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THE WHITE HOUSE
WASHINGTON

June 22, 1990

MEMORANDUM TO GOVERNOR SUNUNU

FROM: D. ALLAN BROMLEY

Dulan

SUBJECT: ASSOCIATE DIRECTOR OF OSTP FOR LIFE SCIENCES

As you know, James Wyngaarden, who has served during this past year as the OSTP Assistant Director for the Life Sciences, has agreed to accept election as the Foreign Secretary of the National Academy of Sciences.

As soon as his election was announced in April I undertook an extensive search for a suitable replacement who could cover the broad range of biological and medical issues that come to OSTP and replace Wyngaarden in such other roles as Chairman of the biotechnology working group for the Competitiveness Council, as an example.

In this search I consulted with the Institute of Medicine, the NAS, FASEB, and the Deans of a number of the major medical schools. One name came to the top of some three quarters of all the lists of possible candidates. That name was:

Donald A. Henderson M.D., M.P.H.
Dean, School of Public Health
Johns Hopkins University, Baltimore

Other persons who were suggested by a number of consultants included:

J. Edward Rall M.D., Ph.D.
Deputy Director for Intramural Research
National Institutes of Health, Bethesda

David Rall M.D., Ph.D.
Director of Environmental Health Science
National Institute of Health, North Carolina

David Korn, M.D.
Vice President and Dean of the Medical School
Stanford University, Stanford, California

My Associate Directors and I met with all four of these individuals. David Rall subsequently withdrew because of deteriorating health.

We were unanimously in agreement among ourselves and with the majority of our consultants that it would represent a very real coup were we able to bring Henderson to OSTP.

He is considered, worldwide, as the one person who deserves credit for the total eradication of smallpox. He is considered the dean of public health activities in the United States and has the confidence of the biomedical community.

He is a member of the National Academy of Sciences and was awarded the National Medal of Science; this and his other awards, listed on the accompanying curriculum vita, attest to his reputation both nationally and internationally.

The only basis upon which we have a possibility of attracting him is that he is just retiring from the Johns Hopkins Deanship, a position that he has held with distinction since 1977.

My colleagues in OSTP and I have met with him on several occasions for lengthy discussions and are enthusiastic about the possibility of his joining us. He would be a more than worthy successor to James Wyngaarden and would bring a significantly broader range of experience and interest to OSTP.

My recommendation is that the President nominate him as Associate Director for the Life Sciences of the Office of Science and Technology Policy.

APRIL 1990

CURRICULUM VITAE

DONALD AINSLIE HENDERSON

BORN:

September 7, 1928
Lakewood, Ohio

OFFICE ADDRESS:

615 N. Wolfe Street
Baltimore, MD 21205
301-955-3540

MARRIED:

Nana Irene Bragg
Rochester, New York
September 1, 1951

HOME ADDRESS:

3802 Greenway
Baltimore, MD 21218
301-889-2880

CHILDREN:

Leigh Ainslie, 1954
David Alexander, 1956
Douglas Bruce, 1960

EDUCATION:

A.B., Oberlin College, 1950
M.D., University of Rochester School of Medicine, 1954
M.P.H., Johns Hopkins University School of Hygiene and Public Health, 1960*Honoris causa:*M.D., Universite de Geneve (1980)
LL.D., Marietta College (1978)
L.H.D., State University of New York (1981)
Sc.D., University of Rochester (1977);
Oberlin College (1978);
University of Illinois (1979);
University of Maryland (1980);
Yale University (1986)
Albany Medical College (1989)

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POSITIONS HELD:

Mary Imogene Bassett Hospital, Cooperstown, New York, Intern in Medicine, 1954-1955; Resident in Medicine, 1957-1959
Communicable Diseases Center, Department of Health, Education, and Welfare, Assistant Chief, Epidemic Intelligence Service, 1955-1956; Chief, Epidemic Intelligence Service and Assistant to Chief, Epidemiology Branch, 1956-1957; Assistant Chief, Epidemiology Branch and Chief, Epidemic Intelligence Service, 1960-1961; Chief, Surveillance Section, Epidemiology Branch, 1961-1965; Chief, Smallpox Eradication Program, 1965-1966
World Health Organization, Chief Medical Officer, Smallpox Eradication, 1966-1977
Johns Hopkins University School of Hygiene and Public Health, Dean and Professor of Epidemiology and International Health, 1977-

PROFESSIONAL SOCIETIES:

American Board of Preventive Medicine, 1963-
American College of Epidemiology, Fellow, 1990-
American College of Preventive Medicine, Fellow, 1978-
American Epidemiological Society, 1963-
American Public Health Association, 1956; Fellow, 1961-
American Society of Tropical Medicine and Hygiene, 1981-
Association of Schools of Public Health, Treasurer, 1978; Vice-President, 1981-1982; 1987-1988; President, 1988-
Indian Society for Malaria and Other Communicable Diseases, Fellow, 1975-
International Epidemiological Association, 1965-
Royal College of Physicians (Edinburgh), Fellow, 1986-
Royal Society of Tropical Medicine and Hygiene, Fellow, 1976-

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SCIENTIFIC AWARDS AND RECOGNITIONS: (United States)

National Medal of Science, 1986
National Academy of Sciences - Public Welfare Medal, 1978
Charles S. Dana Foundation Award for Pioneering Achievement in Health, 1986
American Academy of Arts and Sciences, Fellow, 1986-
Institute of Medicine, National Academy of Sciences, Member, 1978-
Albert Schweitzer International Prize for Medicine, 1985
American College of Physicians - James D. Bruce Memorial Award, 1978
American Public Health Association - Rosenhaus International Award for Excellence, 1975
American Academy of Pediatrics - Honorary Fellow, 1980
Johns Hopkins University - Distinguished Alumnus Award, 1982
Michigan State University - Walter F. Patenge Medal of Public Service, 1984
Vanderbilt University School of Medicine Medal, 1990
Ohio Foundation of Independent Colleges, Hall of Fame, 1990
Blue Cross-Blue Shield - 50th Anniversary Distinguished Service Award, 1979
U.S. Association for the United Nations - Joseph C. Wilson Award in International Affairs, 1978
U.S. General Accounting Office - Comptroller General's Special Recognition, 1986
U.S. Department of Health and Human Services
- Superior Service Award, 1964
- Sustained Superior Performance Award, 1966
U.S. Public Health Service - Distinguished Service Medal, 1976
- Commendation Medal, 1962
Delta Omega Honorary Public Health Society - Member, 1979
- Outstanding Alumnus Award, 1980
Sigma Xi - Member, 1956

