DEPARTMENTS OF LABOR, HEALTH AND HUMAN SERVICES, EDUCATION, AND RELATED AGENCIES APPROPRIATIONS FOR 1982

HEARINGS

BEFORE A

SUBCOMMITTEE OF THE

COMMITTEE ON APPROPRIATIONS

HOUSE OF REPRESENTATIVES

NINETY-SEVENTH CONGRESS

FIRST SESSION

SUBCOMMITTEE ON THE DEPARTMENTS OF LABOR, HEALTH AND HUMAN SERVICES, EDUCATION, AND RELATED AGENCIES

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DELEGATION FOR BASIC BIOMEDICAL RESEARCH

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DEPARTMENTS OF LABOR, HEALTH AND HUMAN SERVICES, AND EDUCATION, AND RELATED AGENCIES APPROPRIATIONS FOR 1982

WEDNESDAY, MAY 6, 1981.

DELEGATION FOR BASIC BIOMEDICAL RESEARCH

WITNESSES

DR. PAUL BERG, NOBEL LAUREATE, DEPARTMENT OF BIOCHEMISTRY, STANFORD UNIVERSITY

DR. KONRAD BLOCH, NOBEL LAUREATE, SCHOOL OF PUBLIC HEALTH, HARVARD UNIVERSITY

DR. GEORGE DUNLOP, PROFESSOR OF SURGERY, UNIVERSITY OF MASSACHUSETTS MEDICAL SCHOOL

DR. MAHLON HOAGLAND, SPOKESMAN FOR THE DELEGATION AND PRESIDENT AND SCIENTIFIC DIRECTOR OF THE WORCESTER FOUNDATION FOR EXPERIMENTAL BIOLOGY

DR. SALVADOR LURIA, NOBEL LAUREATE, DIRECTOR OF THE CENTER FOR CANCER RESEARCH, MIT

DR. STEVEN MULLER, PRESIDENT, JOHNS HOPKINS UNIVERSITY

DR. GEORGE SNELL, NOBEL LAUREATE AND SENIOR SCIENTIST EMERITUS AT THE JACKSON LABORATORY

DR. LEWIS THOMAS, CHANCELLOR, MEMORIAL-SLOAN KETTERING CANCER CENTER

DR. DONALD WALKER, PRESIDENT, SOUTHEASTERN MASSACHUSETTS UNIVERSITY

DR. JAMES WATSON, NOBEL LAUREATE AND DIRECTOR, COLD SPRING HARBOR LABORATORY

Mr. NATCHER. The Committee will come to order. We have before the Committee this morning Dr. Donald Walker, Dr. Steven Muller, Dr. James Watson, Dr. Lewis Thomas, Dr. Mahlon Hoagland, Dr. Paul Berg, Dr. Salvador Luria, Dr. Konrad Bloch, Dr. George Snell and Dr. George Dunlop.

We want you to know that we appreciate your attending this hearing. We start our subcommittee hearings early in the year and it takes us anywhere from 12 to 16 weeks to complete hearings on the annual appropriation bill. The Departments and agencies covered by the Labor, Health and Human Services and Education Appropriations bill account for approximately 35 percent of the budget. Including the Social Security, Railroad Retirement, and unemployment insurance and trust funds along with the amounts that we recommend for the Department of Labor and for the Department of Health and Human Services, we have outlays of about $274 billion. This bill requires careful consideration and we need all of the help, gentlemen, that we can get. And I say that to you frankly. We also have with us this morning the Chairman of the Full Committee on Appropriations, Jamie Whitten of Mississippi. Mr. Chairman, it is a pleasure to have you sit with our subcommittee.

Mr. WHITTEN. I am pleased to be here, Mr. Chairman.

Mr. NATCHER. As I say, gentlemen, we need all of the help that we can get. We deal in this Committee with billions of dollars. Sometimes we wonder where our money is going and whether it is being well spent.

Now, you have been kind enough to appear before this Committee. You know, this is our Committee. We would like for you gentlemen to feel that way too. This is our Committee, and it is our money. And that is the way we feel on the subcommittee and that is the way my Chairman, Mr. Whitten, feels on the Full Committee, as well as the balance of the Members of the Full Committee.

Again I want you to know that we appreciate your appearing. We want you to talk to us. We want you to tell us what you have on your minds. Any suggestions that you have we would appreciate. We just want to hear you and we want to talk with you. We have done this once or twice before. After we hear the Secretaries of each of the three Departments, the assistant secretaries, and all of the witnesses of the Departments, then we have outside witnesses, people from all parts of the Nation.

We asked you to come and appear before us, because we need your advice.

This subcommittee considers appropriations for the National Institutes of Health each year, as you gentlemen well know. Over the past ten years we have appropriated $24,746,124,000. Appropriations rose from $1,476,046,000 in 1972 to $3,537,418,000 in 1981.

We have steadily increased our investment in biomedical research. Gentlemen, as we go along, we want you to discuss this with us and tell us how you feel about it. Now Dr. Hoagland, are you serving as spokesman now for this group?

Dr. HOAGLAND. Yes, sir.

Mr. NATCHER. Well now, we are delighted to have you serve in this capacity. We want you gentlemen to proceed as you desire before the committee and we would like all of you to say something. You are going to make that arrangement, are you not?

Dr. HOAGLAND. Yes, sir, I am.

Mr. NATCHER. We want to hear from all of you gentlemen. Now Dr. Hoagland, we will recognize you at this point.

Dr. HOAGLAND. Thank you very much, Mr. Chairman.

In response to your immediate question I would point out to you that I plan to take about ten minutes to introduce some of our views to you.

Mr. NATCHER. Go right ahead Dr. Hoagland.

Dr. HOAGLAND. Thank you Mr. Chairman. I will take about ten minutes, please, to introduce some of our views to you and then ask each member of our group to speak to you for three minutes, after which I hope we can have an open give and take discussion.

I would like to say that we have a very distinguished group here today and one that represents a wide range of interests in the biomedical area and I would suggest that you have a look in the folder that you have received. It contains lists of the brief biographies of each of the people here so that as we go along and you listen to them you will have some information about their background.

[The information follows:]

PAUL BERG, Ph.D.

Dr. Berg is a professor of Biochemistry at Stanford University, Stanford, California. He was born in New York City, June 30, 1926. He received his Bachelor of Science degree from Pennsylvania State University in 1948, and his Ph.D. from Western Reserve University in 1952.

From 1950-52, Dr. Berg was a Predoctoral Research Fellow with the National Institute of Health. From 1952-54, he was Postdoctoral Research Fellow with the American Cancer Society and worked at the Institute of Cytophysiology in Copenhagen, Denmark and at Washington University in St. Louis, Missouri. He remained at Washington University as a scholar in cancer research and then as a faculty member until 1959. He then joined the Department of Biochemistry at Stanford University. A former chairman of the department, Dr. Berg is currently Willson Professor of Biochemistry at the University and a Non-Resident Fellow of the Salk Institute for Biological Studies.

In 1959, Dr. Berg won the Eli Lilly Award in Biochemistry for his work in DNA. In 1963, he was named California Scientist of the Year, and in 1972 he was designated both the Harvey Lecturer and V.D. Mattia Lecturer. The following year he was named distinguished alumnus of Pennsylvania State University and in 1978 he was awarded honorary Doctoral of Science degrees from both the University of Rochester and Yale University.

In 1966, Dr. Berg was elected a member of both the American Academy of Arts and Sciences and the National Academy of Science and, more recently, to its Institute of Medicine. He is also a member of the American Society of Bacteriologists and former president of the American Society of Biological Chemists. In 1978 Dr. Berg was elected as a foreign member of the Japanese Biochemical Society, and in 1981 as a foreign member of the French Academy of Sciences.

In 1980, Dr. Berg received the Nobel Prize in Chemistry for his fundamental studies of the biochemistry of nucleic acids, particularly, recombinant DNA.

KONRAD E. BLOCH, Ph.D.

Dr. Bloch is presently Professor of Science, School of Public Health, Harvard University in Cambridge, Massachusetts. He was born in Neisse, Germany January 12, 1912. He earned his degree in Chemical Engineering at the Technische Hochschule, Munich, Germany in 1934. He came to the United States in 1936, received his Ph.D. from Columbia University in 1938.

Dr. Bloch was an instructor of Biochemistry at Columbia from 1939-46, an assistant professor at the University of Chicago from 1946-50 and professor of Biochemistry at Chicago from 1950-54. He became Higgins Professor of Biochemistry at Harvard University in 1954. He was the chairman of the Chemistry Department there from 1968-71, and has been the Science Professor at the School of Public Health since 1979. While at Harvard, in 1961, Dr. Bloch published "Lipid Metabolism".

Dr. Bloch has received numerous honorary doctoral degrees and awards. In 1964 he received the Nobel Prize in medicine and physiology, and the Fritzsche Award from the American Chemical Society. In 1965 he won the Centennial Science Award from the University of Notre Dame and the Cardano Medal from the Lombardy Academy of Sciences. In 1967 he was President of the American Society of Biological Chemists, and from 1966-69 he was Chairman of the Section of Biochemistry of the National Academy of Sciences. Dr. Bloch is also a respected member of the American Chemical Society, the American Academy of Arts and Sciences, the Harvey Society and the American Philosophical Society.

GEORGE RODGERS DUNLOP, M.D.

George R. Dunlop, a surgeon at Worcester Memorial Hospital in Worcester, Massachusetts, was born in St. Peter, Minnesota March 31, 1906. He received his Bachelor of Science degree from the University of Cincinnati in 1927 and his M.D. from Harvard Medical School in 1931.

An intern at Cincinnati General Hospital in 1931-1932, Dr. Dunlop served as assistant resident in surgery at New York Hospital-Cornell Medical Center from 1932 to 1935 and as resident in surgery at Worcester City Hospital from 1935 to 1936. He began practicing medicine, specializing in surgery, in 1935. He is a staff surgeon and past chief of surgery at Worcester Memorial Hospital and a professor of surgery at the University of Massachusetts Medical School in Worcester.

Dr. Dunlop, active in a number of professional and civic associations, is past chairman of Massachusetts Blue Shield, former chairman of the board of the National Association of Blue Shield Plans, past chairman of the Massachusetts division of the American Cancer Society and a member of the board of directors and past chairman of the Worcester Foundation for Experimental Biology. He was also a member of the board of directors of the Bancroft School, Worcester Boys Club and Community Chest.

A former president of the American College of Surgeons and past president of the New England Surgical Society and Northwestern Medical Society, Dr. Dunlop is a diplomate of the American Board of Surgery and a member of the American Medical Association, New England Cancer Society, American Gerontological Society, Boston Surgical Society, American Surgical Association and the Pan American Medical Association.

MAHLON BUSH HOAGLAND, M.D.

Mahlon B. Hoagland, president and scientific director of the Worcester Foundation for Experimental Biology in Shrewsbury, Massachusetts, was born in Boston, Massachusetts October 5, 1921. He received his M.D. from Harvard Medical School and an honorary Doctor of Science degree from Worcester Polytechnic Institute in 1973.

Dr. Hoagland was a member of the faculty at Harvard Medical School from 1953-67, serving as an assistant professor of medicine at Huntington Laboratory from 1953-60 and as associate professor of bacteriology and immunology from 1960-67. In 1967 he joined the faculty of Dartmouth Medical School, where he was a professor of biochemistry and chairman of the department. He has been president and scientific director of the Worcester Foundation since 1970.

He has been a fellow at the Carlsberg Laboratory in Copenhagen and a scholar in cancer research for the American Cancer Society. Dr. Hoagland was a member of the medical research unit in molecular biology at Cavendish Laboratory of Cambridge University in 1957 and 1958. He is director of the American Cancer Society (Massachusetts Division) and a trustee of Woods Hole Oceanographic Institute.

Dr. Hoagland is a member of the American Society of Biological Chemists and the American Academy of Arts & Sciences. He has conducted research in carcinogenic and biological effects of beryllium, biosynthesis of co-enzyme A and biosynthesis of protein. He received the Franklin Medal in 1976. He is the author of two books on science for the layman.

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SEYMOUR SOLOMON KETY, M.D.

Seymour S. Kety, professor of psychiatry at Harvard Medical School, was born in Philadelphia, Pennsylvania Aug. 25, 1915. He received his Bachelor of Arts degree in 1936 and his M.D. in 1949 from the University of Pennsylvania. He received an honorary Doctor of Science degree from that university in 1965 and in 1969 received an honorary Doctor of Science degree from Loyola University.

A National Research Council fellow at Harvard Medical School from 1942 to 1943, Dr. Kety joined the faculty of the School of Medicine at the University of Pennsylvania in 1943 as an instructor in pharmacology; in 1944 he became an associate professor and in 1946 an assistant professor. In 1948 he became a professor of clinical physiology in the Graduate School of Medicine, where he remained until 1961.

Dr. Kety was the science director at the National Institute of Mental Health & National Institute of Neurological Disease and Blindness from 1951 to 1956. He remained associated with the National Institute of Mental Health until 1967, when he joined the faculty of Harvard Medical School as a professor of psychiatry. He has also served as director of the Psychiatric Research Laboratory at Massachusetts General Hospital in Boston since 1967.

The recipient of the Theobald Smith Award from the American Association for the Advancement of Science in 1949, Dr. Kety has received numerous awards, including the Max Weinstein Award from the United Cerebral Palsy Research Foundation, the Distinguished Service Award from the Department of Health, Education and Welfare, the McAlpin Medal and Research Achievement Award from the National Association of Mental Health, and the Kovalenko Award from the National Academy of Science.

He is a past president of the Association for Research in Nervous and Mental Disease and the American Psychopathological Association. He is also a member of the National Academy of Science, the Psychiatric Research Society and the American Physiological Society.

Dr. Kety has conducted research in lead citrate complex and therapy of lead poisoning, circulation and metabolism of the human brain, theory of capillary-tissue exchange, psychiatric genetics and the biological aspects of mental illness.

SALVADOR EDWARD LURIA, M.D.

Salvador E. Luria, director of the Cancer Research Center at Massachusetts Institute of Technology in Cambridge, Massachusetts, was born in Turin, Italy Aug. 13, 1912. He received his M.D. from the University of Turin in 1935.

