-and-effect relationships. The information that is available, Mr. Fulton, is information which has been carried out in our laboratories, laboratories of other Federal agencies, State agencies, universities, by competent scientists all over the country and, indeed, all over the world.

This information is, if you will, summarized in the report of this national advisory committee. The technical information has been accumulated in laboratories all over this country, in Federal laboratories, university laboratories, industrial laboratories, on the basis of field and laboratory studies.

Mr. FULTON. Are they narrow or broad figures? Are they figures with a history or are they just current figures?

Dr. WEINBERGER. Some of them are figures with a history.

Mr. FULTON. I wish you would put a statement in the record on that.

Dr. WEINBERGER. I would be happy to do that.

(The information requested is as follows:)

The use of charts 2 and 3 was meant to serve the purpose of illustrating concepts rather than to convey any types of precise quantitative relationships.

Figure 2 refers to a relationship between the concentration of a pollutant and the time of exposure of that pollutant to the water use. Degrees of damage or effect upon the water use produce a family of curves. For certain pollutants these effects are fairly well known and such a curve could be delineated with accuracy. Figures 2A and 2B are examples of the bases for these curves. For most pollutants, however, these cause and effect relationships are not well understood and a great deal of the further work must be done. This is true especially when two or more pollutants act together and the result produces a synergistic or antagonistic effect. Also, a pollutant exhibits varying effects in water of different physical and chemical characteristics. The relationship shown in Figure 2 could be more accurately presented as bands rather than as distinct lines. Here again, the qualitative concept and not a quantitative relationship is implied.

Shown in Figure 3 is an attempt to demonstrate the conceptual relationship between cost and removal effectiveness. The intent of the chart is to convey qualitative and not quantitative information although quantitative information is certainly readily available for certain pollutants, e.g. organic matter, phosphates, inorganic matter, color, etc. Examples of these BOD and COD removal are illustrated in Figures 3A and 3B. The concept is that in order to achieve lower and lower final concentrations, greater and greater costs are required for each unit of concentration removed. Treatment costs are also dependent upon the initial pollutant concentration in the untreated water, thereby producing a family of curves as shown.

