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Folder Title:
President's Council on Science and Technology Advisers

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G	17	7	3	1

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20506

June 29, 1989

Note for Betty Thompson

Re. Nominees for the President's Council of Science and Technology Advisers (PCAST)

I am attaching the June 16 and June 21 memoranda Dr. Bromley sent to Governor Sununu, along with the **June 23 list of PCAST nominees Dr. Bromley presented to the President. Please note that the June 23 list supersedes the June 16 list, as Paul Berg had declined membership and Dr. Bromley thus nominated Daniel Nathans.**

Also attached are phone numbers for the nominees for the PCAST. In the interest of speed, I did not take the time to find out additional numbers for those for whom we have just one number.

Please let me know if I may be of assistance in obtaining further information to help you process these nominees.

Thank you for your help.

Sally Sherman
X 7116

attachments

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20506

Nominees for Membership on the

PRESIDENT'S COUNCIL OF SCIENCE AND TECHNOLOGY ADVISERS (PCAST)

Nominee	Telephone Number(s)
NORMAN BORLAUG	011-525-954-2100 (Institute for Maize and Wheat Improvement in Mexico City, where Dr. Borlaug is currently) 409-845-3041 Texas A&M 214-387-2315 Texas residence
SOLOMON BUCHSBAUM	201-949-5564 NJ office 201-582-5564 NY office
CHARLES DRAKE	603-646-3338
RALPH GOMORY	212-582-0450 office 914-333-8146 car phone 914-238-8522 residence
BERNADINE HEALY	216-444-3900 office 216-423-0013 residence
PETER LIKENS	215-758-3155
THOMAS LOVEJOY	202-786-2263 office 703-442-0399 residence
WALTER MASSEY	312-702-6021
JOHN McTAGUE	313-322-7105 office 313-747-9034 residence
DANIEL NATHANS	301-955-8445
DAVID PACKARD	415-857-2627 office
HAROLD SHAPIRO	609-452-6100

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20506

June 27, 1989 - 3:45 PM

Note for Dr. Bromley

Re. Sununu/Untermeyer Action on PCAST

Katie Winklejohn of Governor Sununu's office called to advise that on June 26 his office forwarded to Chase Untermeyer your sample letter and list of candidates for PCAST.

She said that now Chase will take what action he deems necessary to effect a Presidential invitation and that Diane Dracos will likely be the "physical staff person" who will carry out this action.

Attached is my note to Winklejohn conveying the memo copies she requested yesterday.

Sally Sherman

cc: Bob Post

Called Diane Dracos on 28th. She had not yet received anything from Chase Untermeyer. We should check with this office to see where the listings and draft letter are now. There is some urgency in moving forward with them to meet the President's expressed wishes.

DOB

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
WASHINGTON, D.C. 20506

June 26, 1989

Note for Katherine Winklejohn

Re. June 16 Memo on PCAST

You requested a copy of Dr. Bromley's June 16 memorandum to Governor Sununu re. PCAST.

I enclose a copy of it and Dr. Bromley's June 21 memo which advises that since Paul Berg declined membership in the PCAST, Dr. Bromley is nominating Daniel Nathans in his place.

Also attached is a copy of the June 23 list of nominees for the PCAST -- which is Dr. Bromley's final listing and would supersede the listing in his June 16 memo.

Sally Sherman
X 7116

attach.

NOMINEES FOR MEMBERSHIP

ON THE

PRESIDENT'S COUNCIL

OF

SCIENCE AND TECHNOLOGY ADVISERS
(PCAST)

June 23, 1989

NOMINEES FOR MEMBERSHIP ON THE

PRESIDENT'S COUNCIL OF SCIENCE AND TECHNOLOGY ADVISERS (PCAST)

The following individuals have agreed to serve as members of the President's Council if so requested.

1. **NORMAN BORLAUG** — Agriculture
   Professor, Department of Soils and Crop Sciences
   Texas A&M University

Also a Nobel laureate, Borlaug is the father of the Green Revolution. He has done much of his work at the Institute for Maize and Wheat Improvement in Mexico City but is a U.S. citizen. His credentials as an agricultural pioneer, as an environmentalist, and throughout the Third World are impeccable. I have worked with him on the Indo-U.S. Presidential Science and Technology Initiative and found him to be extremely effective.

2. **SOLOMON BUCHSBAUM** — Industrial Engineer/ Military Science
   Executive Vice President
   AT&T Bell Laboratories

Sol Buchsbaum, an ex-Canadian, happens to be one of the wisest men I know. He served on PSAC for a number of years, was chairman of WHSC for its entire existence, and is completely at home both in the private sector world and in Washington. He has special expertise in matters of military science and technology, in communication and computer science and in industrial manufacturing.

3. **CHARLES DRAKE** — Earth Sciences
   Professor of Geology and Geophysics
   Dartmouth College

Drake is one of the nation's most highly respected earth scientists; he was awarded the National Medal of Science in 1987. Over the years, he has served with distinction on just about every significant committee in the earth sciences -- both nationally and internationally. I have worked with him on National Academy/National Research Council panels and have been much impressed by the breadth of his expertise and his statesmanship.

4. **RALPH GOMORY** Mathematics/Foundation
Senior Vice President
for Science and Technology, IBM
President, Sloan Foundation

Gomory is a very highly respected professional mathematician who served for many years as IBM's Director of Research -- then Chief Scientist. He has just retired from IBM to become President of the Sloan Foundation. His IBM experience in technology transfer, high-tech manufacturing, international sales, etc., together with his Foundation connections, would make him a powerful addition to the Council. I have worked with him on a number of panels and have been much impressed by his judgment and creativity.

5. **BERNADINE HEALY** Biomedicine
Director of Research, Cleveland Clinic
President, American Heart Association

A professional cardiologist, Healy held a professorship in the Johns Hopkins University Medical School before joining Jay Keyworth as Deputy Director of OSTP for two years prior to accepting her current post. During the past year she was a member of Bill Graham's White House Science Council. She is broadly experienced in the biomedical area, and I have served with her on a number of panels and committees where I have been much impressed by her wisdom, common sense and professionalism.

I would suggest that Healy be made Vice Chairman of the Council.

6. **PETER LIKENS** Academic Engineer
President, Lehigh University

An electrical engineer by training, Likens has gained international visibility as President of Lehigh -- a representative of an academic constituency that is frequently neglected but of ever-growing importance: the relatively small, high quality engineering school. He was a very constructive, thoughtful member of the Packard-Bromley WHSC Panel on the Health of U.S. Colleges and Universities and would be a very effective Council member.

7. **THOMAS LOVEJOY** Environmentalist
Assistant Secretary for External Affairs
Smithsonian Institution

Lovejoy was a student of Evelyn Hutchinson at Yale and was one of the earliest ecologists. Formerly Vice President for Research at the World Wildlife Fund, he has gained an international reputation for his work in international environmental and ecological science. He has played an important role in current efforts to retain substantial sections of the Brazilian tropical rain forests. I have served with him on the President's U.S./Brazil Blue Ribbon Panel and, during the past year, on Bill Graham's WHSC. He brings a deep knowledge of environmental science as well as experience in international activities and sound judgment to any panel.

8. **WALTER MASSEY** Physicist/National Laboratory
Vice President for Research
University of Chicago

One of the most distinguished black scientists, Massey is a solid state physicist/chemist. From Dean of the Graduate School at Brown University, he became Director of the Argonne National Laboratory and then took up his present post where he remains responsible for the management of Argonne. He served for six years as a member of the National Science Board and is currently President of AAAS. I have worked with him in many capacities and believe that he would be a very effective, thoughtful member of the Council.

9. **JOHN McTAGUE** Chemistry
Vice President and Director of Research
Ford Motor Company

A chemist by profession, McTague was Director of the National Synchrotron Light Source at Brookhaven before joining Jay Keyworth's OSTP as Assistant Director for Physical Sciences. On Jay's retirement, McTague served for almost a year as Acting Director of OSTP before going on to Ford. He has been extremely successful in increasing Ford's interest in, and support for, research. His industrial, Brookhaven and Washington experience would make him a very effective Council member.

10. DANIEL NATHANS Microbiology
Boury Professor of Microbiology
Johns Hopkins University

A Nobel laureate for his work in microbiology, Nathans is one of the true pioneers in the field of recombinant DNA and its offspring, biotechnology. He has devoted much of his research to the understanding of tumor viruses and their role in the induction of cancer. He has an outstanding reputation throughout his field both for research and for statesmanship.

11. DAVID PACKARD Industrial Engineer
Chairman of the Board of the
Hewlett-Packard Company and of the
David and Lucile Packard Foundation

As one of the **fathers** of Silicon Valley, with an enviable track record both in industry and government (Defense Department), and as a member or chairman of a great number of influential panels and commissions, Packard brings a unique background to any deliberation. He was a very effective member of the White House Science Council during the Reagan Administration, in addition to his many individual activities for President Reagan, e.g., his study of contracting in the Defense Department.

12. HAROLD SHAPIRO Academic/Social Science
President, Princeton University Economist

An economist by profession, Shapiro was formerly President of the University of Michigan. He has participated actively in science and technology related studies for NAS and AAAS and is one of the very few social scientists known to me who finds it easy to work effectively with scientists and engineers. I believe that it will be important symbolically for us to have a social scientist of impeccable repute on the Council. The absence of such a person damaged the credibility of the WHSC and the later PSACs.

THE WHITE HOUSE

WASHINGTON

June 21, 1989

MEMORANDUM FOR JOHN H. SUNUNU

FROM: D. ALLAN BROMLEY

SUBJECT: PCAST

1. Unfortunately Paul Berg of Stanford is unable to serve on PCAST. After consultation with some leading bio folk, I recommend that we replace him with Professor Daniel Nathans of Johns Hopkins University -- also a Nobel laureate in microbiology, as the attached bios indicate. He has an outstanding reputation as one of the true pioneers in modern microbiology and biotechnology.

2. Norman Borlaug of Texas A&M will be happy to serve. His letter of invitation should be addressed to him at the following address:

International Maize and Wheat Improvement Center (CIMMYT)
Lisboa 27, Postal 6-641
Col. Juarez Delg. Cuauhtemoc
06600, Mexico

where he will be during the summer break at Texas A&M.

This then completes the roster for PCAST that I forwarded in my June 16 memo to you. I should appreciate it if you would let me know when the President sends out his letters of invitation so that I can be prepared to follow up with additional detail and begin planning to make PCAST operational. There are several outstanding problem areas where I would like to put them to work as soon as possible.

Attachment

from American Men and Women of Science, 15th ed., 1982

NATHANS, DANIEL, b Wilmington, Del, Oct 30, 28; m 56; c 3. MICROBIOLOGY, MOLECULAR BIOLOGY. *Educ:* Univ Del, BS, 50; Washington Univ, MD, 54. *Prof Exp:* Resident, Columbia-Presby Med Ctr, 57-59; from asst prof to prof microbiol, 62-76, Boury prof microbiol, 76-80, BOURY PROF MOLECULAR BIOL & GENETICS, JOHNS HOPKINS UNIV, 80-, DIR, 72- *Concurrent Pos:* USPHS grant, Rockefeller Univ, 59-62. *Honors & Awards:* Nobel Prize Cowinner in Med, 78. *Res:* Tumor viruses. *Mailing Add:* Dept of Microbiol Johns Hopkins Univ Baltimore MD 21205

from Who's Who in America, 45th ed., 1988-89

NATHANS, DANIEL, biologist; b. Wilmington, Del., Oct. 30, 1928; s. Samuel and Sarah (Levitan) N.; m. Joanne E. Gomberg, Mar. 4, 1956; children: Eli, Jeremy, Benjamin. B.S., U. Del., 1950; M.D., Washington U., 1954. Intern Presbyn. Hosp., N.Y.C., 1954-55; resident in medicine Presbyn. Hosp., 1957-59; clin. assoc. Nat. Cancer Inst., 1955-57; guest investigator Rockefeller U., N.Y.C., 1959-62; prof. microbiology Sch. Medicine, Johns Hopkins, 1962-72, prof., dir. dept. microbiology, 1972-82, Univ. prof., 1982—; sr. investigator Howard Hughes Med. Inst., 1982— Recipient Nobel prize in physiology or medicine, 1978. Fellow Am. Acad. Arts and Scis.; mem. Nat. Acad. Scis. Office: Johns Hopkins Univ Dept Molecular Biology & Genetics 725 N Wolfe St Baltimore MD 21205

June 16th listing superseded by June 23rd list

THE WHITE HOUSE

WASHINGTON

June 16, 1989

MEMORANDUM FOR JOHN H. SUNUNU

FROM: D. ALLAN BROMLEY

SUBJECT: President's Council of Science and Technology Advisers (PCAST)

Enclosed herewith is a listing of those whom I have contacted informally and confidentially about their willingness to serve as members of PCAST if invited to do so. I have emphasized that membership will entail very real work, substantial time commitment and that the members serve without remuneration apart from their out-of-pocket expenses.

All have agreed, enthusiastically, to serve if invited. I have not discussed with you exactly how these invitations are to be extended but am assuming that the President will wish to do this himself. Is it your intention, and his, that members of PCAST would undergo full FBI clearances and perhaps other screening?

I have given you here a list of 12 individuals, and I, as chairman, would make up a total of 13.

Since sending you my last memorandum that included an estimate of $365,400 for the annual operating cost of PCAST, I have had an opportunity to discuss this with Bob Grady of OMB and have requested that this amount be added for this purpose to the amendment that I am requesting Bob to forward to the House and Senate Appropriations Committees requesting additional operating funds for OSTP in FY 1990.

I have discussed these questions at some length, as you suggested, with Dick Darman and Bob Grady, as well as with my senior OSTP staff, and we have worked out an intermediate position that will allow me to bring aboard the senior professionals whom I want to nominate as Associate Directors of OSTP, as well as make a substantial start toward assembling the team that will enable OSTP to live up to the President's expectations.

I continue to be extremely gratified by the quality of those who have indicated a desire to join us.

Attachments

NOMINEES FOR MEMBERSHIP ON THE

PRESIDENT'S COUNCIL OF SCIENCE AND TECHNOLOGY ADVISERS (PCAST)

The following individuals have agreed to serve as members of the President's Council if so requested.

1. **PAUL BERG** — Microbiology/ Professor, Biotechnology
Microbiology
Stanford University

A Nobel laureate, Berg, together with a number of his colleagues, formed one of the original biotechnology companies (DENAX), which was subsequently sold to Schering-Plough, on whose Scientific Advisory Board Berg still is a member, although he has returned full-time to his university position. Berg is very widely respected and is recognized both for his pioneering contributions to microbiology and for his leadership in bringing his scientific community together to consider the possible hazards involved in recombinant DNA research.

2. **NORMAN BORLAUG** — Agriculture
Professor, Department of Soils and Crop Sciences
Texas A&M University

Also a Nobel laureate, Borlaug is the father of the Green Revolution. He has done much of his work at the Institute for Maize and Wheat Improvement in Mexico City but is a U.S. citizen. His credentials as an agricultural pioneer, as an environmentalist, and throughout the Third World are impeccable. I have worked with him on the Indo-U.S. Presidential Science and Technology Initiative and found him to be extremely effective.

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From Who's Who in America, 45th ed., 1988-89

BERG, PAUL, biochemist, educator; b. N.Y.C., June 30, 1926; s. Harry and Sarah (Brodsky) B.; m. Mildred Levy, Sept. 13, 1947; 1 son, John. B.S., Pa. State U., 1948; Ph.D. (NIH fellow 1950-52), Western Res. U., 1952; D.Sc. (hon.), U. Rochester, 1978, Yale U., 1978, Wash. U., St. Louis, 1986. Postdoctoral fellow Copenhagen (Denmark) U., 1952-53; postdoctoral fellow Sch. Medicine, Washington U., St. Louis, 1953-54; Am. Cancer Soc. scholar cancer research dept. microbiology Sch. Medicine, Washington U., 1954-57, from asst. to asso. prof. microbiology, 1955-59; prof. biochemistry Stanford Sch. Medicine, 1959—, Sam, Lula and Jack Willson prof. biochemistry, 1970, chmn. dept., 1969-74, dir. Stanford U. Beckman Ctr. for Molecular and Genetic Medicine, 1985; non-resident fellow Salk Inst., 1973; adv. bd. NIH, NSF, M.I.T., vis. com. dept. biochemistry and molecular biology Harvard U.; bd. sci. advisors Jane Coffin Childs Found. Med. Research, 1970-80; chmn. sci. adv. com. Whitehead Inst., 1984; internat. adv. bd. Basel Inst. Immunology. Contbr. profl. jours.; Editor: Biochem. and Biophys. Research Communications, 1959-68, editorial bd., Molecular Biology, 1966-69. Served to lt. (j.g.) USNR, 1943-46. Recipient Eli Lilly prize biochemistry, 1959; V.D. Mattia award Roche Inst. Molecular Biology, 1972; Henry J. Kaiser award for excellence in teaching, 1972; Disting. Alumnus award Pa. State U., 1972; Sarasota Med. awards for achievement and excellence, 1979; Gairdner Found. annual award, 1980; Lasker Found. award, 1980; Nobel award in chemistry, 1980; N.Y. Acad. Sci. award, 1980; Sci. Freedom and Responsibility award AAAS, 1982; Nat. Library Sci. medal, 1986; named Calif. Scientist of Yr. Calif. Museum Sci. and Industry, 1963; numerous spl. and disting. lectureships including Harvey lectr., 1972, Lynen lectr., 1977, Priestly lectrs. Pa. State u., 1978, Dreyfus Disting. lectrs. Northwestern U., 1979, Lawrence Livermore Dir.'s Disting. lectr., 1983, W.H. Stein Meml. lectr. Rockefeller U., 1984, Charles E. Dohme Meml. lectr. Johns Hopkins U., 1984, Weizmann Inst. Sci. Jubilee lectr., 1984, U. Houston Nobel Prize Winners Series, 1985. Mem. Inst. Medicine, Nat. Acad. Scis. (council 1979—, editorial bd. proc. 1980), Am. Acad. Arts and Scis., Am. Soc. Biol. Chemists (pres. 1974-75), Am. Soc. Microbiology, Am. Philos. Soc. (Nat. Medal of Sci. 1983), Japan Biochem. Soc. (elected fgn. mem. 1978), French Acad. Sci. (elected fng. mem. 1981). Office: Stanford Sch. Medicine 838 Santa Fe Ave. Stanford CA 94305