Dr. Luria served as a research fellow at the Curie Laboratory in Paris from 1938 to 1940, when he moved to the United States to serve on the faculty of Columbia University. He was a Guggenheim Fellow at Vanderbilt and Princeton universities in 1942-1943 and was a member of the faculty of Indiana University from 1943 to 1950. From 1950 to 1959 he was a professor at the University of Illinois, where he also served as a professor of microbiology and chairman of the microbiology committee from 1959 to 1964. He has been the Sedgwick Professor of Biology at Massachusetts Institute of Technology since 1964 and became director of the Cancer Research Center at MIT in 1974.

He has lectured at Columbia University, University of Colorado and the University of Notre Dame, and has been a non-resident fellow of the Salk Institute in California since 1965. Dr. Luria is a member of the National Academy of Science, National Institute of Medicine, American Society of Microbiologists and the American Association for the Advancement of Science.

Dr. Luria received the Nobel Prize in Medicine for his work in genetics in 1969. His research involved bacterial viruses, microbial genetics and the biological effects of radiation.

FRANCIS DANIELS MOORE, M.D.,Sc.D.

Francis D. Moore, surgeon-in-chief at Peter Bent Brigham Hospital in Boston, Massachusetts, was born in Evanston, Illinois Aug. 17, 1913. He received his Bachelor of Arts degree in 1935 and M.D. in 1939 from Harvard University, and in 1966 was awarded a Doctor of Science degree from Suffolk University in Boston.

The recipient of honorary degrees from National University of Ireland and Glasgow University, Dr. Moore was a National Research Council fellow in medicine at Harvard University in 1941 and 1942. He joined the faculty of Harvard Medical School in 1943 as an instructor; in 1946 he became an associate professor, in 1947 an assistant professor and tutor, and in 1948 the Moseley Professor of Surgery, a position he still holds.

Dr. Moore held concurrent positions as assistant resident surgeon at Massachusetts General Hospital in 1942 and 1943, resident surgeon in 1943, surgical assistant from 1943 to 1946 and assistant surgeon in 1946. Since 1948 he has been surgeon-in-chief at Peter Bent Brigham Hospital. Dr. Moore was a consultant to the Surgeon General in Korea in 1951 and was chairman of the surgical study section of the United States Public Health Service from 1956 to 1959. He has also been a visiting professor to the University of Edinburgh, University of London, University of Colorado and the University of Otago in New Zealand.

In 1958 he was elected president of the Society of University Surgeons and in 1971 president of the American Surgical Association. He is a member of the Executive Committee of the National Research Council, Society of Clinical Surgeons, American Medical Association, American College of Surgeons and the Advisory Committee on Metabolism Trauma, Office of the Surgeon General.

Dr. Moore has conducted research in such areas as clinical surgery in gastrointestinal tracts, biochemistry of cellular changes in surgery as revealed by radioactive and stable isotopes, metabolic care in trauma, transplantation of tissues and organs, cancer of the breast, and surgical care and health care delivery.

STEVEN MULLER, Ph.D.

Dr. Muller is currently the President of Johns Hopkins University and the Johns Hopkins Hospital. He is the first person in this century to fill both presidencies. He was born in Hamburg, Germany November 2, 1927. He came to America in 1940 and has been a naturalized citizen since 1949.

Dr. Muller graduated from the University of California at Los Angeles in 1948. From 1949 to 1951 he was a Rhodes Scholar at Oxford University in England, where he received the B. Litt. degree in politics in 1951. He received his Ph.D. from Cornell in 1958. He served in the United States Army Signal Corps during 1954-55.

Dr. Muller was an assistant professor of political science at Haverford College from 1956-58, then joined the Cornell University faculty in 1958 as assistant professor of government. He has also served as visiting professor of political science at UCLA and at Columbia University.

From 1961 until 1966 Dr. Muller served as director of Cornell's Center for International Studies. From 1966 until 1971 he served as vice president for public affairs at Cornell. Between 1961 and 1971 he also held a tenured appointment on the Cornell University faculty as associate professor of government and continued to teach graduate and undergraduate students in addition to his administrative responsibilities.

Dr. Muller came to Johns Hopkins in 1971 as provost. He assumed the post of president in 1972. Dr. Muller is also a member of the President's Commission for the White House Fellowships.

Dr. Muller is a member of the Board of Trustees of the Committee for the Economic Development and of the German Marshall Fund of the United States. He is also a director of the Council for Financial Aid to Education and of the Greater Baltimore Committee, a member of the Board of Editors of DAEDALUS, and Fellow of the American Academy of Arts and Sciences. He is currently serving on the American Council on Education Commission on International Education Relations.

GEORGE D. SNELL, Sc.D.

Dr. Snell is a Senior Scientist Emeritus at The Jackson Laboratory in Bar Harbor, Maine. He was born December 19, 1903 in Haverhill, Massachusetts and received his Bachelor of Science degree from Dartmouth College in 1926. From Harvard University he received his Doctor of Science degree in 1930.

Dr. Snell was an instructor at Dartmouth College from 1929-30 and at Brown University 1930-31, then a National Research Council Fellow at the University of Texas from 1931-33. After a year as assistant professor at Washington University, Dr. Snell joined the Jackson Laboratory as a Research Associate in 1935. During 1949-50 he was Staff Scientific Director at the lab, and in 1957 he became a Senior Staff Scientist Emeritus, a position he holds yet. While with the facility in Bar Harbor, he was a member of the National Institutes of Health Allergy and Immuniology Study Section from 1958-62.

In addition to three honorary doctorate degrees, Dr. Snell has received the Hektoen Silver Medal of the American Medical Association (1955), the Griffen Award from the Animal Care Panel (1962), the 12th Annual Bertner Foundation Award (1962) and the Gregor Mendel Medal from the Czechoslovak Academy of Sciences (1970). Dr. Snell was elected to the American Academy of Arts and Sciences in 1952, the National Academy of Sciences in 1970, and is an Honorary Member of the British Transplantation Society and an Associate Member of the French Academy of Sciences.

These as well as other memberships and honors have been awarded to the scientist during his fifty years in genetic and immunological research. In 1980, Dr. Snell received the Nobel Prize in Medicine/Physiology.

LEWIS THOMAS, M.D.

Lewis Thomas, chancellor of Memorial-Sloan Kettering Cancer Center in New York City, was born in Flushing, New York November 25, 1913. He received his Bachelor of Science degree from Princeton University and his M.D. from Harvard University.

He served as an intern at Boston City Hospital from 1937 to 1939 and at the Neurology Institute in New York from 1939-1941. He was a Tilney Memorial Fellow at Thorndike Laboratory of Boston City Hospital from 1941 to 1942 and was associated with the Rockefeller Institute from 1942-46. In 1946 he joined the faculty of Johns Hopkins University as an assistant professor in the School of Medicine, leaving in 1948 for a two-year position as associate professor and professor of medicine at Tulane University's School of Medicine. From 1950-54 he was professor and director of the pediatric research laboratories at Heart Hospital at the University of Minnesota, leaving in 1954 to become a professor of pathology and chairman of the department at the School of Medicine, New York University. He also served as professor and chairman of the department of medicine from 1958-66 and as dean from 1966-1969, when he joined Yale University School of Medicine. At Yale, Dr. Thomas served as professor and chairman of the pathology department from 1969-72 and as dean of the School of Medicine from 1972-73. He became president and chief executive officer of Memorial-Sloan Kettering Cancer Center and professor of medicine and pathology at Cornell University Medical School in 1973. In 1974 he became codirector of the Graduate School of Medical Science at Cornell.

Dr. Thomas is also a successful writer. He published Lives of a Cell in 1974 and Medusa and the Snail in 1979, notes and more notes of a "biology watcher". Dr. Thomas is also an essayist, regularly included in Discover magazine, the New England Journal of Medicine, as well as other publications.

Dr. Thomas has served as a member of the National Advisory Health Council, the President's Science Advisory Committee, as a consultant to the surgeon general of the United States Army and to the Surgeon General of the United States Public Health Service. He is a trustee of the John Simon Guggenheim Memorial Foundation, Rockefeller University and Draper Laboratory. He is a member of the Board of Directors of the Joshiah Macy Jr. Foundation and is a member of the National Academy of Science and American Academy of Arts & Sciences.

DONALD E. WALKER, Ph.D.

Dr. Walker is president of Southeastern Massachusetts University (SMU) in North Dartmouth, Massachusetts. SMU is a public university which includes colleges of Arts and Sciences, Engineering, Nursing, Business and Visual and Performing Arts. It serves 7,000 students through day and continuing studies programs, has an annual operating budget of approximately $15 million and has a faculty of 309.

Dr. Walker became president of SMU in 1972 after serving as acting president and vice-president for academic affairs at San Diego State College in San Diego, California. Prior to that he held several other administrative positions, including a stint as president of Idaho State University, Pocatello, Idaho. His more than 20 years of administrative experience in public colleges and universities has borne fruit both in his leadership at SMU and in his writing of The Effective Administrator: A Practical Approach to Problem Solving, Decision Making, and Campus Leadership. That was published by Jossey-Gass in 1979 and since has become very popular in administrative circles and has received many favorable reviews. Change magazine published a survey in which several administrative scholars and college administrators were asked to recommend the most essential reading for newly minted college and university presidents. The book which received the second highest number of mentions on that list was Dr. Walker's The Effective Administrator.

A much sought after speaker on the national scene for academic administrative leadership conferences, Dr. Walker has been chairman of the Commission on Leadership Development of the American Council on Education. He speaks several times each year at a variety of institutes for college and university administrators and is vice-president-elect of the American Association of University Administrators. He is a frequent speaker and seminar leader for the programs of the American Council on Education and the American Association of State Colleges and Universities.

Walker is a psychologist, licensed by the states of California and Massachusetts, and holds a Ph.D. from Stanford, a masters and A.B. from the University of Southern California. His writings on psychological and administrative topics have appeared in a variety of professional publications. He is listed in Who's Who in America, as well as many similar publications.

JAMES DEWEY WATSON, Ph.D.

James D. Watson, director of Cold Spring Harbor Laboratory in New York and a professor of biology at Harvard University, was born in Chicago, Illinois April 6, 1928. He received a Bachelor of Science degree in 1947 and a Doctor of Science degree in 1961 from the University of Chicago, a Ph.D. in 1950 and a Doctor of Science degree in 1963 from Indiana University, and a Doctor of Laws degree in 1965 from Notre Dame University.

A molecular biologist, Dr. Watson was a Merck fellow of the National Research Council at the University of Copenhagen in 1950 and 1951, leaving in 1951 to do research work at Cavendish Laboratory of Cambridge University from 1951 to 1953 and 1955 to 1956. Before returning for a year to Cambridge University, he was a senior research fellow in biology at California Institute of Technology from 1953 to 1955. In 1956 he joined the faculty of Harvard University, becoming a professor of biology in 1961. In 1965 he became a trustee of Cold Spring Harbor Laboratory and in 1968 director of the quantitative biology laboratory.

Dr. Watson has been a consultant to the President's Science Advisory Committee since 1962 and was a member of the Board of Scientific Counselors of the National Institute of Arthritis and Metabolic Diseases in 1967. The recipient of numerous awards, including the Eli Lilly award in biochemistry in 1959, the Lasker prize in 1960 and Research Corporation prize in 1962, shared with Francis Crick, Dr. Watson is the author of many articles on research and two books, The Molecular Biology of the Gene (1965) and The Double Helix (1968).

In 1962, Dr. Watson received the Nobel prize in medicine and physiology, along with Francis Crick and Maurice Wilkins, for the discovery of the double helical structure of the DNA molecule. He has also conducted extensive research on the role of RNA in protein synthesis.

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STEVEN WEINBERG, Ph.D.

Dr. Weinberg is currently a physics professor at the University of Texas while on sabbatical from Harvard University. He was born on May 3, 1933 in New York City. He received his BA from Cornell University in 1954 and did postgraduate work at the Copenhagen Institute for Theoretical Physics in 1954-55. He received his Ph.D. from Princeton University in 1957.

Dr. Weinberg was a physics instructor at Cornell from 1957-59 and a Research Associate at the Lawrence Radiation Laboratory in Berkeley, CA in 1959-60. He joined the faculty of the University of California at Berkeley in 1960 and became a professor of physics in 1965. Dr. Weinberg then went to MIT as a professor from 1969-73 and joined the Harvard faculty in 1973 as a Higgins Professor of Physics.

During his years at UCal Berkeley, Dr. Weinberg also served as an AP Sloan Fellow from 1961-65, a Loeb Lecturer at Harvard in 1966-67, and a visiting lecturer at MIT from 1967-1969. While at Harvard, Dr. Weinberg was a Consultant, U.S. Arms Control and Disarmament Agency (1971-73); Counselor, American Physics Society (1972-75); Consultant, Stanford Research Institute (1973-); as well as various lecturer posts.

Dr. Weinberg has received the J.R. Oppenheimer Prize in 1973 and the Nobel Prize in Physics in 1980.

Dr. HOAGLAND. Mr. Chairman, I think it was on March 27th of this year that a pleasant exchange occurred between you and Dr. Fredrickson concerning the government's commitment to basic science, including a reference to our enjoyable and productive visit to this Committee in 1978 which was a memorable occasion for us. I might say it was particularly memorable because I recall that every single Member of your Committee was present on that occasion and it looks to me very close to a repeat of that performance this time. I am truly honored to see that.

We are very pleased to be invited to return here where we can sit with you informally to discuss our concerns. Since 1978 and that visit we worked closely with you to effect two fundamentally important results for science. One was a sharpening focus on the importance of basic science, promoted through the investigator-initiated project grant; and the second was the stabilization of research support by the guarantee of fixed number of investigator-initiated grants, new grants, each year.

DECLINING SUPPORT FOR SCIENCE

But while we have all enjoyed a happy meeting of minds on these matters, the overall support of science in our nation has steadily continued a shaky and irresolute decline.

After World War II, it became our national policy to nuture on a large scale science in this country and the result of that active buildup of science has been a prodigious outpouring of new discoveries which is still coming along today and which are still affecting in a positive way the welfare of our people. Only one example needs to be given you today, at this moment, and that is the remarkable achievement in the field of DNA research and recombinant DNA technology with its implications for immediate benefit to humanity. In the biomedical area alone it has been estimated for every dollar spent in research some $15 have been saved in longer life and reduced illness.