SCIENTIFIC AWARDS AND RECOGNITIONS : (Other Countries)

The Japan Prize, 1988
Republic of China - Health Medal of the First Grade, 1988
Government of Uruguay - Medal of Abnegation, 1988
Universidad Peruana Cayetano Heredia, Honorary Professor, 1988
Commemorative Award of Seventh World Congress of the International Physicians for the Prevention of Nuclear War, 1987
Gairdner Foundation (Canada) - International Award of Merit, 1983
Royal Colleges of Physicians of the United Kingdom - Faculty of Community Medicine - Honorary Fellow, 1981
Royal Society of Medicine
Richard T. Hewitt Award, 1986
Honorary Member, 1980
London School of Hygiene and Tropical Medicine and Royal Society of Tropical Medicine and Hygiene - George McDonald Prize and Medal, 1976
Government of Ethiopia - Medal for Contributions to Health, 1979
Government of Afghanistan - *Roghtya Neshan* (Health Medal), 1976
Ernst-Jung Foundation, (Germany) - *Ernst-Jung Preis für Medizin*, 1976
Government of India - Special Award, 1975
Indian Society for Malaria and Other Communicable Diseases - Special Award, 1975
Lahore, Pakistan - Certificate of Merit, 1977

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AWARD TO WHO FOR SMALLPOX ERADICATION:

Special Albert Lasker Public Health Service Award, 1976

SPECIAL LECTURESHIPS:

Alumni Reunion Lecture, Oberlin College, 1990
Cleveland City Club Forum Speaker, 1990
Vanderbilt University World Health Week, Keynote Speaker, 1990
Kathryn Boucot Sturgis Lecture, 1990
Alumni Reunion Lecture, University of Rochester, 1989
John P. McGovern Lecturer, Baylor College of Medicine, 1989
Annual Banquet Address, Clinico-Pathological Society of Washington, 1989
Phyllis Lewander Memorial Lecture - Children's Hospital National Medical Center, Washington, D.C., 1989
American Pediatric Society - Washington, DC, 1988
Bloomfield Lecture - Case-Western Reserve University, 1987
Joseph Mountin Lecture- Centers for Disease Control, 1987
Agaard Lecture - University of Washington, 1987
Frontiers of Science Lecture - University of Florida, 1987
Eighteenth International Pediatric Congress - Keynote Speaker, 1986
Chief Guest and Keynote Speaker, 30th Anniversary of Indian Public Health Association - Calcutta, India, 1985
National Convention on the Management of Health Systems - Convention Orator; Jaipur, India, 1985
P.D. Agarwal Memorial Oration - Calcutta, India, 1985
Oberlin College Sesquicentennial Speaker - 1983
Harvard Medical School Bicentennial Speaker - 1982
Rameshwar Sharma Oration - School of Medicine, Jaipur, India, 1981
Harben Lecture - Royal Institute of Public Health and Hygiene, London, 1980
Stephens Lecture - Oberlin, Ohio, 1980.
V.W. Scully Distinguished Lecture - Hamilton, Ontario, Canada, 1979
Joseph C. Wilson Lecture - Rochester, New York, 1979
Julia M. Jones Memorial Lecture - American Lung Association and American Thoracic Society, 1979
Merck Sharpe and Dohme Lecture - Canadian Public Health Association, Ottawa, Canada, 1977
James Bordley III Lecture - Mary Imogene Bassett Hospital, Cooperstown, New York, 1977
Jenner Memorial Lecture - Bristol (UK) Royal Infirmary, 1975
Commencement and Convocation Addresses:
San Diego State University School of Public Health - 1988
University of California (San Diego) School of Medicine - 1984
Michigan State University School of Medicine - 1984
University of Southern California School of Medicine - 1978

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PROFESSIONAL COMMITTEES: (Present)**World Health Organization**

Expert Advisory Panel on Virus Diseases, 1976-

Committee on Orthopoxvirus Infections, 1981-

Consultant Group on Poliomyelitis Eradication, Chairman, 1988-

Pan American Health Organization

Technical Advisory Group on Immunization, Chairman, 1985-

American Journal of Epidemiology,

Board of Overseers, Associate Editor, 1965-1977; Chairman, 1984-

Editorial Advisory Board - Bibliography of Bioethics, 1979-

International Association for Maternal and Neonatal Health, Scientific Council, 1981-

Rotary Foundation of Rotary International, Polio Plus Advisory Committee, 1985-

Government Accounting Office

Advisory Board, Program Evaluation and Methodology Division, 1988-

U.S. Department of State

Advisory Committee on Oceans, Environmental and Scientific Affairs, 1988-

Department of Health and Human Services

National Vaccine Advisory Committee, 1988-1989; Chairman, 1990-

Secretary's Council on Health Promotion and Disease Prevention, 1989-

Association of Academic Health Centers

Task Force on Health Promotion /Disease Prevention, 1989-

"AIDS Patient Care" magazine - Editorial Advisory Panel, 1987-

United Fresh Fruit and Vegetable Association, Scientific Advisory Panel, 1988-

Institute of Medicine, Board on International Health, 1988-

Charles A. Dana Foundation Awards Jury, 1990-

Foundation for Development of International Health (Japan), Scientific Consultant, 1990-

BOARD OF DIRECTORS/TRUSTEES:

Indian Institute of Health Management Research, 1985-

Maryland Society for Medical Research, Inc., 1978-

Population Crisis Committee, 1981-

International Center for Diarrheal Disease Research (Dhaka), 1988-

Medical Alumni Association, Mary Imogene Bassett Hospital, 1989-

BIOGRAPHICAL LISTINGS:

Who's Who in the World

The International Who's Who

Who's Who in America

Who's Who in Frontiers of Science and Technology

American Men and Women in Science: Medical and Health Sciences

Dictionary of International Biography

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PROFESSIONAL COMMITTEES: (Past)**American Public Health Association**

Committee on Hepatitis, Chairman, 1961-1965

Multiple Antigen Committee, 1964-1966

Epidemiology Section Council, 1965-1967

Surgeon General's Advisory Committees on:

Influenza, Secretary, 1961-1963

Measles Vaccines, Secretary, 1963

Immunization Practice, Secretary, 1964-1966

World Health Organization

Special Committee on Measles Vaccine, Consultant, 1963

Scientific Group on Human Virus Vaccines, Member, 1965

Global Commission for the Certification of Smallpox Eradication, 1978-1980

Program Advisory Group for the Prevention of Blindness, 1978-1982

Programme for Research and Training in Tropical Diseases - Scientific and Technological Advisory Committee, 1982-1984