from Who's Who in America, 45th ed., 1988-89

BORLAUG, NORMAN ERNEST, agricultural scientist; b. Cresco, Iowa, Mar. 25, 1914; s. Henry O. and Clara (Vaala) B.; m. Margaret G. Gibson, Sept. 24, 1937; children: Norma Jean (Mrs. Richard H. Rhoda), William Gibson. BS in Forestry, U. Minn., 1937, MS in Plant Pathology, 1940, PhD in Plant Pathology, 1941; ScD (honoris causa), Punjab (India) Agrl. U., 1969, Kanpur U., India, Royal Norwegian Agrl. Coll., Luther Coll., 1970, Mich. State U., Univ. de la Plata, Argentina, Uttar Pradesh Agrl. U., India, 1971; Sc.D. (honoris causa), U. Ariz., 1972, U. Fla., 1973, Univ. Catolica de Chile, 1974, Univ. Hohenheim, Fed. Republic Germany, 1976, U. Agr., Lyallpur, Faisalabad, Pakistan, 1978, Columbia U., N.Y.C., 1980, Ohio State U., 1981, U. Minn., 1982, U. Notre Dame, 1987; L.H.D., Gustavus Adolphus Coll., 1971; LL.D. (hon.), N.Mex. State U., 1973; D. Agr. (hon.), Tufts U., 1982; D. Agrl. Scis. (hon.)., U. Agrl. Scis., Hungary, 1980, Tokyo U. Agr., 1981, Univ. Nacional Pedro Henriques Turena, Dominican Republic, Univ. Cen. del Estes, Dominican Republic, 1983; D. Honoris Causa, Univ. Mayor de San Simón, Bolivia, Univ. de Buenos Aires, 1983, Univ. de Cordoba, Spain, Univ. Politecnica de Catalunya, Barcelon, Spain, 1986. With U.S. Forest Service, 1935-38; instr. U. Minn., 1941; microbiologist E.I. DuPont de Nemours, 1942-44; research scientist in charge wheat improvement Coop. Mexican Agrl. Program, Mexican Ministry Agr. Rockefeller Found., Mexico, 1944-60; assoc. dir. assigned to Inter-Am. Food Crop Program Rockefeller Found., 1960-63; dir. wheat research and prodn. program Internat. Maize and Wheat Improvement Ctr., Mexico City, 1964—; cons. Internat. Maize and Wheat Improvement Ctr., 1982—; cons., collaborator Inst. Nacional de Investigationes Agricolas, Mexican Ministry Agr., 1960-64; cons. FAO, North Africa and Asia, 1960; ex-officio cons. wheat research and prodn. problems to govts. in, Latin Am., Africa, Asia.; Mem. Citizen's Commn. on Sci., Law and Food Supply, 1973—, Commn. Critical Choices for Am., 1973—, Council Agr. Sci. and Tech., 1973—, Presdl. Commn. on World Hunger U.S.A., 1978-79; dir. Population Crisis Com., 1971; asesor especial Fundacion para Estudios de la Poblacion A.C., Mexico, 1971—; mem. adv. council Renewable Natural Resources Found., 1973—; A.D. White Disting. prof.-at-large Cornell U., 1983—; Disting. prof. Internat. Agr., Dept. Soil & Crop Scis., Tex. A&M U., Jan.-May, 1984—; advisor The Population Inst., U.S.A., 1978; bd. trustees Winrock Internat. U.S.A.; life fellow Rockefeller Found., 1983—. Recipient Disting Service awards Wheat Producers Assns., and state govts. Mexican States of Guanajuato, Queretaro, Sonora, Tlaxcala and Zacatecas, 1954-60; Recognition award Agrl. Inst. Can., 1966; Recognition award Instituto Nacional de Tecnologia Agropecuaria de Marcos Juarez, Argentina, 1968; Sci. Service award El Colegio de Ingenieros Agronomos de Mexico, 1970; Outstanding Achievement award U. Minn., 1959; E.C. Stakman award, 1961; named Uncle of Paul Bunyan, 1969; recipient Disting. Citizen award Cresco Centennial Com., 1966; Nat. Disung. Service award Am. Agrl. Editors Assn., 1967; Genetics and Plant Breeding award Nat. Council Comml. Plant Breeders, 1968; Star of Distinction Govt. of Pakistan, 1968; citation and street named in honor Citizens of Sonora and Rotary Club, 1968; Internat. Agronomy award Am. Soc. Agronomy, 1968; Distinguished Service award Wheat Farmers of Punjab, Haryana and Himachal Pradesh, 1969; Nobel Peace prize, 1970; Diploma de Mento El Instituto Tecnologico y de Estudios Superiores de Monterrey, Mexico, 1971; medalla y Diploma de Mento Antonio Narro Escuela Superior de Agricultura de la U. de Coahuila, Mexico, 1971; Diploma de Mento Escuela Superior de Agricultura Hermanos Escobar, Mexico, 1973; award for service to agr. Am. Farm Bur. Fedn., 1971; Outstanding Agrl. Achievement award World Farm Found., 1971; Medal of Merit Italian Wheat Scientists, 1971; Service award for outstanding contbn. to alleviation of world hunger 8th Latin Am. Food Prodn. Conf., 1972; Nat. award for Agrl. Excellence in Sci. Nat. Agri-Mktg. Assn., 1982, Disting. Achievement award Council for Agrl. Scis. and Tech., 1982; inaugural lectr., medal recipient Dr. S.B. Hendrick's Meml. Lectureship., 1981, other honored lecturships; named to Halls of Fame Oreg. State U. Agrl., 1981, Agrl. Nat. Ctr., Bonner Springs, Kans., 1984, Scandinavian-Am., U.S.A., 1986, dedicated in his name Norman E. Borlaug Centro de Capitación y Formación de Agrs., Santa Cruz, Bolivia, 1983, Borlaug Hall U. Minn., 1985, Borlaug Bldg. Internat. Maize and Wheat Improvement Ctr., 1986; numerous other honors and awards from govts., ednl. instns., citizens groups. Hon. fellow Indian Soc. Genetics and Plant Breeding; mem. Nat. Acad. Sci., Am. Soc. Agronomy (1st Internat. Service award 1960, 1st hon. life mem.), Am. Assn. Cereal Chemists (hon. life mem., Meritorious Service award 1969), Crop Sci. Soc. Am. (hon. life mem.), Soil Sci. Soc. Am. (hon. life mem.), Sociedad de Agronomia do Rio Grande do Sul Brazil (hon.), India Nat. Sci. Acad. (fgn.), Royal Agrl. Soc. Eng. (hon.), Royal Soc. Edinburgh (hon.), Hungarian Acad. Sci. (hon.), Royal Swedish Acad. Agr. and Forestry (fgn.), Academia Nacional de Agronomia y Veterinaria (Argentina); hon. academician N.I. Vavilov Acad. Agrl. Scis. Lenin Order (USSR.), Am. Council on Sci. and Health (trustee 1978—), Internat. Food Policy Research Inst. (trustee 1976-82), Royal Soc. Office: Tex A&M Univ Dept Soil & Crop Sci College Station TX 77843

from Who's Who in America, 45th ed., 1988-89

BUCHSBAUM, SOLOMON JAN, physicist; b. Stryj, Poland, Dec. 4, 1929; came to U.S., 1953, naturalized, 1957; s. Jacob and Berta (Rutherfoer) B.; m. Phyllis N. Isenman, July 3, 1955, children: Rachel Joy, David Joel, Adam Louis. B.S., McGill U., 1952, M.S., 1953; Ph.D., Mass. Inst. Tech., 1957. Mem. tech. staff Bell Labs., Murray Hill, N.J., 1958-61, dept. head Bell Labs., 1961-65, dir., 1965-68, v.p. Sandia Labs., Albuquerque, 1968-71; exec. dir. Bell Labs., 1971-76, v.p., 1976-79, exec. v.p., 1979—; sr. cons. Def. Sci. Bd., chmn., 1972-77, 81— mem. AEC Controlled Thermonuclear Fusion Com., 1965-72, Pres.'s Sci. Adv. Com., 1970-73, Pres.'s Com. on Sci. and Tech., 1975-76; mem. fusion power coordinating com. ERDA, 1972-76, adv. group sci. and tech. NSF, 1976-77; chmn. Energy Research Adv. Bd., 1978-81; mem. Naval Research Adv. Com., 1978-81; mem. vis. com. M.I.T., 1977—, mem. corp. devel. com., 1980—, cons. Office Sci. and Tech., 1976-82; chmn. White House Sci. Council, 1982—; trustee Rand Corp., 1982—, mem. Draper Lab. Corp., 1983—, bd. dirs., bd. Govs. Argonne Nat. Lab., 1985— Assoc. editor: Revs. Modern Physics, 1968-72, Jour. Applied Physics, 1968-70, Physics of Fluids, 1963-64, co-author: Waves in Plasmas, 1963, contbr. numerous articles to profl. jours. Trustee Argonne Univs. Assn., 1979-82. Moyse traveling fellow, 1953-54; IBM fellow, 1954-56; recipient Anne Molson Gold medal, Sec. of Def. medal for Outstanding Pub. Service, 1977, Sec. of Energy award for Exceptional Pub. Service, 1981; Nat. Medal of Sci., 1986. Fellow Am. Phys. Soc. (chmn. div. plasma physics 1968, mem. council 1973-76), IEEE (Frederk Philips award 1987), Am. Acad. Arts and Scis., AAAS, mem. Nat. Acad. Engring. (exec. com. 1975-76), Nat. Acad. Scis., Cosmos Club. Research in gaseous and solid state plasmas, communications. Research in gaseous and solid state plasmas, communications. Office: AT&T Bell Labs Crawfords Corner Rd Holmdel NJ 07733

from Who's Who in America, 45th ed., 1988-89

DRAKE, CHARLES LUM, geology educator; b. Ridgewood, N.J., July 13, 1924; s. Ervin Thayer and Elizabeth (Lum) D.; m. Martha Ann Churchill, June 24, 1950; children—Mary Aiken, Caroline Elizabeth, Susannah Churchill. B.S. in Engring., Princeton, 1948; Ph.D., Columbia, 1958. Research assoc. Lamont Geol. Obs. Columbia U., N.Y.C., 1948-56; sr. scientist Lamont Geol. Obs. 1956-58, acting asst. dir. Lamont Geol. Obs., 1963-65; mem. faculty geology dept., 1958-69, prof. geology, chmn. dept., 1967-69; prof. dept. geology Dartmouth Coll., Hanover, N.H., 1969—, chmn. dept. geology, 1978-79, dean grad. studies, assoc. dean sci. div. Dartmouth Coll., 1979-82; mem. coms. Nat. Acad. Sci., NSF, Nat. Aero. Space Adminstrn., 1964-86; mem. Nat. Adv. Com. on Oceans and Atmosphere, 1971-74; chmn. earth scis. div. NRC, 1973-76; mem. geophys. research bd., 1968-82. Trustee Village S. Nyack, N.Y., 1963-65, 66-69; dep. mayor, 1968-69. Served with AUS, 1943-46. NSF postdoctoral fellow, 1965-66. Mem. Internat. Council Sci. Unions (pres. interunion commn. on geodynamics 1970-75, chmn. U.S. Geodynamics com. 1970-78, chmn. U.S. nat. commn. geology 1979-81), Am. Geophys. Union (pres. 1984-86), A.A.A.S., Am. Assn. Petroleum Geologists, Geol. Soc. Am. (pres. 1976-77), Geol. Soc. France (hon.), Seismol. Soc. Am., Royal Astron. Soc., Soc. Exploration Geophysicists, Marine Tech. Soc., Sigma Xi, Club: Cosmos. Home: RFD 1 East Thetford VT 05043

from Who's Who in America, 45th ed., 1988-89

GOMORY, RALPH EDWARD, mathematician, business machines manufacturing company executive; b. Brooklyn Heights, N.Y., May 7, 1929; s. Andrew L. and Marian (Schellenberg) G.; m. Laura Dumper, 1954 (div. 1968); children: Andrew C., Susan S., Stephen H. B.A., Williams Coll., 1950, Sc.D. (hon.), 1973; student, Kings Coll., Cambridge U., Eng., 1950-51; Ph.D., Princeton U., 1954, LHD (hon.), Pace U., 1986, DSc (hon.), Poly. U., 1987. Research assoc. Princeton U., 1951-54, asst. prof. math., Higgins lectr., 1957-59; with IBM, Yorktown Heights, N.Y., 1959-86, Armonk, N.Y., 1986—, dir. math. scis., research div. IBM, 1968-70, dir. research, 1970-86, v.p., 1973-84, sr. v.p., 1985—, sr. v.p. for sci. and tech., 1986—, also mem. corp. mgmt. bd., dir. Asia Pacific Group; Andrew D. White prof.-at-large Cornell U., 1970-76; dir. Indsl. Research Inst., Bank of N.Y., Nova Pharm. Corp.; mem. adv. council dept. math. Princeton, 1982—, chmn., 1984-85; mem. adv. council Sch. Engring., Stanford U., 1978-85; chmn. vis. com. div. applied scis. Harvard U., 1987—; mem. White House sci. council Council on Fgn. Relations; chmn. adv. com. to Pres. on High Temperature Superconductivity, 1987—. Trustee Hampshire Coll., 1977-86, Princeton U., 1985—, Alfred P. Sloan Found., 1988—, mem. governing bd. Nat. Research Council., 1980-83. Served with USN, 1954-57. Recipient Lanchester prize Ops. Research Soc. Am., 1964, Harry Goode Meml. award Am. Fedn. Info. Processing Socs., 1984, John Von Neumann Theory prize Ops. Research Soc. Am. and Inst. Mgmt. Scis., 1984, IRI medal Indsl. Research Inst., 1985; IBM fellow, 1964. Fellow Econometric Soc., Am. Acad. Arts and Scis., mem. Nat. Acad. Scis. (council 1977-78, 80-83), Nat. Acad. Engring. (council 1986—), Am. Philos. Soc. (council 1986—). Research integer and linear programming, non-linear differential equations. Home: 260 Douglas Rd. Chappaqua NY 10514 Office: IBM Corp Old Orchard Rd Armonk NY 10504

from Who's Who in America, 45th ed., 1988-89

HEALY, BERNADINE P. physician, cardiologist, educator; b. N.Y.C., Aug. 2, 1944; d. Michael J. and Violet (McGrath) Healy; m. Floyd Loop, Aug. 17, 1985; 2 children by previous marriage, Bartlett Bulkley, Marie McGrath Loop. AB summa cum laude, Vassar Coll., 1965; MD cum laude Harvard Med. Sch., 1970. Diplomate Am. Bd. Med. Examiners, Am. Bd. Cardiology, Am. Bd. Internal Medicine (bd. dirs. 1983-87); lic. physician, Md., D.C. Intern in medicine Johns Hopkins Hosp., Balt., 1970-71, asst. resident, 1971-72; staff fellow sect. pathology Nat. Heart, Blood & Lung Inst., NIH, Bethesda, Md., 1972-74; fellow cardiovascular div. dept. medicine Johns Hopkins U. Sch. Medicine, Balt., 1974-76, fellow dept. pathology, 1975-76, asst. prof. medicine and pathology, 1976-81, assoc. prof. medicine, 1977-82, asst. dean for postdoctoral programs and faculty devel., 1979-84, assoc. prof. pathology, 1981-84, prof. medicine, 1982-84, active staff medicine and pathology Johns Hopkins Hosp., 1976—, dir. CCU, 1977-84, dep. dir. Office Sci. and Tech. Policy, Exec. Office of White House, Washington, 1984-85, chmn. research Cleve. Clinic Found., Ohio, 1985—; co-dir. Mary Elizabeth Garrett Symposium, 1980; regional rep. com. admissions Harvard Med. Sch., Boston, 1974—, steering com., 1981—; co-dir. short course in Ischemic Heart disease, Internat. Acad. Pathology, 1977-81; chmn. Office of Tech. Assessment Panel in Devels. in Biotech., U.S. Congress, 1986—; bd. dirs. Stetler Research Fund for Women Physicians, 1979—; cons. Nat. Heart, Lung and Blood Inst., NIH, 1976—, cardiology adv. com., 1978-82, others. Editorial cons. numerous jours., abstract reviewer; editorial bd. Jour. Cardiovascular Medicine, 1980—, Am. Jour. Medicine, 1976—, Am. Jour. Cardiology, 1981-82, Circulation, 1981—, Jour. Am. Coll. Cardiology, 1982— Contbr. articles to profl. jours. Matthew Vassar scholar, 1962-65, Harvard Nat. scholar, 1965-70; Eloise Ellery fellow, 1965-66, Stetler Research fellow, 1976-77; recipient Ohio State award, Network for Continuing Med. Edn. Program, 1980; Nat. Bd. Ann. award for Medicine, Med. Coll. Pa., 1983; Spl. award for service, Am. Heart Ass., 1983, 84. Mem. Am. Fedn. Clin. Research (pres. 1983-84), Am. Heart Assn. (fellow Council on Clin. Cardiology, Council on Circulation, dir. 1983-84), Am. Coll. Cardiology (bd. govs. 1979-82), ACP, Assn. Am. Med. Colls., Internat. Acad. Pathology, Am. Med. Women's Assn., Assn. for Women in Sci., Am. Soc. Clin. Investigation. Office: Cleveland Clinic Research Div 9500 Euclid Ave Cleveland OH 44106

from Who's Who in America, 45th ed., 1988-89

LIKINS, PETER WILLIAM, university president; b. Tracy, Calif., July 4, 1936; s. Ennis Blaine and Dorothy Louise (Medlin) L.; m. Patricia Ruth Kitsmiller, Dec. 18, 1955; children: Teresa, Lora, Paul, Linda, Krista, John. B.S. in C.E. Stanford U., 1957, Ph.D. in Engrng. Mechanics, 1965; S.M. in C.E. MIT, 1958; hon. doctorates, Lafayette Coll., 1983, Moravian Coll., 1984. Devel. engr. Jet Propulsion Lab., Pasadena, Calif., 1958-60; asst. prof. engrng. UCLA, 1964-69, assoc. prof., 1969-72, prof., 1972-76, asst. dean, 1974-75; asso. dean, 1975-76; dean engrng. and applied sci. Columbia U., N.Y.C., 1976-80; univ. provost Columbia U., 1980-82; pres. Lehigh U., Bethlehem, Pa., 1982—; engrng. cons. U.S. and fgn. corps. and govt. agys., 1965— Author: Elements of Engineering Mechanics, 1973, Spacecraft Dynamics, 1982; Contbr. articles to profl. jours. Ford Found. fellow, 1970-72; named to Nat. Wrestling Hall of Fame. Fellow AIAA; mem. Nat. Acad. Engrng., ASME, Am. Soc. Engrng. Edn. Phi Beta Kappa, Sigma Xi, Tau Beta Pi. Office: Office of Pres Lehigh U Bethlehem PA 18015