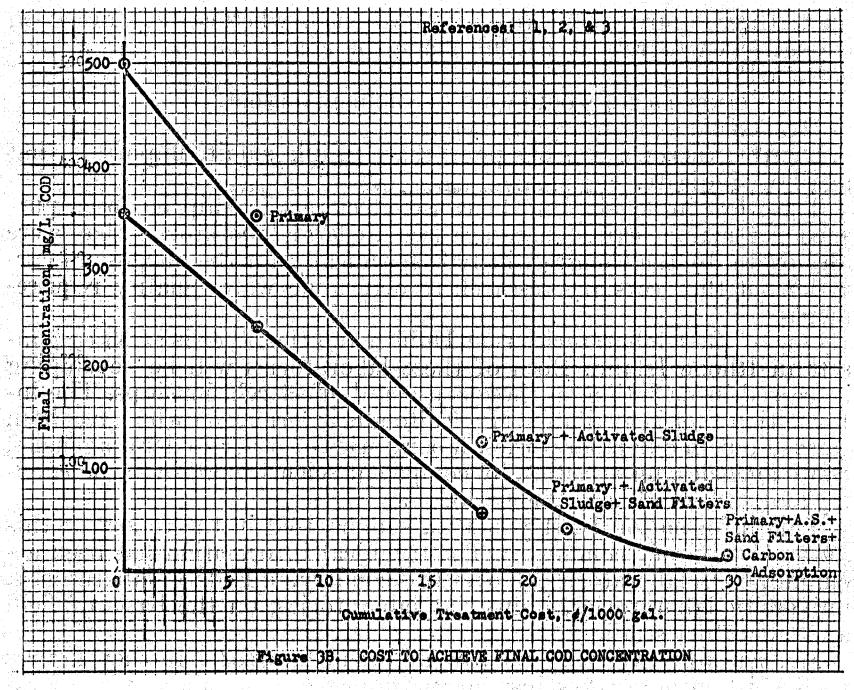


Figure 3B. COST TO ACHIEVE FINAL COD CONCENTRATION

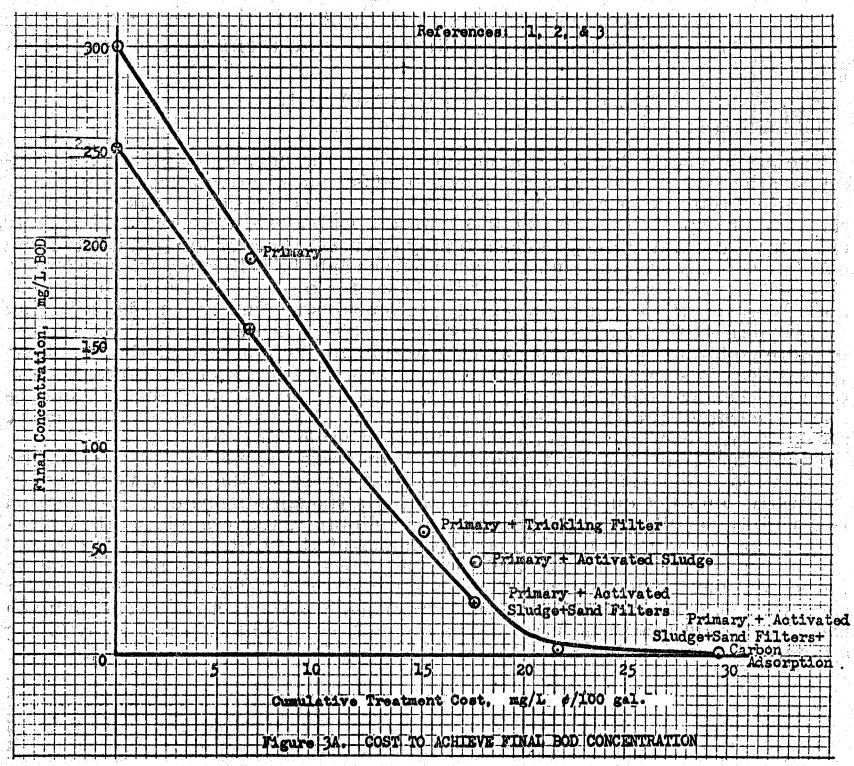


Figure 3A. COST TO ACHIEVE FINAL BOD CONCENTRATION

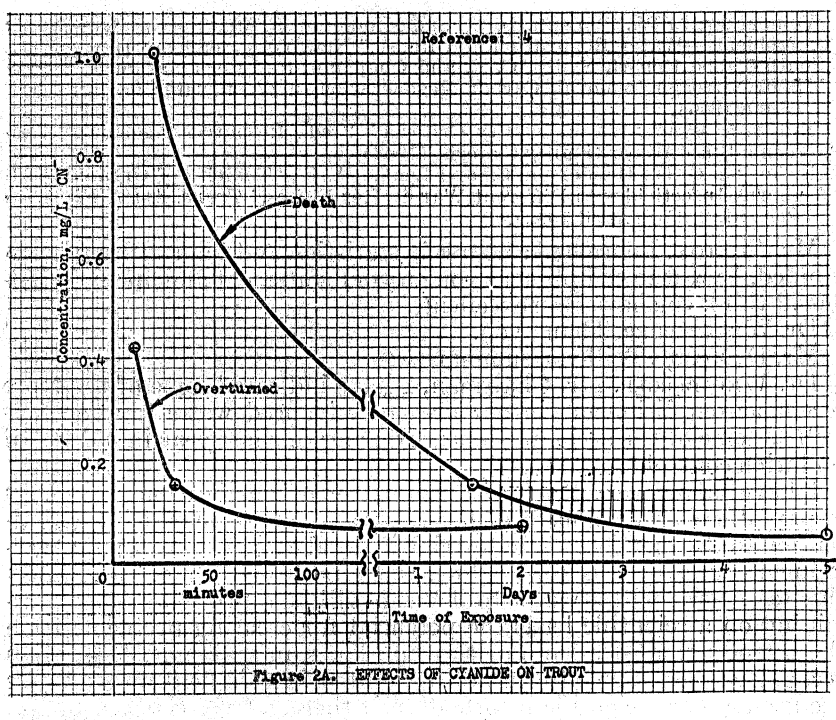


Figure 2A. EFFECTS OF CYANIDE ON TROUT

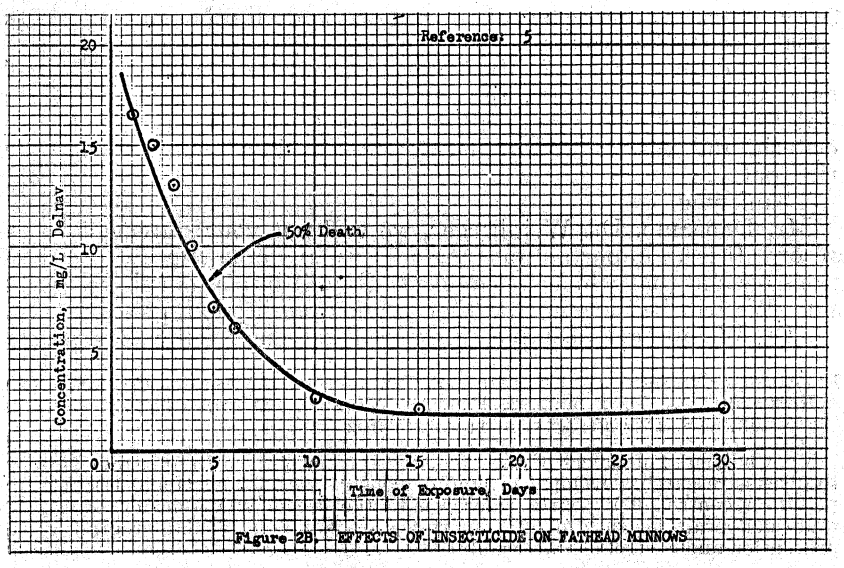


Figure 2B. EFFECTS OF INSECTICIDE ON FATHEAD MINNOWS

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Mr. FULTON. I once had a course in statistics, and I am still statistics-minded. I want to compliment you on your statement and openmindedness. I think you have been excellent.

Dr. WEINBERGER. Thank you.

Mr. DADDARIO. Will you summarize?

Dr. WEINBERGER. Mr. Chairman, I have indicated some of the more recent accomplishments in our area of advanced waste treatment as well as some of the accomplishments during this last year in industrial pollution control.

I have talked very briefly on the matter of purification. I do have in parentheses "enrichment of lakes, streams, and estuaries." I call attention to the fact there is industrial-Federal cooperation, a joint Government-industry task force which was established. One of the things this task force will attempt to develop will be a procedure for determining on a scientific basis the potential for creating problems from the introduction of all impurities into lakes and streams. It is again recognized that our information is limited in this field and that we need some more scientific information if there is to be cooperation between industry, the Federal Government, and all other interested and capable scientific groups.

I introduce a reference, Mr. Chairman, to this interim report as well as a report that was not prepared by us but by Professor McKie at Cal Tech which goes into a full treatise on the setting of water quality criteria and has thousands of references in it of specific work carried out.

Thank you.

Mr. DADDARIO. Dr. Weinberger, we will put your statement in the record. It is an important one, and offers many opportunities for questions beyond that which we could possibly fit into a morning's discussion. We will be in contact with you about additional questions.