There are other impressive figures I think will come out during our discussion which I will not go into now. But I must say that those before you today feel that this wonderful era in the support of science, the generous support to science in this country shows many signs of coming to an end.

Many technologically advanced societies today are imitating the science support schemes that we developed during the last 20 or 30 years and are now surpassing us in their research and development performance and we are profoundly concerned about that. We feel that a continuation of this trend would be a calamity for the United States.

SCIENCE EDUCATION

One of the areas that we do want to discuss with you as a background to our concern about science support in general is what is happening to science education in this country. I am not going to say more than that we are confronted with a growing scientific and technological illiteracy in our country. We are losing not only the potential for generating scientists to perform the jobs of science and technology in our country but we are also losing a literate public to understand the meaning and importance of science and technology in our country and therefore to help us to fund the whole processes and then give it the kind of support that is necessary.

Now, I would like to say just a word or two about the matter of science support. Amidst the gloom that pervades the science scene today, minor adjustments, within the budget of the National Institutes of Health, have less and less significance for the nation's real needs. What I am saying in other words is that we must begin to talk about a major reevaluation of the way we look at the support of science both within the NIH and elsewhere. As a nation, and this is the figure we have discussed before and I remember it came out in our discussions in 1978, we spend $300 billion a year for health care in this country and $1.5 billion for basic research in the health sciences.

Appropriations for science have been declining since the 1970's. In spite of the resulting stringencies the progress we have made in the matters I discussed with you earlier, in which this committee had a major role, namely the stabilization of science support through the investigator-initiated project grant and the guarantee of approximately 5,000 grants a year, plus the recognition that basic science was fundamental to the whole process; in spite of our progress in this area we have to recognize that we are failing in maintaining the total effort at a level that allows it to function optimally.

Let me just give you one thought on this in terms of a few numbers and do not hold me to the exact correctness of these numbers; they are round figures. If NIH were to maintain its effort effectively at the level it was in 1979, which is approximately 1,000 more new project grants each year, and taking account, of course, of inflation and so on, if it were to maintain in 1982 the level it was supporting in 1979, it would require approximately $550 million added to the budget. Now I am not suggesting that this be appropriated immediately but I want you to understand that this is the kind of sums that I think we have to begin to think about.

In addition to that, in order to upgrade equipment, to have an adequate supply of equipment throughout the country, to support that type of research establishment, we would need another $100 million. In order to maintain institutional support in the form of the BRS grants at a level which we would consider adequate for the national effort we would need another $100 million. And I am just going to throw in $50 million more for renovation of space and the need for upgrading facilities.

Now, I say that obviously to give you some sense of the kinds of dollar amounts that one has to think about in order to bring the level of our operation back to something that would be considered optimal to compete in the world today.

As funding gets more scarce the flexibility and innovativeness and responsiveness of a large science-supported agency like NIH, of course, declines rapidly. And I know that Dr. Frederickson has called this to your attention and has expressed this concern that the NIH, itself, as funds steadily decline, is unable to function in the effective way that one would like to see it function.

Mr. Chairman, in conclusion, if I may be permitted a homely analogy, I see us as parents, each day clothing our child, our hope for the future, in increasingly threadbare garments as he goes off to school more and more ragged.

The Soviet kid across the street, the German kid next door and the German girl on the other side are marching to school in neat, new clothes. Our child, our hold on our own immortality if you will, can be walking down the street naked one morning and the shock might come too late to mend our mortal embarrassments.

Science support by government on a large and enlightened scale is an American offspring. We need to cherish that child for the security, prosperity and comfort it can bestow on the coming generations.

Mr. Chairman, I would now like to ask my colleagues, in turn, to make comments on some aspects of what I have said and whatever they may wish to say to you.

[Dr. Hoagland's prepared statement follows:]

Notes on The Status of Science

May 6, 1981

We are living in a technology-dominated society, yet we are failing in the cultivation of science which is the source of technology's vigor, and of our economic productivity. Science, the disciplined search for universally verifiable truth is a complex and not widely understood process which puts a premium on curiosity, skepticism, imagination and scholarship. The route of science's advance toward understanding is frequently indirect, circuitous; big discoveries are often by-products of searches for something else; progress of exploration is slow and the interval between discovery and social benefit is long.

After World War II, it became our national policy to nurture this complex exploratory process on a large scale. In what is widely appreciated as one of the most enlightened achievements of any government anywhere, the U.S. constructed a support system that optimally encouraged science with a minimum of regulatory interference. The result has been a prodigious outpouring of new discoveries and benefits for people. In the biomedical area alone it has been estimated that for every dollar spent in research, $15 have been saved in longer life and reduced illness (1). Furthermore, non-health related commercial exploitation of biomedical discoveries alone is returning $37 billion per year to our economy, one year of which is equal to the nation's total investment in biomedical science (2). And biomedical science depends, in turn, on the continued healthy activity of its "parent" sciences, chemistry and physics.

Sadly, the lustrous era of U.S. leadership in science shows signs of coming to an end. Many technologically advanced societies which have put the American science support system to their own use are now outstripping us in productivity increases. Our leadership role is passing to W. Germany, Japan, the Soviet Union (3). We believe that a continuation of this trend would be a calamity for the U.S.

Science Education

There is a growing scientific and technological illiteracy in our country (4). The contribution of science and technology to our health, prosperity and security depends on the skill, competence and inventiveness of our scientists. It also depends on the American people who, while having no direct involvement in science, nevertheless have influence upon governmental funding, regulations and policy decisions that set directions for scientific inquiry and technological development. And of course people reap the benefits of and appraise the usefulness of science and technology.

The number of our young people who graduate from high school and college with only the most rudimentary notions of science, mathematics and technology is growing (4).

Shortages of qualified science teachers in secondary schools have become critical. Schools and colleges are not able to keep up with the revolution in technology. Teaching laboratories are obsolescent.

Erosion of teacher support systems and resources for science teaching has led to lowered student achievement (5) just at the time when such knowledge is more than ever needed in our technical society.

The declining emphasis on science and mathematics in our school systems is in marked contrast to other industrialized societies. Japan, China, Germany and the Soviet Union all provide rigorous training in science and mathematics for all their citizens (4).

The nation's commitment to the predoctoral and postdoctoral training of scientists is also weakening. Funds for science education through the NSF were 27% of its budget in 1970, and are now 7.5% (the total budget has about doubled). President Reagan now intends to essentially eliminate NSF's science education activity (6). The NIH's support of training has fallen from 15% of its budget to 3.5% in the same period.

We confront a major national problem in the disintegration of science education. Only renewed national dedication will allow us to begin the repair process.

Science Support

Amidst the gloom that pervades the science scene today, minor budgetary adjustments within an increasingly inadequate and rigid framework of science support have less and less significance for the nation's real needs. They occupy the attention of scientists and administrators who are trying to hold the enterprise together, but they divert us from the growing crisis and the need to remedy it. As a nation we spend 300 billion dollars a year on health care--and one and a half billion dollars on health related basic science. It is time to look squarely at the big picture!

Appropriations for science have been declining through the 1970s (3). In spite of the resulting stringencies, some salutary progress has been made in stabilizing year-to-year science support at NIH,for example including the provision of a fixed number of new and competing project grants each year. We applaud the House Subcommittee on Appropriations for Health and Human Services for its help in this area. Yet, indicative of the larger issue we now address, the commitment to 5000 competing grants now seems to be viewed as a maximum, not as the minimum envisioned in its planning.

And as project grants have held our attention, institutional grants, funds for plant construction and equipment acquisition have steadily diminished while the need has steadily risen (7).

Our inability to increase substantially the number of investigator-initiated project grants for research is particularly indicative of the current science decline. Overall at NIH the grant award rate (grants funded/grants approved) is at 32% an all-time low and a level that sorely taxes the effective operation of the whole award mechanism.

As funding gets scarcer, the flexibility, innovativeness, and responsiveness of a large science-supporting agency of government like NIH also declines. Its ability to sustain all of its interrelated programs and change emphasis as national needs change is increasingly compromised. The problem cannot be solved by redistributing limited funds. Additional appropriations are clearly necessary if the overall mission is to be accomplished.

Science Advice

After Sputnik in 1957, as the nation's commitment to scientific advance in all areas rose, President Eisenhower appointed a full time science and technology assistant, James Killian. This was in addition to an 18 member President's Scientific Advisory Committee (PSAC). Killian said at the time that the President desired "unbiased technical expertise to reassure the nation about its technological future and to reach wise policy decisions on space, weapons systems, disarmament and the maintenance of American leadership in science." This is a good statement of a need that now is greater than ever. Indeed, today's challenge exceeds that presented by Sputnik. It is unthinkable that we should plan this nation's future in the age of science without strong independent advice to the President from its community of scientists. And the same considerations apply, in our view to the Congress on whose shoulders rest comparable burdens of decision. Could not the Office of Technology Assessment include competence to advise on science?

Where shall the nation find the resources for the pursuit of a reawakened science enterprise? We have the most crucial resource at hand in abundance: our people. Young people will aspire to a career in science if opportunity and stability are restored. The majority of our people will support a vigorous scientific enterprise if they understand it. All of us, motivated by national pride in discovery and the hope of a better future, can and will find a way to divert an adequate measure of our wealth to the search for knowledge. At a small fraction of the cost of a massive weapons buildup and a swelling "safety net"(8), a rebirth of the quest for knowledge across the nation is our best defense against our enemies and the worst in ourselves.

The Delegation for Basic
Biomedical Research

and colleagues.

80-735 O—81——4

References

1. Selma J. Mushkin: Biomedical Research: Costs and Benefits. Ballinger Publishing Company, Cambridge, MA, 1979.

2. Biomedical Discoveries Adopted by Industry for Purposes Other than Health Services. A report by the Office for Medical Applications of Research, NIH, to the NIH Director, March, 1981.

3.(a) R&D expenditures by the U.S. have decreased from 2.9% of the GNP in 1967 to 2.2% of the GNP in 1978--a 25% drop. During the same time R&D expenditures by the USSR have increased from 2.9% of their GNP to 3.5%--a 20% increase. R&D expenditures by West Germany and Japan have increased from 2.0 and 1.5% of their GNP to 2.2% and 1.9%, respectively. Since these last two countries do not have defense and space R&D expenditures, they invest nearly twice as much as the U.S. in civilian R&D.

(see: National Patterns of Science and Technology Resources, 1980. NSF 80-308,pg 3.)

(b) Scientists and engineers engaged in R&D, as a fraction of the labor force, declined slightly between 1965 and 1977 for the U.S., but nearly doubled during that period for the USSR, Japan and West Germany.

(see: Science Indicators, 1978. NSF pg 8.)

(c) Patents granted to U.S. inventors have declined from some 55 thousand in 1966 to some 42 thousand in 1977, while patents granted by the U.S. to foreign inventors have increased from some 14 thousand in 1966 to some 25 thousand in 1977 (a 75% increase).
(see: Science Indicators, 1978. NSF, pg 17.)

(d) From 1973 to 1977, seven of nine major fields saw decreases in the number of science and technology articles by U.S. authors. These declines ranged between 5 and 25%. Only articles in clinical medicine and biomedicine continued to rise in number over this period. The greatest decline occurred in mathematics, followed by engineering and technology, chemistry, earth and space science, biology, psychology and physics.

(see: Science Indicators, 1978. NSF, pg 51 and 53.)

(e) In light of the above mentioned trends, it is interesting to look at changes in productivity--output per worker-hour--between 1968 and 1980. In Japan productivity increased by over 70% and in West Germany by about 60%. In the U.S. it increased by only 18%. No reliable figures are available for the Soviet Union.

(see: R. C. Atkinson: Federal Support for Science: An Investment in the Future. The Chronicle of Higher Education, March 2, 1981, pg 64.)

4. Science and Engineering Education for 1980s and Beyond. NSF 80-78.

5. Scholastic Aptitude Test (SAT) scores reached an all-time high in 1963 and declined thereafter, gradually during the 1960s and then precipitously in the 70s.

(see: America Enters the 80s: Some Social Indicators. Annals of the American Academy of Political and Social Science, pgs 107, 115, 168.)

6. Without education - is there science?
S. Kirschner, Chemical and Engineering News,
April 6, 1981, pg 38.

7.(a) NIH programs that provide institutional support and equipment (notably DRR) were authorized at up to 15% of the total NIH extramural grant support program (PHSA Act, Title III, Part A, Section 30 (a)(3)). They reached 7% in 1967 and are now at a level of less than 2%. In terms of constant dollars these programs have lost more than 60% of their purchasing power.

Other forms of institutional support like the $5,000 institutional allowance on NRSA fellowships is projected for phase out by the Reagan administration.

From 1961 to 1974, NSF administered the Institutional Improvement for Science Program, another form of institutional support which is no longer available to academic research institutions.

(b) Decreased funding for facilities construction has both reduced the amount of construction and limited the funds available to equip new facilities. Both buildings and equipment are now frequently obsolete. Researchers in academic settings now look with envy to the facilities available to their colleagues in industry and to researchers in foreign laboratories, notably those in West Germany and Japan.

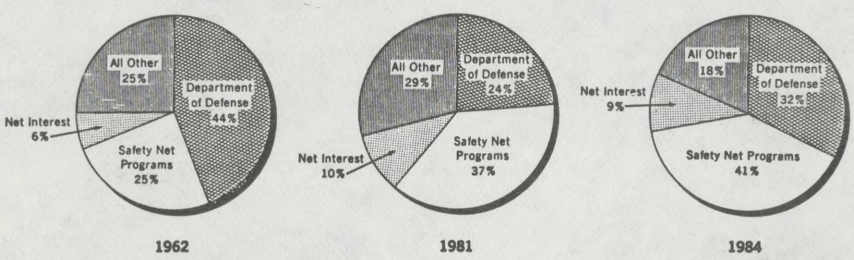
(see: The Scientific Instrumentation Needs of Research Universities. A report of the NSF by the AAU, June, 1980.)