from Who's Who in America, 45th ed., 1988-89

LOVEJOY, THOMAS EUGENE, biologist, association executive, conservationist; b. N.Y.C., Aug. 22, 1941; s. Thomas Eugene and Audrey Helen (Paige) L.; B.S. (scholar), Yale U., 1964, Ph.D. in Biology, 1971; m. Charlotte Seymour, 1966 (div. 1978); children—Elizabeth Paige and Katherine Seymour (twins); m. Anne Williams. Research assoc. in biology U. Pa., 1971-74; exec. asst. to sci. dir. Acad. Natural Scis., Phila., 1972-73; asst. to v.p. for resources and planning, 1972-73; program dir. World Wildlife Fund-U.S., Washington, 1973-78; v.p. for sci., 1978-85; exec. v.p., 1985-87; asst. sec. external affairs Smithsonian Inst., Washington, 1987—; bd. dirs. Manhattan Life Ins. Co., N.Y.C., chmn. 1986—; research assoc. in ornithology Acad. Natural Scis., 1971—; chmn., bd. dirs. Wildlife Preservation Trust Internat., 1974—; treas. Internat. Council for Bird Preservation—Pan Am. Sect., 1973-84; sci. fellow N.Y. Zool. Soc., 1978—; mem. adv. bd. Environ. Assessment Council, 1980—; vis. lectr. on tropical ecology Yale U. Sch. Forestry and Environ. Studies, 1982; dir. Manhattan Life Corp., 1975-86; chmn. 1986; chmn. exec. com., 1982—; mem. Smithsonian Council, 1982-87; trustee Millbrook Sch., N.Y., 1971—; Rocky Mountain Biol. Lab., 1984—; Acad. Natural Scis. Phila., 1987—; mem. U.S.-Brazil panel White House Office of Sci. and Tech., Washington, 1986—; chmn. U.S. Man and Biosphere Com., 1987—; sec. J. Paul Getty Wildlife Conservation prize, Washington, 1974-87; co-prin. investigator World Wildlife Fund INPA, North Manaus, Brazil, 1979—; bd. govs. N.Y. Botanical Garden, N.Y.C., 1986—; dir. Ctr. for Plant Preservation, 1987— Grantee Nat. Geog. Soc., NIH, NSF, Mellon Found., Rockefeller Found., recipient Ibero-Am. award II Ibero Am. Ornithological Congress, 1983, Cert. of Merit, Goeldi Mus., 1985, named comdr. Order of Merit of Mato Grosso, 1987. Fellow N.Y. Zool. Soc., AAAS (wildlife panel 1981), Linnean Soc. London, mem. Am. Inst. Biol. Scis., Am. Ornithologists Union (elective), Ecol. Soc. Am., Brit. Ecol. Soc., Brit. Ornithologists Union, Cooper Ornithol. Soc., Soc. Study of Evolution, Internat. Union for Conservation of Nature (species survival commn.). Clubs: Century, Cosmos, Knickerbocker, New Haven Lawn. Co-author: Nearctic Avian Migrants in the Neotropics, 1983; co-editor: Key Environments: Amazonia, 1985; Conservation of Tropical Forest Birds, 1985; contbr. articles, chpts. to profl. publs. Home: 3526 Georgetown Pike McLean VA 22102 Office: Smithsonian Inst. Washington DC 20560

from Who's Who in America, 45th ed., 1988-89

MASSEY, WALTER EUGENE, physicist, university official, b. Hattiesburg, Miss., Apr. 5, 1938; s. Almar Clevel and Essie (Nelson) M.; m. Shirley Streeter, Oct. 25, 1969; children: Keith Anthony, Eric Eugene. B.S., Morehouse Coll., 1958; M.A., Washington U., St. Louis, 1966, Ph.D., 1966. Physicist Argonne (Ill.) Nat. Lab., 1966-68; asst. prof. physics U. Ill., Urbana, 1968-70; assoc. prof. Brown U., Providence, 1970-75, prof., dean Brown U. (Coll.), 1975-79; cons. Argonne Nat. Lab., dir., 1979-84, v.p., 1984—; v.p. for research U. Chgo., 1982—; mem. NSB, NSF, 1978-84; cons. Nat. Acad. Scis., 1973-76. Contbr. articles on sci. edn. in secondary schs. and in theory of quantum fluids to profl. jours. Trustee Brown U., 1980—, Mus. Sci. and Industry, Chgo., 1980—; bd. dirs. Urban League R.I., 1972-74. NSF fellow, 1962, NDEA fellow, 1959-60. Fellow AAAS (pres.-elect 1987—, bd. dirs. 1981—); Mem. Am. Phys. Soc. (councillor-at-large 1980-83), Am. Assn. Physics Tchrs. (Disting. Service award 1975), Sigma Xi. Home: 4950 Chicago Beach Dr Chicago IL 60615 Office: Univ Chgo 5801 S Ellis Chicago IL 60637

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MCTAGUE, JOHN PAUL, automobile manufacturing company executive, chemist, b Jersey City, Nov 28, 1935, s James Aloysius and Teresa Eugenia (Hanley) McT, m Carole Frances Reilly, Dec 30, 1961, children Kevin W, Catherine E, Margaret A, Maureen E BS in Chemistry, Georgetown U, 1960, PhD, Brown U, 1965 Mem tech staff N Am Rockwell Sci Ctr, Thousand Oaks, Calif, 1964-70, prof chemistry, mem Inst Geophysics and Planetary Physics UCLA, 1970-82, chmn nat synchrotron light source dept Brookhaven Nat Lab, Upton, N Y, 1982-83, dep dir Office Sci and Tech Policy, Exec Office of Pres, Washington, 1983-86, acting sci advisor to Pres Reagan, 1986, v p research Ford Motor Co, Dearborn, Mich, 1986—, adj prof chemistry Columbia U, 1982-83 Alfred P Sloan Research fellow, 1971-73, NATO sr fellow, 1973, John Simon Guggenheim Meml fellow, 1975-76 Fellow Am Phys Soc mem Am Chem Soc (Calif sect award 1975), AAUP, Soc Automotive Engrs, Engring Soc Detroit, Sigma Xi Club Barton Hills Country (Ann Arbor, Mich) Office Ford Motor Co 20000 Rotunda Dr Room S2106 Sci Research Lab Bldg PO Box 1603 Dearborn MI 48121

from Who's Who in America, 45th ed., 1988-89

PACKARD, DAVID, manufacturing company executive, electrical engineer, former deputy secretary of defense, b. Pueblo, Colo., Sept. 7, 1912; s. Sperry Sidney and Ella Lorna (Graber) P.; m. Lucile Salter, Apr. 8, 1938 (dec., 1987); children: David Woodley, Nancy Ann Packard Burnett, Susan Packard Orr, Julie Elizabeth Stephens. B.A., Stanford U., 1934, M.E.E., 1939; LL.D (hon.), U. Calif., Santa Cruz, 1966, Catholic U., 1970, Pepperdine U., 1972; D.Sc (hon.), Colo. Coll., 1964; Litt.D (hon.), So. Colo. State Coll., 1973, D. in Eng. (hon.), U. Notre Dame, 1974. With vacuum tube engring. dept. Gen. Electric Co., Schenectady, 1936-38; co-founder, ptnr. Hewlett-Packard Co., Palo Alto, Calif., 1939-47, pres., 1947-64, chief exec. officer, 1964-68, chmn. bd., 1964-68, 72—; U.S. dep. sec. defense Washington, 1969-71; dir. Genetech, Inc., 1981—, bd. dirs. Caterpillar Tractor Co., 1972-83, Chevron, 1972-85; chmn. Presdl. Commn. on Def. Mgmt., 1985-86; mem. White House Sci. Council. Mem. President's Commn. Personnel Interchange, 1972-74, Trilateral Commn., 1973-81; pres. bd. regents Uniformed Services U. of Health Scis., 1975-82; mem. U.S.-USSR Trade and Econ. Council, 1975-82; trustee The Ronald Reagan Presdl. Found., 1986—; mem. bd. overseers Hoover Instn., 1972—; bd. dirs. Nat. Merit Scholarship Corp., 1963-69; dir. Found. for Study of Presdl. and Congl. Terms, 1978—, Alliance to Save Energy, 1977-87, Atlantic Council, 1972-83, (vice chmn. 1972-80), Am. Enterprise Inst. for Public Policy Research, 1978—, Nat. Fish and Wildlife Found., 1985-87, Hitachi Found. Adv. Council, 1986—, trustee Herbert Hoover Found., 1974—, dir. Wolf Trap Found.; vice chmn. The Calif. Nature Conservancy, 1983—, trustee Stanford U., 1954-69, (pres. bd. trustees 1958-60), Hoover Instn., The Herbert Hoover Found. Decorated Grand Cross of Merit Fed. Republic of Germany, 1972; recipient numerous awards including Medal of Honor Electronic Industries Assn., 1974, Silver Helmet Defense award AMVETS, 1973, Washington award Western Soc. Engrs., 1975, Hoover medal ASME, 1975, Gold Medal award Nat. Football Found. and Hall of Fame, 1975, Good Scout award Boy Scouts Am., 1975, Vermilye medal Franklin Inst., 1976, Internat. Achievement award World Trade Club of San Francisco, 1976, Merit award Am. Consulting Engrs. Council Fellows, 1977, Achievement in Life award Ency. Britannica, 1977, Engring. Award of Distinction San Jose State U., 1980, Thomas D. White Nat. Def. award U.S. Air Force Acad., 1981, Disting. Info. Scis. award Data Processing Mgmt. Assn., 1981, Sylvanus Thayer award U.S. Mil. Acad., 1982, Environ. Leadership award Natural Resources Def. Council, 1983, Dollar award Nat. Fgn. Trade Council, 1985. Fellow IEEE (Founders medal 1973), mem. Nat. Acad. Engring. (Founders award 1979), Instrument Soc. Am. (hon. lifetime mem.), Wilson Council, The Bus. Roundtable, Bus. Council, Am. Ordnance Assn. (Crozier Gold medal 1970), Sigma Xi, Phi Beta Kappa, Tau Beta Pi, Alpha Delta Phi (named Disting. Alumnus of Yr. 1970). Clubs: Bohemian, Commonwealth, Pacific Union, World Trade, Engrs. (San Francisco), The Links (N.Y.C.); Alfalfa, Capitol Hill (Washington). Office: Hewlett-Packard Co 3000 Hanover St Palo Alto CA 94304 •

from Who's Who in America, 45th ed., 1988-89

SHAPIRO, HAROLD TAFLER, economist, university president. b. Montreal, Que., Can., June 8, 1935; s. Maxwell and Mary (Tafler) S.; m. Vivian Bernice Rapoport, May 19, 1957; children: Anne, Marilyn, Janet, Karen. B.Comm., McGill U., Montreal, 1956; Ph.D. in Econs. (Harold Helm fellow, Harold Dodd sr. fellow), Princeton U., 1964. Asst. prof. econs. U. Mich., 1964-67, assoc. prof., 1967-70, prof., 1970-76, chmn. dept. econs., 1974-77, prof. econs. and pub. policy, from 1977, v.p. acad. affairs, 1977-79, pres., 1980-87; research adv. Bank Can., 1965-72; prof. econ. and pub. policy, pres. Princeton U., 1988—; cons. forecasting U.S. Treasury, 1965-68; dir. Unisys Corp., Kellogg Co., Dow Chem., mem. tech. adv. council Ford Motor Co., 1985— Trustee Alfred P. Sloan Found., 1980—, chmn., Spl. Presdl. Com., The Research Libraries Group, 1980—; mem. Gov.'s High Tech. Task Force, Mich., 1980-82; mem. Gov.'s Commn. on Jobs and Econ. Devel. (Mich.), 1983-87; mem. Nat. Acad. Scis. Council of Govt.-Univ.-Industry Research, 1984—; mem. Carnegie Commn. on Coll. Retirement, 1984-86; mem. adv. bd. to bd. dirs. Soc. for Advancement Behavioral Econs., 1984—; mem. adv. panel on technology transfer, intelligence com. CIA, 1984-86; bd. advisors Am. Bd. Internal Medicine, 1985—; mem. exec. com. Assn. Am. Univs., 1985—; chmn. mid-decade rev. com. program in edn. and culture The Ford Found. Recipient Lt. Gov.'s medal in commerce McGill U., 1956. Fellow Mich. Soc. Fellows (sr.). Office: Princeton U. 1 Nassau Hall Princeton NJ 08544

Document Originally
Attached to
Following Page

27 May 89

THE WHITE HOUSE
WASHINGTON

TO: Ian N.

FROM: CHASE UNTERMEYER
Assistant to the President
and Director of Presidential Personnel

Please call BSS to find out about this Council.
I wouldn't be surprised if BSS were the inventor, having put it into a campaign speech.

Chase

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
WASHINGTON, D.C. 20503

MEMORANDUM FOR CHARLES G. UNTERMEYER

FROM: ROBERT GRADY

SUBJECT: Appointments to the New Presidential Council of Science and Technology Advisors

The President has now announced his intention to appoint Dr. D. Allan Bromley as the Director of the Office of Science and Technology Policy. In "Building a Better America", the President also announced his intention to establish a Council of Science and Technology Advisors drawn from distinguished scientists, engineers, and executives.

Before the process to select the members of this Council progresses too far, I want to bring to your attention a concern voiced by Rep. Silvio Conte in a recent letter to the President. Rep. Conte argues that in the past biomedical sciences, and life sciences generally, have been relegated to a secondary status within the White House science advisory apparatus. To a large degree he is correct. The current White House Science Council (of which Dr. Bromley is a member) has only two members (out of 17) whose field is primarily within the life sciences or biomedical disciplines. This is an increase over the one "life sciences" member in the last several years. In addition there have only been a few periods since 1981 where a permanent (i.e., not an agency detailee) senior OSTP staff member has had the life science/biomedical portfolio on a full-time basis.

Rep. Conte suggests that the solution to this is to establish a separate Advisor for Life Sciences. While we cannot support that notion, we believe that his concerns can be largely addressed by more evenly balancing the membership on the new advisory council among physical sciences, engineering, and life science, and perhaps by appointing an OSTP Deputy Director with explicit responsibility for life sciences/biomedical issues. We would, of course, expect that the Science Advisor and his staff would continue to work closely with the relevant agencies and offices within EXOP on life sciences/biomedical issues.

I have attached a copy of Rep. Conte's letter to the President. Please let me know if you would like to discuss this matter further.

Attachment

cc: Richard Darman
Allan Bromley
Jan Naylor

...ATIONS
... MEMBER
...ITTEES
...ALTH AND HUMAN
...VICES—EDU... ...ON
...RANSPORTATION
LEGISLATIVE
EX OFFICIO MEMBER
OF ALL SUBCOMMITTEES

COMMITTEE ON SMALL BUSINESS
SUBCOMMITTEE ON
PROCUREMENT, INNOVATION, AND
MINORITY ENTERPRISE DEVELOPMENT

MIGRATORY BIRD
CONSERVATION COMMISSION

BOARD OF REGENTS
SMITHSONIAN INSTITUTION

Congress of the United States
House of Representatives
Washington, DC 20515

WASHINGTON ADDRESS:
2300 RAYBURN OFFICE BUILDING
WASHINGTON, DC 20515
PHONE: 202-225-5335

DISTRICT OFFICES:
FEDERAL BUILDING
78 CENTER STREET ARTERIAL
PITTSFIELD, MA 01201
PHONE: 413-442-0946

187 HIGH STREET
HOLYOKE, MA 01040
PHONE: 413-532-7010

March 1, 1989

President George Bush
The White House
1600 Pennsylvania Ave.
Washington, D.C. 20500

Dear Mr. President:

I have reviewed your budget proposal for "Building A Better America" and, of the many excellent proposals you have presented, there is one in particular that I would like to single out. That is your proposal to upgrade the President's Science Adviser to Assistant to the President, and to involve him actively in the Economic Policy Council.

While I fully support that initiative, there is an additional step you could take that would correct a longstanding weakness within the Office of Science and Technology Policy, and that is the appointment of a Science Adviser to the President for Life Sciences.

Recent White House Science Advisers have had very little effect on the place of biomedical research in the federal science effort. They have acted instead as advocates for physical science or "hard" science projects like the Strategic Defense Initiative or the superconducting supercollider. The most effective way to correct this situation, I believe, is to create a separate adviser for life sciences.

Too often in the past, the White House has had to go outside this office to find someone qualified to speak out on biomedical issues. Just last year, when the President's AIDS Commission published its recommendations, the White House had to turn, not to its Science Adviser, but to Dr. Donald Macdonald, the Drug Abuse Policy Adviser, in order to find someone with the biomedical expertise necessary to analyze the recommendations and respond with knowledge and credibility.

You have the opportunity now to restructure the science advisory structure and to guarantee that this Administration, and those to follow, has the benefit of a strong representative of biomedical interests.

The relative inattention that is paid to biomedical sciences under the current structure of the Adviser's office even crops up in your budget plan for "Building A Better America" -- it describes your plan to create a President's Council of Science and Technology Advisers, to be composed of leading scientists, engineers and distinguished executives from the private sector. What's missing from this configuration is biomedical science.

The reasons for assuring a spokesperson for life sciences and biomedical research are obvious. Let me list just a few. Many of the most critical needs, and most promising opportunities, are now presenting themselves in the life sciences. In the past fifteen years, we have seen a revolution in this country in the field of biotechnology. However, U.S. preeminence in this field is being increasingly challenged by Japan and several European countries. We can't allow ourselves to fall behind.

Furthermore, rapid advances in biomedical research have brought us to a threshold as important and as promising as the first launch into space -- but this threshold involves a plunge into a single cell, in order to map the human genome and to unlock the key to the genetic disorders that will plague our children and grandchildren. This effort will eventually require a massive commitment of dollars, as well as coordination among various agencies, and a decision as to what rate of growth is appropriate -- all complex decisions which will face you.

In addition, the biomedical research field is facing a critical need for infrastructure improvements -- including new construction, renovation, instrumentation, and diagnostic equipment -- improvements that will be necessary not only to preserve the quality of research being done, but also to equip researchers to handle the changing nature of biomedical research. These needs will have to be addressed if continuing support for biomedical research grants is to be meaningful.

Finally, the effect that AIDS will have on this country, even if a cure is developed tomorrow, adds to the urgency of responsibly addressing the other critical life science issues.

Your guidance in these areas will be essential in the coming years. I call upon you to create, preferably, a White House Science Adviser for Life Sciences, or, as a less preferable alternative, to divide the mandate of the new Science Advisor equally between life sciences and physical sciences, and to include those interests on the Council you have planned to create. By doing so, you could send a strong and reassuring signal to the research community, and to the American people, that the health and well-being of this Nation are recognized as a science issue whose importance is second to none.