(Dr. Weinberger's complete prepared statement follows:)

PREPARED STATEMENT OF DR. LEON W. WEINBERGER, ASSISTANT COMMISSIONER, RESEARCH AND DEVELOPMENT, FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, U.S. DEPARTMENT OF THE INTERIOR

Mr. Chairman, Members of the Committee, I am pleased to appear before you to discuss research, development, and demonstration (R and D and D) in water pollution control. This early reference to the second "D"—demonstration—is quite deliberate because of the importance of that facet of our program in the prevention and control of water pollution.

ROLE OF R AND D AND D IN POLLUTION CONTROL

An effective water pollution control program consists of a number of elements, namely: scientific and technical answers and solutions, economic resources to construct and operate pollution control facilities, a strong enforcement and pro-

gram implementation effort, adequate planning and administration, and competent manpower. Research and development is needed to provide new and improved analytical tools, scientific knowledge, and engineering controls. I, of course, do not intend to minimize the importance of role of research and development; however, we should recognize that many of the water pollution problems facing our nation today can be alleviated by the application of existing technology. In fact, in the immediate future, the most significant progress will be made in this way. Through research and development, we will find solutions where none now exist, we will better define the effects of impurities on water uses, we will improve the effectiveness of available solutions, and we will reduce the costs of waste treatment systems. Gentlemen, I have complete confidence that we will find solutions—acceptable solutions, in my opinion—to all our pollution problems.

The solutions will be satisfactory from a scientific and technical point of view, but *they will cost money.* Although you may believe that it is obvious that pollution control will cost money, there are many polluters who are apparently unwilling to recognize any solution as acceptable unless it is a zero cost solution. We shall seek these zero cost solutions—indeed, in some instances, through wastes recovery or by-product development, a profit may be realized—but we must be willing to pay for pollution control. What is meant by an economically acceptable solution is certainly to be the subject of considerable debate. Conventional cost-benefit analyses are not totally applicable because we are not able to define in a quantitative manner all the benefits of water pollution control nor assess the total damages resulting from water pollution. Research into the socio-economic aspects of water pollution control may provide us with some of these analytical tools—tools which will enable us to evaluate the "intangible" benefits.

COSTS AND BENEFITS OF WATER POLLUTION CONTROL

Our knowledge of the costs and benefits associated with water pollution control is rapidly improving.

The Federal Water Pollution Control Administration has just completed a study entitled "The Cost of Clean Water." This is in response to Section 16(a) of the Federal Water Pollution Control Act, as amended, which directs the Secretary of the Interior to conduct a comprehensive analysis of the national requirements for and the cost of treating municipal, industrial, and other effluent to attain water quality standards established under the Act. These first analyses are required to be submitted to the Congress in January 1968 to cover Fiscal Years 1969–73, inclusive, and to be updated each year thereafter.

These studies are extremely important because, although there is widespread agreement that water pollution is a significant, growing problem which must be dealt with, there are no firm estimates as to what the national requirements are, or what it will cost the Federal Government and other affected units of government to achieve a satisfactory abatement level. Various cost estimate studies of municipal and industrial needs have been conducted in the past but they have not been sufficiently comparable in geographical coverage, time phases covered, cost criteria, types of facilities included, or in cost estimate technique to provide a fully meaningful guide to the national requirements and costs involved.

The "Cost of Clean Water" study represents the initiation of what will be a continuing evaluation, aimed at developing more accurately the national costs of pollution control. Although it has not been possible to arrive at a completely definitive estimate of required costs, it is believed that the present study provides a more comprehensive cost estimate than has previously been developed and a sound base of information upon which to build future analyses. This estimate is expected to improve in accuracy with each yearly updating.

Other studies being completed under the requirements of the Federal Water Pollution Control Act include a study of the economic impact on affected units of government of the cost of installing waste treatment facilities, and a study of possible economic incentives to industry for pollution control. Both these studies will add substantially to our knowledge of the economics of the problem.

Determination of benefits is far more difficult, since many of the benefits of pollution control are non-monetary in nature. However, some progress in quantifying pollution control benefits is being made. A specific example is in the compre-

hensive water quality control study conducted by the Federal Water Pollution Control Administration in the Delaware River Estuary. In that study five water quality objectives were analyzed to determine the costs of their achievement by various means and the financial and economic benefits expected to accrue from their fulfillment. The study was conducted over several years with the cooperation of State and local governments and industry. Therefore, considerable detailed data not usually available were analyzed in developing the proposals. The study has become a model for this kind of exercise and is being adapted in other regions in those cases where this type of analysis is needed to guide pollution control decisions.

RESEARCH AND DEVELOPMENT PROGRAM AND PLANNING

Figure 1 illustrates the program structure and elements of the research and development program of the Federal Water Pollution Control Administration. It represents the framework within which we can plan our program, establish goals and determine needed resources to achieve goals, allocate available resources, and evaluate the effectiveness of ongoing research. Subprograms 11, 12, 13, 14, and 15 contain the elements dealing with specific sources of wastes; subprogram 16 is a general category containing the elements of pollution identification, fate and persistence of pollutants in the invironment, water quality control, eutrophication, water resources planning and resource data, cold climate research, and basic research; subprogram 17 contains the elements dealing with waste treatment; and subprogram 18 is the research on water quality requirements or effects of water pollutants on all water uses. The element 1608—Water Quality Control encompasses pollution control techniques such as recovery and reuse, product modification, process change, elimination, dispersion, dilution, detention, diversion and environmental treatment. This structure for categorizing our research and development was established last year and we believe will facilitate interagency coordination and cooperation. The categories are compatible with those established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

RESEARCH PRIORITIES

The research program of the Federal Water Pollution Control Administration is directed primarily to the *solution* of water pollution problems.