(c) Instrumentation needs are not being fulfilled in part because the inadequacy of available funds for project grants generates an unhealthy conservatism among peer reviewers attempting to stretch their dollars to the maximum, thus disapproving equipment acquisitions (ibid. pg 5). The fraction of NIH research project support allocated to permanent equipment decreased from 11.7% in 1966 to 5.7% in 1974. At NSF the equivalent figures are 11.2% and 7.1%, respectively (ibid. pg 11). Another reason for the serious erosion in the quality of research instrumentation is the rapid increase in the purchase, operation and maintenance costs of this equipment. Start-up costs for instrumentation needed for frontier research in a synthetic organic chemistry lab were estimated by the AAU group to be $116,500 in 1970 and $741,000 in 1979 (ibid. pg 15). Operating and maintenance costs for the equipment was estimated to increase at the rate of 25% per year.

In 1978, Jerome B. Wiesner (Universities and the federal government: a troubled relationship; Chemical and Engineering News, December 11, 1978, pg 31) estimated the scientific instrument deficit to be $200 million and growing. Translated to FY 1982 the deficit would be of the order of $500 million.

8. President Reagan's budget message of February 18, 1981, "America's New Beginning: A Program for Economic Recovery," in the Section "Budget Reform Plan", page 11, summarizes the Reagan administrations shift in budget priorities as follows:

Shift in Budget Priorities
(Percent Composition of Outlays)



The scientific community wonders what the fate of R&D in the U.S. is going to be in view of these projections, in which "all other", the repository for R&D, is being squeezed between defense and "safety net".

The lack of any mention of R&D in the White House report (see pgs 5 & 6) which accompanied the President's message when discussing economic growth. This is disturbing since it is known (ref. 5 pgs 160 and 164) that R&D is of prime importance in national productivity and its vigor the best indicator of future economic performance and individual well being.

FACT SHEET

1. In biomedical area, every dollar invested in research has won a return of $15.00

2. Non-health related application of biomedical research is boosting GNP by $37 billion annually. This $37 billion yearly return exceeds NIH support of research for 40+ years.

3. National Institutes of Health grant award rate is at alltime low of 32%.

4. NIH support for training has fallen from 15% of its total budget in 1970 to 3.5% in 1981.

5. The fraction of NIH research project support allocated to permanent equipment decreased from 11.7% in 1966 to 5.7% in 1974. At NSF the equipment support figures are 11.2% and 7.1%, respectively.

6. U.S. spends $300 billion annually on health care, but only 1.5 billion on health related basic science.

7. R&D expenditures in U.S. have decreased from 2.9% of the GNP in 1967 to 2.2% of the GNP in 1978...a 25% drop. During the same period, R&D expenditures by the U.S.S.R. have increased from 2.9% of their GNP to 3.5%...a 20% increase. R&D expenditures by West Germany and Japan have increased from 2.0 and 1.5% of their GNP to 2.2 and 1.9%, respectively. Since neither of these nations have defense or space R&D expenses, they invest nearly twice as much as the U.S. in civilian R&D.

8. U.S. patents granted to American inventors dropped from some 55,000 in 1966 to about 42,000 in 1977; U.S. patents granted to foreign inventors have increased from some 14,000 in 1966 to about 25,000 in 1977 (a 75% increase).

9. Scientists and engineers in R&D, as a fraction of the labor force declined slightly between 1965 and 1977 in the U.S., but nearly doubled during that period in the U.S.S.R., West Germany and Japan.

10. Start-up costs for instrumentation for synthetic organic chemistry lab were estimated by the AAU group to be $116,500 in 1970 and $741,000 in 1979. Operating and maintenance costs for the equipment was estimated to increase by 25% per year.

Mr. NATCHER. Dr. Hoagland, thank you very much. We will be pleased to hear from you gentlemen.

Dr. WALKER. Chairman Natcher and Chairman Whitten, distinguished Members of the Committee: I am not a scientist but I am a consumer of science and a number of reflections have occurred to me as I have thought about appearing before this distinguished Committee. This is a young nation, although we often do not feel that we are. In the year that Thomas Jefferson died, Abraham Lincoln was 17 years old. In the year that Abraham Lincoln died, Woodrow Wilson was eight. In the year Woodrow Wilson died if I have counted correctly, President Reagan was 13. In four presidential lifetimes you span the entire history of the Republic, yet it is one of the oldest and most durable forms of government in the world today. I think there are many reasons for that. These are two I would like to highlight. Max Lerner in his "America is a Civilization," was once asked "What one word would you pick to summarize the genius of this country?" And after some thought he said "Access."

I think another word could be added to that, "Science."

The budget for science that is before this Committee, I think, impinges both access and science and as a consumer of science and as an educator I am concerned. We are embezzeling away our capital in the area of science. We do science exceedingly well as a nation.

I met with our scientists on the campus to ask them what words of wisdom they would share with this Committee and they gave thoughts such as this: If I were a dedicated enemy of the United States and wanted really as a member of the Soviet Union to undermine this nation, I would undercut the science education budget of this country for ten years and the struggle would be over.

I found a quote to support that view from Breznev. "The field of scientific and technological progress is today one of the major fronts in the historical battle between the two systems."

Other scientists gave me quotes such as this, "Equipment starts to become obsolete in three years, completely obsolete in ten." From a chemistry professor, "With this equipment we are not teaching science, we are teaching the history of science." From another, "We are being asked to train tomorrow's workers on yesterday's equipment."

The budget of the National Science Foundation, particularly its education budget, is very important to our kind of institution. Gentlemen, we ask that in the long perspective of time you give some thought to the fact that the American public operates on the pendulum principle. The concerns that agitate us today, and I speak as a taxpayer, may not concern us tomorrow. And we are over the long term concerned with fundamental values. We hand our public servants, including college presidents and Members of Congress, the tab when we make a mistake. I would urge that you consider very carefully the need to maintain science education at high levels in the next decade if we indeed are to survive. This is a most fundamental value. Thank you.

Mr. NATCHER. Thank you, Dr. Walker.

Dr. MULLER. Mr. Chairman, gentlemen of the Committee, I am Steven Muller of the Johns Hopkins University. I would first like to say, Mr. Chairman, how much we respect your opening comments and your statement that we should think of this Committee as our Committee. We know that you have awesome responsibilities in trying to deal with national priorities for appropriations with respect to a great many things. You are extremely courteous and we appreciate being asked for our comments. I guess the most fundamental comment you will hear from us is that our future as a society depends on the state of science and technology that we as a nation can muster; yes, for security purposes but also in terms of the way we function industrially and competitively in the world.

RESEARCH TRAINING AND SCIENTIFIC EQUIPMENT

I would like to make only two very basic points in support of our common cause. First I would just like to make sure how clear it is that speaking for one of the country's major research universities, research and training are absolutely linked. And this is not because of some academic doctrine or some academic preference. But when you are talking about science, particularly about the education of people at the doctoral level in science, you have to produce people who are working on the most modern equipment in what we call the state of the art of science at the time.

They are useless for academic research but they are also useless to government and they are useless to industry, unless they can both master their field, itself, and the ever-more complex technology that they have to use in order to make progress. Industry is interested in the what research universities produce, but it is even more interested in the people that we produce, the trained scientist who can work in labs all over this country.

The second point which is equally obvious, is that if there were no inflation at all, if we were back in the good old days where three percent a year inflation would have been considered a calamity, the cost of doing research in science is rising, has risen, will continue to rise.

I do not know, gentlemen, what comes into your mind as I speak about science. If you think about research, some of you may think of that wonderful image of Einstein standing by a blackboard in Princeton with chalk scribbles behind him or you may remember labs in which you studied, a chem-lab full of beakers and smelly sinks.

Chemistry today involves electronic microscopes, it involves spectroscopy. All science has become big science as we know so much more.

The problem of maintaining state of the art which is constantly moving forward, state of the art instrumentation, training and research, requires funding. And of course it is our conviction that a large investment in that, for the benefit of the United States, has the highest possible prospect for our national future. Thank you very much.

Mr. NATCHER. Thank you very much, Dr. Muller.

Dr. HOAGLAND. Dr. Berg.

Mr. NATCHER. We would be pleased to hear from you.

Dr. BERG. I am very pleased for the privilege of appearing here to transmit my own comments on the subject for today. Mr. Natcher and Members of the Committee: When I was in Sweden last December as part of the Nobel activities we had a number of press conferences. One of the questions which was frequently asked us: "Why is there such a preponderance of Americans amongst the winners each year of the Nobel prizes?" I think it is an interesting question, also a difficult one to sort out all of the answers. But in my view one of the major reasons has been the vision which was shown in the 50's and early 60's in investing in basic research.

SUPPORT OF YOUNG INVESTIGATORS

But more importantly it was allowing young investigators in the prime part of their lives, their creativity, the independence to develop as scientists. Unlike the European system where the young people have to work for the "Herr Geheimrat" professor, in this country we have allowed the young person to develop independently and to lead in the development of these new branches of science. An important part of this whole development has been the support and funding of an active training for young people to enter science. I myself was the recipient of National Institutes of Health predoctoral and subsequently post-doctoral support to allow me to go through this training period and learn the wherewithall of research. This commitment has paid off. I think we are now entering a phase where that kind of support is wavering and I think we have great concern about what will happen in the future; namely, are we going to support the young people to enter science and to provide the leaders of our science for the next couple of decades.

I am quite shocked, in fact, by the proposal of the Administration to cut back the support of the training grants that NIH has developed over these last few decades. I think we will pay a dreadful price for not supporting the young people at this early stage in their careers.

I think there is a misconception about what the training programs do.

I was surprised not too long ago in talking to a member of one of the committees to find that the perception of training is of the young graduate student or post-doctoral fellow who follows along behind the profesor and listens to his words of wisdom, takes notes, and then goes back and reads his notes and that is the way you become scientists. In point of fact, much of the development of the science that we all extol and for which we are all being congratulated worldwide has been done by graduate students and post-doctoral fellows. It is indeed the professor who has directed this research. But many of the key ideas and the inspiration have come from the graduate students and post-doctoral fellows who are supported by the NIH and National Science Foundation fellowship programs. If we are now to cut back in that we are removing the hands that are doing the research. I found that an appalling prospect. I think if we remove that kind of support we are going to lose the active participation of the cream of our youth. So I want to make a very special plea to reconsider the budget allotments in the training programs. I think to have removed the support for graduate students is in fact ill-advised.

INSTITUTIONAL ALLOWANCES

The concept I had when I spoke to this person in the Congress is that there was no need for institutional allowances to support these students. But in fact the institutional allowance pays for the very chemicals, the isotopes, equipment, enzymes with which they do their work. It is not to featherbed the universities; it is in fact to carry out the research which they are doing and for which the institutions are being supported on their research grants. So I repeat my plea that we reconsider the way in which the budget has been written to remove both institutional allowances and overhead in support of the training programs or else we are going to see a decline in the quality and number and amount of research that we will be able to do.

Mr. NATCHER. Dr. Berg, we want you to know that we appreciate your statement.

Dr. Hoagland?

Dr. HOAGLAND. Salvador.

TIME DELAY FROM RESEARCH TO APPLICATION

Dr. LURIA. Mr. Chairman, Members of the subcommittee, as a person who is almost on the verge of retirement I think it is only appropriate that I should look to the future. I think that the problem I want to mention here is the question of the long-term look at the science processes, rather than on the narrow one. The two points I would like to refer to are first: There is a very great lag between the time a discovery or a finding with potential application is made, and the time in which the application becomes available and useful and applied. The second point, which is related to the first, is that I think that any new finding can only come to fruition if there is a large critical mass of science going on, so that various approaches come to converge and finally come up to the applicable, to the usable result. I would like to give a couple of examples. For example I am sure that some of you, most of you have read last week in the Washington Post or New York Times the story of reconstructing bones surgically by means of powdered and ground bone material treated in special ways, which was reported from Boston, and was also carried out in some other places. If you look at this, it appears to be a discovery. But you have to go back not only many years ago on the study and composition of the bone done by anatomists and histologists but to the whole problem of learning to grow cells in dishes or in test tubes, so on, which really only started in the 1940's as a successful undertaking. Only when the two techniques, plus many other techniques, coming from completely different research in biology, cell biology, can come together; there comes about a remarkable advance in the field of surgery.

IMPORTANCE OF A CRITICAL MASS OF SCIENTISTS

I can mention the polio virus, vaccine. It was in the late 1930's that the virus of poliomyelytis was isolated and identified. It was 1956 before we had a usable vaccine for the public. The difference between them is not because people worked and did not succeed on making vaccine, but because the discovery had to await the swelling growth of the biological, basic science that was able to grow cells in culture, then the work of Dr. Anders and his colleagues that produced the way of making special cultures of human cells in which a polio virus cell could grow, then by the techniques of bioengineering, the production of virus, then the techniques of biochemistry to learn to inactivate the virus without losing its ability to be a vaccine. It took in all cases innumerable avenues to reach the result. They can be reached because the critical mass of basic science in this country had been flourishing. I can speak a moment for myself. I think three signficant findings I did in my life were done between 1943 and 1952 and the outcome, distant outcome which is DNA recombination and genetic engineering took all of the work of biochemists, the work of cell biologists, all other people, before it can be played into a medical and industrial technology that could be used. If during the time there had not been this backlog of new discoveries coming up so that they could interlock, there would have been absolutely no possibility for bringing these findings to fruition. So my point is that it is in the interest of the progress of science to keep a very large variety of basic science research going on because without them any important finding may become useless and obsolete by not having the proper connection with the other. I think for that reason I agree with my colleagues that this is where American science in which I had the privilege of participating for only 41 years has been really an astonishing operation. The fact is that there is practically no area in which some progress, some important progress has been done in this country, and I think that that is what it is the responsibility of ourselves as citizens, yours as Members of Congress, to keep it going in the same way.

Thank you.

Mr. NATCHER. Dr. Luria, we want you to know that we appreciate your statement.