With my warmest personal regards, I am

Cordially yours,

Silvio O. Conte
Member of Congress

cc: John Sununu, Chief of Staff to the President
Richard Darman, Director, Office of Management and Budget
Don M. Newman, Acting Secretary, Department of Health and Human Services
Dr. Frank Young, Commissioner, Food and Drug Administration
Dr. James Wyngaarden, Director, National Institutes of Health
Dr. Frederick Goodwin, Administrator, Alcohol, Drug Abuse, and Mental Health Administration

EXECUTIVE OFFICE OF THE PRESIDENT
OFFICE OF MANAGEMENT AND BUDGET
WASHINGTON, D.C. 20503

MEMORANDUM FOR CHARLES G. UNTERMEYER

FROM: ROBERT GRADY

SUBJECT: Appointments to the New Presidential Council of Science and Technology Advisors

The President has now announced his intention to appoint Dr. D. Allan Bromley as the Director of the Office of Science and Technology Policy. In "Building a Better America", the President also announced his intention to establish a Council of Science and Technology Advisors drawn from distinguished scientists, engineers, and executives.

Before the process to select the members of this Council progresses too far, I want to bring to your attention a concern voiced by Rep. Silvio Conte in a recent letter to the President. Rep. Conte argues that in the past biomedical sciences, and life sciences generally, have been relegated to a secondary status within the White House science advisory apparatus. To a large degree he is correct. The current White House Science Council (of which Dr. Bromley is a member) has only two members (out of 17) whose field is primarily within the life sciences or biomedical disciplines. This is an increase over the one "life sciences" member in the last several years. In addition there have only been a few periods since 1981 where a permanent (i.e., not an agency detailee) senior OSTP staff member has had the life science/biomedical portfolio on a full-time basis.

Rep. Conte suggests that the solution to this is to establish a separate Advisor for Life Sciences. While we cannot support that notion, we believe that his concerns can be largely addressed by more evenly balancing the membership on the new advisory council among physical sciences, engineering, and life science, and perhaps by appointing an OSTP Deputy Director with explicit responsibility for life sciences/biomedical issues. We would, of course, expect that the Science Advisor and his staff would continue to work closely with the relevant agencies and offices within EXOP on life sciences/biomedical issues.

I have attached a copy of Rep. Conte's letter to the President. Please let me know if you would like to discuss this matter further.

Attachment

cc: Richard Darman
Allan Bromley
Jan Naylor

Sam

THE WHITE HOUSE
WASHINGTON

Date: June 26, 1989

FOR: CHASE UNTERMEYER

FROM: **GOVERNOR JOHN H. SUNUNU**

☒ **Action**

☐ **Your Comment**

☐ **Let's Talk**

☐ **FYI**

The attached PCAST nominees are fine with me. Please process the invitation as appropriate and keep Dr. Bromley informed.

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NOMINEES FOR MEMBERSHIP

ON THE

PRESIDENT'S COUNCIL

OF

SCIENCE AND TECHNOLOGY ADVISERS
(PCAST)

June 23, 1989

NOMINEES FOR MEMBERSHIP ON THE

PRESIDENT'S COUNCIL OF SCIENCE AND TECHNOLOGY ADVISERS (PCAST)

The following individuals have agreed to serve as members of the President's Council if so requested.

1. NORMAN BORLAUG — Agriculture
Professor, Department of Soils and Crop Sciences
Texas A&M University

Also a Nobel laureate, Borlaug is the father of the Green Revolution. He has done much of his work at the Institute for Maize and Wheat Improvement in Mexico City but is a U.S. citizen. His credentials as an agricultural pioneer, as an environmentalist, and throughout the Third World are impeccable. I have worked with him on the Indo-U.S. Presidential Science and Technology Initiative and found him to be extremely effective.

2. SOLOMON BUCHSBAUM — Industrial Engineer/ Military Science
Executive Vice President
AT&T Bell Laboratories

Sol Buchsbaum, an ex-Canadian, happens to be one of the wisest men I know. He served on PSAC for a number of years, was chairman of WHSC for its entire existence, and is completely at home both in the private sector world and in Washington. He has special expertise in matters of military science and technology, in communication and computer science and in industrial manufacturing.

3. CHARLES DRAKE — Earth Sciences
Professor of Geology and Geophysics
Dartmouth College

Drake is one of the nation's most highly respected earth scientists; he was awarded the National Medal of Science in 1987. Over the years, he has served with distinction on just about every significant committee in the earth sciences -- both nationally and internationally. I have worked with him on National Academy/National Research Council panels and have been much impressed by the breadth of his expertise and his statesmanship.

4. RALPH GOMORY Mathematics/Foundation
Senior Vice President
for Science and Technology, IBM
President, Sloan Foundation

Gomory is a very highly respected professional mathematician who served for many years as IBM's Director of Research -- then Chief Scientist. He has just retired from IBM to become President of the Sloan Foundation. His IBM experience in technology transfer, high-tech manufacturing, international sales, etc., together with his Foundation connections, would make him a powerful addition to the Council. I have worked with him on a number of panels and have been much impressed by his judgment and creativity.

5. BERNADINE HEALY Biomedicine
Director of Research, Cleveland Clinic
President, American Heart Association

A professional cardiologist, Healy held a professorship in the Johns Hopkins University Medical School before joining Jay Keyworth as Deputy Director of OSTP for two years prior to accepting her current post. During the past year she was a member of Bill Graham's White House Science Council. She is broadly experienced in the biomedical area, and I have served with her on a number of panels and committees where I have been much impressed by her wisdom, common sense and professionalism.

I would suggest that Healy be made Vice Chairman of the Council.

6. PETER LIKENS Academic Engineer
President, Lehigh University

An electrical engineer by training, Likens has gained international visibility as President of Lehigh -- a representative of an academic constituency that is frequently neglected but of ever-growing importance: the relatively small, high quality engineering school. He was a very constructive, thoughtful member of the Packard-Bromley WHSC Panel on the Health of U.S. Colleges and Universities and would be a very effective Council member.

7. THOMAS LOVEJOY Environmentalist
Assistant Secretary for External Affairs
Smithsonian Institution

Lovejoy was a student of Evelyn Hutchinson at Yale and was one of the earliest ecologists. Formerly Vice President for Research at the World Wildlife Fund, he has gained an international reputation for his work in international environmental and ecological science. He has played an important role in current efforts to retain substantial sections of the Brazilian tropical rain forests. I have served with him on the President's U.S./Brazil Blue Ribbon Panel and, during the past year, on Bill Graham's WHSC. He brings a deep knowledge of environmental science as well as experience in international activities and sound judgment to any panel.

8. WALTER MASSEY Physicist/National Laboratory
Vice President for Research
University of Chicago

One of the most distinguished black scientists, Massey is a solid state physicist/chemist. From Dean of the Graduate School at Brown University, he became Director of the Argonne National Laboratory and then took up his present post where he remains responsible for the management of Argonne. He served for six years as a member of the National Science Board and is currently President of AAAS. I have worked with him in many capacities and believe that he would be a very effective, thoughtful member of the Council.

9. JOHN McTAGUE Chemistry
Vice President and Director of Research
Ford Motor Company

A chemist by profession, McTague was Director of the National Synchrotron Light Source at Brookhaven before joining Jay Keyworth's OSTP as Assistant Director for Physical Sciences. On Jay's retirement, McTague served for almost a year as Acting Director of OSTP before going on to Ford. He has been extremely successful in increasing Ford's interest in, and support for, research. His industrial, Brookhaven and Washington experience would make him a very effective Council member.

10. DANIEL NATHANS Microbiology
Boury Professor of Microbiology
Johns Hopkins University

A Nobel laureate for his work in microbiology, Nathans is one of the true pioneers in the field of recombinant DNA and its offspring, biotechnology. He has devoted much of his research to the understanding of tumor viruses and their role in the induction of cancer. He has an outstanding reputation throughout his field both for research and for statesmanship.

11. DAVID PACKARD Industrial Engineer
Chairman of the Board of the
Hewlett-Packard Company and of the
David and Lucile Packard Foundation

As one of the **fathers** of Silicon Valley, with an enviable track record both in industry and government (Defense Department), and as a member or chairman of a great number of influential panels and commissions, Packard brings a unique background to any deliberation. He was a very effective member of the White House Science Council during the Reagan Administration, in addition to his many individual activities for President Reagan, e.g., his study of contracting in the Defense Department.

12. HAROLD SHAPIRO Academic/Social Science
President, Princeton University Economist

An economist by profession, Shapiro was formerly President of the University of Michigan. He has participated actively in science and technology related studies for NAS and AAAS and is one of the very few social scientists known to me who finds it easy to work effectively with scientists and engineers. I believe that it will be important symbolically for us to have a social scientist of impeccable repute on the Council. The absence of such a person damaged the credibility of the WHSC and the later PSACs.

June 19, 1989

DRAFT

Dear X:

It is with the greatest pleasure that I write to invite you to serve on my Council of Science and Technology Advisors. It is my intention that this Council, drawn from among the Nation's most distinguished scientists, engineers and executives from the private sector and chaired by Dr. D. Allan Bromley, my Assistant for Science and Technology, will be the senior federal advisory body in these increasingly vital areas.

I shall look to you and to your fellow Council members not only for expert evaluations and recommendations concerning the growing range of science and technology related issues that reach my Office, but also for early warning of problems of national consequence not yet over the horizon but for which it will be important for me and my Administration to become aware and, where appropriate, take preparatory action.

I look forward to meeting with the Council to share in its deliberations as often as my schedule permits and to becoming acquainted with all of its members.

Dr. Bromley will provide you with additional details concerning the Council and its operations if, as I hope will be the case, you find it possible to accept my invitation.

I look forward to welcoming you to membership in my Council and to the White House.

Sincerely yours,

George Bush

ROBERT A. ROE, New Jersey, CHAIRMAN

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JAMES H. SCHEUER, New York
MARILYN LLOYD, Tennessee
DOUG WALGREN, Pennsylvania
DAN GLICKMAN, Kansas
HAROLD L. VOLKMER, Missouri
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DAVID R. NAGLE, Iowa
JIMMY HAYES, Louisiana
DAVID E. SKAGGS, Colorado
JERRY F. COSTELLO, Illinois
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JOHN TANNER, Tennessee
GLEN BROWDER, Alabama

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Republican Chief of Staff

March 12, 1990

Dr. David W. McCall, Chairman
National Commission on Superconductivity
The Executive Office of the President
Washington, DC 20506

Dear Dr. McCall:

Thank you for appearing before the Subcommittee recently. Please review the enclosed copy of your testimony for transcription accuracy. If there are any typographical or transcription errors, please make the appropriate corrections and return a copy of the transcript to the Subcommittee.

Our Committee rules specifically require that the printed hearing record be a strictly verbatim transcription of those proceedings, that is, only what was actually said may be printed. This means that we may not accept any changes to the transcript for clarity of meaning, such as the insertion or deletion of a word or phrase. The text of the applicable committee rule is attached.

If you feel that additional comments or clarification are necessary, our rules allow these to be footnoted in the text at the appropriate place. A short clarification may be footnoted at the bottom of the page, and a longer clarification may be appended to the end of the hearing record, but they may not be incorporated into the body of the transcript.

If the Committee has not received a correct transcript (or any additional comments submitted in the footnote form) within 15 working days, the transcript will be published in its current form.

Return transcripts to: Mrs. Virginia Lindsey, Subcommittee on Transportation, Aviation and Materials, Committee on Science, Space, and Technology, 2321 Rayburn House Office Building, Washington, DC 20515.

Sincerely,

TIM VALENTINE, Chairman
Subcommittee on Transportation,
Aviation and Materials

TV:ss
Enclosure

Congress of the United States
House of Representatives

COMMITTEE ON
SCIENCE, SPACE, AND TECHNOLOGY
SUITE 2321, RAYBURN HOUSE OFFICE BUILDING
WASHINGTON, DC 20515
(202) 225–6371

Dr. David McCall

Referred to your testimony begins on page 37.

Testimony given by you before the Committee appears in the attached typewritten transcript. Committee rules require the publication of a verbatim transcript. Please attach all requested information, preferably in typewritten form, to the proper page or pages, within five working days, and return immediately so that this information may appear in the final printed volume.

* Rule 23 of the Committee Rules Governing Procedure states:

"The transcripts of those hearings conducted by the Committee which are decided to be printed will be published in verbatim form, with the material requested for the record inserted at that place requested, or at the end of the record, as appropriate.

"Any requests by those Members, staff or witnesses to correct any errors, other than errors in transcription, or disputed errors in transcription, will be appended to the record, and the appropriate place where the change is requested will be footnoted. (Emphasis added.)

"Prior to approval by the Chairman of hearings conducted jointly with another Congressional committee, a memorandum of understanding will be prepared which incorporates an agreement for the publication of the verbatim transcript."

If any other change is deemed necessary, a written appeal must be made to the Chairman.

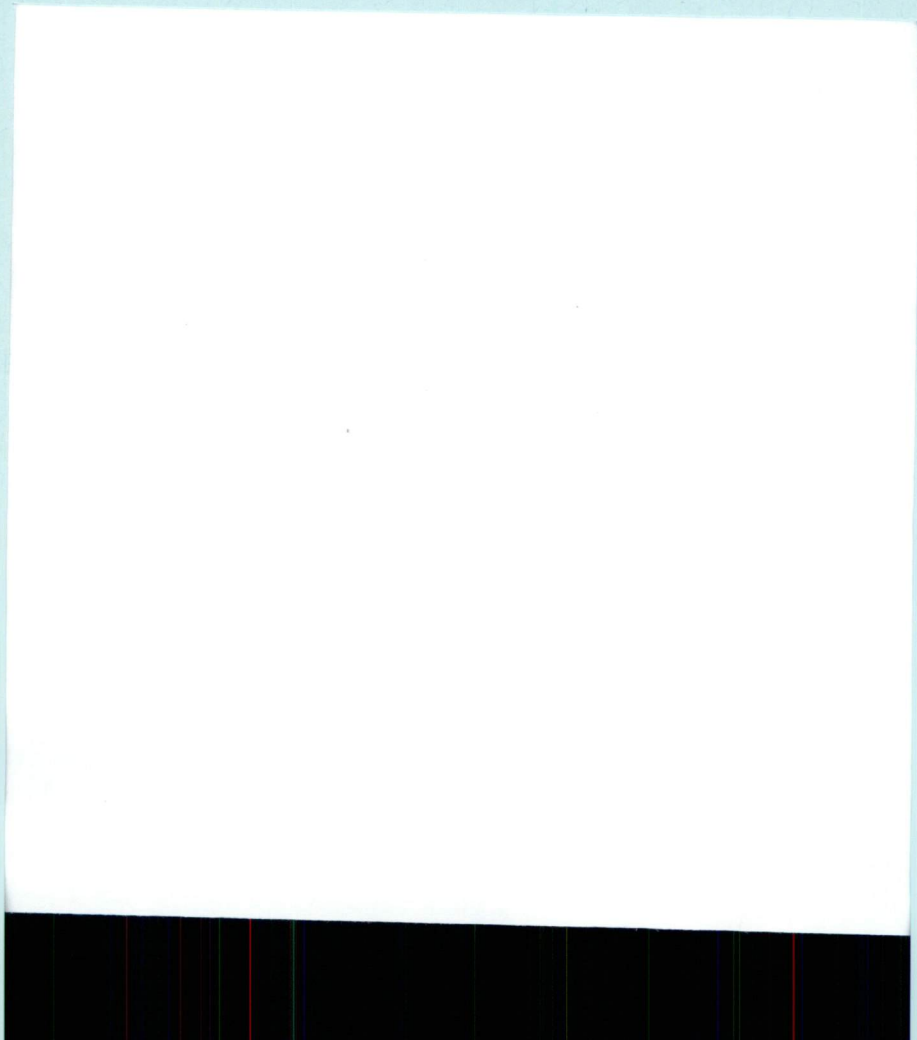
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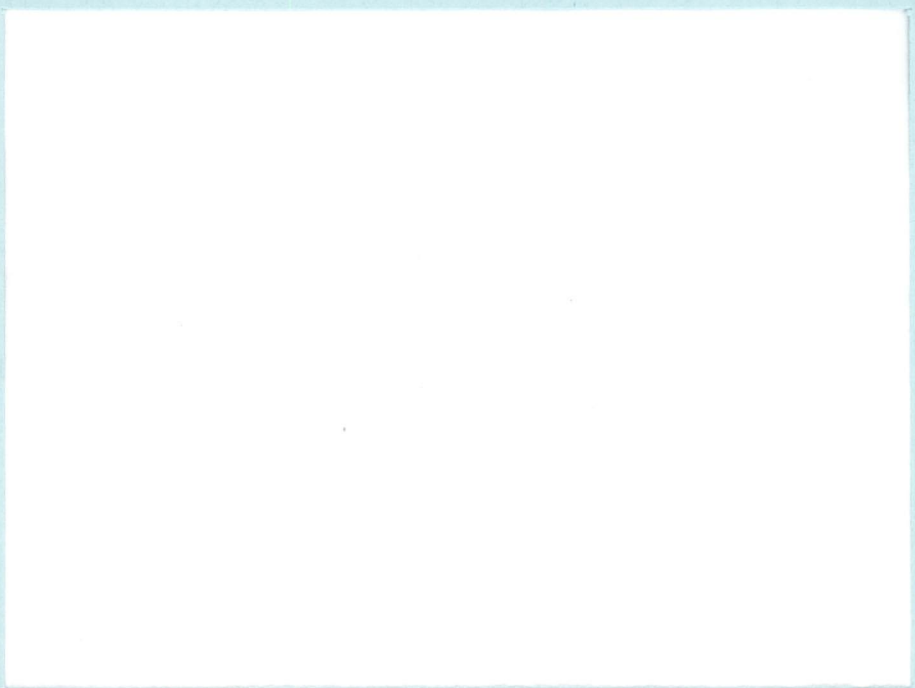
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HEARING ON SUPERCONDUCTIVITY

WEDNESDAY, FEBRUARY 21, 1990

U.S. House of Representatives

Subcommittee on Transportation,

Aviation and Materials

Committee on Science, Space and Technology

Washington, D.C.

The subcommittee met, pursuant to recess. at 11:38 a.m. in room 2321, Rayburn House Office Building, Hon. Tim Valentine [chairman of the subcommittee] presiding.

Mr. VALENTINE. The subcommittee will be in order.

This morning is a continuation of the hearing we began last October in which we examined our Nation's efforts in pursuing the application of new high energy superconductors. In that hearing we heard from a number of outside witnesses and experts with views on the subject.

As was noted then, these new superconductors present us with an opportunity and a challenge to develop whole new technologies in such diverse areas as transportation, electronics, medicine, and energy. A number of countries, most notably Japan and France, have undertaken national programs to accelerate the understanding and applications of these new materials. They obviously understand the economic as well as the technological consequences of moving ahead in this area, even if the national efforts must be continued over a period of five, ten, or more years.