Caribbean Epidemiology Center - Scientific Advisory Committee, 1980-1983

National Research Council, National Academy of Sciences

Board on Science and Technology in International Development, 1981-1983

Committee on Research Grants, 1982-83

National Academy of Sciences, Institute of Medicine,

AID Health Strategy Study, Steering Committee, 1978

Steering Committee for the Study on Clinical Investigations in Developing Countries, 1978-1980

Advisory Committee on Health, Biomedical Research and Development, Chairman, 1981-1983

Steering Committee, Study of Tropical Diseases, 1984-1987

Government Accounting Office

Research and Education Advisory Panel to the Comptroller-General, 1977-1986

Department of Health and Human ServicesPHS Hospitals *ad hoc* Advisory Committee, 1978

Secretary's Committee on Influenza, Vice-Chairman, 1979

National Ethics Advisory Board, 1977-1980

CDC Programs and Policy Advisory Committee, 1978-1980

Immunization Practices Advisory Committee, Centers for Disease Control, 1982-1986

Chairman, Mayor's Task Force on Environmental Carcinogens (Baltimore), 1977-1978

NASA - Planetary Protection Study Group, 1978**Executive Office of the President, Office of Science and Technology**

Task Force for Science and Technology in Foreign Assistance, Chairman, 1980

Advisory Committee on Science, Technology and Development, 1978-1979

Consultant, 1978-1982

Harvard University,

Visiting Committee, University Health Services, 1981-1985

Burroughs-Wellcome Fund - Pharmacoepidemiology Awards Committee, 1983-1987

City University of New York Medical School, National Visiting Council, 1986-1989

Institute of Medicine, National Academy of Sciences,

Committee on the Evaluation of Polioomyelitis Vaccine, 1987-88

U.S. Agency for International Development

Research Advisory Committee, 1983-1990

PUBLICATIONS:

More than 100 scientific publications dealing primarily with smallpox eradication, epidemiology and immunization.

February 1990

Book

Fenner, F, Henderson, DA, Arita, I, Jezek, Z, and Ladnyi, ID.
Smallpox and Its Eradication, published by World Health
Organization, 1988.

Book-Chapters (BC)

- (1) Karzon, DT, Henderson, DA
Current Status of Live Attenuated Vaccines.
Advances in Pediatrics Volume XIV, 1966, pp. 121-200.
Year Book Medical Publishers, Inc.
- (2a) Henderson, DA
Smallpox.
Maxcy-Rosenau Preventive Medicine and Public Health, 10th
edition, edited by Sartwell, P.E.
Appleton-Century-Crofts, 1973, pp. 104-116
- (2b) Henderson, DA
Smallpox.
Maxcy-Rosenau Preventive Medicine and Public Health, 11th
edition, edited by Last, J.M. New York.
Appleton-Century-Crofts, 1980, pp. 95-110.
- (2c) Henderson, DA
Smallpox.
Maxcy-Rosenau Preventive Medicine and Public Health, 12th
edition, edited by Last, J.M. Appleton-Century-Crofts,
1985, pp. 129-138.
- (3a) Henderson, DA
Smallpox.
Epidemiology and Community Health in Warm Climate
Countries. Edited by Russell and Standard. Churchill
Livingstone, Edinburgh, 1976, pp. 160-167.
- (3b) Henderson, DA
Smallpox.
Epidemiology and the Community Control of Disease in Warm
Climate Countries, edited by Robinson. Churchill
Livingstone, Edinburgh, 1985, pp. 249-261.
- (4a) Henderson, DA
Variola and Vaccinia.
Cecil Textbook of Medicine, 16th edition, edited by
Wynngaarden, J.B. and Smith, L.H. W.B. Saunders,
Philadelphia, 1982, pp. 1658-1663.
- (4b) Henderson, DA
Variola and Vaccinia.
Cecil Textbook of Medicine, 17th Edition, edited by
Wynngaarden, J.B. and Smith, L.H. W.B. Saunders,
Philadelphia, 1985, pp. 1724-1728.

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- (4c) Henderson, DA
Variola and Vaccina.
Cecil Textbook of Medicine, 18th Edition, edited by
Wyngaarden, J.B. and Smith, L.H., W.B. Saunders,
Philadelphia, 1988 (in press).
- (5) Henderson, DA
Smallpox: Eradication of a Killer.
Encyclopedia Britannica, Medical and Health Annual -
1979, pp. 125-144.
- (6) Henderson, DA
Explicit Goals for Prevention and Public Health.
Working for a Healthier America, edited by McNerney,
W.J., pp. 87-94. Ballinger Publishing Co., Cambridge,
1980.
- (7) Henderson, DA
Lessons from The Smallpox Eradication Experience in Medicine,
Science, and Society, edited by K.J. Issalbacher, John Wiley
and Sons, New York, pp. 715-726.
- (8) Foege, WH and Henderson, DA
Management Priorities in Primary Health Care in Selective
Primary Health Care Intervention, edited by Walsh, J.A.,
Warren, K.S. The University of Chicago Press, Chicago and
London, pp. 313-321.
- (9) Henderson, DA
Smallpox and Vaccinia in Vaccines, edited by Plotkin, S. and
Mortimer, T., pp. 8-30. W.B. Saunders Company, 1987.
- (10) Warren, KS, Bundy, DAP, Anderson, RM, Jamison, DT, Davis, A,
Senft, A, Prescott, NM, Henderson, DA
Helminth Infections.
Chapter in Evolving Health Sector Priorities in
Developing Countries, December, 1989.