APPLICATIONS OF BASIC RESEARCH RESULTS

Dr. SNELL. Mr. Chairman, Members of the Commitee, for some 37 years I have been engaged in one area of basic research. One of the satisfactions of the work has been to see it expand into applied areas with more applications in prospect. I think my experience following this pathway from basic to applied is typical. So let me illustrate the processes with my own experiences. My work has concerned the genes which determine immunity and resistance to transplants of tissue or organs. We have learned a great deal with these genes, and have identified some 50 of them. One of the suprises was that a very small group of these genes all link on one chromosome, and play a uniquely important role. A similar group in man was found by Professor Dausset in France. It has been identified in a number of mammals and poultry. This led to the concept of the major histocompatability antigenic complex. Very rapidly this was applied to the improvement of kidney transplants. This is still improving. The basic research which has gone on in this area provided the background for the greatest success in kidney transplants. This application was not so much a surprise, it could have been foreseen to a certain extent. But there was one turn which the research took which was a total surprise. It has been found by studies in many labs that this histocompatability complex is the controller mechanism of the immune response which we have against various diseases and possibly against cancer.

It is a very complex but a very important mechanism. These genes determine the production of a variety of substances which are the regulators of the immune process. This has not yet actually been applied but I think everybody working in the area feels that applications are imminent.

They are going to be able to control the immune process, manipulate it at will in ways never possible in the past. This will certainly be important in dealing particularly with virus diseases. It may have implications for cancer.

Let me just summarize four aspects of this story which I think are important. First, the time element. I have been working on this, as I said, for some 37 years. The most important applications, I think, are five or ten years away. They will keep on expanding after that, roughly a span of 45 to 50 years.

Obviously, this varies greatly with any particular area but I think that the long-time interval is very typical.

Second, the most interesting results were often totally unexpected. The discovery of the role of this group of genes in the immune response was something that couldn't have been foreseen at all but I think undoubtedly it is the most important outcome of all, that is where the important applications are going to be.

Third, I don't think that any prodding is necessary to assure that basic research becomes applied. Some scientists are primarily interested in basic research, some more interested in applications; you keep freedom of communication and the people who want to apply research are going to be there and take it up.

Finally, funding: I was supported almost entirely by NIH grants and many other pepole in this area have also been supported by NIH grants.

This work would have been totally impossible without that support. It has a future and I think it would be tragic if this is limited by reduction in adequate support.

Mr. NATCHER. Dr. Snell, we appreciate your statement.

Dr. Hoagland, Dr. Watson.

Dr. WATSON. Chairman Natcher, Chairman Whitten. I feel very honored in being asked to come back here to speak and I would like to just mention two points.

IMPORTANCE OF CONTINUED SUPPORT FOR SCIENCE

One is that the United States has been the international leader in the field in science and now particularly in biology. We now read much of the future national wealth of the United States may depend on the exploitation of biology. That means biology will become a bigger subject. And we will move in the direction of chemistry; with time there will be giant interests which depend on industrial segments which depend on trained biologists.

The number of scientists will have to increase, not stay constant. Therefore, as long as we essentially say that appropriations at NIH stay constant we may be in trouble because biology is not what it was when we were doing it before.

So I think we can talk a lot about redistributing money, and I know this isn't the year to say more money, but I think we are going to have to, soon, if we are going to be a leading country in the development of biology.

We are strong in the United States because of what physics was 30 years ago in the development of electronics, the whole computer industry; we are going to have to move this way in biology. And that is going to mean an increased budget, not a budget which is steadily decreasing.

I think that is my main point. We obviously have to continue to train younger people but we are also going to have to give them money in order not only to be trained but to continue the research.

There is a slightly seedy quality in American science. You just have to walk in the labs. That wasn't true 15 years ago. It depresses us. Of course, I am speaking from the viewpoint of a vested interest but I think it is a vested interest which will be very important for the future of the United States. And just as our Defense Department budget should rise if we are essentially to be number one and I have always wanted to be number one, I can't quite see why we shouldn't be that.

If we are to do that, we have to utilize our genius. Your genius is going to be expressed through our science and that is going to lead to industry.

It is wonderful to see what the work of Paul Berg has accomplished leading to development of the DNA industry. There will be other ones based on immunology. That is going to require an expansion. I hope it comes.

Thank you.

Mr. NATCHER. Dr. Watson, we appreciate your statement.

Dr. Hoagland.

Dr. HOAGLAND. Dr. Bloch.

Dr. BLOCH. Chairman Natcher, Chairman Whitten, members of the committee: Like some of the speakers before me, I have enjoyed the support by the Federal Government for several decades and I am grateful for it.

I am concerned and hopeful that the generation that succeeds us will be in a similar fortunate position. I would like to address briefly some practical aspects of research grants.

COSTS OF CONDUCTING RESEARCH

If you look at the NIH budget for biomedical scientists and the NSF budget, these areas seem to fare reasonably well. However, if you analyze each individual budget you find that we spend money more and more in areas which we previously did not have to support.

To give you one example: Until a few years ago every single graduate student in the life sciences was supported for a five-year period either by training grants or teaching fellowships at his institution.

Now, the individual investigator has to support the graduate student for three out of the five years and the money comes from his research grant. Therefore, the active research grant is reduced by this amount. So I think the total number of dollars, given to a researcher, although it may not have declined, is in fact used for different purposes which benefit research, to be sure, but which have to be taken away from efforts which were previously supported from other sources, primarily the training grant.

As has been alluded to, life science has become big science. The scale of sophistication of instruments has gone up roughly by a factor of 10 in the last three years. These instruments are expensive to buy and maintain.

We need supporting personnel allowances not made in the research grant awards for these additional expenditures.

There is a very heavy energy-related component in carrying out biomedical research. Chemical solvents are energy-based and their price goes up with the price of petroleum.

Again, no allowance is made for this in research grants. I would like for you to realize that although the actual figures which you see seem to indicate that our enterprise has been treated relatively well that these figures are deceptive.

Finally, I would like to underline what the speakers before me have said, that we must engage in long-range planning. We had recently examples of the disastrous effects on the American economy of short-range planning.

We are concerned as scientists that the life sciences, with an essential growth industry, do not suffer the same fate.

Thank you.

Mr. NATCHER. Thank you very much, Dr. Bloch. We appreciate your statement.

Dr. Hoagland.

Dr. HOAGLAND. Dr. Dunlop.

Mr. DUNLOP. Mr. Chairman, members of the committee: Next month I will have been in the practice of surgery 50 years. During that time almost everything that our profession has been able to do for patients, people in trouble, have come from the men who have been doing the basic biomedical research.

I feel a great debt of gratitude to these men and women. I am concerned when I note that the support of this type of research is eroding in this country, whereas, it is being strengthened in many other Western countries.

TIME DELAY FROM RESEARCH TO APPLICATION

Last week I attended a meeting of the American Surgical Association in Chicago. We saw a photograph of a young man with a markedly deformed skull, which was rebuilt with this demineralized bone powder, which was put over his brain after his deformed skull had been removed.

At the same meeting we were shown grafted skin on one arm of a badly burned patient and cultured skin on the other.

Again, these remarkable advances in medicine and surgery resulted, as has been pointed out to you, by years of basic research.

One of the most difficult things I am sure that Members of Congress face is the allocation of funds for projects that may not bear fruit for many years to come, long after some of you have left the Congress, long after your constituency has forgotten where that money went. But this requires statesmanship and it takes a long time.

Let me give you one other example: The year I was born a Spanish surgeon had a patient with an aneurysm behind his knee. Because he had done a little research on this problem in the past he removed the aneurysm and replaced it with a piece of vein. That man's leg was saved.

This created a tremendous wave of excitement in surgical circles all over the world. Other surgeons attempted to reduplicate this operation. But all these efforts failed. The vessel clotted and the leg became gangreous and had to be amputated.

It wasn't until 1916, long after this effort had been forgotten, that a young third-year medical student working in Dr. Howell's laboratory at Johns Hopkins University was studying the physiology of the liver. He was interested in finding out what the liver did for a human being.

And in that process he noted that there was a substance liberated by the liver which seemed to have some effect on the clotting of blood. He made a note of this but didn't pursue it further and continued with his interest in the physiology of the liver.

About 15 years later, two scientists working in Toronto, looking for something that would prevent the clotting of blood, ran across this statement of this young scientist. They developed a method for producing this material from the lungs of animals and from the heart and developed Heparin.

With this we had the emergence of all vascular surgery, organ transplantation, even methods of preventing clots passing to the lung as they are dealing with Mr. Brady's problem right now here in Washington.

Now the end result, the ability to handle this sort of problem took years to evolve. But this represents the very foundation of our knowledge.

I urge you gentlemen, as one who deals with the public, that many members of our society recognize this.

I am disturbed to see increasing billions of dollars spent on the management and care of disease and a diminishing amount of money being spent on efforts to find the cause of the disease. It seems to me that we do need to take another hard look at our priorities.

Thank you very much.

Mr. NATCHER. Dr. Dunlop, we appreciate your statement and your experience.

Dr. Hoagland.

Dr. HOAGLAND. Dr. Thomas.

Mr. NATCHER. We would be pleased to hear from you.

Dr. THOMAS. Chairman Natcher, Chairman Whitten, members of the committee: Rather than trying to summarize my colleagues' presentations which would be impossible in the short time in any case, I would like to emphasize two of the major themes that are on the minds of all of us here on this side of the table.

We are, of course, deeply worried about 1981 and 1982, but we are realists and we did not come here in order to try to change the world over the next two years.

FUTURE OF AMERICAN SCIENCE

Our deepest anxieties are for the long-term. We are worried about where American science will be in the late 1980s and 1990s. We find it easy to predict that there will be problems confronting our society at the turn of the next century.

We cannot begin to guess at what these will be but they will surely have to do with the health of our citizenry, with the environment, its pollution, energy, the food and fiber needs for this country and the world.

We see no way of getting at problems of that magnitude except for science. And we are concerned that the underpinning of that kind of science, what we call basic research, be sustained over the next 20 years.

And for this we will need our brightest and our most talented young people coming into the profession of science year after year and probably coming in in increasing numbers.

That is one point.

The second point is, I think, of some encouragement, which you have heard from each of my colleagues. There has never been a time like this in biological and medical science, not in all of the history of the endeavor.

We are able to do things and to take up seriously questions about living processes, about what goes on in cells, at very profound levels which would have been unthinkable just five or six years ago.

We called it a biological revolution when Dr. Watson and Dr. Crick discovered the nature of the DNA molecule, but in the time since we have experienced one revolution after another. And the information is coming in in cascades.

I think that the future for medicine, itself, is beginning to look quite different from what it looked to me at any other time in my professional career.

I can see the prospect ahead, somewhere in the next 5, 10, 20 years of comprehending the mechanisms, the deep internal mechanisms of each of the human diseases that now present problems for our society, including the one that I am most interested in, cancer.

I think the problem ahead for us over the next 20 years is to make sure that the information bank which we accumulated over the last 20 years is kept full and kept solvent and that continuing platoons of young people come into the field and keep the effort going.

Thank you, sir.

Mr. NATCHER. Dr. Thomas, we appreciate your statement.

Dr. HOAGLAND. That completes our presentations.

Mr. NATCHER. Yes.

It is a privilege to have the chairman of the full Committee on Appropriations, Mr. Whitten, with us today and, Mr. Chairman, we would be pleased to yield to you.

Mr. WHITTEN. Thank you, Mr. Chairman.

May I say that it is indeed a pleasure to be here. I say to you gentlemen that you are in good hands, Bill Natcher of Kentucky is one of the outstanding Members of Congress and I am glad to see your foresight in arranging for this meeting.

It has been impressive to listen to your statements. I always, by tendency, I guess, jump one step ahead. I think all of you gentlemen and those whom you represent do a great job and have done a great job for this country.

There are funds that you feel you must have and this committee I know will do the best they can. We really test the value of what you do by how wise you are in the application of those funds.

To make these expenditures worthwhile they should not be used just to satisfy curiosity but to make use of what is learned. I am afraid that has not been fully done in all instances. We expect to do the best we can and hope we can improve.

Again, Mr. Chairman, I appreciate you having these gentlemen here. I am glad that the Congress has given you the recognition, because that is what it is. I am glad you in turn are willing to give your time to help us in the Congress by sharing your views with us.

Thank you very much.

PEER REVIEW

Mr. NATCHER. Thank you, Mr. Chairman.

Gentlemen, as you well know, NIH supports research which is directly or indirectly related to hundreds of different diseases.

Among the major ones are cancer, arthritis, stroke, hypertension, diabetes, allergies, diseases of the heart, lung, blood, kidney, skin, neurological and digestive disorders, maternal and child health, and so on down the line.

This committee relies heavily on the peer review system at NIH to make the decisions as to which research should be supported. We avoid making recommendations or decisions on individual projects and we believe that is right. We don't believe we should do it.

My question, gentlemen, is this: Is the peer review system working properly? Do we have the right emphasis, the right balance at NIH?

Gentlemen, I would be pleased to hear from you. Any one of you, anyone that wants to make any comments. This is a matter that we have had under consideration now for a number of years. Go right ahead, Dr. Hoagland.

Dr. HOAGLAND. Mr. Natcher, before I respond to that question I just would like to say that if the committee has questions that they would like to address to us we would be very happy to entertain them in writing or whatever form would be appropriate and respond to them at a later date.

Mr. NATCHER. That would help us. We would appreciate it.

Dr. HOAGLAND. We would be happy to do that.

I believe that the peer review system is one part of the very special unique features of the total NIH structure for the support of science and that it has in the past and at present worked extremely well.

I think there have been criticisms of the system. As you know, a couple of years ago, maybe it is more than that, NIH reviewed the whole procedure, entertained widespread comments and criticisms on it and I think came up with a pretty clean bill of health.

As those who are on the receiving end of it, and I speak now for myself because I haven't discussed it with my colleagues just before this meeting, I feel that it is a system that functions well and that is a remarkably effective system in allocating funds for research.

One of the problems is that as funds for the support of science decline, there is a tendency for the priority ratings to be squeezed upwards as peers attempt to give some chance for reasonably good research to be supported.

I think that any system of that sort would tend to break down under the pressure of reduced funding. But on the whole I think it is functioning now very well.

Mr. NATCHER. Dr. Berg.

Dr. BERG. In a way I think it is the best game in town. I heard that comment being applied to some other questions that are being considered by the Congress today. In fact, it is the system which is emulated, copied, adopted in most other countries.