It was with this understanding of the need for a long-term national commitment that Congress late in 1988 passed Public Law 100-927, the National Superconductivity and Competitiveness Act. This Act called for establishing a national action plan for advanced superconductivity research and development, to include goals and priorities as well as funding recommendations for a period of five years. The director of the White House Office of Science and Technology Policy was given the responsibility for establishing the

plan. The action plan was completed in its final form last December.

It's our hope to discuss here this morning the details of that plan as well as the President's budget request that will impact directly on implementation of the plan.

Let me say at the outset that I see this as an ongoing process. The plan we have before us is a good first step that some believe that more needs to be done with, particularly in clarifying its goals and priorities and in establishing appropriate funding over the full five years of the plan.

We are very pleased to have here today the President's science advisor, a very distinguished American doctor, Allan Bromley, who will testify on the National Superconductivity Action Plan and we are looking forward to an informative discussion with him on this subject and hopefully these hearings will prove useful in giving us further insight into how we can proceed to ensure our Nation's continuing competitiveness in superconductivity.

To that end, we also have with us this morning another distinguished scientist, Dr. David McCall, chairman of the National Commission on Superconductivity which has been charged with providing advice to the President and the Congress as to how we can best proceed in this important area.

We are looking forward to hearing his thoughts and views on this topic also. Let me issue a word of special and personal welcome to both of you gentlemen, and Dr. Bromley, to thank you again for your visit to North Carolina and the events there about a month ago.

We have strong competition today. This hearing was scheduled for 9:30 this morning. This hall was in use by the Chairman at a meeting of the full committee. So, we were moved to this time and we have the leader of Czechoslovakia who is addressing a joint session of the House and we hope to have more Members here before you complete your testimony.

Welcome. I recognize our distinguished colleague and the senior Republican on this subcommittee, Mr. Tom Lewis from Florida.

[The prepared statement of Mr. Valentine follows:]

********** INSERT **********

Mr. LEWIS. Thank you, Mr. Chairman.

The National Action Plan on Superconductivity Research and Development, the subject of today's hearing, proposes an ambitious program that will place the U.S. and world leadership in the superconductor race. Expert witnesses at the October 31st, 1989 superconductivity hearing agreed that although the U.S. made great progress in high temperature superconductivity research, Japan is far ahead of us. Nevertheless, there is no reason why we cannot only effectively compete with other countries but surpass them.

One recurring theme in the testimony given on October 31 is Japan's long-term commitment to superconductivity research. The August 1989 issue of Physics Today concludes, Japan's agency for industrial science and technology has made a commitment of $800 million to six Japanese companies for a 10- year project on superconducting electronics. By comparison, the efforts mounted by the three U.S. consortia and the small startup of firms looks somewhat paltry.

Carl Rosener of Intermagnetics General Corporation testified in October that the U.S. was already well behind Japanese industry in the development of superconductivity applications. We need to keep America first. We need to provide consistency of funding, something Drs. Paul Chu of the University of Houston and Elton Kaufman of Argonne

National Labs discussed in depth during their October testimony.

Unfortunately, typical Federal funding is firm for only a year at a time. One area not addressed by the plan is education. Some educators have expressed a fear that there may be a shortage of superconductivity specialists. Where will the next generation of superconductivity scholars or specialists come from? U.S. students need to be encouraged to continue in graduate school.

There are grand possibilities of future technologies using superconductivity. The National Action Plan on Superconductivity Research and Development is a step in the right direction. If we act quickly and commit ourselves for the long term, I have every confidence that America can and will again be in a preeminent position in a world of superconductivity. I want to welcome Dr. Bromley and I look forward to hearing his testimony on superconductivity and certainly, our associations from the past with your testimony have certainly been enlightening.

Welcome, Dr. Bromley.

Mr. VALENTINE. Thank you, sir. As stated, our first witness is Dr. D. Allan Bromley, director of the Office of Science and Technology Policy, the Executive Office of the President. Your statement will appear in the record as presented to us and feel free to summarize or otherwise

proceed as you deem appropriate. Thank you, sir.

STATEMENT OF MR. D. ALLAN BROMLEY, DIRECTOR, OFFICE OF SCIENCE AND TECHNOLOGY POLICY, EXECUTIVE OFFICE OF THE PRESIDENT, WASHINGTON, D.C.

Mr. BROMLEY. Thank you, Mr. Chairman.

I welcome this opportunity to come before the committee to discuss with you the National Action Plan on Superconductivity Research and Development and I will only highlight the formal testimony that I would ask be included in the record.

The Plan which as you stated was publicly released in December of 1989, was prepared with the help of staffs of the National Critical Materials Council and the OSTP Committee on Materials, COMAT, as well as with input from a large number of other experts in the field. It is based on the precept that the United States must maintain its position at the forefront of superconductivity R&D and be ready to translate the scientific knowledge that we obtain into viable applications.

The Plan was a formal response to a legislative requirement. Its preparation also reflects the tremendous promise that we agree with you resides in superconductivity. There are already important commercial applications and with certain breakthroughs that I feel reasonably confident will occur in the not too distant future, it can become an enabling technology leading to a wide range of new and

attractive products.

In general, I would say that superconductivity is one of a number of critical technologies in which the United State has a very vital stake in remaining at the cutting edge of research and development, and sir, of application. Before I discuss the Action Plan in detail, let me make a few general comments if I might about the whole question of superconductivity.

As you know, gentlemen, it was discovered back in 1911, the same year that the nucleus was discovered, by a Dutch physicist, Kammerlingh Onnes, and the discovery at the time was something of a curiosity. He found that the resistance of a rod of frozen mercury dropped to zero when cooled to below 4.2 degrees absolute, 4.2 degrees Kelvin.

Over the next 75 years, as research group after research group worked on this topic trying to get this temperature where resistance disappeared higher and higher, we finally by 1985 had gotten that transition temperature up to 23 degrees absolute and since it's a well established rule in the application of superconductivity that you can't effectively operate the superconductivity at more than three quarters of that transition temperature, that really required that you needed to cool the superconductors effectively with liquid helium if you were going to have a reliable system. This posed one of the major requirements

on all applications of low temperature superconductivity.

Despite those difficulties, however, Mr. Chairman, it's important to recognize that American companies have led the way in applying low temperature superconductivity in very important applications. Nuclear magnetic resonance imaging, for example, is a noninvasive new medical technology that is having revolutionary impact on medical diagnosis and treatment. Low temperature superconductors have also played essential roles in particle accelerator design and in the development of new and very sensitive electronic instrumentation. As of 1987 which is the last year for which I have the detailed numbers, worldwide sales of superconducting devices amounted to $400 million. Of this amount, nuclear magnetic resonance imaging devices and electronic instrumentation each accounted for roughly $150 million.

Here in the U.S., as all of you are very much aware, the superconducting super collider is of course going to be one of the large scale users of low temperature superconducting magnets. This is a facility that has a circumference at the moment of 54 miles, will require more than 10,000 superconducting magnets containing over 2,000 tons of actual superconductors costing something like $320 million.

Now, commercial development of low temperature superconductivity, I think we would have to agree has

developed rather slowly and future commercialization, I suspect, will not be terribly rapid either in terms of low temperature superconductivity although I think that we will continue to see commercialization grow at a steady by relatively modest pace.

The first place where I feel that we will see large scale application of this superconductivity is in the development of the new generation or perhaps the next few generations of major computers. As we pack more and more information handling devices into smaller and smaller volumes, the problem of removing heat from that entity becomes ever more important and under those circumstances, superconductivity becomes a unique component of the new designs.

I think also that we have done substantial research and development in this country already on underground electrical transmission cables, superconducting cables, energy storage systems, ship propulsion systems, and magnetically levitated transport. To take just one of those examples, the magnetically levitated transport as I think all of you gentlemen know what is involved here, is using magnetic fields in the guideway and in the vehicle train essentially so there is no material contact between the train and the- K B L - ¢ J C - ¢ B DK ¢

Now, we at the moment, internationally, focus on the use

of low temperature superconductors or conventional conductors in the designs that are most highly developed. These permit clearances between the vehicle and the roadway of about three- eighths of an inch. Were we to change to superconductors, that clearance would change to something like six inches and would make for substantial savings in the requirements on the roadbed. It could be much rougher. It could be much less carefully and expensively designed and constructed.

Now, in this area in the fiscal 1991 budget, the President has requested a 400 percent increase in funding. It comes through the Corps of Engineers, through the Department of Energy, through the Department of Transportation and we are still however well behind our foreign competitors. Those foreign competitors are both Japan and Germany.

The exciting development, Mr. Chairman, perhaps one of the most exciting developments in modern physics, took place in December, 1986 when it was first announced that a group working at IBM's laboratory in Zurich had found a ceramic material that became superconducting at a temperature about 30 degrees absolute. Indeed, within the next two days, high schools across the country were fabricating superconducting ceramics and this became one of the largest cottage industries going for a short period. It rapidly became clear that to understand what was going on, one required the

sophistication and the instrumentation of the major national laboratories. It's a good indication of the power of those laboratories in conditions of this kind and in some of the major industrial laboratories.

Within two years however, steady progress had raised the temperature at which superconductivity occurred to temperatures above 100 degrees. This was a remarkable surprise and the importance is difficult to overestimate because these materials can be cooled with liquid nitrogen rather than liquid helium and in this country, liquid nitrogen costs roughly 22 cents a gallon, whereas liquid helium costs something on the order of $6 a gallon and it's better to think of that as the difference between the cost of cheap beer and premium scotch. That gives you a slightly better feeling for the enthusiasm for these high temperature materials.

Now, if we had just extrapolated where we might expect to find these new materials above 100 degrees absolute from the progress that had been made since 1911, we would have expected to achieve them somewhere around the year 2190. That's some measure of the excitement that occurred back in 1986.

We've made a lot of progress, Mr. Chairman, but there are some very outstanding problems. I don't want to go into detail on them. Let me simply mention two of them. One is

that these materials tend not to carry the high currents without destructing their superconducting characteristics at a much lower critical current than does the low temperature superconductivity materials with which we have become familiar. The second thing is that it is much more difficult to fabricate attractive and useful shapes out of a brittle ceramic than it is out of a metallic compound like niobium tin or niobium germanium.

Now, we are making progress even here, however. During this past year, for example, an AT&T Bell Laboratory research group reported gains 100-fold in the electrical current densities that they were able to obtain by treating their samples appropriately with neutrons. This is the sort of breakthrough that I expect will continue and it is in fact not at all unreasonable for us to visualize that the limiting characteristics currently standing in the way of much broader application of high temperature superconductors, I believe, will be removed in the next few to five years.

What we must do is begin focusing much more strongly than we have to date on preparing to apply those techniques. In my formal testimony, Mr. Chairman, I have given some specific details that we have learned from recent trips to Japan on the techniques that they have used and they are counting on us to make many of these basic research

developments although they too are working in the area. Where they are really way ahead of us is in preparing to apply the discoveries once they are made. They have targeted this field as a technology of major importance to the nation and are taking the appropriate steps which we can discuss later on.

Turning now to the plan that we bring to you, it was prepared in response to the National Superconductivity and Competitiveness Act of 1988 and that legislation calls for us to produce updated annual reports to you on this subject. The basic strategic approach in the plan that we made available to you in December is that based on the understanding at the moment, the situation is not sufficiently well defined for us to narrow our focus. We feel that it is much wiser for us to maintain a broad based interagency Federal R&D program that takes a lot of approaches into consideration, that follows up on a lot of alternatives.

As we move forward over the next few years, I believe that we will be able on the basis of new knowledge, to focus our attention much more narrowly and to put a much larger fraction of our resources into application development rather than into the fundamental research.

I believe that in the long term, this focus now on improving our fundamental knowledge and moving

systematically as we improve that knowledge toward application, is the appropriate one. The fact that we will be providing to you, Mr. Chairman, annual reports, gives us the opportunity to keep you and us up to date with the development of our knowledge base and with the shift that I have just mentioned in our research program from fundamental toward more applied.

The budget cross cut that was submitted for superconductivity is part of the President's fiscal year 1991 budget request to the Congress is the basis for the table that is included in my formal testimony. We have further divided that table into two categories: high temperature and low temperature superconductivity. In terms of high temperature superconductivity, we propose to increase U.S. Federal funding for R&D by 10 percent in going from 1990 to 1991.

In terms of low temperature superconductivity funding, there is what might appear on the surface to be an anomaly in the President's budget in that taking simply the numbers at face value, it appears as though there is a 19 percent reduction in funding for low temperature superconductivity research and development. That however, Mr. Chairman, is an anomaly because it reflects the fact that we have moved some 18 million that has been devoted to the development of the superconducting magnets for the superconducting super

collider from the research and development category into the preconstruction category at SSC. So in fact, we have held the support for low temperature superconductivity research constant in this new budget.

Now, with respect to the out year funding estimates that have been discussed previously with you and with the staff of this subcommittee, I have to point out that routinely, out year funding estimates are not included in the Administration's budget request for any of the technology cross cuts including superconductivity. Our intention here is to provide a stable multi-year base program that will allow us to continue rapid progress in fundamental research and we will I anticipate in our annual reports to you from here on in, Mr Chairman, give you the out year budget tables that we have discussed in the past. We do not have one for you at the moment but we will have them for you in all of our subsequent annual reports.

Now, one of the key things that I want also to mention briefly to you is the importance I attach to the three-way partnership that we discuss all too often and don't all too frequently make function. That's the three-way partnership between the private sector industries, academia, and the Federal Government. The plan that we have brought to you recommends the formation of industry-university-government laboratory consortia focusing on superconductivity. This

was a recommendation also made by the Committee to Advise the President on Superconductivity that was chaired by Dr. Ralph Gomory and in addition, both the National Critical Materials Council and the new President's Council of Advisors in Science and Technology, PCAST, that I have the honor of chairing, will provide vehicles in these next months to provide more private sector and academic input into the policy and decision making within government in these and other high technology areas.

OSTP activities in superconductivity, I would like to emphasize, Mr. Chairman, fall within and will be an integral part of a broader examination than I hope to provide for the whole question of material science. I have long felt that material science is one of the very much neglected areas in our science and technology and one that has an enormous payback potential for U.S. industry and for our economic competitiveness. If I can give you just a single example, Mr. Chairman, on the other end of the temperature spectrum, Oak Ridge recently estimated that almost all industrial processes in this country are ultimately limited by the behavior of material, particularly at high temperatures and if we could raise the temperature of the average industrial process in this country by a single degree Fahrenheit, we would gain $2 billion a year and we would continue to gain $2 billion for each degree Fahrenheit for quite an extended

range.

So this is a real challenge for all of us working in material science. I believe we have a responsibility to coordinate and integrate what is being supported by the Federal Government so that we get the maximum positive benefit from the funding that you are able to make available to us. Superconductivity is clearly a part of this broader view of material science. There are some excellent examples already of cooperation in the private sector. There are the superconductivity pilot centers in Department of Energy laboratories at Los Alamos and Argonne and a particularly successful cooperative program involving industry, academia and a National laboratory is the High Temperature Materials Laboratory at the Oak Ridge National Laboratory. All of these projects provide for cost sharing, for collaborative R&D agreements, joint publication and broad industry participation.

Let me then simply note that in the President's 1991 budget, the funding for these pilot centers has increased from $6 million in 1989 and 1990 to $15 million. It's a major increase recognizing the importance we attach to the activities in these centers.

Let me then conclude that superconductivity both high and low temperature, remains an area with very exciting potential and an open-ended future. We have a very good

position at the moment in terms of our research capabilities, in terms of the rate of discoveries of a fundamental nature. Where we have difficulties is in preparing for the utilization of these materials as they become available. Let me finally say that the real challenge here, Mr. Chairman, is a step beyond anything we have discussed so far.

There are two discoveries that could have truly dramatic impact in this field. The first would be the discovery of room temperature superconductors. That's the Holy Grail that's on the horizon in all of this work, room temperature superconductors that have the most dramatic impact in all areas of industry and national security. Another area that would have almost the same impact would be organic superconductors, relatively cheap, easily fabricated, presumably reasonably high temperature organic superconductors and their applications in wide varieties of fields are just limited by our imagination.

So let me conclude there, Mr. Chairman, and be prepared to address your questions.

[The prepared statement of Mr. Bromley follows:]

********** INSERT **********

Mr. VALENTINE. Thank you very much, Dr. Bromley. We have just a few questions which I hope will help to emphasize some things which you already said and get clarification on some others.

With respect to the National Commission on Superconductivity, what role do you see for that Commission in the Plan and in the future?

Mr. BROMLEY. I see a major role, Mr. Chairman, for that group. As we go forward and produce the annual reports to you and perhaps even more importantly, as we go forward as I very much hope to do in this coming year, in pulling together an integrated, cross-agency research plan in material science and particularly in superconductivity, we will draw very heavily on the expertise represented in NCOS in all that we do in this area of superconductivity. That will be a major resource for all of our activities.

Mr. VALENTINE. The same question, Doctor, with respect to NCMC, the National Critical Materials Council?

Mr. BROMLEY. I'm happy to be able to report to you, Mr. Chairman, after a long period which predated my presence here, that a few days ago, the President did indeed sign the appropriate documents and that committee has been placed in operation. I have the honor of chairing that committee and am joined in it by Henson More, the Deputy Secretary of

Energy and by T.S. Aries, who is the Director of the Bureau of Mines in the Department of the Interior. We look forward very much to making that an active part of the overall Federal program that I've mentioned that we're trying to develop in materials science.

So I am happy to be able to tell you this morning, sir, that that is now functioning.

Mr. VALENTINE. I know you understand and appreciate the special interests of this committee. That's part of our name and a major portion of the mission of this subcommittee.

A follow up on that, do you plan to make changes such as increasing staff in other areas to emphasize or make more effective the contribution of the council?

Mr. BROMLEY. Yes, I do, Mr. Chairman. I have with me here this morning, Dr. Robert Post, the Executive Director of the National Council of Critical Materials and I look forward to expanding that staff significantly during this coming year. I should also tell you, sir, that I very much look forward to using not only a revitalized FCCSET, Federal Coordinating Council for Science, Engineering, and Technology--that's an intergovernmental body that we are in the process of reinvigorating right now--and in parallel, the President's Council of Advisors in Science and Technology, which was established in fact while the President was visiting your

good State a few weeks ago.

We have had the first formal meeting of that group, PCAST group, with the President at Camp David, in fact, on Saturday, February 3rd and it is my intention, Mr. Chairman, to use the PCAST structure to rectify one of the failings that I have long sensed in the FCCSET mechanism, namely that there was no provision in it for bringing private sector input into the discussions and deliberations and our private sector here has much to contribute.

Mr. VALENTINE. How will PCAST interact with the Commission and/or NCMC?