February 1990

Scientific Papers

- (1) Armijo, R, Henderson, DA, Timothee, R, Robinson, HB
Food Poisoning Outbreaks Associated with Spray-Dried Milk - An Epidemiological Study.
Am. J. of Public Health 47:1093-1100, 1957.
- (2) Poskanzer, DC, Henderson, DA, Kunkle, EC, Kalter, SS, Clement, WB and Bond, JO
Epidemic Neuromyasthenia, An Outbreak in Punta Gorda, Florida.
New Eng. J. Medicine 257:356-364, 1957.
- (3) Clement, WB, Henderson, DA, Lawrence, JW and Bond, JO
Epidemic Neuromyasthenia, An Outbreak in Punta Gorda, Florida - An Illness Resembling Iceland Disease.
J. Florida State Med. Assoc. 45:422-426, 1958.
- (4) Henderson, DA and Shelokov, A
Medical Progress: Epidemic Neuromyasthenia-Clinical Syndrome.
New Eng. J. Med. 260:757-764, 814-818, 1959.
- (5) Henderson, DA and Hawn, CVZ
The Epidemiology of Antibiotic-Resistant Staphylococci in the Community.
Surg. Clinics of North America, 40:971-982, 1960.
- (6) Trotter, Y, Dunn, FL, Drachman, RH, Henderson, DA, Pizzi, M and Langmuir, AD
Asian Influenza in the United States, 1957-1958.
Am. J. Hyg. 70:34-50, 1959.
- (7) Quirce, JM, Vargas-Mendez, O, Nunez, J, Montoya, JA, Brody, J, Henderson, DA and Martins da Silva, M
Vaccination with Attenuated Polioviruses in Costa Rica.
First International Conference of Live Poliovirus Vaccine, Scientific Publication No. 44, Pan American Sanitary Bureau, 1959, pp. 510-513.
- (8) Dull, HB, Jensen, KE, Rakich, JH, Cohen, A, Henderson, DA and Pirkle, CI
Monovalent Asian Influenza Vaccine. Evaluation of Its Use during Two Waves of Epidemic Asian Influenza in Partly Immunized Penitentiary Population.
J. Amer. Med. Assoc. 172:1223-1229, 1960.
- (9) Aach, RD, Elsea, WR, Lyster, JL and Henderson, DA
Efficacy of Varied Doses of Gamma Globulin During an Epidemic of Infectious Hepatitis, Hoonah, Alaska, 1961.
Am. J. Pub. Health 53:1623-1629, 1963.
- (10) Langmuir, AD, Henderson, DA, Serfling, RE, Sherman, IL
The Importance of Measles as a Health Problem.
Am. J. Pub. Health 52 (Sup.):1-3, 1962.

- (11) Guinea, VF, Casey, HL, Ruthig, DW, Henderson, DA, et al.
A Collaborative Study of Measles Vaccines in Five United States Communities.
Am. J. Pub. Health 53:645-651, 1963.
- (12) Henderson, DA, Witte, JJ, Morris, L, Langmuir, AD
Paralytic Disease Associated with Oral Polio Vaccines.
J. Amer. Med. Assoc. 190:41-48, 1964.
- (13) Langmuir, AD, Henderson, DA, Serfling, RE
The Epidemiological Basis for the Control of Influenza.
Am. J. Pub. Health 54:563-571, 1964.
- (14) Henderson, DA
Viral Hepatitis: Experience in the United States.
The Milbank Memorial Fund Quarterly XLIII(2):
Part 2:404-411, 1965.
- (15) Foega, WH, Leland, OS, Mollohan, CS, Fulginiti, VA, Henderson, DA,
Kampe, CH
Inactivated Measles Virus Vaccine.
Pub. Health Reports 80:60-64, 1965.
- (16) Joseph, PR, Millar, JD, Henderson, DA
An Outbreak of Hepatitis Traced to Food Contamination.
New Eng. J. Med. 273:188-194, 1965.
- (17) Dizon, JJ, Alvero, MG, Joseph, PR, Tamayo, JF, Mosley, WH,
Henderson, DA
Studies of Cholera El Tor in the Philippines.
1. Characteristics of Cholera El Tor in Negros Occidental Province, November 1961 to September 1962.
Bull. Wld. Hlth. Org. 33:627-636, 1965.
- (18) Joseph, PR, Tamayo, JF, Mosley, WH, Alvero, MG, Dizon, JJ,
Henderson, DA
Studies of Cholera El Tor in the Philippines. 2. A Retrospective Investigation of an Explosive Outbreak in Bacolod City and Talisay, November 1961.
Bull. Wld. Hlth. Org. 33:637-643, 1965.
- (19) Tamayo, JF, Mosley, WH, Alvero, MG, Joseph, PR, Gomez, CZ,
Montague, T, Dizon, JJ, Henderson, DA
Studies of Cholera El Tor in the Philippines.
3. Transmission of Infection among Household Contacts of Cholera Patients.
Bull. Wld. Hlth. Org. 33:645-649, 1965.
- (20) Mosley, WH, Alvero, MG, Joseph, PR, Tamayo, JF, Gomez, CZ,
Montague, T, Dizon, JJ, Henderson, DA
Studies of Cholera El Tor in the Philippines.
4. Transmission of Infection among Neighborhood and Community Contacts of Cholera Patients.
Bull. Wld. Hlth. Org. 33:651-660, 1965.

- (21) Guinea, VF, Henderson, DA, Casey, HL, Wingo, ST, Ruthig, DW, et al.
Cooperative Measles Vaccine Field Trial. I. Clinical
Efficacy. II. Serological Studies.
Pediatrics 37:649-665, 1966.
- (22) Witte, JJ, Henderson, DA
The Cerebrospinal Fluid in Type III Poliomyelitis.
Am. J. Epidemiology 83:189-195, 1966.
- (23) Morris, L, Witte, JJ, Gardner, P, Miller, G, Henderson, DA
Surveillance of Poliomyelitis in the United States, 1962-1965.
Pub. Health Reports 82:417-428, 1967.
- (24) Neff, JM, Lane, JM, Pert, JH, Moore, R, Millar, JD, Henderson, DA
Complications of Smallpox Vaccination. I. National Survey in
the United States, 1963.
New Eng. J. Med. 276:125-132, 1967.
- (25) Neff, JM, Levine, RH, Lane, JM, Ager, EA, Moore, H, Rosenstein, BJ,
Millar, JD, Henderson, DA
Complications of Smallpox Vaccination. II. Results Obtained
by Four Statewide Surveys.
Pediatrics 39:916-923, 1967.
- (26) Miller, G, Gale, J, Villarejos, V, James, W, Arteaga, CG, Casey, H,
Henderson, DA
Edmonston B and Further Attenuated Measles Vaccine - A Placebo
Controlled Double Blind Comparison.
Am. J. Pub. Health 57:1333-1340, 1967.
- (27) Henderson, DA
Smallpox Eradication and Measles-Control Programs in West and
Central Africa - Theoretical and Practical Approaches and
Problems.
Industry and Tropical Health VI, 112-120, Harvard School
of Public Health, Boston, 1967.
- (28) Arita, I, Henderson, DA
Smallpox and Monkeypox in Primates.
Primates in Medicine 3:122-123, 1969.
- (29) Gelfand, HM, Henderson, DA
A Program for Smallpox Eradication and Measles Control
throughout West Africa.
J. of International Health 2:24-33, 1966.
- (30) Arita, I, Henderson, DA
Smallpox and Monkeypox in Non-Human Primates.
Bull. Wld. Hlth. Org. 39:277-283, 1968.
- (31) Henderson, DA
La Evaluacion en los Programas de Vacunacion.
Boletín de la Oficina Sanitaria Panamericana 66:426-434,
1969.