It is the system which gave rise to what I mentioned earlier, the opportunity for bright young people with good ideas and the ability to work independently. And it, I think, is the underpinning of our whole system for the support of the best kind of research that could possibly be done.

It doesn't obligate a young person to work in a senior person's laboratory because it is the senior person by virtue of his reknown to gather the funds, but it provides the opportunity for the young person to present his ideas for review and to acquire the independence at these early stages that has given rise to impetus and drive in our basic science enterprise.

Mr. NATCHER. Thank you, Dr. Berg.

Now, Mr. Conte, I yield to you.

Mr. CONTE. Gentlemen, I respect your sharing your expertise and views with us. We share your concern for the future leadership and strength of American science.

I agree with your observations that education at all levels is critical to this Nation's continued scientific growth. I have sat on this Appropriations Committee now for 23 years.

I have seen a lot of witnesses across that table but I have never seen a more distinguished and illustrious group of scientists as I have this morning.

I am very pleased to be a member of this committee and be able to hear your presentations.

DECLINE IN U.S. DOMINANCE OF SCIENCE

One of your statements mentioned the illustrious era of leadership in United States science shows signs of coming to an end. Those are your words. Why, in your opinion, may the era of United States dominance in science be threatened?

May I add one thing to that? I said 23 years, so I have seen this budget grow. Ten years ago we appropriated about $300 million-some odd, for the National Institute for Cancer. This year we are up to a billion dollars. I would like to have an answer to that.

Dr. WATSON. Well, lack of money. We used to have enough money to bring many people from other countries to work in our laboratories and many of them stayed. So our leadership was partly through importing the best from the rest of the world.

Now our research grants are severely restricted. We find it hard if we want to bring a person from Japan or from Germany; the salary structure has eroded.

So it is sort of one-way traffic, people coming to the United States, that is not so apparent. I think that was a great source of our strength.

Dr. MULLER. May I just follow Dr. Watson by making an additional comment?

You know it is a little humiliating, I think both for you and for us, to talk about being threadbare or slightly seedy and losing national leadership and we would like to stop that. But I think it is up to us to make graphically comprehensible what we are talking about.

COSTS IN SUPPORT OF RESEARCH

I speak, of course, as an administrator who, in a small miniature way, faces the problems you do in trying to see how to best support research. Perhaps I could share with you the kind of problem that Dr. Watson alludes to when he talks about lack of money, because I agree that is the problem.

We are hiring at this point at my university two professors, two full professors of chemistry. We have had some losses due to death and retirement. So we are able to hire two senior people.

The salaries of the two people we are hiring, although they are relatively high because these are people of distinction, are no great problem. But each one of these people comes with a team, because the work they are doing is not work that they do alone. So you are not talking about two individual salaries, you are talking really about a total of eight salaries, because these people have to bring some of their junior colleagues.

And the big discussion that the dean and I have had about these two appointments involves the fact that right now in order to get people who are in biochemistry, we are going to have to spend $2,720,000 to equip their laboratories.

At the Cancer Center, the Regional Cancer Center which operates at Johns Hopkins, there is a big discussion about whether we need a third nuclear reactor because of the real, almost explosion, in patient care through radiation therapy in cancer as a new and extremely productive means of treatment.

We are, therefore, also disposing of radioactive waste, a problem we never had, in the past, faced before. The Johns Hopkins Medical Institution alone disposes of 100 tons of radioactive waste a year. That is a shattering new expense.

What we are trying to say is that if you look at the rising cost of appropriation, as you plus and discount them by inflation and look at constant dollars, you can say, well, at best, we haven't slipped much, but what we are telling you is that American science must not become the victim of its own success.

When we have developed all kinds of new ways of dealing with things, I am told by my colleagues, in an other example, it may be that psychiatric wards by the next century will go the way of TB hospitals because we will know so much about the brain and the neuro-stimulators and the use of drug therapy. We may be able to deal with psychiatric problems in much better ways than segregating patients and trying to deal with them in these methods.

These things cost more. If we are going to stay in the lead we are going to have to spend more in constant dollars.

The plain answer to your question, Mr. Chairman, is other countries are doing that, admittedly with fewer institutions and fewer people but people of very high quality and we are no longer able to do it.

Dr. HOAGLAND. If I may, also, Mr. Conte, in your fact sheet in your folder, there are a number of pieces of data there that I think confirm what these gentlemen have said, particularly the overall percentage of gross national product which we are now devoting to research and development compared to those of other countries.

You can look at it in any number of different ways; the fact is that our commitment to basic and applied science is falling off as other nations' commitment rises.

Mr. CONTE. Do I have time for another question?

Mr. NATCHER. Then we will alternate, if you don't mind. Mr. Obey.

Mr. OBEY. Thank you, Mr. Chairman.

Mr. Chairman, first of all, I want to congratulate you and whoever else was responsible for bringing all of you here today.

If there were a television camera in the room the country might get 30 seconds or 40 seconds of information about your message today. Probably that would do a whole lot more to help your position than spending a lifetime on Capitol Hill.

I don't have a question. I have just an observation which I would like to share with you and then I won't be able to stay to hear the rest of your responses because I have to go to a Budget Committee meeting at eleven o'clock.

Although that committee knows virtually nothing about the specifics of the problems which you are discussing, decisions which that committee makes will have a lot more to do with the money that you get this year than we will on this committee.

I say that respectfully as a member of the Budget Committee, but it is institutionally a fact of life.

I guess all I would say is that I think you have a political problem. I was up in Boston last fall, talking to a number of scientists and medical people. I said the same thing then that I am going to say now. One of the problems we have is that not all of us are fortunate enough to come from districts which have large medical teaching centers or learning centers.

So in many districts throughout the country there is really no constituency for the message which you are bringing to us today. It is rather like the Institute of General Medical Sciences. It has been noted many times that no one dies of general medical disease, so for many years that institute has been treated as a stepchild.

Some of the more glamourous institutions which have been able to build up political support groups behind them have fared rather more well than has the Basic Science Institute. But the problem you have, very frankly, is that there are not enough linkages between people like you and general medical practitioners throughout the country.

If I could just offer you a gratuitous piece of advice, it would simply be that you find ways to reach out for support, to a greater extent than you have in the past, from the general medical profession.

It would be nice when I talk to my physicians in my district, for instance, if I could find more than a handful who are interested in any other question than whether or not they are going to get stuck with national health insurance.

I probably have more pressure from physicians to cut the budget than from any other group that I can think of. And I think, frankly, they give very little thought to the fact of life that if the budget is cut significantly, that health programs are going to share in that cut. Basic science, because it has no politically sexy or politically effective constituency out there, is going to get hurt in the end as much or more than anybody else.

I would ask you to look for ways to win the battle at the grass roots, because you aren't going to win it here until you win it there. That means that we are going to have to find ways to generate a lot more political support in communities all across this country for added expenditures, not just for basic science but for all items which help determine what our productivity is going to be.

You have to help us find ways to define capital investment in terms that include human beings as well as buildings and machines. We haven't been able to do that very well. I think also, if I can be somewhat ironic or cynical, that we have got to find a way to label more things as defense.

I received my college education under a National Defense Education Act fellowship. That is the only reason I am here today. If we could find a way to label it the National Defense Scientific Research Act of 1981, we could put in all the money in the world and nobody would lift a finger to object to it.

The third thing I would suggest that you do is by all means come back and keep in contact with this committee, but pay a lot more attention to the budget process. That is a new layer around here, it is a Rube Goldberg layer, but it is a layer nonetheless.

And what it does is inhibit the ability of this committee to really make the adjustments that we know on the merits are necessary in the programs you are talking about.

My advice to you would be to pay a lot more attention to what happens earlier in the cycle in the budget process as well, because once that committee locks in its judgments we are really very limited in terms of what we can do here.

And I know people do not understand, frankly, why it will be impossible for this committee to provide a significant increase in the area of the budget you are talking about.

Under the rules that are evolving in the budget process this committee will simply not have the authority to increase funding within any but the narrowest limitations.

You are the best thing we have going for us in this country in terms of communicating to people what the problems are. If there is any one of you who has any idea about how you can establish that linkage that I am talking about with the medical profession around the country, so that they do begin to pay some attention to these kinds of issues, you would be doing a great service not only to the scientific community but also to those of us on this committee and other places who would like to carry a little more water for you but are really prevented by circumstances from doing so.

I thank you all for coming.

Mr. NATCHER. Mr. O'Brien.

Mr. O'BRIEN. Thank you, Mr. Chairman.

Dr. Hoagland and gentlemen, we appreciate your coming. Let me make three comments, much like Mr. Conte did. I don't think I have any questions.

PREEMINENCE OF U.S. SCIENCE

Recently I met with a Sir Gustav Nossal, the Director of Cell Immunology at the Hall Institute of Medical Research in Melbourne, Australia. Quite a fellow. I was very impressed.

He mentioned the fact that our science is indeed the top of the world. He pointed to awards, international awards, given since World War II. They are pretty heavily weighted in favor of American science. So I guess the point is that we are on top of the game now. Your message is to make sure we stay there.

I do note, however, that Sir Gustav is the recipient of several NIH grants, so science obviously is not limited by national constraints. I suspect that is probably the best way to go because communication seems to be better in your field than any other that I am familiar with.

Secondly, going to Dr. Watson's comment, which I subscribe to, that America should be Number 1 just about everywhere, I would like to have us be. That would include defense. When you comment that other countries are devoting more of their resources to science, as you describe it, keep in mind that the Premier of Japan is coming here next week. In any event, his comment before he left was, without referring to the automobile industry, that they were not doing anything about national defense, living in the shadow of the bear.

Now, that is a responsibility that has fallen on us, but goodness knows, we have it. I would assume that being Number 1 in that position protects you as much as it does me.

Finally, this past week, three presidents of distinguished Illinois universities, University of Illinois, Chicago University and my school, Northwestern University, visited with the Illinois Delegation, commenting directly to the points that you were making and urging us to make sure we don't neglect basic medical research because they are the major research institutions, in my State.

I recall one of them, Dr. Hoagland, said—I believe it was the president of the University of Illinois—that they have run across a very hot item in terms of a skilled investigator in your field and they really finally got to the point where they weren't sure they could afford him because of all the things that would be required to support him; that they just did not have the funding for it.

I was tempted to comment about HSA where, in my home town, you will argue whether Silver Cross Hospital gets a CAT scanner because St. Joseph has one. He was quick to state that is true in that area, but with respect to science, things that you people do you cannot duplicate enough. I am hardly in a position to argue the point, but I do believe you have to remember that we do have a defense burden that isn't just parochial. Japan thinks we ought to carry the ball. It is very hard to compete with them, let's say in terms of dollars that they might be in a position to give to medical research.

Thank you, Mr. Chairman.

Mr. NATCHER. Mr. Stokes.

Mr. STOKES. Thank you, Mr. Chairman.

BASIC RESEARCH AND MEMBERS OF CONGRESS

Dr. Hoagland and gentlemen, let me say to you how appreciative I am of the presentation you have made this morning to this subcommittee. If I have any real regret at all, it would be that all of the Members of the House of Representatives did not have the opportunity to listen to your presentation this morning, particularly on a day when the House is likely to vote in an atmosphere of budget-cutting mania and in an atmosphere of somewhat twisted priorities.

I was particularly struck, for instance, at the information imparted to us in your formal presentation on page 3 where you refer to the fact that there is a growing scientific and technological illiteracy in our country today; where you tell us about the number of young people who now graduate from high school and college with only the most rudimentary notions of science and mathematics and technology; and where you talk about the shortage of qualified science teachers in secondary schools.

On page 4 you refer to how Japan, China, Germany and the Soviet Union all provide rigorous training in science and mathematics for all of their citizens.

What I get out of the entire presentation today is that there has to be some vehicle, some mode, or media by which you can transmit the information that you have imparted to this subcommittee today to the American people. I don't know what that mechanism is, but it certainly seems to me that if Congress is to change national priorities in order to address the deterioration of our technology, then the American people must understand and must be educated to this so that they, in turn, can educate their Representatives in the Congress.

I think that is my statement. Thank you very much.

Mr. NATCHER. Thank you, Mr. Stokes.

Mr. Pursell?

Mr. PURSELL. Thank you very much.

PRIVATE SECTOR FUNDING FOR RESEARCH

I guess as a representative of two large universities, including the University of Michigan, I have spoken strongly on behalf of research. I want to congratulate Chairman Natcher, Joe Early, Sil Conte and all other members here who have consistently recognized the importance of research. We are digging ourselves a hole here with the changing attitude of the American public. It looks like research is going to be cut back. That is very difficult for us to accept on the committee.

If we Americans continually depend on a small cadre of researchers that in effect, says research is going to be funded only by NIH, National Science Foundation and a few private foundations, we are heading for serious trouble.

Is it possible that, as you pointed out, Dr. Hoagland, that the large number of professionals in the health field that spends $300 billion a year, have gained personally from others' research which have developed, new dimensions and solutions to our health problems. Perhaps we ought to go beyond general dependency on the Federal Government for funding and ask the health profession itself through the hospitals and other institutions to set aside a percentage of their investment and their budgets toward matching our dollars and make us more competitive?

I think if we continually depend on the public sector for financing, we are going to have these highs and lows, depending on national elections.

Would you comment on the possibility of having a broader portfolio in research, rather than just a dependency on Federal programs?

Dr. HOAGLAND. I will ask Dr. Thomas.

Dr. THOMAS. I wouldn't be at all sanguine, Mr. Pursell, about the possibility of engaging the financial interest of the practicing physicians and surgeons of the country for the support of basic science. I would like to see it done, but I don't think it is a likely outcome. However, there is a very large, important segment of American industry that has a heavy stake in the future of basic biomedical research and science.

Pharmaceutical firms are beginning to display active and genuine interest in working out some arrangements, small-scale to be sure, for partnership between the industrial science community and the university-academic science community, which I think is a very healthy thing for the country. They can make a difference. They can not, of course, replace a signifiant portion of the Federal support for science, but they can do a lot to stabilize it by coming in and investing long-term and particularly in the stabilization of relatively long-term salaries for our younger investigators.