In planning research, a major task is to establish priorities of research within available resources and the directives provided by legislation. In our program, priorities are based on the needs, recommendations, and ongoing research of the following:

1. FWPCA Regional Directors and their staffs. They are knowledgeable of the problems as they exist or may develop in their respective regions (river basin),
2. FWPCA program directors at headquarters,
3. Other Federal agencies,
4. State and local agencies,
5. University professors and researchers,
6. Consultants and advisory groups,
7. Committee on Water Resources Research, and
8. Industrial groups.

The setting of research priorities and the allocation of research resources is still, to a considerable extent, based on a subjective analysis. The analysis, however, has considerable merit when carried out by competent knowledgeable people who have available to them the information obtained from answers to the following series of questions:

1. What is the problem?
2. What is the magnitude of the problem?
3. What answers or solutions do we need?
4. What answers or solutions are available? (The statement of problem should not be considered equivalent to needed research.)
5. When do we need the solutions?
6. What are the specific objectives being sought? What answers are being sought? How will you know when these objectives have been achieved or answers found?

7. How much work has been done on this problem to date, by whom, and when was it started? Has an adequate literature review been made? What is the magnitude of the ongoing research effort and who is doing it? What cooperative work is being undertaken and by whom?

8. What work is being planned by others? (NOTE: This is probably the most difficult information to obtain.)

9. Can the answers be obtained from proposed research?

10. What will be the total cost of research and development and demonstration effort to obtain answers?

11. How long will it take to obtain answers? When will project be terminated?

12. What effort or information must be provided by others in order to complete research?

13. If new answers are found, will they have any significance?

14. How are the results to be disseminated? How will effort be coordinated with other related programs?

15. Should research be carried out at laboratory, pilot plant, or at field evaluation scale?

16. How much replication of effort should be carried out?

17. What types and levels of competence of personnel are required? Do we have these people?

18. What facilities, equipment, and instrumentation are required? Are these available?

19. Should the work be performed in-house, by grants, or by contracts? Where can the work best be done? If in-house, which laboratory? If contract, are there contractors with special or unique competence?

20. Are there other approaches to solving the problem? What are they?

21. Does proposed approach and methodology differ substantially from those recognized in the field of study? Why?

22. Has the proposed program been subjected to technical review?

23. Are there predictable technological developments in this or related fields which could substantially affect your research effort?

24. If program or project is approved, when can the next decision be made as to termination or continuation of work?

25. What is probability of success?

The implementation of approved program plans consists of the following aspects:

1. Development of detailed operational plans and resource requirements.
2. Review and approval of detailed plans.
3. Allocation of resources.
4. Reports and review of progress and resources utilization.
5. Evaluation of progress.
6. Redirect efforts as necessary to incorporate new decisions, results, and actions affecting program.
7. Publication and disemination of results.
8. Integration of research efforts into total solution of problem.

ALLOCATION OF RESOURCES

The research and development program of the FWPCA is conducted through both in-house and extramural support. The in-house effort is conducted at laboratories at Corvallis, Oregon; Ada, Oklahoma; Athens, Georgia; College, Alaska; Duluth, Minnesota; and Cincinnati, Ohio, and although the permanent building has not been constructed, at Narragansett, Rhode Island. Additional research and development is conducted at field sites across the nation.

It is obvious that to have a successful research and development program, in addition to the competence available in the Federal Government, the best scientific and engineering talent in the nation including that available in the university and private research institutions, industries, and in state and municipal organizations, must be incorporated in the national effort to control water pollution. This we are doing through our extramural grants and contracts. It is important to note that approximately 80% of our research and development funds is spent in our extramural program.

Our experience has demonstrated the great importance and efficiency in conducting simultaneous and complementary in-house and extramural research proj-

ects. It has also shown that the overall effectiveness of grant and contract research can be very greatly enhanced through the intensive application of technical direction, coordination, and monitoring. A grant and contract support staff of engineers, scientists, economists, and other professional personnel must provide continuing planning, data interpretation and analysis, and systems optimization services to the program by using the most up-to-date techniques and principles, such as operations research, critical path ananlysis, and cost engineering. This staff must develop the interest and obtain the ideas and suggestions of the most competent scientific and engineering minds in the Nation; encourage the submission of proposals in light of the overall broad attack on the problem; monitor, direct, and coordinate projects in progress; and interpret and evaluate results and recommend continuance, termination, or redirection of the work. The staff must also conduct adequate liaison with other agencies and organizations, both within and without the Federal government.

The assistance of industry, in the form of ideas, processes, products, or services, will undoubtedly hasten the solution to some of the Nation's industrial and non-industrial pollution problems. Industries, for purposes of research and development, may be classified as follows:

1. Industries having a pollution problem.
2. Industries who have or expect to develop a commercial position in pollution control equipment, chemicals, instrumentation, processes, systems, or services.
3. Industries having a research and development capacity which has not been directed to pollution control.
4. Combinations of the above.

I would like to point out some of the factors which industry considers in participating in a federally supported research and demonstration effort.

POSITIVE FACTORS

1. Fees associated with contract.
2. Experience gained by personnel.
3. Advance of technological position.
4. Publicity associated with contract award.
5. Financial risk minimized.
6. Earlier demonstration of efficacy of results thereby establishing market.

NEGATIVE FACTORS

1. Time and effort of proposal preparation.
2. Time and effort of proposal negotiation.
3. Diversion of competent personnel from other research and development activities.
4. Personnel who have gained experience at company expense produce results available to competitors.
5. Contractor's art may be disclosed earlier than usual to competitors.
6. A non-contracting competitor can improve his competitive position with a minimum of contribution and a minimum of risk.
7. Unfavorable publicity resulting from negative results.