Mr. BROMLEY. Well, I'm in a somewhat peculiar position, Mr. Chairman, that I will chair the Federal Coordinating Council which has the COMAT committee as one of its committees. I also am chairman of the NCMC and I also chair PCAST. So it really is my responsibility and I have no one to blame if we do not actually bring all three of those together in effective coordination and cooperation.

Mr. VALENTINE. Would it be possible, Doctor-- incidentally, this subcommittee will be holding a hearing later on this year on NCMC--would it be possible to identify a technology driver, so to say, such as magnetic levitation, so as to help focus research with clear cut, identifiable goals and objectives and if you think that's a fairly accurate statement, would you give us what you think to be the

advantages and disadvantages of such a proposition?

Mr. BROMLEY. Let me if I may, Mr. Chairman, back off just a little bit to give you some additional information on activities already underway that relate to your question.

At the request of the Senate Armed Services Appropriations Committee, we are undertaking a major examination in my office during this next year of the critical technologies list prepared separately by the Department of Commerce and by the Department of Defense. We have been charged with pulling those together, with selecting a final list of 20 that drawn from the two larger lists from the civilian sector and the national security sector, and we will be devoting very substantial effort to that critical technology activity.

In terms of critical materials, we again have highlighted that as a major part of our overall study of materials. In terms of specifically setting targets for superconductivity, we have not done that yet because we have felt that unlike the Japanese who have specifically targeted large-scale power generation equipment and magnetic levitation as the long-range goals that may be 10 and even 20 years into the future, we have preferred at this point to hold off, to focus on the more fundamental research and understanding, feeling that it was a little premature to fix a particular long-range technical application because those can change so

rapidly in the light of the discoveries that we confidently expect in the next year or so.

I will say, sir, that my own feeling and that of my colleagues is that the first major commercial application of consequence here is going to be in the computer field and in particular as we move to much more powerful computers and those where the simple question of heating becomes a very serious problem. We do have in mind an overall approach to the whole question of materials and we treat superconductivity as a part of that.

We are also very much taken, I may say, Mr. Chairman, by the report that the National Research Council has just recently issued on material science. I feel that again it is an outstanding report that emphasizes the orphan nature of material science in American universities and in a lot of our laboratories. It doesn't fit neatly into any of the standard sciences and it doesn't fit neatly into the usual departmental structure. So it has tended to be neglected to some degree. We would like to correct that.

We also note that that NRC report identifies a very major gap in American research and development as compared to the rest of the world. The report indicates that we do very well in all areas except synthesis and fabrication and in those two areas, we are simply far behind our competitors. Let me give you a very specific example. We still lead the

world in terms of developing new materials, new ceramics, new compasses, new materials of all kinds. We also still lead the world in being able to characterize any material. If you give us a piece of material, we will tell you its characteristics, its strength, its behavior, all of those things, but unfortunately, in an increasing number of examples, the sample that we characterize of a material that we develop in the United States, has to be fabricated in Japan because they have supertechnicians who have become world experts in that field.

We can't afford to have ourselves so dependent in areas of that kind and it emphasizes something, Mr. Chairman, that the two of us have discussed, namely, the importance of training very high quality technicians, supertechnicians, that powerfully important intermediate group between a literate public and the professional research scientists.

Mr. VALENTINE. Absolutely. When you got into that, you kind of anticipated what is to be at least at this time my maybe last question or next to last question. What you have said seems, Doctor, to translate in the minds of many people to something like this. Maybe it results from a lack of scientific sophistication, scientific background or knowledge, but it translates, I think, in the minds of indeed many Members of Congress to a situation where the business segment of the economy is saying to the government,

we need more money to develop better things and then after they're developing the same business people come back in and we need more money to help us sell them.

I know there's a problem about education and God knows I know that. We need to be able to have people who are not only literate in that they can read the phone book and maybe have been introduced to Gulliver's Travels but can also have a literate in the sense that you're talking about.

Isn't this a question of merchandising and the aggressiveness of business? Isn't there a large job in here for somebody else besides the government?

Mr. BROMLEY. I agree with you, sir. There are several points there. I think there is a very real role for our private sector to be more aggressive in many of these areas but I also believe there is a role for the Federal Government, for the Administration and the Congress working together. There are a great many technologies and superconductivity I would take to be an example of those that I would call generic or enabling technologies.

They can affect a great many areas of our economic competitiveness and our national security but for any given company, for any given industry, the amount of benefit that they can capture personally may not be large enough to justify for them the kind of expenditure that's needed to do the development we need and our foreign competitors are

aided and abetted by their governments in coming together and in that period from the basic discovery through to the development of the technology where someone can use it in an actual production sense, government is involved in a catalytic sort of way, bringing people together so that the individual players don't have to reinvent the wheel in each case.

We can't remain competitive in an international marketplace if our competitors are being brought together to share the risk, to share the cost, to speed up the process of developing these technologies that underlie the products and service that they will end up selling back to us.

I think we have to level the playing field in that we have a role in putting together the kind of consortia, the kind of groups, the kind of cooperation that help us to avoid having each of our companies do parallel development, taking the time and the cost and the risk that's involved. We can't be competitive if we do it that way.

We also have a major challenge, Mr. Chairman, to use the unique results and resources that we have in our national labs and in government facilities more effectively as transferred to the private sector. That's a real challenge.

Mr. VALENTINE. Thank you.

Tom.

Mr. LEWIS. Thank you, Mr. Chairman.

I'd like to pursue that with you, Dr. Bromley. In your report, you point out that, for example, in using the Japanese, that they have committed both resources and private sector as well as government and government's very much involved in it but the private sector more so, particularly in superconductivity. Then apparently you go on, after they-- whatever it might be that they get together in, then they go out and compete against each other in the market which is great and you've alluded to this in your recent comment.

How do you foresee the United States Government becoming involved in the private sector in such things as superconductivity and we use that because that's the hearing emphasis, when the United States Government is such a lousy partner? We get the private sector to commit and I think the National Aerospace Plan is such an excellent example where the private sector has provided $2 for every $1 of the government and then the government wants to dump the program on them.

How can we move ahead in these areas, clear up the debris that we've left behind and get into a cooperative consortium?

Mr. BROMLEY. It's an excellent question you ask, sir. One of the reasons why we have the new President's Council of Science and Technology Advisors reporting directly to the

President--that's the first time that's happened for more than 15 years--is specifically because we think it's very important to have representatives, senior respected representatives of the private sector speaking directly to the President and he is committed that he will meet with this group on a monthly basis to try to avoid the sort of thing that you've alluded to.

We do have to form a more effective partnership than we have at the moment and I think basic to that is first of all, the development of better communication to the highest level of the Administration and the Congress. I think also we need to develop a greater level of trust than we have at the moment. One of the things that stands in the way of the kind of cooperation to which we have both alluded just recently is not that the anti-trust regulations now on the books prohibit that kind of cooperation but it is simply that many companies in this country do not yet feel comfortable with the kind of cooperation that only a few years ago would have gotten them into substantial legal difficulty.

So we have to develop, I think, a sense of trust among the private sector and government so that we will feel comfortable as partners working in this kind of relationship.

Mr. LEWIS. Well, that's very good. I think that the

commission of private sector input to the President certainly would be helpful. Now, how do we get that into the Congress? We get sort of parochial in the Congress and we look to our own front yards rather than the vast need of a particular development. Then we have the differences in the political body of course, between the Administration and the Congress.

Is there a way that you see that the Office of Science and Technology Policy, other than through you, or, maybe only through you, get the Congress to see the big picture and just where we have to make the investments of both policy and funds in order to work with the private sector in an area such as this?

Mr. BROMLEY. Well, let me say first, sir, that I have the highest regard for the Office of Technology Assessment which is an organization that can through its structures provide you with excellent advice--has been providing you with excellent advice and reports and information over the years.

For my own case, I have considered it one of my highest priorities since taking office to rebuild bridges between my office and the Congress and to that end, I have been meeting with various staff groups and I am planning in the not too distant future to begin informal meetings with selected groups of Members of the House and of the Senate to just discuss issues of mutual interest at that given moment.

So I am actively working to try to rebuild these bridges between OSTP and the Congress because my office is one that you created back in 1976 and I wear the two hats as director of that office and therefore reporting to you and as assistant to the President for science and technology and therefore reporting to the President.

So let me only volunteer that my staff and I look forward to the possibility of working much more closely with you and your colleagues than has been the case perhaps in recent years in our office.

Mr. LEWIS. That certainly is refreshing. You can plan on hearing calls from many of us because I think it's very important that we have a cohesiveness and an understanding. A lot of times, most of our problems occur because of a misunderstanding or a personal interpretation of what the issue is rather than what it actually is.

I would like to--in your National Action Plan, you recommended that superconductivity R&D serve in the United States competitive efforts. Can you broaden that just a little bit?

Mr. BROMLEY. To be very specific there, I was treating superconductivity in that context as one of the critical or enabling technologies and it's a little early for me to specify precisely where the applications will occur. I'm just completely confident that they're going to be there and

if we're there first, they're going to be of enormous help to us in terms of competitiveness. I can't specify, sir, in detail right now. I don't think anyone can with any degree of detailed knowledge.

Mr. LEWIS. Well, as we move back to where we started in our conversation about the government and private sector and we talk about technology transfer, do you think it's possible that we could form consortia with other countries in some of these vast efforts and still not have the body contact problem that we have with technology transfer?

Mr. BROMLEY. First of all, let me say that within moments, I know that there are a great many countries that would love to form joint programs with us because they are quite prepared to recognize that across the board, we still have the strongest science and technology enterprise anywhere in the world.

So a lot of people would like to cooperate with us. The problem that I think we have to address is the question of where we draw the line. In terms of pure, basic research, I have always been committed to the principle that that's open, freely available to everyone. We benefit from work done abroad. They benefit from work done here.

As we move through the development of technology to the point where we are getting close to a competitive stage, then it seems to me that we have to think very carefully

about the extent to which we are prepared to make available the technologies, the know-how in particular, the systems integration know-how that's all important in many of these areas that has been paid for by the American taxpayer.

We have to be careful about how freely we're going to make that available because that, after all, in this economic competitiveness arena, is our edge--know-how. It's high technology. We have to be sensitive to the fact that we can't simply just make it widely available. Basic research, absolutely. Technologies and highly-applied research, I would have to consider each case on its own merits but I have real concern about passing on information of this kind to competitors who for whatever reason can use it against us very effectively.

Mr. LEWIS. Let me ask you a question you may not want to answer in total. With the Department of Defense in certain areas making agreements with foreign countries on any co-development, is the Office of Science Technology Policy involved in that decision and are the pluses or minuses established in your office to give it back to them?

Mr. BROMLEY. These, sir, are typical of the kinds of questions that come up where science and technology are important components of the input to a decision but not necessarily the dominant ones. So very definitely, we have had our input in these discussions and again it's I think a

case by case question but I must say quite frankly, sir, that I have concerns. I think those concerns are shared by many of my colleagues in the Defense Department about our becoming dependent in critical ways on suppliers beyond our immediate control.

Mr. LEWIS. So in the National Action Plan on Superconductivity R&D, how does that plan address military and national security issues?

Mr. BROMLEY. There is no specific addressing of those issues in the plan. What we are doing is working closely with Defense Department representatives, with Department of Commerce representatives. As we move forward, they will play a significant role as we develop our plans and as we produce these annual reports that we are going to bring forward to you and when we can discuss applications openly, we certainly will. When for various reasons it is not appropriate to discuss them openly, we can on an appropriate restricted basis, be more than happy to tell you what's going on.

Mr. LEWIS. Final question, Mr. Chairman, for Dr. Bromley, regarding the Plan's policy on the environment, health, safety, mining, handling and disposal of toxic elements required for many present HTSs, they are certain to cause environmental problems to some degree. What standards exist or are being developed to handle these concerns?

Mr. BROMLEY. I'm afraid, sir, there I am not in a position to answer you in any detail. That is not an area in which I am really up to date. Some of my staff, I'm sure, are. I will be happy to get that information for you and provide it for the record.

Mr. LEWIS. Thank you. I appreciate that.

Thank you, Mr. Chairman.

Thank you, Dr. Bromley.

Mr. VALENTINE. Thank you, sir.

Thank you, Doctor. We appreciate very much your spending this time with us and there might be some other questions which we would like to submit in writing and have you answer if you would.

Mr. BROMLEY. I would be most happy to respond, Mr. Chairman.

Mr. VALENTINE. Thank you, sir.

The other witness, Dr. David McCall, as I've stated is chairman of the National Commission on Superconductivity. Dr. McCall, we are happy to have you with us here today also. Your prepared statement will appear in the record as presented to the subcommittee and you may summarize or otherwise proceed as you deem appropriate. Welcome, sir.

STATEMENT OF MR. DAVID MC CALL, CHAIRMAN, NATIONAL COMMISSION ON SUPERCONDUCTIVITY

Mr. MCCALL. Mr. Chairman, Mr. Lewis, I want to thank you for this opportunity to offer some thoughts on the National Action Plan on Superconductivity Research and Development and to give an interim report on the role of the National Commission on Superconductivity.

I feel that the Action Plan has the appropriate level of detail at the present early stage of this technology. The Plan delineates coordination among the policy organizations. It covers the essential ground in the technical areas and the policy areas emphasize actions that will enhance pursuit of long-range investment strategies that are necessary to develop this field.

The annual reports will include analyses of funding which will give policy makers a chance to assess where the funds are going and what results are coming in from that. In the research phase which is where we are very largely here, it is unwise to set too specific goals with insufficient understanding and I believe the Plan has avoided this pitfall very well and that's an important one.

The background supporting documents for the Plan give valuable summaries of earlier recommendations, the present technical status and other issues that bear on superconductivity. A guide to applications is included

there. I think the Plan lays the groundwork very well. It's a good baseline from which to begin and I believe as the time goes on and the annual reports come out that it will be a good document from which to grow.

That's all I plan to say about the Action Plan this morning. I would like to turn to the National Commission on Superconductivity, if I may.

The Commission was created by the Omnibus Trade and Competitiveness Act of 1988 and it was assigned the task to review all major policy issues regarding United States' applications of recent research advances in superconductors in order to assist the Congress in devising a national strategy including R&D priorities, the development of which will assure United States leadership in the development and application of superconducting technologies.

The Commission membership has representation from all the organizations and disciplines specified in the legislation and I believe it is well positioned to carry through the assignments. Four working groups have been established. Technical and competitive issues is chaired by Dr. Praveen Chaudhari of IBM, research coordination and enhancement is chaired by Professor Theodore Geballe of Stanford, government policy issues is chaired by Dr. Irvine Shain of Olin Corporation and national security issues is chaired by Dr. Craig Fields of DARPA.

All of these people are well known in the field. They understand the issues deeply. They've been involved in previous studies and I feel that they are in an ideal position to do a good job with this. The Commission has held meetings. So far we've had three meetings and we've been briefed on the issues that are important including previous reports that have been submitted, government policy issues such as taxes, anti- trust and patent policy matters. The OST Action Plan has been reported to us, national laboratory, university and funding agency perspectives, business perspectives, and the state of activity in Europe and in Japan.

Today I can offer my personal thoughts based on meetings of the Commission but there is no documented consensus at this point so you'll have to take these as my views. They are based however on discussions that I have had with the Commission. The Commission members are specifically concerned that the support of individual research scientists will be neglected as large-scale funding is advanced and accelerates. This has been mentioned in a number of previous reports but it tends to be forgotten even if it's mentioned right up front. I think this is an essential matter that we've got to pay attention to continuously.

It's particularly important where we have young scientists just starting in. This route to beginning research in our

universities and in our other laboratories, it's very important that they get the support early on without crippling their careers in terms of the work that they can get done.

I might say that this is consistent with the plans to increase funding through the National Science Foundation which is a critical funding agency. The Commission has heard a good deal of very favorable testimony in connection with vigorous Federal support of superconductivity R&D. I mention these only in passing. Specifically, the NSF deserves high marks for the flexibility that it exhibited in reprogramming funds in response to the breakthroughs that occurred three years ago -- that became known three years ago.

DARPA has also moved quite quickly and effectively in support of this emerging science and the Department of Energy is a key supporter of basic and applied research and maintains an essential reservoir of talent and we mustn't underestimate the need for that.

The national laboratory pilot centers that Dr. Bromley referred to for superconductivity commercialization were strongly supported by business people and government people. I think they found a very good formula there and we think that the advancing support of that is very justified.

Finally, the database and standards activities of the

National Institute of Standards and Technology were also favorably reported.

In regard to the level of funding, the Commission's preliminary assessment indicates that government funding in the United States and Japan are roughly equal at this time. Europe is slightly behind. The Soviet Bloc does not appear to be a major player but they have a great deal of underlying strength in the science and they mustn't be overlooked. In the area of industrial funding however, it appears that the U.S. is substantially weaker in superconductivity support than in comparison with Japan.

Furthermore, the underlying causes of this lack of aggressiveness on the part of our industries--these causes are complex, they are pervasive, and we do not think that they're subject to easy solutions. In other words, we're in for the long haul here and it's going to take a long time to work our way out of this. To give you an example, interest rates--our interest rates are high compared to Japan's and it has an enormous impact on investment for something that takes a long time to develop.

We say the national commitment is necessary. A long term commitment is necessary if we are to be competitive in this business. The field of superconductivity offers society a diverse and important collection of benefits, as you noted in your opening statement, Mr. Chairman. The impact is seen

in medicine, power and energy, transportation, electronics and computers, military sensors, launchers and ship propulsion and scientific research.

The Commission is considering the wisdom of near-term, large-scale commercialization in these sectors but no clear consensus has emerged in this area. In decisions of this kind, the technical position is a necessary but not necessarily dominant factor and projects must be considered in the context of relevant non-technical issues. I believe in many cases--MAGLEV may be a good example--there will be other political factors and many other features that will be dominant.

U.S. industries must however be technologically prepared to manufacture as the opportunities arise and that's a great worry. If we don't involve ourselves in the research and development at an early stage, we won't be ready when the opportunities come to get in there and manufacture.

Now, in closing, I want to make a personal comment about the field of superconductivity. In the U.S. today, there is an alarming lack of enthusiasm for science and technology on the part of our young people. Superconductivity has proven to be a uniquely exciting field and the attractions must not be lost by inaction. It's a charismatic science. Physics, chemistry, material science, and engineering, all are affected and the future need for an educated work force must

receive continued attention.

The U.S. is in the race and we're running well in superconductivity but our position could be easily lost. Superconductivity is a national initiative of great moment and it must be vigorously pursued on a long-term basis. Thank you very much.

[The prepared statement of Mr. McCall follows:]

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Mr. VALENTINE. Thank you very much, Dr. McCall.