They have a lot to gain from this. I am not talking about near-term products; I am talking about the prospects for new products in the 1990s if basic, fundamental science is continued through the 1980s. The industry does have a real stake in this, and they are, as I said, beginning to display some interest, and it should be fostered.

TAX CREDITS FOR INVESTMENT RESEARCH

I think if they do invest in university science, it should not be on the basis of noblesse oblige or philanthropy. I think it would be important for someone down here to work out some tax credit system so that there would be more incentive for them to make an investment. I don't think any longer that there would be the feeling on the university side of being entrapped in problems of confidentiality or secrecy or product, because I am not talking about a partnership that would be aimed at products this year or next. I am talking about the possibility of quite long-range support.

Dr. MULLER. Could I add a word?

Mr. NATCHER. Go right ahead.

WIDESPREAD APPLICATIONS OF RESULTS OF BASIC RESEARCH

Dr. MULLER. Once again I would like to invoke an earlier statement by Dr. Watson and take the liberty of pointing out that although most of my colleagues have achieved enormous distinction in biological research, we are talking about science on a very broad scale, not confined to that alone.

In biology, though, when you talk of national interest and national security, you are talking about the foundations of a new industry. There has been a lot of talk of the future of biogenetics, and it may make possible new advances—it already has all the tendency to do that—in better health care and in better health maintenance. But the industrial component is not going to be confined to human beings as the primary target or at least not as the initial target.

I think the most interesting application, and that is already, I think, becoming publicly apparent, may be in the field of agriculture. That is going to have an enormous impact on the productivity of this country, our relative standing in the world and, in fact, the world's future in terms of food consumption, which is something the world will not do without.

So we are talking here about something very fundamental that is not addressed solely to the question of the Nation's health, addressed to the question of the Nation's productivity. Once you begin to talk about food, it is not a far step to security.

IMPORTANCE OF FEDERAL SUPPORT OR RESEARCH

The other brief point I would like to make is that we are very conscious, I think all of us are, of the fact that we cannot confine ourselves in reaching out, to give our message to the people, to this committee, to this Congress. We are trying to reach a wider segment of the public. But I think it is so important that you who have the mantle of statesmanship and who do have a primary responsibility when it comes to the Federal budget, that you continue to have faith in the reality of our needs, the merit of what we are talking about, and this understanding, Mr. Pursell, that we, too, think particularly since I represent a private university, we think of partnership with government, where government does not carry the sole load, but we need government to continue to recognize the public stake in what we are doing, because all these things are closed circles.

We are attracting more private support, but our ability to attract private support also depends on the continued participation of government.

Mr. PURSELL. I understand that the universities do about 80 percent of the research in this country in the broad sense that you speak of. I want to ensure that we have a better sense of balance, that we don't totally depend on the Federal Government for research. I think that puts the country in a very weak position.

I appreciate your comments.

Mr. NATCHER. Mr. Early?

INSTITUTIONAL ALLOWANCES AND RESEARCH TRAINING

Mr. EARLY. Thank you, Mr. Chairman.

In the 1978 meeting with the Delegation, I think we dealt with a few more specifics than we've dealt with today. I have heard Dr. Berg, Dr. Bloch and Dr. Snell say that if it wasn't for NIH and NIH grants, you might not be here today. Dr. Berg, you commented on your reservations on the cutback in training grants and cutbacks on institutional allowances.

I would like to ask you, or your colleagues: What happens to the pipeline that we spoke about, that we tried to establish in 1978, of a line of young investigators, especially the recruitment of M.D.'s? Several of you are M.D.'s. What is going to happen if we cut back severely on training grants and institutional allowances?

Dr. BERG. I think you are going to get fewer people down the line and less research in the immediate future. At the moment the rescission proposal is to remove the support funds for each of the students.

There are no two ways about it. You take out $50,000 from a grant to our department, then there is less available for people to do research. Now, there is some misconception, I think, that these institutional allowances get into the university coffers and are used in ways to keep the lawns green, and so on. That is an absolute misconception. The funds are being used to provide the chemicals, the supplies, the enzymes, the isotopes to do the research. If those funds are withdrawn, then there is going to be less research.

The funds will have to be taken from research grants and that means less overall. That is a direct consequence of the proposal to eliminate the institutional funds that go with these grants. I think it stems from the feeling that graduate students and post-doctoral fellows are not doing the work at the bench. This is probably the most valuable asset our research enterprise has.

If I were to say this in my own institution, I would probably be in trouble, but in point of fact, we have the cheapest and best source of our scientific productivity from our graduate students and post-doctoral fellows. If we are to remove the support that they have, we are going to get less research and the rate of decline will increase. There is no other way around it.

Mr. EARLY. Thank you, Mr. Chairman.

Mr. NATCHER. Yes. Mr. Livingston?

Mr. LIVINGSTON. Thank you, Mr. Chairman.

SETTING PRIORITIES

Gentlemen, I once spoke with our colleague, Mr. Udall. He told me a story about the fellow that went into a clothing store and bought a nice sport coat. He said that the guy tried it on, it looked good, fit perfectly. So he paid cash for it. He went over to another department, saw a nice shirt he wanted to try on, so he took off the sport coat and put it on the counter. While he was trying on the shirt, a thief ran by, picked up the coat, put it on and started running out of the store. The store detective saw him, pulled his gun, aimed it at the guy and said, "Stop thief." The fellow kept running. The guy who was trying on the shirt saw his coat running out the door. He said, "Shoot him in the pants, shoot him in the pants."

The point is, nobody wants to get shot in the coat. And I hear this recurring theme, the same theme that I have heard from many people of varied backgrounds. We are particularly honored and pleased to have people of your background and worthy distinction here, but it is the same theme. We are in a political environment now drastically different than it has been in past years. The American people seem to be genuinely concerned that the Government has overextended itself.

In voicing those concerns, I have heard concerns expressed right on the floor of the House of Representatives and perhaps NIH that it has overextended itself. I have heard converse arguments. Listening to you gentlemen, I have to agree with you. I don't think we should neglect our basic medical research.

What I am concerned about is, if you consider political realities and economic realities for this country, you have to realize that we are in the process of reorganizing our priorities for this Nation. I just wonder if you gentlemen have given any consideration to reorganizing the priorities of NIH and to ranking priorities of medical research so that we can hit those areas that really need to be hit immediately and put off some of the projects that perhaps we can put off down the line.

I understand you can't put parameters, that you may not want to put definitions or limitations on basic research. I hear your arguments that you have to get the people in line so they could carry on the research of the future, but in tune with the need of this country to cut back, is there any way to define what is most necessary today and what can be put off until tomorrow?

Dr. HOAGLAND. I would like to just say that your comments, Mr. Livingston, are understandable in view of the present atmosphere. I think our problem is that what we have been trying to say is that research, research for knowledge, the building of information that allows us to reach the point where it is a benefit to man, is a long-term process. One has to build these things over a long period. One has to exercise a good deal of statesmanship in order to see that it isn't something that you can cut off here or there.

The fact is, too, that in very practical terms, in the biomedical area, for instance, for every dollar spent in research I think some very sound studies have now been done that show that this leads to a technology which, in turn, leads to benefits for people which probably exceed the $1 by a factor of 15. So that we are not talking about something that is just of benefit to one disease here and one there, on a short-term basis, but a long-term commitment of the country to activities that will lead to a greater productivity in all areas.

Mr. NATCHER. Mr. Dwyer?

Mr. DWYER. Thank you, Mr. Chairman.

I am going to forgo any questions, but I want to thank this committee for appearing here today for what has been the most impressive, the most thought-provoking meeting that I have attended in my 120 days here on the Hill. I am certain I will remember what has been said here this morning for many years to come.

Again, I want to thank you and I want to thank the chairman for a very, very fine meeting.

Mr. NATCHER. Mr. Porter?

Mr. PORTER. Thank you, Mr. Chairman.

ALTERNATIVES TO GOVERNMENT FUNDING

I want to pursue a question raised by the gentleman from Michigan, Mr. Pursell. That question regards other sources of funding outside of Government, because I think that given the fact that we need an increase in constant dollars. As Dr. Muller said a few minutes ago, that we are going to have to look in a long-term framework to see where those dollars are coming from.

In a very certain and real sense, I find it unseemly that men of science like yourselves should have to come to Government to ask for funding for your important work.

The gentleman from Wisconsin, Mr. Obey, said that you have to take some of your valuable time and learn about our budgeting processes so that you might better influence funding to go into basic research. I find that kind of unseemly, myself.

It seems to me that what we need to do is to look for alternatives to Government funding. Not that we don't need Government funding, but that we need other sources to tap. We need to look at foundations, universities, associations, corporations, and to decide what appropriate part they can play in providing the necessary funding. Will this sourcing be more restrictive or less? Can Government make their efforts more attractive to them? What plans can we all put into place so that, looking down the road 10 or 15 years, we can assure not only that the Government is a constant participant, but that other sources of funding are constant and available to you gentlemen?

I don't know that I want an answer for the record right now. If you would like to comment, I would appreciate it. I think it is something all of you might work together on to see if there isn't a plan to find other places to achieve the same funding result.

Dr. WATSON. If I could reply, looking to different countries where other forms of support have been found, professors there often seem to work for about five industries and the science is very poor. We have a case where it has worked wonderfully in the United States with Government support. To think that we are going to generate another system which is going to work better, I think it will work less efficiently, because the only real body which has a truly vested interest in the support of science is the American public.

If you take a particular industry, it will have an interest in some particular, narrow aspect, but it won't see the broad picture. The broad picture is the important one. It has worked wonderfully. We are saying now we can't do it any more, but I think we ought to know what we are saying.

Mr. PORTER. I used the wrong term. Maybe I should have said supplements to Government funding, rather than alternatives.

Dr. WATSON. Boy, are we looking for these supplements.

Dr. BERG. If I may, I think all of you are probably aware, by reading any of the newspapers, of the rising excitement about genetic engineering, a flourishing new industry that is being developed. All of that grows out of university-based research. But it was, in fact, the kind of research which was high risk, long range. One would not have been able to deduce that the work done five or ten years ago would have led to these discoveries, and now to a new industry.

I think industry is recognizing perhaps now the need that they should be supporting this kind of basic research because in the end it will lead to that. But my estimates are that that is a drop in the bucket compared to the Federal funding base. What one could expect, even in the most optimistic cases of support from industry, is not going to make the difference we are talking about. It will help and it will be a supplement, but it could not replace it.

Mr. NATCHER. Dr. Bloch?

SUPPORT OF SCIENCE AS NATIONAL DEFENSE

Dr. BLOCH. I think some of us have alluded to, but not very explicitly stated, that we consider the support of basic research or science a form of national defense. The country can have the strongest national defense. If it does not have a scientific basis which feeds our economy, our weapons will be hollow and we will suffer a colossal defeat.

I think in the future nations will be known just as much by their accomplishments in the scientific field and economic performance as by the number of nuclear warheads they have.

Mr. NATCHER. Dr. Muller?

Dr. MULLER. If I could just make one other comment, and I will speak here as a citizen, not as a representative of academic science, I fully recognize, Mr. Livingston, the problem that you face. But I would submit that it would be my hope, as a citizen, that this Congress—and I am not referring to party here—Members of Congress in both Houses and of both parties would consider on the one hand the importance of a national investment in the training of young people, in the importance of science, in the whole spectrum of Amercican society, and look at it also from the standpoint of national defense.

I will make just two observations. My university runs one of the largest federally funded research laboratories this country has, the Applied Physics Laboratory, which works for the Navy. One of the most grave questions I have is whether the personnel in the Navy, which is a cross-section of America's young people, has the competence to properly utilize the technology that, with our help, the Navy is able to deploy.

While I cherish the ambition of the preeminence of the United States and believe absolutely in national security and in a substantial investment in national security, I would also hope that the Congress will question the utility of buying military hardware in large quantities that is outmoded when purchased, let alone deployed.

The future of our national defense also depends on our state of the art in terms of the people we have to use that equipment and the equipment available. So I would ask that you consider that the primary way of dealing with this problem is not by reorienting priorities within NIH, but really taking a look at national priorities.

Mr. NATCHER. Dr. Walker, you wanted to make an observation.

Dr. WALKER. Thank you, Mr. Chairman.

I think the apparent concern Mr. Livingston and Mr. Pursell and Mr. Obey speak to is the recognition that we all share that we are accomplices to one another; we all feel like ants trying to steer a log. I would only say that somewhere, and we share the responsibility with you, serving what we know to be the best interests of this Nation in the long term requires an act of will, an act of will in leadership at all levels.

Certainly we would join with you in taking whatever steps can be taken to summon the very real appreciation in the grassroots of America for the contributions of science. Most of us wouldn't be here today if it weren't for science in some form or would be afflicted by the plagues that have pursued mankind since the dawn of history. So certainly in whatever way we can, we join in an act and a will of leadership, and hope you would, to begin to address the problems. Thank you.

Mr. NATCHER. Thank you, Dr. Walker.

Dr. Dunlop?

CARE VERSUS RESEARCH

Dr. DUNLOP. When budgets get tight, Mr. Chairman, it is natural to look around for places where we might cut back, or at least hold the line. As a practicing surgeon, I would like to just make a couple of remarks which might bear on this.

We are spending today almost as much money to dialyze people who have dead kidneys as we are putting into basic medical research. Now, just think about that for a moment.

That is one little, teeny area. Every time a young man or a woman graduates from medical school today, they generate, as you well know, between $250,000 and $300,000 in new costs to the health care financing system. Why is this true? Because they generate the needs, as it were, for this additional financing, because they are faced with a demand for medical services that represents a bottomless pit.

We have so many worried well in this country, so many persons who are happy to have a lot of laboratory tests conducted to reassure them that they are doing all right.

I am simply saying that there is a lot of fat in the system; that there are things that perhaps we could cut back on. Certainly we don't need to expand them. Now, I am sure this committee has had pressures brought to bear on it to enlarge the dialysis program in this country. It is there. But in making a decision as to where you are going to allocate your funds, is it wise to expand the dialysis system, we will say, and cut back on the funding of basic medical research?

Is it wise to continue to graduate an unlimited number of physicians who create new costs for the financing system?

Is there a point in this manpower production where we ought to take a second look at it?