DEMONSTRATION AND FIELD EVALUATION

Earlier, I mentioned the importance of the demonstration aspects of our research and development and demonstration efforts. On May 11, 1966, before the Subcommittee on Air and Water Pollution, Committee on Public Works, United States Senate, we stated the following:

"The solution of water pollution problems will require the application of existing techniques plus additional research and development for new and improved techniques. Research and development generally goes through a series of steps ranging from exploratory studies through laboratory research, field evaluation, and demonstration. In the past, our efforts have been mainly in laboratory research and there has been a recognized deficiency in the application of research findings. The application of research findings requires that someone undertake the construction and operation of a new type facility which is often very expensive and which is associated with a greater risk of failure than with

processes which are already proven in practice. The construction of remedial facilities in water pollution control is the responsibility, to a considerable extent, of local authorities who may have limited financial resources. Often these authorities feel that they cannot afford the risk associated with trying new methods. It may very well be in the best public interest for the Federal government to design, construct, and operate full-scale facilities to develop and demonstrate new ways of pollution control. Such facilities could be built in cooperation with existing or new municipal installations or at Federal installations."

The Clean Water Restoration Act of 1966, which amended the Federal Water Pollution Control Act, provides for grants for the purpose (1) of assisting in the development of any project which will demonstrate advanced waste treatment and water purification methods or new or improved methods of joint treatment systems for municipal and industrial wastes, and (2) for research and demonstration projects for prevention of pollution of waters by industry including, but not limited to, treatment of industrial waste. This program is approximately one year old and there is ample evidence to indicate that the most significant contribution to the solution of water pollution by the development and application of new and improved technology will result from this program.

The Pulp Manufacturers Research League, Inc., in their 1967 Annual Report, made the following reference to grant support which they received from the Federal Water Pollution Control Administration:

"A fair estimate is that this League—Federal project will move ahead by as much as five years the time when pulp and paper mills will have a solid dollars and cents foundation upon which to base a yes or no decision for reverse osmosis. If this in-plant process proves as sound financially as it is already proved technically, the industry will have an effective and economical method for treating dilute effluents to a previously unattainable level of purity."

A complete listing of our grant and contract awards for projects authorized under this new legislation is available. As of January 25, 1968, 84 grants and contracts totaling $33,257,950, including storm and combined sewer projects, have been awarded.

MAJOR WATER POLLUTION PROBLEMS

Figure 1 represents the total scope of the research and development efforts of FWPCA. Each of the elements is important in our drive toward total pollution control; however, some problems stand out because of their magnitude and the need for solutions in the near future:

1. Municipal waste treatment.
2. Industrial waste treatment and control.
3. Improved methods for measuring effects of pollutants (water quality requirements), including temperature effects.
4. Disposal of impurities (solids) removed from wastes.
5. Mine drainage.
6. Irrigation return flows.
7. Agricultural land runoff.
8. Storm and combined sewer discharges.
9. Lake, estuary, and ocean disposal of treated and untreated wastes.

We have discussed these problems before, but I would like to dwell on one of them to illustrate what can and should be done in solving the problem. Municipal waste treatment has been discussed in terms of providing technology which makes it possible to achieve *any* degree of waste treatment desired, in fact, to return a waste water to a quality at least as high as that of the water before use. The following illustrates some additional areas for research and development under that category:

1. Improved procedures to accomplish more effective operation of plants.
2. Methods for increasing the capacity and performance of existing plants.
3. Improved design and constructing procedures, including materials of construction.
4. Treatment plants which would occupy a minimum of land area.
5. New systems for combining the waste treatment-water purification steps of the water cycle.
6. Treatment systems which would result in valuable by-products.

The identification of pollutants, the source of pollutants, and the fate-persistence of pollutants in the water environment require the application and development of scientific and technical instrumentation, relationships, methods, analyses, and techniques.

The criteria for measuring the quality of water for various uses and the relationships between those criteria and effects on water use have to be established (Water quality requirements—Subprogram 18—Figure 1). It would be most desirable to have data on the effects of different concentrations of pollutants (or deleterious results produced by pollutants) related to the time of exposure. This concept can be reviewed by examination of Figure 2. The complete set of data would result in a series of curves indicating biological, economic, and aesthetic effects on a short or long term basis. The complexities associated with biological and ecological systems, the synergistic and antagonistic relationships among pollutants, and quantification of aesthetic factors all may be found in this area of research.

The development of treatment processes and pollution control techniques and the determination of the capital and operating costs associated with those systems is another major area for Research and Development and Demonstration. The results of this effort may be illustrated by a series of curves—Figure 3, which would prevent the costs of reducing the concentration of any pollutant (having an initial concentration of C_1, C_2, C_3, etc.) to any desired residual level. The total pollutional load from any pollutant may be obtained by relating concentration to flow or volume of wastes.

The scientific and technical data and information which could be presented in a form as illustrated by Figures 2 and 3, would enable the water quality control administrator to know the costs of achieving or protecting any water use. The gathering of that data and information has top priority in the research and development effort of FWPCA. Considerably more data than currently available are needed.

We have had no experience to date in the enforcement of violations of established water quality standards for interstate waters. The standards submissions, including their plans of implementation and enforcement, of 15 States have been approved and are Federally enforceable. The range of expert scientific and technical competence recruited to assist in the development of water quality standards, as represented most notably by the 84 scientists and water authorities comprising the National Technical Advisory Committee to the Federal Water Pollution Control Administration on Water Quality Criteria, provides substantial weight and support, technical and legal, to the established standards if challenged in this regard.

ADVANCED WASTE TREATMENT—RECENT PROGRESS AND STATUS

Research and development on advanced waste treatment (AWT) technology was begun, on a very modest scale, in 1961. The objective of this program is to develop and demonstrate the technology necessary to achieve, at minimum cost, any level of waste treatment which may be required to meet pollution control needs. The methods being developed range across the spectrum of physical, chemical, and biological separation techniques. They range from the mundane (filtration and sedimentation), through the novel (biological denitrification), to the exotic (reverse osmosis). Techniques are under study to improve the performance of primary treatment, to upgrade and extend the capability of secondary treatment, and to extend the purification train on to tertiary treatment.