- (32) Millar, JD, Roberto, RR, Wulff, H, Wenner, HA, Henderson, DA
Smallpox Vaccination by Intradermal Jet Injection.
Bull. Wld. Hlth. Org. 41:749-760, 1969.
- (33) Henderson, DA
The Status of the Global Smallpox Eradication Programme in
September, 1969.
Proceedings of Symposium on Smallpox, Yugoslav Academy of
Arts and Sciences, Zagreb, 23-35.
- (34) Arita, I, Henderson, DA
Freeze-dried Vaccine for the Smallpox Eradication Programme.
Proceedings of Symposium on Smallpox, Yugoslav Academy of
Arts and Sciences, Zagreb (1969), 39-50.
- (35) Henderson, DA
Control and Eradication of Smallpox.
Tropical Doctor 1:33-35, 1970.
- (36) Henderson, DA
Smallpox Surveillance in the Strategy of Global Eradication.
Health Centre Journal 12:59-66, 1970.
- (37) Wehrle, PF, Posch, J, Richter, KH, Henderson, DA
An Airborne Outbreak of Smallpox in a German Hospital and its
Significance with Respect to Other Recent Outbreaks in Europe.
Bull. Wld. Hlth. Org. 43:669-679, 1970.
- (38) Henderson, DA, Labusquière, R, Millar, JD, N'Dow, PJ, Nicholas, CC,
Rey, M, Ristori, C, Sulianti-Saroso, J
Design for Immunization Programs in the Developing Countries.
International Conference on the Application of Vaccines
against Viral, Rickettsial and Bacterial Diseases of Man.
PAHO (Washington) (1971) 626-635 and Pediatria Indonesia
12:408- 426, 1972.
- (39) Henderson, DA
Smallpox: The Problem.
International Conference on the Application of Vaccines
against Viral, Rickettsial and Bacterial Diseases of Man.
PAHO (Washington) (1971) 139-143.
- (40) Henderson, DA
Epidemiology in the Global Eradication of Smallpox.
Intl. J. Epidemiology 1:25-30, 1972.
- (41) Henderson, DA
Smallpox Vaccination.
Proceedings of the Seminar on Vaccination in Africa.
Centre International de l'Enfance (Paris), 1971,
pp. 44-46.

- (42) Henderson, DA, Arita, I
Monkeypox and its Relevance to Smallpox Eradication.
WHO Chronicle 27:145-148, 1973.
- (43) Henderson, DA
La Variole.
Médecine et Hygiène 31:709-719, 1973.
- (44) Henderson, DA
Eradication of Smallpox: The Critical Year Ahead.
Proc. Royal Soc. 66:493-500, 1973.
- (45) Henderson, DA
Genesis, Strategy and Progress of the Global Smallpox
Eradication Program.
J. Communicable Dis. 6:155-159, 1974.
- (46) Foege, WH, Millar, JD, Henderson, DA
Smallpox Eradication in West and Central Africa.
Bull. Wld. Hlth. Org. 52:209-222, 1975.
- (47) Henderson, DA
Global Smallpox Eradication Programme.
Swasth Hind 19:116-118, 1975.
- (48) Henderson, DA
Smallpox Eradication - the Final Battle (Jenner Lecture).
J. Clinical Pathology, 28:843-849, 1975.
- (49) Henderson, DA
Surveillance of Smallpox.
Intl. J. Epidemiology 5:19-28, 1976.
- (50) Henderson, DA
Current Status of Smallpox in the World.
J. Com. Dis. 7:165-170, 1975.
- (51) Henderson, DA
The Eradication of Smallpox.
Scientific American 235:25-33, 1976.
- (52) Arita, I and Henderson, DA
Monkeypox and Whitepox Viruses in West and Central Africa.
Bull. Wld. Hlth. Org. 53:347-353, 1976.
- (53) Henderson, DA
Smallpox Eradication.
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THE WHITE HOUSE

WASHINGTON

July 11, 1990

MEMORANDUM FOR SECRETARY JAMES *Jim* WATKINS

FROM: D. ALLAN BROMLEY

SUBJECT: BASIC RESEARCH *Duan*

You perhaps will recall from a decade or so ago when a group at MIT, under the auspices of the Club of Rome, carried out a major computer-base study that culminated in a publication entitled The Limits of Growth. In many ways it was the ultimate illustration of the famous garbage-in-garbage-out rule of computer usage. The first group that really pointed this out in detail and published a book in response entitled The Limits of Doom was the science policy research unit at the University of Sussex in England.

Recently under a grant from the National Science Foundation, John Irvine, Ben Martin, and Phoebe Isard, who are members of this research unit, have undertaken a study of how the U.S. Government supports academic research and in particular, how competitive from an international point of view that support is at the present time.

Erich Bloch recently sent me a copy of the paper that the group has produced and points out that there are two very important conclusions. They are the following:

1. In relation to its size and wealth, the United States invests less overall in academic and related research than leading scientific nations in Western Europe with the apparent shortfall being largest in the physical sciences.
2. While the U.S. is still the predominant world player in academic research, if life science is excluded, however, or if expenditure is normalized for difference in population, then the U.S. compares less favorably with the European countries.

I believe that both of these conclusions are matters of serious concern for us in the United States. We have long recognized that by any of the usual measures, such as fraction of gross national product and the like, our support of research and development overall is substantially less than that in Germany or Japan. What we have not recognized prior to this report was that the situation is more broadly based in Europe when we focus on academic research in comparison with the United States. It is also the case that once we face the European community in 1992, where there is substantial discussion and consensus building internal to the EC, I expect us to find ourselves crunched evermore effectively between Japan on the one side with the other Pacific Rim nations accelerating rapidly, and the European Community on the other.

This document from the University of Sussex simply underscores the conviction that I think we share that we, as a nation, are under-investing in research and development generally and in the support of academic research, particularly in the physical sciences.

I thought that you would find this report interesting.

Enclosure

IS US GOVERNMENT SUPPORT FOR ACADEMIC AND
RELATED RESEARCH INTERNATIONALLY COMPETITIVE?

John Irvine, Ben R. Martin and Phoebe A. Isard*

Abstract

In relation to its size and wealth, the United States invests less overall in academic and related research than leading scientific nations in Western Europe, with the apparent shortfall being largest in physical sciences.