I come from a State, Massachusetts, where we are graduating 450 new doctors a year. Except for Washington, D.C., we probably have the highest density of physicians in the United States.

Mr. NATCHER. Thank you, Dr. Dunlop.

Mr. Conte, I yield to you.

Mr. CONTE. Well, I again go back and say how pleased we are to have you here and what a great presentation you made this morning. I think it was Mr. Stokes who said it is too bad the whole Congress can't hear this.

I might offer a suggestion. I had a little brainstorm. This might be a great thing to present to "60 Minutes." It seems every time CBS has "60 Minutes" on Sunday night, Congress reacts. Let me suggest it would be great for an exchange with this group and maybe some Congressmen, to have a dialogue. It would be a very, very powerful thing.

PRIORITY OF RESEARCH

As part of the Republican leadership, the ranking member of this committee, I have some very difficult choices to make. I believe we are going to have to put our house in order. We can't continue on with double-digit inflation. In fact, if we had that inflation down, you could do a lot more basic research than you are doing now because everything costs so much more now. So we have to put our house in order.

But in putting your house in order, you don't throw the baby out with the bath water. I think we have to order our priorities. I looked at your schedule. We already marked up here a rescission and we did pretty well. The President asked for some heavy rescissions in the National Institutes of Health. We put a lot of money back in there. You are going over to the Senate this afternoon. You want to talk to those guys over there, because I understand they have a heavy hand. It is very, very important. There is where you had better make your points. Then you are going to talk to the budget people down town in your schedule, I notice. Another important meeting. Talk to the young slasher. He is a smart guy, he is intelligent. Let him know about how important this is.

We are not going to violate their bottom line, but we feel that this area has top priority. I agree with you. I equivocate with this on defense. I went to a meeting last night—I wish Obey was there—with the Chief of Staff of the Navy, Admiral Hayward. He showed us some pictures of the Soviet Union, what they have developed since the Cuban blockade. We had a frightening evening.

I went home and didn't sleep last night. I kept thinking about it, how far behind we had gotten. Likewise with biomedical research. It is darned important. I have one question.

INTERNATIONAL COOPERATION

I believe there is a tremendous need for cooperation among nations in science, specifically in biomedical research. But the question remains: To what extent are our own scientific advancements being put to greater productivity in other countries? How is this happening? Are we being maybe too cooperative, too sharing in our resources with some of these countries?

Mr. NATCHER. Go right ahead, Dr. Thomas.

Dr. THOMAS. I think it is very much to the advantage of this country that the kind of free exchange of information that goes on every day in biological and in the physical sciences as well be continued. I note every day that people in the corridors of my own institution are aware of research going on at Melbourne, Paris, London, Edinburgh, Tokyo, just as though, or almost as though the other chaps were down the corridor. I can assure you that the telephone bills in my institution are very high. People are in close touch with each other and feed each other on a scale I have never before observed in science.

We are learning a great deal from the work going on at Pasteur Institute in Paris, and that going on in Melbourne, and I would encourage this rather than worry about it.

Dr. WATSON. I think right now in the area of DNA research there is a shortage of people. The fundamental discoveries were for the most part made in the United States. We hope to exploit them. Many young companies are trying it. But unless we have a rather large base of trained people, 10 years from now these discoveries will be best exploited in Japan. The chief worry that we have here today is how we can have this base of people able to exploit the American genius.

Mr. CONTE. May I make one observation?

Mr. NATCHER. Go right ahead.

Mr. CONTE. I am very pleased to welcome Dr. Luria. He was born in Italy, very close to where my mother and father were born. I am really very proud to have him here.

Mr. NATCHER. That is a good observation.

PRIVATE FUNDING OF RESEARCH

Dr. HOAGLAND. I would like to comment very briefly on Mr. Porter's comments earlier on his question of whether private funding could significantly help in the overall picture.

Without wanting to sound facetious at all, many of us here at this table spend a good portion of their waking hours trying to squeeze money out of reluctant prospective donors. I try to raise about $1 million a year for my institution. I am pretty exhausted at the end of the year. I think it is a hopeless task, to consider that what we could raise from the private sector would in any way significantly affect the things we are talking about today.

There is a government, a Federal Government need to foster the ongoing research. We may be able to fill in here and there with private funds, but the bulk of the money is going to have to come from the Federal Government.

Mr. PORTER. May I respond to that?

Mr. NATCHER. Make it brief, Mr. Porter, because I am going to have to yield.

Mr. PORTER. Come back to me.

Mr. NATCHER. That will be fine. Mr. Stokes?

Mr. STOKES. No further questions, Mr. Chairman.

Mr. NATCHER. All right. Mr. O'Brien?

Mr. O'BRIEN. Dr. Dunlop, your comment of fat in the system is very basic. The terms we use out here are fat, fraud, waste and abuse. As Silvio referred, our friend in the Michigan Samurai was being criticized by some of our colleagues on the other side, why he didn't get it out. He said, "Well, Senator, I am sorry to say it is not a line item. You don't find it just readily in the budget."

With respect to what Dr. Watson said earlier on about the high cost, expenses, the way the thing is getting out of hand, if we do our job this year, I really believe this, maybe when you come back next year, even though we don't give you any money, the money you have may be doing more for basic medical science. That is the heart of the matter. We have gotten to the point where the dollars you have don't do what they did a couple of days ago.

Thank you.

Mr. NATCHER. Mr. Early?

Mr. EARLY. This is evidently my last question, so I don't know what to focus on.

DECLINING SUPPORT FOR SCIENCE IN U.S.

In your fact sheet, you tell us that the Soviet Union turned out 7500 certified secondary school physics teachers last year, 7500 just last year. In this whole country, our country, we only have 10,000 certified secondary school physics teachers. That scares me.

Dr. Walker suggests that we are teaching science today with the equipment that is not up-to-date—that we are not teaching science; we are teaching the history of science. We are cutting back on the cooperative use of new equipment to save money.

You've suggested that discoveries in the early 1940s didn't show until the late 1960s. What do we do to make sure that we have people out here like this group in the 1990s and in 2000? Is the private sector going to pick it up?

You have heard the argument today to cut back, the private sector will absorb it. They may absorb it, in my opinion, when they can make a profit. In basic research, you are lobbyists for 200 million people. What do we do, Dr. Luria, to assure that we at least regain our position with regard to Russia, Japan, Germany, so that we remain the leaders in research? You know, we have surgeons coming in here telling us that research is where we should spend our money.

What do we do, Dr. Luria, to assure that the discoveries that come to light in the 1940s and 1950s, continue to be pursued?

Dr. LURIA. It is a very difficult question to answer, Mr. Early. I would say money is one thing. That is the key thing. But the other thing is to be well aware that basic research, as was said before by my colleagues, is one of the greatest items in the defense and security of this country. The future is there, in the schools, in the research. You can have all of the teaching of science in the high school and in college, but unless people see a future in going into research as a profession, they are going to go elsewhere. Therefore, it seems to me that the research money is at least as important as the training money.

Mr. NATCHER. Thank you. Mr. Livingston?

Mr. LIVINGSTON. No questions, Mr. Chairman. I just want to thank these gentlemen.

Mr. NATCHER. Excuse me just one minute.

Dr. Thomas, you wanted to make an observation.

Dr. THOMAS. I would like to observe to Mr. Early that in addition to the advice that we have received, that we should, as representatives of the scientific community, find better ways of communicating with the public. I think we would be immensely helped if people in your position, with your eloquence, your perception of the problem, also spoke to the public. I think you would have more impact than any of us would any day of the week. I am very grateful for your remarks.

Mr. CONTE. They don't believe us.

Mr. NATCHER. Mr. Livingston?

Mr. LIVINGSTON. Once again, I have no questions, but, gentlemen, I want to thank you. I think you have been very eloquent in presenting your case. Thank you very much for coming.

Mr. NATCHER. Thank you. Mr. Dwyer?

Mr. DWYER. Thank you, Mr. Chairman.

Thank you for all the wisdom that you imparted to me today.

Mr. NATCHER. Mr. Porter?

Mr. PORTER. Thank you, Mr. Chairman. I will try to be brief.

ALTERNATIVES TO FEDERAL FUNDING

In response to Dr. Hoagland's statement, let me express, first, my own basic support for basic research. If I learned anything when I was a student at MIT, I learned that. But I listened during the meeting that Mr. O'Brien referred to earlier with the presidents of universities. I listened to Congressman Hyde say in no uncertain terms, "Look, you have a problem. There is no constituency there. We have to get control over the budget. You had better worry and look for alternatives to raise funds that are necessary."

Congressman Hyde suggested a tax credit for basic research for corporations. It seems to me that it is a worthy idea. It seems to me that if we are spending, say, $2 billion on basic research in your field today, that by means of a tax credit we could raise three times that amount of money and have it available through corporations for the type of work that I think is necessary.

So let me urge you again: Think about these alternatives. It may well be that you will be before the Ways and Means Committee saying this is something that you think is a good idea, because I think we have to look at other sources of funding.

Mr. O'BRIEN. Will the gentleman yield for a comment, Mr. Chairman?

Mr. NATCHER. Go ahead.

Mr. O'BRIEN. With respect to your comment about Hyde's comment, I think what these gentlemen are saying is, if you get that kind of money from corporations and tax credit, you are looking at targeted research. It is unlikely you will get that money from tax credits for basic research. I don't dispute your point, but it is a problem.

Mr. PORTER. I agree to this extent: If it isn't drawn carefully, if the tax credit isn't made for basic research only, you do get applied research in that which you are seeking.

Mr. NATCHER. Gentlemen, again we want you to know that we appreciate your attending this hearing with us today. This, to me, is one of the best hearings we have ever held on this subcommittee.

As I explained to you gentlemen in the beginning, we need all the help that we can get. I say that to you frankly now. That is the reason we asked you to come. Each year we ask people to appear. We hear all the Government witnesses and they are excellent witnesses, and excellent, outstanding people. But this is the kind of a hearing that helps us.

Gentlemen, again I want you to know that I appreciate it, all of us do. You are busy. You have been kind enough to come in and give us your views and your observations, and we appreciate it.

Now, Mr. Matheny, our friend Bradie Matheny, as you gentlemen on the committee know, has worked with us in arranging this meeting. In fact, he has done all of the work. Mr. Matheny, we appreciate it. We want you to know it.

Mr. NATCHER. Gentlemen, again I want you to know that I appreciate your attending this meeting with us today. We are going to try it again in the future. Thank you very much.

Dr. HOAGLAND. May I just say in behalf of my colleagues here, Mr. Natcher, that this has been a very, very enlightening and helpful meeting to us. We know the problems you face, but the intelligence and perception of your comments and your questions are very gratifying to us, and we look forward to interacting with you as much as possible in the future.

Thank you very much.

Mr. NATCHER. Thank you.

The subcommittee will now recess until 2 o'clock.

[The following questions were submitted to be answered for the record:]

BASIC SCIENCE RESEARCH

MR. PORTER. The Chairman, Mr. Whitten, mentioned the need for application as well as discovery in basic science research if we are to avoid merely "satisfying curiosity".

DR. HOAGLAND. There is a widespread impression among non-scientists that basic research discoveries tend to languish unexploited, unapplied. Basic science exploration and discovery tend sometimes to be looked upon as "merely" a matter of "satisfying curiosity", a kind of luxury activity. Application is seen as superimposing on basic science, a special form of managerial input to bring discovery to bear on human welfare.

These ideas have little basis in fact. No substantive evidence exists that new discoveries are not rapidly used for human benefit when they are ready. There are sometimes delays in applying basic science discoveries but they can seldom be traced to the failure of a social mechanism. It is intrinsic in the function of science that knowledge must accumulate in several areas over considerable periods before useful application is possible. And basic science itself is for more than the mere satisfaction of curiosity. Basic science is the essential and only mode for acquiring new knowledge of nature. It fuels the application machinery. It is the underpining of our national productivity and of a healthy economy.

Application of knowledge in not America's problem. For example, non-health related commercial exploitation of biomedical discoveries alone is returning $37 billion a year to our economy. This sum equals our <u>total</u> investment in biomedical research. What we need most is to greatly strengthen our knowledge exploration base through education and vigorous research support. Application will flow naturally therefrom.

APPLICATION

MR. PORTER. The Japanese, for instance, have proven adept at application, sometimes with fruits of our own basic research.

DR. HOAGLAND. Let us not delude ourselves about the Japanese. It is an American myth that the Japanese are imitators and appliers of others knowledge. That may have been true to some extent in the past but since World War II the Japanese have geared up to top performance nationally in both basic and applied research. They are rapidly outstripping us in science and technology. In terms of national commitment, the percent of GNP devoted to science has been steadily rising (while ours has been steadily declining). Measured by performance, their gobbling of 25% of our car market is due to the fact that they produce a superior car. Their performance in the computer industry is also a reflection of their commitment to excellence in science and technology.

The Japanese are adept not just at application but in science, and they have invested impressively in the future--in all aspects of science, technology and education.

MR. PORTER. Does the system currently at NIH hinder the application of scientific knowledge?

DR. HOAGLAND. On the contrary, the NIH system is the best governmental system known for uncovering new knowledge and getting it out where it can help people. And it is cost-effective. For every dollar invested in research $15 have been saved in longer life and reduced illness.

NIH retains patent rights to discoveries made in institutions receiving NIH grants. Only a very few of these institutions (90 out of 1000 NIH grantee institutions) have negotiated agreements with NIH allowing them to patent and license discoveries. It would be helpful if NIH would implement more patent agreements in order to encourage institutions to exploit their own discoveries.

MR. PORTER. Are other countries more adept?

DR. HOAGLAND. The U.S. has been the leader among the countries of the world in supporting science on a large scale through enlightened government. In the biomedical area, the NIH is a model that other countries have copied. We are still in a leading position but it is rapidly eroding, while Japan, West Germany and the Soviets are rapidly moving ahead of us. Our flagging support of research, our increasingly obsolescent facilities and equipment and our failure to sustain a vigorous training program for young scientists have weakened our position. In another decade we will be in a sorry state indeed.

MR. PORTER. Have they better organization and structure for the application of discoveries?

DR. HOAGLAND. They don't have better structures but they have the will, the urge to excellence that we are losing.

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