The pollutants to be removed or destroyed in waste treatment may be generally categorized as:

(1) suspended and colloidal solids
(2) dissolved biodegradable organics
(3) dissolved refractory organics
(4) nutrients
(5) inorganic salts
(6) microorganisms

Many processes are, of course, capable of treating wastes in more than one category; others may be effective for only one type. Likewise, pollution control

needs vary from location to location. Considerable effort is being expended, therefore, in developing optimized "systems" of processes which will meet whatever localized requirement may be specified. This research is being carried out both by in-house scientists and engineers of FWPCA and through contracts and grants with outside organizations. As with any "process development" program, effort normally starts at the desk or in the exploratory laboratory. With successful results, the development then moves to bench-scale or bread-board studies and thence to the pilot plant, the field evaluation, and ultimately to full-scale demonstration.

Within the last year or two, substantial progress has been made in moving a number of AWT processes well along in the above process development sequence. In total, some 60 separation or ultimate disposal processes have been evaluated. Approximately 25 percent have been rejected for technical or economic reasons; another quarter are undergoing laboratory or bench-scale study, almost a third are at the pilot-scale; and the remainder, some dozen processes, are now being field evaluated or actually demonstrated. Examples of progress within the last 12–18 months include the following:

a. A joint study with the City of Los Angeles to evaluate improved operational methods for the activated sludge process is scheduled to begin this month.

b. A 7.5 mgd demonstration plant including granular activated carbon adsorption, ammonia stripping, lime coagulation and precipitation of phosphates, multi-media filtration, absorbate incincerations, lime recalcination and recovery, and disinfection is under construction and nearing completion.

c. Cost of the granular activated carbon adsorption process for achieving 98–99% removal of organic pollutants from secondary sewage effluent was reduced by 20% to an estimated 8.3¢/1000 gal. (at 10 mgd plant size.)

d. A new method for high-efficiency removal of phosphates from municipal wastes through addition of small amounts of chemicals has been developed and proven effective in bench-scale tests. Preliminary tests at 2 full-scale waste treatment plants were completed with promising results.

e. Solutions have been found to the serious membrane fouling problems which have been prevalent in electrodialysis treatment of wastewater. Pilot-scale verification of these techniques is now underway.

f. Pilot plant studies of the powdered activated carbon adsorption process have shown high quality, reliable performance and give promise that this technique for refractory organic removal may be lower in cost than granular carbon adsorption. Very recent results indicate that the process might even be a substitute for conventional biological secondary treatment.

g. Consistent biological nitrification-denitrification has been achieved in bench-scale studies of a new type two-stage biological process. It has been discovered that effective denitrification can also be achieved through use of a feed supplemented packed column contracter.

h. The existence of a high efficiency phosphate removal phenomenon within certain existing activated sludge plants was brought to light. Some controlling variables have been established, others are now being confirmed.

i. The effectiveness of organic polyelectrolytes as additives in primary treatment was demonstrated in a full-scale plant.

j. Pilot-scale studies of several types of reverse osmosis equipment have been initiated.

k. The technical feasibility of two new oxidation processes, involving ozone and light-catalyzed chlorine, was established.

l. Anion exchange resins were found to be effective in removing up to 50% of the soluble organics from secondary effluents without irreversible fouling.

m. A comprehensive summary of capital and operating costs for both conventional and advanced waste treatment processes has been completed.

n. Studies of various methods for powdered carbon regeneration were initiated. Preliminary results are quite promising.

o. To predict and control the performance of waste treatment processes by computer, mathematical models for these processes are being formulated. A preliminary model for the activated sludge process was completed.

p. Arrangements have been made for field evaluation of pipelining and surface spreading of digested sludges to revegetate and reclaim disturbed

land areas such as strip mines and to reduce acid mine drainage pollution from these areas.

q. A technique for recovering and reusing chemical precipitants used in treatment for phosphate removal has been evaluated. The technique may lead to significant cost reductions for phosphate removal.

r. Exploratory research has shown that the hydrolysis of sewage sludge can recover amino acids and other dissolved nutrients which may be usable as a by-product from sludge disposal operations.

ACCOMPLISHMENTS IN INDUSTRIAL POLLUTION CONTROL PROGRAM

During FY 1967, studies were initiated to identify and analyze the problem areas and determine the status of treatment and control technology in selected industries. In addition, a major new program for industrial waste pollution control (authorized by Section 6(b) of the 1966 Act) was implemented. Under this authority, 10 grant projects amounting to $2.6 million in grants were awarded. These included eight full-scale demonstration facilities on control of pollution from industries in the fields of pulp and paper, meat-packing, potato and sugar beet processing, citrus fruit, etc. The ongoing FY 68 program currently has research and demonstration grants covering representative industrial pollution from such other major sources as metal and metal products, leather and tanning, chemical and allied products, etc. These grants now cover representative industrial pollution from sources encompassing a combined total of three-fourths the entire industrial pollution load in terms of volume and biochemical oxygen demand. This program through FY 69 also includes the top priority projects which resulted from the FWPCA studies on immediate needs for the river basins.

It is anticipated that approximately 25 grants will be awarded in FY 68, which will include new and novel physical, chemical and biological treatment processes for abatement of pollution from industrial sources.

National organizations, representative of the various manufactures, i.e., API, National Canners Association, TAPPI, National Metal Finishers Association, etc., have been contacted and their key committees on water pollution problems are being utilized to provide the required guidance on a program of mutual concern.