New technologies are increasingly crucial to a nation's economic prosperity. Because many of these technologies depend on the results of science, basic research seems set to play a fundamental role in economic and social development.¹ Hence, the major industrial nations (and those that aspire to greatness) are all investing heavily in basic research, whether conducted in academic, government or industrial laboratories. Responsibility for developing and maintaining the necessary science base at present rests largely with federal and state governments rather than industry. This raises two questions. First, how much should government invest in research within universities and related laboratories? Given the increasingly competitive nature of science as well as technology, funding agencies need to know how their spending compares with that in other nations, both in overall terms and at the level of specific fields. Second, what funding mechanisms are most appropriate for supporting academic and related research? For example, what emphasis do different countries place on institutional core-funding of universities relative to peer-reviewed projects (or programmes) and intramural work conducted within agency laboratories? Such comparisons may provide some insights into which funding arrangements work most effectively.

In what follows, we examine the main trends in US government expenditure on academic and related research between 1975 and 1987, looking at the similarities and differences between the United States and five other industrial nations (the United Kingdom, Federal Republic of Germany, Netherlands, France and Japan). Our analysis draws upon the findings of a study undertaken for the National Science Foundation and the British Advisory Board for the Research Councils² which reported comparable

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figures on spending broken down into nine fields (e.g. physical sciences) and forty subfields (e.g. chemistry) for each country. In addition, we identify the factors underlying changes in the level and distribution of academic funding by government using information from the published literature and from interviews with agency officials and science-policy specialists. Among the issues addressed are the political priority given to basic science in general as well as to specific fields, and the pressures underlying the restructuring of research-support mechanisms that is underway in many countries. However, one question outside the study's remit relates to the changing balance between private and public-sector finance for academic research. When interpreting our results, therefore, the reader needs to bear in mind not only that industrial funding varies from country to country, but also that much academic research is supported by charitable foundations, especially in the biomedical and health fields.

Approach

Disaggregated data were compiled for three categories of expenditure: (a) academic research financed through general university funds given to institutions by federal or state governments; (b) academic separately budgeted research provided in the form of grants, contracts and other finance earmarked for specific research projects by public-sector funding agencies; and (c) academically related research undertaken outside universities in (i) national or international laboratories operating central facilities for use by academic scientists (e.g. Fermilab or the National Optical Astronomy Observatory), and (ii) institutes financed primarily through government core-funding which are engaged in longer-term basic research similar to that conducted within universities in other nations (e.g. the intramural programs of the National Institutes of Health).

As can be seen from Figure 1, coverage of academically related research includes certain types of expenditure by Federally Funded R&D Centers (FFRDCs) and research council establishments in Europe together with basic work in agricultural and medical laboratories, many of which have a role in postgraduate training. Academically related research can be viewed partly as a residual category enabling funding for functionally equivalent organizations formally outside universities to be taken into account, hence ensuring that the financial statistics for different countries are truly comparable. This helps overcome a major limitation with data from the

Organization for Economic Cooperation and Development (OECD). Such figures are widely used in international comparisons of academic research, but reflect the varying definitions of the higher education sector employed in different countries. For example, the OECD statistics cover only doctorate-granting universities in the Netherlands, while junior and technical colleges are included for Japan and the US figures even encompass mission-oriented FFRDCs such as Los Alamos.

To compare trends in real terms from 1975 to 1987, expenditures for earlier years were converted to 1987 prices using the OECD deflators for gross domestic products. Although this procedure may understate the rate of inflation for research costs¹, especially in fields where there has been a significant increase in the sophistication of experimental equipment and facilities, the lack of internationally comparable R&D deflators means there is currently no alternative. National currencies were then converted into US dollars. Since official exchange rates fluctuate appreciably and rarely represent actual domestic spending power or labour costs, we have relied mainly on the 'purchasing power parity' (PPP) rates calculated by OECD. However, economists differ over whether this represents the best way to compare research expenditures so alternative figures based on average official exchange rates (OERs) are also reported. Finally, in presenting the results, we have frequently contrasted US spending with that for the four European nations combined (henceforth termed 'Europe') which have a not dissimilar aggregate population.

Trends in overall expenditure

Table 1 contains purchasing power parity-adjusted expenditure data broken down into general university funds (GUF), separately budgeted research (ASER) and academically related research (ARR). Although GUF grew by over 50% in real terms in the United States between 1980 and 1987 (largely as a result of increased institutional finance from state administrations), it still represented only 20% of total academic and related research compared with around 45% for 'Europe' and over 65% for Japan. At the same time, 'Europe' appears to have begun to move a little towards the US funding model by giving less emphasis to GUF and more to project-based and other earmarked research support for universities, all four countries witnessing large increases of 20-40% in ASER since 1980. Nevertheless, US expenditure

on separately budgeted research (\$9.9 billion in 1987) still dwarfed the total for the four European nations (\$2.5 billion), with Japan far behind (\$0.9 billion). In contrast, 'Europe' gave greater emphasis to academically related research, spending \$3.3 billion compared to \$1.9 billion by the United States despite the faster growth evident over recent years. For academic and related research combined, the total for the four European countries in 1987 (\$11.0 billion) was approximately three-quarters of the US figure (\$14.9 billion), while Japan's was about one-quarter (\$3.7 billion). However, if official exchange rates are used, 'European' expenditure rises to \$13.3 billion (i.e. much closer to the US total of \$14.9 billion which, by definition, remains unaltered). In addition, the Japanese total increases to \$5.5 billion, well over a third of the US figure.

What do the statistics show when spending is adjusted for differing country size and economic strength? One way to do this is to express the results in terms of expenditure per capita. Figure 2 reveals that, for academic and related research combined, US spending of \$61 per capita in 1987 was broadly comparable with that by 'Europe' (\$60) on a purchasing power parity basis. Although the Japanese figure of \$31 was relatively low, it should be stressed that a considerable proportion of government research support is concentrated in mission-oriented laboratories falling outside our definition of academically related research - for example, the R&D institutes coming under the Ministry of International Trade and Industry. (Furthermore, the apparent gap compared with the other nations narrows considerably when official exchange rates are used; Japanese expenditure rises from \$31 to \$45 per capita - while the (unaltered) US figure (\$61) is now somewhat below the 'European' average of \$71.)