You mentioned in your statement that the Commission is considering the wisdom of near-term implementation in sectors having to do with magnetic levitation and so on. The quote is as follows and I want to ask you if you would expand on this quote. ''The Commission is considering the wisdom of near-term implementation in these sectors but as yet, no clear consensus has emerged.''

Could you expand on that and are you referring to a national initiative such as MAGLEV?

Mr. MCCALL. We've considered it in various contexts. The notion is, should we recommend and seek support for a large-scale project which would have national visibility, which would give rise to a lot of cash flow coming back to research in the area, would generate the subindustries that go with whatever the large-scale application is? The reason that the wording is not very crisp there is that the Commission is not on agreement on this. There are many different opinions.

I do think that the Commission is in agreement that we are in an early stage and there is no one that I'm aware of on the Commission and it's about two dozen people, that is willing to say let's go for it. This is a good application. We should really go for it. I don't see that commitment on

the part of any one member.

Does that respond to your question?

Mr. VALENTINE. Yes, sir. I think it does. Could you go any further with respect to your personal views as to the advantages and disadvantages of that type of proposal?

Mr. MCCALL. I feel it's a little bit like research and development. Research in superconductivity is clearly warranted. It's one of the really terrific fields. Before committing to go to development, however, we have to be very sure that the timing is right and that the field is right. Development is very expensive as compared with research.

So I think it's a deep and difficult decision and I feel that too early commitment to a development project when we don't understand enough and that is the situation today is a big mistake and I believe it can give the field a black eye and can hurt us in the future. So I think the timing is very important and the choice of the subject matter. I don't mean to be evasive here.

Mr. VALENTINE. I understand. I don't think it's evasive and we understand the problem, I think.

On the whole question of research and development and it's the part of the corporations in this country and overseas does present quite a problem. One can understand why management who have to go to a stockholders meeting once a year would want to tuck away money on the hope, expectation,

in many cases a sheer gamble as to whether or not something will develop so they'll have merchandise they can market in ten years.

Are Japanese corporations different from American corporations in that respect or is it purely and simply Japan Incorporated and the participation of the Japanese government?

Mr. MCCALL. Well, it's very different. There's no question about that. I'm not an expert on this and I would be going beyond my expertise to try to tell you about it but the Japanese industries have tremendous advantages. We've mentioned interest rates as one clear cut advantage which is particularly important on long-term developments but anyone who's walked through the electronics markets in Tokyo knows that the Japanese pay three times for TV sets--the same TV set that we can buy in this country. In other words, they tax their people to support those industries. There are many other factors involved as well. As I said, I don't believe this is an easy problem.

Mr. VALENTINE. But you don't think it's an impossible problem either.

Mr. MCCALL. Well, I think we have certain advantages. The United States is still running very strongly in research. I think we have the strongest university system in the world and I think also the strongest industrial research system in

the world.

Mr. VALENTINE. How do you envision the role of the Commission in working with the science advisor in revising the National Action Plan?

Mr. MCCALL. I think that the Commission has a number of important strengths. One of the important strengths of the Commission from my point of view is the diversity of the membership. The Commission has members that are not superconductivity experts but they are people who work in government day by day and they are able to give their input directly in all of our deliberations on what is going to be valuable on the part of the Congress and on the part of the Executive Branch. So I think that will be an invaluable aid as we prepared recommendations.

Mr. VALENTINE. Do you see additional roles for the Commission?

Mr. MCCALL. Well, the Commission will have some roles that--some of the assignments are the same as other groups have performed before. Other reports exist on this subject. I believe the Commission report is more general than the other reports. Most of those were specific to one field or another and I think that the time is ripe for that kind of general assessment. I think it will be useful.

Mr. VALENTINE. When do you expect to complete the report for the President and the Congress?

Mr. MCCALL. We expect to complete the report soon. I guess I will be deliberately evasive this time. We'd like to measure it in weeks.

Mr. VALENTINE. You mentioned concern for individual versus large unit funding in conducting research. In your view, are individual researcher programs as currently funded adequate?

Mr. MCCALL. We're still discussing that in the Commission meetings. There seems to be no question that many worthy university scientists are not getting all the funding that they need. I haven't gotten to the bottom of this. I'm not a university scientist. I'm trying to probe that to be sure it's really the case but there is a strong representation by Commission members that there is a need for more funding of the type that comes from the National Science Foundation for specific research projects for individuals.

Mr. VALENTINE. You noted, Doctor, that in the area of industrial funding, it appears that the United States is substantially weaker in support of superconductivity research and development than Japan. Could you expand on that statement?

Mr. MCCALL. Well, in terms of the dollar values, we have estimates of that. As I said, the Federal funding in the United States and Japan is about equal. I wouldn't argue about the differences. The numbers are a little hard to get

because they leave salaries out of some of their numbers and we put those in ours.

In terms of the industrial funding, our industrial funding is about a third of the total effort and the Japanese industrial funding is about two thirds of the total effort. So there's a huge difference there. If one looks at the mix of companies that are engaged in superconductivity research, in the United States we have the very largest companies, perhaps the top ten, and a group of startups--very, very small companies.

In Japan, they have all of the largest companies but they go much further down the list of the biggest ones and they have lots of middle-sized companies as well. So I think there's this missing middle in terms of our industrial investment in superconductivity.

Mr. VALENTINE. Thank you.

Mr. Lewis.

Mr. LEWIS. Thank you, Mr. Chairman.

Dr. McCall, I'm really enthralled with your statement about the lack of enthusiasm for science and technology on the part of our young people and I think this is a real serious situation we have whether it's with superconductivity or any of the other sciences.

A few years ago, I amended our NASA bill to allow several hundred million dollars for science and math, for teachers

to go back to school and depending on the amount of time that these teachers went back, to change their curriculum and go back and depending on the amount of time that they taught, their loans could be forgiven.

This had an initial impact but nothing happened thereafter. We still don't see any great droves where we see people now running to the fields of law and political science and communication and wanting to be in medicine and there's certainly nothing wrong with that but in other countries, it's just the opposite. The curve goes the other way.

I'm just wondering what you or members of your Commission feel can be done in order to accelerate younger people into math and science in this country and what it will take at all levels in order to do that. Have you looked at this at all?

Mr. MCCALL. I wish I could give you a good answer for that. I really don't have a good answer for that question. It has been discussed but I haven't heard anything that's persuasive along those lines. I feel that for the future of the country that this is an absolutely essential issue that we've got to get at one way or another. It's been studied before.

As you are quite aware, the report called, ''A Nation At Risk'' that came out several years ago was concerned very

much with this. The situation is still moving in the wrong direction. In many of the engineering and science fields that we deal with, over half of the graduate students in United States universities--American universities--are foreign.

Mr. LEWIS. This is true.

Mr. MCCALL. Furthermore, if you follow what happens to those people, many of them stay in the United States which is good, we've always done that, but they're moving disproportionately into the faculties of leading universities and I believe that it's at least going to change things and I think it's an important matter to look into.

Mr. LEWIS. I know the hearing is not for this purpose and I don't want to dwell on it too long, do you think that we have de-glamorized science compared to other countries, compared to say Japan or to Germany or even to England and we're there now and we're resting on the top rung of the ladder but we're about to fall?

Mr. MCCALL. I think we have de-glamorized it, I think, the relative position of science to other things that young people are drawn to. I think it's possible that we've put too much emphasis on measuring success by making money and making money doesn't mean creating--

Mr. LEWIS. So they're not going to do it as an engineer.

Have to get into politics to do that.

Mr. MCCALL. Right.

Mr. LEWIS. Well, that's a good point. I know engineers who leave the engineering field and study law in order to make money because they can't make it, not that they're not good engineers. Don't misunderstand me. They just can't meet their obligations in that discipline so they move on to another one.

Well, you don't have the magic bullet for that. So, looking at something else, Carl Rosener spoke in the October hearing of the difference between our government's role in superconductivity and R&D versus that of our competitors and our competitors tend to pick a target and move forward while we fall into our endless policy of industrial debate and policy debate and what do you think is an appropriate goal for the current stage of superconductivity R&D that we are engaged in and what would be our next stage?

Mr. MCCALL. Well, I believe that I agree with what Dr. Bromley said earlier, that we are in the research stage where there is an awful lot that we do not understand, particularly about high temperature superconductivity. It's a different ball game than the low temperature superconductivity that we probably know a lot about. I think that when we are in a situation where we are actually lacking in understanding, it's a mistake to specify specific

goals to go after with time tables and development kinds of teams.

I believe that the emphasis on the research side is appropriate at this time. I believe it has to be studied continuously. We have to follow what other people are doing. We have to keep abreast of what's going on. We have to keep a reasonable reservoir of talent trained and ready to go. We have to have all of the know-how in development, but I think it would be a mistake to go after big time and very expensive projects at this stage of the game. At least I haven't been persuaded of that yet.

Mr. LEWIS. I see.

Has the Commission looked at or will be looking at any general goals that we can try to shoot for rather than use the shot gun approach?

Mr. MCCALL. It's part of that discussion and at this point, there is just no agreement on it. We have 24 opinions.

Mr. LEWIS. That's understandable. A couple of technical questions. What is the current maximum critical transition temperature that we've achieved?

Mr. MCCALL. It's 125 degrees Kelvin, I believe is the highest one. As Dr. Bromley pointed out, in almost all materials, you will only operate at about three quarters of that or some reduced temperature below that. Another very

important factor, of course, is the critical magnetic field that will kill the superconductivity of the material and also the critical current. So the most useful high temperature superconducting material probably only has a critical temperature of 90 some degrees Kelvin.

Mr. LEWIS. What's the current density that has been achieved and what do you think is needed for practical applications. What do you think would be practical?

Mr. MCCALL. I think many applications can be worked through at liquid nitrogen temperature which is about 77 degrees Kelvin. If you ask me where will we see it come in first, I can give you one person's opinion.

Mr. LEWIS. That's fine.

Mr. MCCALL. That's all it would be.

Mr. LEWIS. Your opinions are something.

Mr. MCCALL. I think the first applications you'll see of the high temperature superconducting materials, the important applications, will be in passive microwave devices. These are cavities which can be made smaller and they're useful in things like cellular telephony and satellite communications and the like. You can make smaller antennas using these materials and the fact that they work at 77 degrees is quite valuable because it's easier to deal with.

You can do that by refrigeration, for example, instead of

coolant. I think that there are other electronics applications that will appear in time as well. The Japanese are working very hard on interconnection between solid state devices and I think there's a reasonable chance that that kind of circuitry will show up.

Mr. LEWIS. When we're talking about magnetic levitation earlier and you look at the physical size of what you have to use to move a train, for example, back and forth, how many years away are we from a practical temperature in order to meet the cost obligations of having a train that could be used with ML, using superconductivity?

Mr. MCCALL. I'm not competent to answer that. MAGLEV lives. There are working examples, both non-superconducting and superconducting magnetic levitation. So we know it can be done and it's really just engineering to take it from here to there and it's a matter of financing and I really can't tell you what it will pay.

Mr. LEWIS. I see. How about the issue and what kind of progress are we making in practical devices despite the brittleness factors? Despite the brittleness factor of the temperatures, are we having any achievements in those areas?

Mr. MCCALL. I think brittleness is a very important matter in trying to make wire. If somebody asked me could you make wire out of these materials, I would have said no, but they're doing it, so it must be possible. It's very

difficult. In the electronics applications, they're put down as thin films on other substrates and brittleness is not nearly the problem there. So I think that's a minor issue for the electronics application.

Mr. LEWIS. Thank you, Doctor McCall. I don't have any other questions at this time.

Thank you, Mr. Chairman.

Mr. VALENTINE. Mr. McMillen.

Mr. MCMILLEN. Thank you, Mr. Chairman.

Dr. McCall, I was reading your testimony and I was curious if there might be some counter currents in it that I wanted to question you about. One is that you made a statement that a long-term national commitment is essential to a competitive future. On the other hand, you said the National Action Plan has appropriate level of detail in the early stages of technology. My concern is that really in the National Plan, there is really--as it has been criticized, it's another piece of paper in regards to any real funding commitment or long-term funding plan.

Both Dr. Bromley and yourself both indicate that that is one of the great advantages that the Japanese have, is that they are able to make those long-term commitments. My question is, in your testimony, on the one hand you say the Plan has sufficient detail. On the other hand, you say long- term commitments are essential and there are no

long-term commitments in the Plan. How does all that jive? How does that work out?

Mr. MCCALL. I wasn't setting out to confuse you when I wrote that. I think that Dr. Bromley and I probably see eye to eye on the position. I believe the Plan itself is a baseline. It's to lay out the facts and to get the situation in focus. It's something to build upon. I believe that those expenditures or recommendations for expenditures will develop.

Now, he does have--in the supporting documents on the Plan, there is considerable amount of detail on what is going on and that's the nature of the Plan as it exists now. I think where we will go, where we should be going, those kinds of decisions, will develop in the annual reports to come.

Mr. MCMILLEN. But you would concur at this--in saying that the Plan really doesn't have any long-term commitment of funding. It has a baseline funding.

Mr. MCCALL. Yes, I think it tells us where we are.

Mr. MCMILLEN. All right. So it's more descriptive than prescriptive; is that correct?

Mr. MCCALL. I think at this time, yes. Dr. Bromley may not agree with me.

Mr. MCMILLEN. Do you think that descriptive kind of analyses are what we need?

Mr. MCCALL. I think that we need to put forward programs

that will drive the technology and develop important applications at the proper time. At this moment, the Commission has not settled on any application that we would drive heavily at that point. It may come out in the final report but we haven't gotten there yet.

Mr. MCMILLEN. We could look forward to some more prescriptive analysis from the Commission, hopefully.

Mr. MCCALL. I hope so.

Mr. MCMILLEN. Okay. Let me ask you something about the Freedom of Information Act and the trade secret status of research and that was in something from Superconductor Week, a comment that we should limit--the United States should limit the amount of information available under the Freedom of Information Act.

Is your Commission looking at that at all?

Mr. MCCALL. We have not discussed that and I'm not certain we will. That is I sometimes feel very conservative and when I'm railing against the Japanese automobiles or other things of the sort but I think it's almost a non-problem because so many corporations are multi-national now and it's almost impossible to get something that's purely American.

Mr. MCMILLEN. The last question I'd like to ask has to do with--part of this whole process is to get a programmatic and budget cross cut so we can see where we're spending and what we're spending. One of the interesting things that I find

quite fascinating is looking at the Japanese, the Taiwanese, the Korean approaches. Obviously they have centralization advantages that we don't but obviously, having that kind of format gives them ability to coordinate a lot more than our system where we are much more dispersed, the system of Federalism itself, that we have the States doing many similar things across this country.

Is there any attempt to try and coordinate all the research, not only nationally but more on a State level as well so we avoid the redundancies and the inefficiencies that may be part of our Federal system?

Mr. MCCALL. Well, I think there is an attempt and there's a beginning at that although it's not complete yet. One of the things that we've called for in our Commission hearings is that we want a compilation of the State activity and the National Science Foundation is making an attempt to keep track of that. So I think that there is a beginning to coordinate that.

Mr. MCMILLEN. You think that should go under the National Science Foundation's aegis?

Mr. MCCALL. They're keeping the data. They're not running the programs. They're collecting the data for us and for their other purposes and I think that's an appropriate way to do it. I would say that it seems to me as though there's a strength in having the States developing programs on their

own at a reasonable level. I think that they are uniquely able to see the local values that can come out of this. From my point of view, I think that's a strength rather than a weakness.

I'm opposed to redundancy and the loss of funds by duplicative efforts and the like but as I've looked through the Federal funding and other funding, I don't see very much of that. It seems to me as though it may be a miracle but the Nation is in pretty good shape in that regard.

Mr. MCMILLEN. I appreciate that comment, that perspective. Thank you.

Mr. VALENTINE. Mr. McCurdy.

Mr. MCCURDY. Thank you, Mr. Chairman.

Dr. McCall, good to see you. I apologize for not being able to hear Dr. Bromley and the first part of your testimony. However, I'm familiar with the work that both of you are attempting to do. I applaud your commitment and your interest in the program. I certainly agree with the rhetoric and the statements of support. I'm a little--not a little --I'm sorely disappointed in the budget though and the follow through that we in the Federal Government have been unable to really come up with.

The idea behind the legislation which I authored and with the bipartisan support of this subcommittee was to seize upon the opportunity that the recent discoveries vis a vis

high temperature superconductors offered and I would agree with the statements of the former chairman of the--not National Science Foundation but the Academy of Sciences who said this is probably the critical test of whether or not the United States will be competitive in the future in technology.

I have to take a little exception with Dr. Bromley's statements. You know, when Dr. Bromley testified before the full committee laying out the Administration's science plan, there was one sentence about superconductivity in that testimony. In this--and now he comes forward with a major statement but the first section of it deals with old technology, low temperature superconducters, and continues to go back to the super colliders saying that we're going to use the magnets. That's low temperature. That's not high temperature. That's not taking the technology in the future and for some reason to argue that there's a commitment from a budgetary standpoint for superconductivity by including money for an old technology when in fact what we're trying to do is stretch the future doesn't really match.

So we're disappointed with that. I'm not sure I can blame you. Personally, I don't know whether--to the degree that you're successful within the Administration internal battles, I understand those internal battles in committees versus committees in the Congress and having to deal with

the Administration and I know there's been statements that Mr. Sununu has some strong views of his own in this area and they may not share or coincide with our views of the importance of this technology in that the government does have a major role to play and that we're going to miss it if we don't pursue it.

I can't take exception with your statement. I love your last line, ''A long term national commitment on many levels is essential to a competitive future, '' but you know, we haven't picked any major levels. We continue to--the President talks about his thousand points of light. Well, it seems like we have a thousand points of policy, a thousand points of commitment, a thousand points of areas we'd like to support but we're going to lose if we continue to spread so thinly and not bridge that gap between the laboratory and the shop bench and the manufacturing floor.

At some point, the government is going to have to play a role in helping bridge that gap. This effort I find, is a little deficient. I sit on the Armed Services Committee, Research and Development Subcommittee. We have the DARPA budget. Each year--I thought it was interesting. Dr. Bromley commends DARPA for increasing the funding. Yes. We increased the funding for them and encouraged them to get in that direction, which they did but in the Department of Defense, we had that flexibility. We could. We had the

funds to shift it but when we try to put that as a priority within DOD or DOE and NSF or NASA, then we hit the traditional argument. Well, it has to compete with all these other things.

So in effect, we shortchange it. We will--I'm not sure what we're going to do with this budget. I'm not sure how much flexibility we have but I can assure you that I am going to do everything I can to get greater emphasis on there. We're going to continue to keep the spotlight on this issue. I would urge you to go back to your shop and perhaps blame us for the heat that you're getting and that Congress is not satisfied with the work and you have to go back and argue for some more. Maybe we can--and if I have to yell at you to do that, then use that as an excuse but the point is and again, I'm not directing it at you. I'm just saying the Administration in my view has fallen short. We would hope that we could make much greater progress in this area.