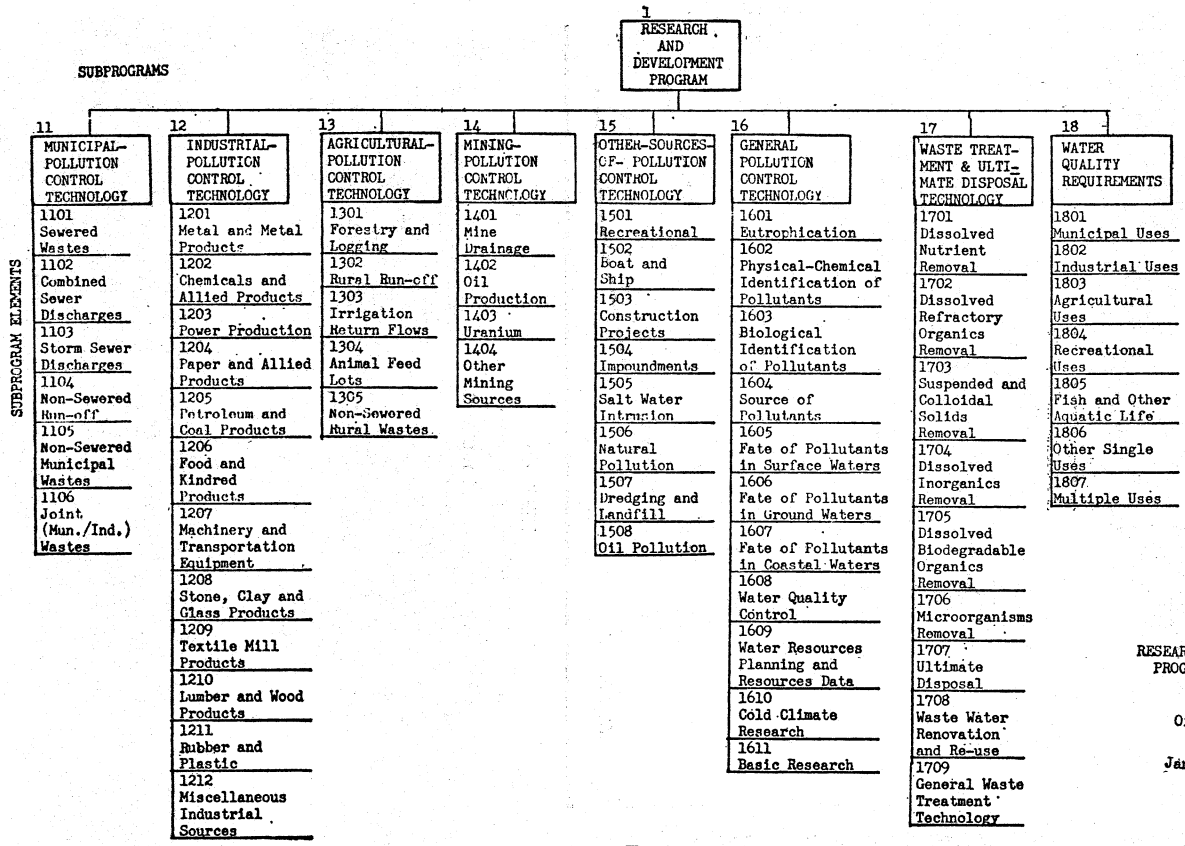
EUTROPHICATION

The complex problem of establishing the relationships between water pollution and the undesirable effects of eutrophication (enrichment) of lakes, streams, and estuaries is being attacked with increased effort. A joint government-industry task force to recommend a cooperative research program has been established. This task force has recently announced that it will attempt to develop a standardized procedure to determine the algal growth potential (AGP) of various chemicals and waters.

The proposed procedure would be designed to: (1) anticipate the effect on algal production of introducing various nutrients; (2) determine the extent to which nutrient levels must be reduced in a body of water to remedy eutrophication; (3) determine at what point along the time scale of progressing eutrophication a body of water lies; (4) evaluate the effectiveness of waste treatment processes in removing elements that support or stimulate the growth of algae; and (5) be adaptable for special problem purposes.

WATER QUALITY CRITERIA AND USE OF WATER

There have been a number of beneficial uses of water identified, including: public water suppliers; industrial water supplies; agricultural water supplies; fish, other aquatic life and wildlife; and recreation and aesthetics. For each of these uses, water quality criteria have been identified and selected. The reports of "National Advisory Committee on Water Quality Criteria to the Secretary of the Interior, June 30, 1967," and "Water Quality Criteria" by McKee and Wolf in 1963, contain the most complete information on water quality criteria as related to water uses.