The conventional approach to normalizing research expenditures for differences in size of national economies is to express them as a proportion of gross domestic product (GDP). Figure 3 shows that the United States devoted 0.34% of GDP to academic and related research in 1987, appreciably less than 'Europe' (0.47%). However, the US figure increased by 12% during the 1980s whereas that of 'Europe' remained constant and Japan's dropped from 0.26 to 0.23 as rises in research spending failed to keep pace with rapid economic growth.

In short, allowing for variations in country size suggests that the United States probably invested less relative to 'Europe' in 1987. Certainly, when comparisons are made excluding life sciences (i.e. biological, agricultural and medical research - areas where, as we show below, support has been much higher than elsewhere), then US expenditure emerges as appreciably lower than the 'European' average irrespective of whether expressed in per capita or GDP terms.

Distribution across fields

Table 2 contains data on academic and related research expenditure in 1987 broken down by field. To take engineering research first, US spending of \$2.0 billion was 40% greater than that for the European countries and more than twice Japan's. The United States and 'Europe' both committed 13% of their overall funds to engineering (including materials research), much less than the 22% figure for Japan. In contrast, physical sciences (i.e. physics, chemistry and astronomy) accounted for under 15% of the Japanese total, well below the six-country average of 21%. The US emphasis on physical sciences (16% of overall effort) was also far lower than in the European nations (25%). Indeed, this is the only major scientific field where 'Europe' outspent the United States. The budgetary share received by life sciences in the US (49%) was well above that in 'Europe' and Japan (34% in both cases), reflecting the high level of funding for the National Institutes of Health. However, government support for arts and humanities (\$0.4 billion) was considerably less than in 'Europe', this being the result of a difference in cultural priorities as well as the greater emphasis on general university funding in Western Europe.

International comparisons of the distribution of research effort across fields are made easier if we consider the Relative Expenditure Priority (REP) index shown in Figure 4. This is defined as follows:

$$\text{REP for field A in country X} = \frac{\% \text{ share of field A in country X}}{\% \text{ share of field A for all six countries}}$$

Hence, for physical sciences where the US share (15.6%) was just under three-quarters of the six-country average in 1987, one obtains an REP of 0.74. After increasing between 1975 and 1984, this figure began to slip back. Engineering, professional/vocational studies (e.g. architecture,

education, law, management science) and arts/humanities also had index values well below 1.0, although in the first two cases there have been modest increases since 1980. The largest improvement was in mathematics and computer science where the REP rose to 0.90. By contrast, appreciable declines were recorded in environmental and social sciences. As might be expected, the field with the largest REP in the US is life sciences with 1.35 in 1987, followed by environmental sciences (i.e. atmospheric science, geosciences and oceanography) with 1.20.

A similar analysis can be carried out at the subfield level, although with a lower degree of statistical confidence. Among US priorities for academic and related research in 1987 were aerospace engineering (with an REP of 1.8), materials research (1.6), biological sciences (1.4), agricultural and medical research (both 1.3), psychology (1.3) and political science (1.3). Lower priority areas included languages (0.3), history (0.4), astronomy (0.4), sociology (0.4), and chemical and civil engineering (both 0.7). Also well below 1.0 were physics (0.75) and chemistry (0.77) - in other words, it would appear that physical science is given only just half the funding priority of life sciences in the United States.

Research-support mechanisms

Let us now turn to certain policy issues concerning research-support mechanisms which have surfaced over recent years. Within universities, a central concern in Europe and Japan has been the balance between general university funds (GUF) provided to institutions relative to finance for separately budgeted research (ASBR). Table 3 shows how the proportion of academic research accounted for by separately budgeted grants - i.e. the ratio $ASBR/(GUF + ASBR)$ - has varied over time. Since GUF is largely tied to the salaries of tenured university faculty who often cannot easily transfer from one field to another, this index may be regarded as an indicator of the degree of 'flexibility' available to policy-makers to set new research priorities in line with changing scientific or societal needs. The top half of the table reveals appreciable increases in the index since 1980 for Britain, West Germany and especially the Netherlands. Although the gap has narrowed, the French figure (0.51) remains higher since much of the nation's academic research is supported through CRS and other agencies. The United States has by far the largest index value, primarily

because, unlike the others, it does not operate a formal dual-support system for university research. However, there are signs of a change here as state governments have begun to provide universities with increased core-funding for facilities and infrastructure to help overcome problems associated with over-reliance on generally shorter-term federal project funding.

For agencies, an equally important question during the 1980s has been the balance between expenditure on intramural laboratories (i.e. ARR) and separately budgeted finance for university research (i.e. ASBR), especially peer-reviewed grants for individual investigators. The lower section of Table 3 relates to trends in the ASBR/ARR index - that is, ASBR divided by ASBR plus academically related research (ARR). Since intramural funding is often linked to the support of permanent staff in laboratories while ASBR mostly takes the form of shorter-term commitments, this ratio may again give an indication of the 'flexibility' to redeploy resources. There has been a rapid increase in the British and Dutch indices, bringing them up to the French level of approximately 0.5. In the United States and Japan, the ratio has historically been much higher (between 0.7 and 0.8) because government-supported research is generally conducted either on university campuses or in mission-oriented laboratories falling outside our definition of academically related research (e.g. Los Alamos, Lawrence Livermore and the Jet Propulsion Laboratory).

A US expenditure 'gap'?

Given the earlier indications of a shortfall in US spending on academic and related research relative to 'Europe', it is worth exploring the nature and magnitude of the difference in greater detail. One way to do this is to express expenditures in each field as a ratio of the average for the four European nations (the 'European' average) - that is, in terms of the Relative European Funding Index (REFI) shown in Figure 5. This is defined as follows:

$$\text{REFI for field A in country X} = \frac{\text{Spending on field A in country X}}{\text{'European' average spending on field A}}$$

Thus, overall US funding of \$61.1 per capita for academic and related research in 1987 translates into a REFI value of 1.03 when compared with the 'European' average of \$59.5 (based on purchasing power parities). At

the level of fields, the index for the US was particularly high for life sciences (1.48) and environmental research (1.26), with engineering (1.08) also supported rather more generously than in 'Europe'. In contrast, physical science was accorded lower priority (0.66) - less than social sciences (0.77) and only slightly higher than professional/vocational studies (0.62) and arts/humanities (0.40), fields traditionally receiving the least government support in the United States. Mathematics and computing fared just a little better with a REFI of 0.84 in 1987. These figures again point to a difference in political and cultural priorities between the two continents.