Just as a further aside, I was in California all last week. I visited at least ten electronics and aerospace firms and many that are doing work in superconductivity. Many see the great potential but are somewhat frustrated that there is not more assistance from the Federal Government in going beyond just the issues of thin film. It seems like everybody is doing a little work in thin film. I mean that may be the most immediate payoff but in the other

areas they say we can't afford to do that right now. We have to take this step.

I think that we in the government ought to consider what that next step is and see if there's a way we can support that. If they've gotten to the point where they can walk on the thin film, maybe we ought to be at the next step. What is that next step? That's why we're asking for an action plan. We can't dictate there's going to be a 5-year funding level of a billion dollars, here it is. We barely got an action plan passed. I mean we were threatened veto's and opposition all along from the Administration to even lay out a 5-year action plan.

Now that's ridiculous. This is not industrial planning. This is not industrial policy. What we're trying to do is have some common sense and try to set forth an area of agreement that you and I--to finance goals. What do we want to achieve at the end of this time.

So I'm not sure I have any questions. I would be glad to actually have a dialogue with you. If you object to anything I've said, I'd like for you to state that and let's discuss this a little more.

Mr. MCCALL. I think if I really wanted to get into trouble, I could begin to play the role of an apologist for Dr. Bromley's plan. I think that would be wrong. Let me make a comment however about the high temperature, low

temperature superconductivity.

The legislation that gave rise to the National Commission on Superconductivity, the Omnibus Trade Bill, I thought that was very well written legislation. It never mentioned high temperature superconductivity. It said ''improved superconductors.'' Improved superconductors exist both in high temperature and low temperature forms and it's important to keep them under the same umbrella.

I think it would be a terrible mistake to separate them out and let them compete with one another actively as opponents. I think that the science has to come together and it would be a mistake to try and treat them as separate entities. So I think it's very important to keep that unity in mind.

As far as the new budget is concerned, I guess I--

Mr. MCCURDY. It's a similar phenomenon. We'll grant that.

Mr. MCCALL. There are differences.

Mr. MCCURDY. I understand but I'm saying we are talking about ''superconductivity'' but the issue is if for some reason the Administration tries to justify a super collider by saying -- and justify the funding levels by saying well, we're already doing work in there, that's being a little disingenuous when it comes to saying yes, we're responding to and giving you a constant level or an increase in funding because that in fact is not the case. That is a separate

program that happens to use a technology that still may be--you know, I was at General Dynamics. They're making the magnets for the 7,000 or whatever they are, for the super collider and I was briefed on their program and I understand it but that's still not--what we're asking for is the action plan.

Mr. MCCALL. Just my inexpert view of it, if I look at the 1990 and 1991 budgets, the low temperature--taking the super collider out of it--the low temperature budget is level and the high temperature superconductivity budget is up by about 10 percent. That strikes me as being fairly reasonable. I think there's more new work being developed in the high temperature area and I think that makes sense to see it expand but I don't think we should do it at the expense of the low temperature area because that's still very important.

All of the magnetic resonance imaging machines that our hospitals are using are low temperature devices.

Mr. MCCURDY. Would you run those numbers--I'm looking at Dr. Bromley's budget figures, 1990 and 1991.

Mr. MCCALL. I'll probably have to appeal for help here.

[Pause.]

Mr. MCCURDY. As I understand, we're talking about increase. When we say 10 percent increase, we're talking about $13 million, out of a $220 million effort, both high

temperature and low temperature. So from $130 million to $143 million is ''our commitment'' to this area.

Mr. MCCALL. That's the additional.

Mr. MCCURDY. From 130 to 143, a $13 million from 1990 to 1991 is the commitment. No one I'm sure ever asked you what the Japanese level was and what the other countries. Do you know those?

Mr. MCCALL. Well, we haven't got hard numbers on them. As I said earlier here, our assessment is the federal funding for all superconductivity is about the same in Japan as it is in the United States. They're in the same ball park. Europe is somewhat smaller but not a lot smaller. Europe is about 20 percent smaller, I would guess, or 15 percent smaller. Where the difference comes in is the industrial funding.

Mr. MCCURDY. It's hard to separate industrial and federal funding in Japan because the way their system is.

Mr. MCCALL. If you look at it as a total, they're putting in more but the difference tends to occur, at least as we've measured it, on the industrial side.

Mr. MCCURDY. Is Dr. Saito still running that effort? Have you met with Dr. Saito?

Mr. MCCALL. No.

Mr. MCCURDY. Do you know who he is?

[No response.]

Mr. MCCURDY. He's the man that's running the Japanese effort and has testified before our subcommittee in the past and could give you probably a little different estimate on the amount of money that is being dedicated for this. I would urge you at some point to make an effort to meet him and find out if you can a little more about their effort.

Mr. MCCALL. We thought we had a really good estimate because there's a team under Professor Dresselhouse at MIT who has just been to Japan and they brought the numbers to us and they had analyzed them very carefully and I was quite satisfied with the results they had given us.

Mr. MCCURDY. Is that a report?

Mr. MCCALL. It's called the JTEC report.

Mr. MCCURDY. Can we have a copy if we don't have a copy?

Mr. MCCALL. It is publicly available. I can give you the phone number now.

Mr. VALENTINE. He means free.

Mr. MCCALL. I'm sure there's someone who will send you a report free.

Mr. MCCURDY. No, we'd just like to have a copy for the record because I think it's important to find out what they base those on.

Mr. MCCALL. Perry Lindstrom will provide you with a copy of the JTEC report.

Mr. MCCURDY. I didn't catch the introduction of the

others. Can you tell me who the people are who are accompanying you?

Mr. MCCALL. Perry Lindstrom is the--these gentlemen are from OSDP. Perry Lindstrom is the person on the National Critical Materials Council staff that is doing all the work on the National Commission on Superconductivity. That was called for in the legislation.

Mr. MCCURDY. Is he the staff director? I understand you only have one staff. That's kind of like they say about South Dakota. When they have a Congressional delegation meeting, they convene it in one office.

Mr. MCCALL. This is Bob Post, also from OSDP.

Mr. MCCURDY. Thank you.

How often does your Commission meet, Dr. McCall?

Mr. MCCALL. We have had three meetings and we will probably have one more.

Mr. MCCURDY. One more for the year? One more total? What, total?

Mr. MCCALL. In between and during the meeting there will be a lot of writing going on and there's a lot of communication back and forth along the way. The Commission only got started with our meetings last October and we're supposed to be finished at the end of March.

Mr. MCCURDY. Do you see a need for reappointment or reactivation, continuation of the Commission?

Mr. MCCALL. That is an issue that is being discussed by the Commission members and as yet we don't have a consensus there. Some folks feel that a standing committee would be a good idea.

Mr. MCCURDY. A standing committee of the Commission?

Mr. MCCALL. It would not be the Commission. The Commission has a sunset clause in this legislation but a standing committee to look after superconductivity. There is some sentiment in favor of that.

Mr. MCCURDY. Right. What did you see as your objective of the Commission?

Mr. MCCALL. Well the objective is written out in the legislation, is to produce a report to advise the Congress and the President in this superconductivity area.

Mr. MCCURDY. With that report, you effectively are trying to establish--state some policy, some goals, objectives that could be achieved over time?

Mr. MCCALL. Right.

Mr. MCCURDY. Do you see those as short-term horizon, low horizon or the far out horizon? Tell me about your goals a little bit.

Mr. MCCALL. I think the Commission is specifically not looking at short-term goals. I think the Commission's goals will be long-term in character and probably generally stated rather than stated in detail.

Mr. MCCURDY. If you were doing a time line and going back to some of the other sciences and you were trying to chart on this time line the genesis of superconductivity up to this point, where do you see us in this? Do you think we're early in the stages? Do you think we're midway? Are we about to tap the knowledge here? Where do you see us?

Mr. MCCALL. I think in low temperature superconductivity, we're in what I would call mid-range. The breakthroughs in low temperature superconductivity that made it practical occurred in the 1950s and since that time, we've seen the development of a modest industry but quite useful devices which have a lot going for society. I think the magnetic resonance imaging is an outstanding example of that. To take 30 years, or I guess it took 20 years to develop from that point, that's not unusual. From the first identification of research to actual application to take 20 years is a normal kind of development period.

Mr. MCCURDY. At the low temperature area, that may be. I'm not sure I would disagree with that. It's interesting though that also bears considerable cost. I mean, the magnets for the super collider, for instance--one of the largest operational costs of that whole system is the cooling required for the magnets; is that not the case? Is that accurate?

Mr. MCCALL. No. I'm sorry?

Mr. MCCURDY. One of the largest component costs--operational costs once you've built the system--one of the largest operational costs of the super collider in the future is the cost of cooling the magnets. In other words, the renewable costs of keeping them superconducting.

Mr. MCCALL. I guess the analyses that I've seen have played down that cost.

Mr. MCCURDY. Well, I just mentioned that but I'm not trying to sandbag you by any means. Dr. Bromley admitted in the last hearing that we had that that was a major factor as do the reports from General Dynamics when I was in San Diego last week and discussed it with them. They just indicated that that was a major factor within the total overall cost.

Back to the point though on the time line. Where do you see high temperature?

Mr. MCCALL. I think high temperature superconductivity is really in its infancy. The field didn't exist five years ago. It wasn't even a gleam in the eye five years ago. The theory is not there. We don't have a theoretical understanding to base our predictions and hopes on. There's an awful lot to be done in the high temperature area.

Mr. MCCURDY. Stop right there. I want to quote those. For the record there, I want to cull that from the record at some point. That's probably the most salient statement I've heard today. ''It's in its infancy. A lot of work yet to

be done.''

Now, if you're going to meet one more time and make your report, would it not seem logical that in your report you would recommend either a standing committee or reactivation of the Commission to follow this technology? I guess I need only one other quote from you first. How important is this technology to the United States?

Mr. MCCALL. Well, my belief is that the technology is very important. I think it's different from silicon, for example, because I think it has many more--it probably has lower level applications but across the board in many more areas but I think it is a very important applications area. I would not resist the notion of a standing committee. As I say, that's been discussed in the Commission. I think that the Commission is not the suitable body for it. The Commission is too big and I think that you would want a somewhat differently structured body to be a standing committee to follow this.

Mr. MCCURDY. How big is the Commission?

Mr. MCCALL. It's 24 people.

Mr. MCCURDY. It's too big because it acts like a commission or a committee as opposed to someone kind of--do you debate? Is it a debating society or what? Is it just too unwieldy?

Mr. MCCALL. No, no. The Commission is very disciplined.

I have no problem with that but just to get 24 people to meet in the same room in the same city on a given day is very difficult.

Mr. MCCURDY. I understand. Do you feel--that's the wrong word. Do you believe that the Commission has credibility within the Administration? Do you believe it has weight and force when it makes a proposal? How do you weigh it? In other words, if the Commission were to come forward with a recommendation, do you meet with Governor Sununu? Have you ever had anyone in a cabinet meeting submit a statement as to the findings and reports? At what level do you penetrate the Administration as far as you can tell?

Mr. MCCALL. Well, the level of penetration at this stage, up to this point, has been Dr. Bromley and what I found is that when we have needed help, Dr. Bromley has taken our part, he's gone to Sununu and he's gotten things to happen. So I've been totally satisfied with his responsiveness.

Now, we haven't been in the stage where I needed a lot of input but when I needed that input, he's always been there and he's been very responsive. So I have to be totally gratified by his activity there. In terms of clout or how much weight do we carry, that remains to be seen. I don't know the answer to that but I will say that the Commission members, the membership, has people on it that are highly respected in the area. If you look through there, you will

see that these are stars from the previous groups that have been together on this. So it deserves credit and we'll see what happens.

Mr. MCCURDY. Well, we will watch as well and again, I concur. I think Dr. Bromley is eminently well qualified and is certainly well intentioned when it comes to his proposals and understanding of the issue. I am still at somewhat of a loss to understand where the resistance comes from within the Administration when it comes to laying out higher priority on this.

Just from the standpoint of science, you say it's not quite as great as silicon but you know, that's all right. Some people said it's as revolutionary as the development of the transistor. So we've had a wide range of hopes and aspirations and acclaim given to this. Where do you rank this? Out of the recent discoveries of the last ten years in science, 20 years, where would this have to rank?

Mr. MCCALL. Well, the comparison I meant was with the transistor. Silicon is what I hoped I said but I make that mistake sometimes. I think it's really too early to tell at this point and a lot will depend on what you want to measure. If we go after dollar sales value, it's going to be very tough to catch up with the business that silicon generates. Silicon itself is not that big a business. I think worldwide, silicon --

Mr. MCCURDY. Certainly not in America anymore.

Mr. MCCALL. We're not out of it but it's bad. I think worldwide it's something like $50 billion a year but that, silicon, that's the basis for a better part of a trillion dollars worth of business in consumer electronics, in computers, and all other things. So that's a pretty hard standard to measure up to for something that's a new science.

Mr. MCCURDY. But the potential, as yet undefined, potential as yet not solidified, but in its infancy, if those estimates are correct that it may be as important as the development of the transistor and the potential a trillion dollar economy out there, do you think that a $13 million increase designates a level of commitment which--the level of commitment that--if you were an investor, you know, and I'm not talking about Michael Millken and junk bonds. I'm talking about someone who's a prudent director for the future and you saw the potential and you were operating from a trillion dollar budget as well and recognizing the science and you saw that potentially down the road this has the potential payoff of a major sector of the economy. I don't know whether it's a trillion dollars. Who knows what the figures are. The Japanese understand it to be a major factor, a major player.

Would you think that as just an observer from the outside

that $130 million budget is a demonstration of a level of commitment that's relative to the potential payoff?

Mr. MCCALL. Well, you're a very persuasive gentleman and you might convince me to change my views of things.

Mr. MCCURDY. Good. I hope it's reflected in your report.

Mr. MCCALL. I thought that the money that's now available for superconductivity research and development in the United States was quite good. That was my personal reaction to it. You may convince me otherwise but it seems to me as though it's large. If you put a lot more money into superconductivity, you've got to decide what you're going to do with it. You've got to hire people. You've got to rent space and get equipment. At this point, I believe that we're operating at about the right level because we have to develop understanding.

Mr. MCCURDY. Dr. McCall, do you know what the budget request of the Administration this year was for, for SDI?

Mr. MCCALL. I'm sorry. I didn't understand.

Mr. MCCURDY. SDI? Strategic Defense Initiative? Do you know what the budget request was by the Administration this year for SDI?

Mr. MCCALL. I don't know what it was.

Mr. MCCURDY. It was $4.7 billion. Now, that's out of a $38 billion R&D request, Department of Defense. In 1985, it was up to $43 billion and we're talking $130 million for

high temperature superconductivity which has the potential economic impact of maybe a trillion dollars. Now would you like to restate your position as far as a level of commitment? Out of a trillion budget, out of a $300 billion defense budget, out of a $300 billion defense budget, we're talking $61.8 million in the DOD for this technology.

Mr. MCCALL. I don't want to restate it. As I say, when we analyzed it, it didn't appear unreasonable to me. We will be looking at that again and again and taking comparisons.

Mr. MCCURDY. Listen, to my constituents, $61 million is a hell of a lot of money and it's a lot of money to me but you have to put it into perspective of what the national commitment is and if you write on your paper, on your report, that the United States of America is committed to this technology, then I think you need to put it in the perspective of the total U.S. involvement in research and development, Department of Defense spending, Department of Commerce spending and all the other aspects of the Federal Government and if you put it in the context of that, it ain't much of a commitment; is it? That may be more rhetorical a question.

Mr. MCCALL. I've responded at least honestly.

Mr. MCCURDY. I do not question your veracity or your honesty. I agree with you. I was hoping to put a little more perspective when you go back to your position and that

is, yes, you stated there is a commitment but I think it's important that you understand the context--

Mr. MCCALL. They will hear about this conversation.

Mr. MCCURDY. Well, and they'll probably dismiss it from everything we've heard in the past and seen and they know where it's coming from but it's not just one member. It's not a Democratic issue, a Republican issue. It's bipartisan. We have worked on this for a number of years and believe that there has to be a greater commitment.

Again, from the perspective of one member who has served in this Congress for only ten years, who sits on three committees that deal with technology: Armed Services, Science and Technology, and Intelligence, and as we watch the rapidly changing world and it is.

I've listened to Vaclav Havel, President of Czechoslovakia, freely elected, address a joint session of Congress, the world is changing. When Europe 1992 evolves, a unified Germany, a Europe that is going to be totally different and certainly increasing market, as the threat from the Soviet Union declines, not as fast as some people think but it will decline over time, as we in the United States try to assess where we are and where we're going to be ten years from now, we have to redefine our objectives and goals just as we have to redefine our national security strategy.

Our strategy has to be based on economic security and the economic security, to me, the investment is, as compared to investing $4.7 billion in SDI or $70 billion in the B-2, or $100 plus million per copy for an A-12 or some other weapon and I can roll them off as long as we sit here, that when you have to shift the emphasis from military security to economic security and how industry in this Nation is going to make that transition--it's not going to be easy--then we should redefine what our priorities are and I would submit to you, sir, that you're in one of the most important positions of the government today.

You really are and I'm not just blowing hot air at you. I'm telling you. You're truly in one of the most important positions in the government because you can play a role in that redefinition of what our priorities are going to be and if we are going to make that transition, it's going to come sooner or later and by God it better come sooner, then we need to work together.

You can have the same speech from Newt Gingrich on the Republican side or from many of my Democratic colleagues and people who are learned in the sciences but the message has not penetrated the Administration sufficiently when we look at this budget.

Mr. MCCALL. I agree with a great number of things you've said and implied here. I'm sure we'd find a lot to agree on

across the board.

Mr. MCCURDY. I hope we'll have more conversations and I would hope that you would look to us as a resource because we're going to look to you as one and we're going to put a little more pressure and hope that you can take those messages back.

This is one of the most exciting times in my life and I'm sure yours as well but it's ours to grab and piecemeal, $13 million here, $13 million there, is not going to be the direction we need.

Dr. McCall, thank you.

Any questions from the staff or other Members? They dare not follow that, I guess.

Thank you for your testimony. We really do look forward to working with you and hope that we can open a dialogue here that can be sustained.

Mr. MCCALL. Thank you. That was a very stimulating discussion.

Mr. MCCURDY. Thank you. The subcommittee is adjourned.

[Whereupon, at 1:44 p.m., the subcommittee was adjourned, to be reconvened at the call of the Chair.]

* * * SPEAKER LISTING * * *

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