RESEARCH AND DEVELOPMENT PROGRAM STRUCTURE

Office of R&D
FWPCA

January 12, 1968

FIGURE 1

EFFECTS ON WATER USES BY POLLUTANTS

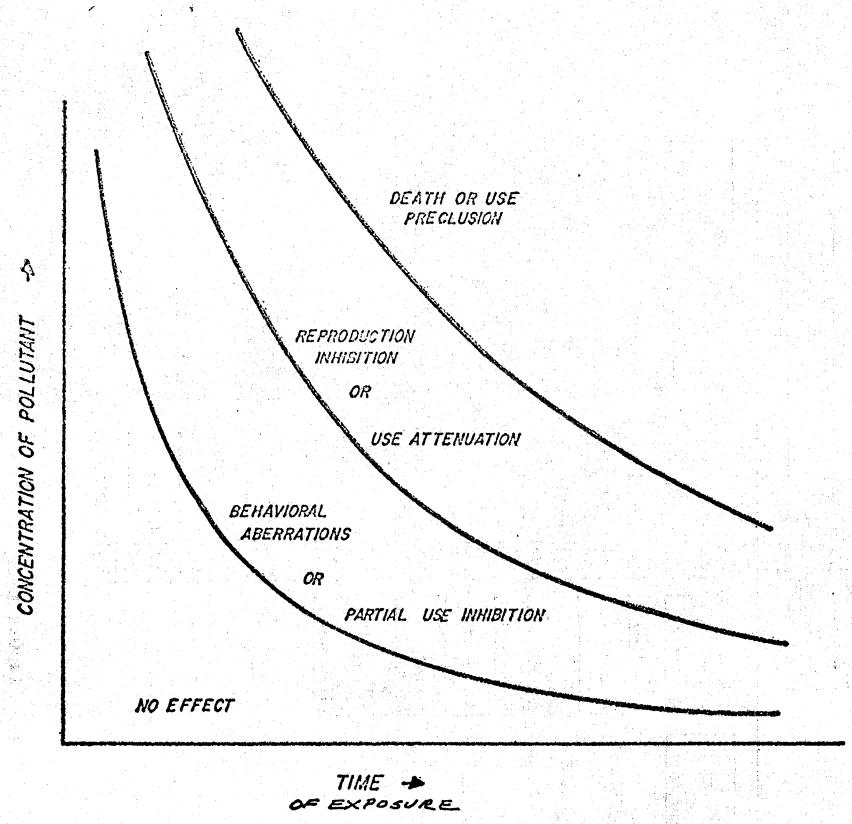


FIGURE 2

COST TO ACHIEVE FINAL CONCENTRATION IN WASTE TREATMENT OR CONTROL

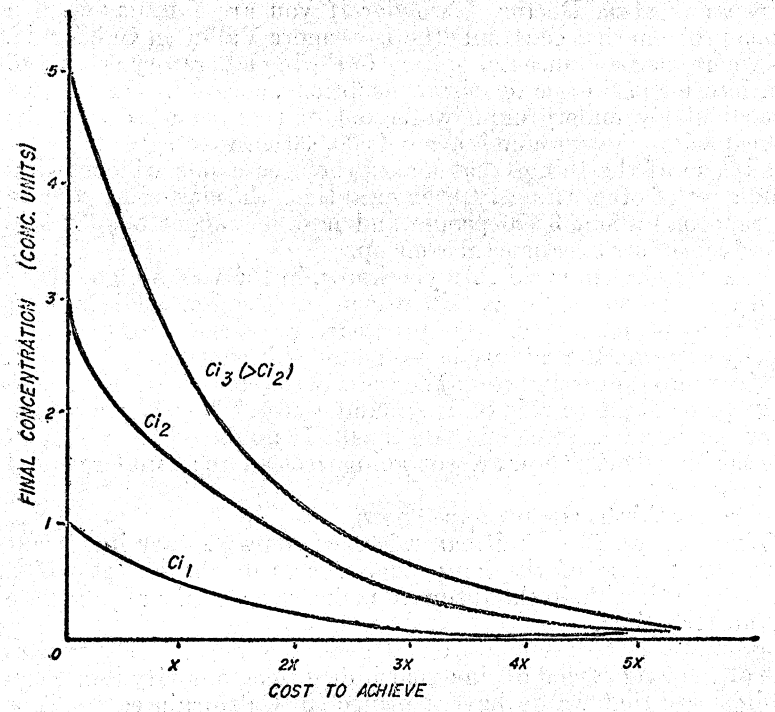


FIGURE 3

Mr. DADDARIO. We appreciate your statement and your cooperation.

Mr. Chairman?

Chairman MILLER. Doctor, I wonder if you are familiar with a vexatious problem that confronts the Livermore Valley in California. That is where the Lawrence Laboratory or the big laboratory is located. It is an interior basin due to seismic eruptions, cut off of the natural flow, particularly underground water out of this basin, so that the storage capacity underground is around 500,000 acre-feet.

That is one of the things that makes the area a fine winegrowing area and a lot of other things. In the meantime, the city of Livermore at one time had about 3,500 people and now has about 30,000. The usual problem of sewage disposal came up.

Alameda Creek drains this. As you know, in the west we get all of the rain and the runoff in certain seasons of the year. The rest of year the creek is nearly dry. They proceeded to do the things that we did some years ago. We said we have treated this effluent. It is sterile. So we will dump it into the creek. The wells in the city of San Francisco have the prior right to this underground water. They began to get traces of detergent in some of this effluent. It might be hard enough to clean the big lake, but how are you going to clean up an underground supply of water?

Suffice to say this has been stopped now.

Dr. WEINBERGER. The Chairman raises, of course, a very important question about some of the long-range effects or the effects which may only be noticeable in the future to make sure we take appropriate steps at an early time.

Contamination of ground water, of course, is particularly critical because of the long period of time that it does take to purify it or clean it. I might say that we do have a project in California east of Los Angeles, which is also a restricted basin. But there, by proper treatment of wastes, by using the best technology which we have, they will be taking their waste water and deliberately putting it back into the ground to recharge. We do not anticipate any problems.

Chairman MILLER. I think if you treated the water when you let the effluent itself get in there, seep underground, this is another thing. A very distinguished scientist, one Athelstan Spilhaus, told me long ago the best thing we could do was to start teaching the people of the United States they had to use reconstituted water. This seems very repugnant, but it is being done now in certain parts of the country and we don't know it. It is something we have to do. These are going to create greater problems.

The discharge from the condensers that were used to produce heat at Richland, Wash., were in no way contaminated. It was only heated and put into the Columbia River, but it changed the ecology of that river so far as salmon are concerned. The migrating salmon coming upstream expect to find a certain temperature of water and found it 3° or 4° higher. They just refuse to go through with their natural process. So we can lose things in this way, too.

Mr. FULTON. Mr. Chairman?

Mr. DADDARIO. Are you finished?

Chairman MILLER. Yes.

Mr. FULTON. I wanted to compliment the chairman. I thought they were good, specific questions of the effects of actions that are taken