Given the wide range of REFI values in Figure 5, an obvious question is, 'How much more or less would the United States have to invest in order to attain the 'European' level?' The results in Figure 6 indicate that expenditure on life sciences in the US was no less than \$2.4 billion greater than the 'European' average in 1987. This was apparently at the expense of physical sciences (with a funding 'deficit' of \$1.2 billion) and arts and humanities (where there was a \$0.6 billion 'gap'). Indeed, for all the main fields excluding life sciences, there was a net 'deficit' of \$2.0 billion compared to the 'European' mean.

Similar calculations suggest that Japan would also need to spend vastly greater sums to bring it up to the four-country average - perhaps of the order of \$3.5 billion per annum according to this indicator - primarily on physical and life sciences.

How has the 'gap' between the United States and 'Europe' changed over time? As regards the funding for all fields combined, after worsening between 1975 and 1982, the situation then improved over the next five years. However, if we examine the field breakdown, it is apparent that the turnaround stems largely from increased funding for life sciences. In contrast, the relative situation of the least well-endowed area - physical sciences - has scarcely changed since 1984. Figure 6 also reveals a decline in the fortunes of social sciences (including psychology), which slipped from being \$220 million ahead of 'Europe' in 1975 to a position where there was an apparent 'shortfall' of \$230 million in 1987 following major cutbacks at the beginning of the decade.

Such per capita-based estimates of absolute funding 'gaps' clearly need to be treated with greater caution than the earlier data relating to differences in relative expenditure priorities across countries. In particular, the statistical dangers involved in relying on figures derived by subtracting one large and uncertain number (for the United States) from another (for the 'European' average) should be recognized. Nevertheless, the example of the 'balance of payments gap' statistics in the field of economics illustrates that there is sometimes little alternative but to employ imperfect indicators of this sort in policy-making. In such circumstances, the best that can be done to minimize the uncertainties is to explore a range of indicators. The preference of certain politicians to view spending on academic research as a 'consumption' item (i.e. a cultural luxury which can best be afforded by more affluent nations), and not just as an investment in the future, is another reason why one needs to consider parallel statistics on funding differences calculated from comparisons of expenditure expressed as a percentage of GDP.

The results in Figure 7 illustrate how important it is not to rely on a single indicator in assessing the relative level of spending by the United States. For all fields combined, adoption of a GDP-based approach points to a considerably larger US 'gap' of \$5.9 billion compared to 'Europe' in 1987. This is much the same irrespective of whether life science is excluded, and compares with the non-life science 'shortfall' of \$2.0 billion suggested by the earlier per capita figures. The reason for such a discrepancy between the two estimates is not obvious (although the fact that using official exchange rates rather than purchasing power parities substantially reduces the divergence may be significant). Nevertheless, it is clear that both sets of indicators show a large deficit in five of the eight main fields. In other words, it would appear that the United States invests proportionately less than 'Europe' in a wide range of academic research areas, though life science is relatively well funded. Moreover, there seems little doubt that the amount by which US spending lags behind that of 'Europe' is considerable for physical sciences, our estimates ranging from \$1.2 to \$2.7 billion in 1987.

Conclusions

Before summarizing the main findings, we must again emphasize the intrinsic uncertainties involved in comparing spending levels across countries with

rather different systems for financing and conducting research. Any attempt to assess the 'adequacy' of US funding relative to 'Europe' must therefore allow for the fact that our figures exclude the growing sums given to universities by industry and charitable foundations. Decisions on funding policy also need to take into account other measures of scientific activity such as numbers of researchers. Furthermore, indicators of research output (e.g. publication data) and of scientific impact (e.g. citation statistics) are often at least as important as those relating to inputs.

With these provisos in mind, let us turn to the conclusions which may be drawn. First of all, in terms of absolute spending, US support for academic and related research in 1987 (\$14.9 billion) was similar to the combined expenditure of Japan and the four European nations (\$14.7 billion). Hence, the United States is still by far the dominant world player in the sphere of academic research. However, if life science is excluded, or if expenditure is normalized for differences in population, then the United States compares less favourably with the European countries. Similarly, 'Europe' invests appreciably more in academic and related research relative to GDP. Irrespective of the basis used for comparison, Japanese spending has remained extremely low in international terms. This is despite the government's expressed intention to strengthen fundamental science in response to criticisms voiced especially in America that Japan has been 'free-riding' on the scientific efforts of the United States and Western Europe instead of contributing its 'fair share' of resources to the support of basic research.

At the field level, the picture is more complicated as a result of the dominance of US expenditure on life sciences - in 1987, the figure of \$7.3 billion amounted to 45% more than the total spent by the other five nations combined. The effect of the expansion in NSF support for engineering can be seen in the gradual increase in the Relative Expenditure Priority (REP) index, although it was still only 0.92 in 1987. Conversely, investment in environmental sciences remained at a level 20% higher than the international average in 1987 despite a decline in the field's share of total US government spending in recent years.

While the low priority given to social sciences, professional/vocational studies and arts/humanities is perhaps predictable, the relative funding

situation of physical sciences in the United States may cause some concern not least because of the technological and economic significance of much of the research within the field. In 1987, the Relative Expenditure Priority index stood at 0.74, little higher than the value for Japan (0.69) and considerably lower than for the Federal Republic of Germany (1.19) and France (1.41). Furthermore, although the REP rose between 1980 and 1984, it has since begun to fall back. At the subfield level, US expenditure priorities include aerospace engineering, materials research, biological sciences and medical research. In contrast, chemical and civil engineering, physics, chemistry, astronomy and several humanities areas all have low REPs.

As regards mechanisms for financing research, the United States relies predominantly on separately budgeted grants, whereas the 'dual-support system' operated in European countries results in academic research receiving two-thirds of its finance through general university funding. This may be one reason why concern about inadequate investment in facilities and instrumentation has so far been more muted in Europe. However, during the 1980s the Netherlands, United Kingdom and Federal Republic of Germany have begun to move somewhat closer to the US model by giving greater emphasis to separately budgeted funding. The hope is that this will result in academic research becoming more responsive to changing scientific and societal needs.

Finally, our analysis of differences in government funding across countries suggests that overall spending by the United States at best matched that of 'Europe' in 1987. At worst, there was a sizeable funding 'gap'. While life science was supported reasonably well, the indications are that physical sciences received far lower support than elsewhere - by \$1-2 billion less per annum relative to the 'European' average. Of course, there is no reason why the same disciplinary priorities should be adopted in the United States as in 'Europe'. However, the magnitude of the difference does suggest that US policy-makers should at the very least reconsider whether existing priorities are in line with national needs.

Such a reassessment might possibly conclude that most of the existing scientific advances over coming decades are likely to occur in new areas of life sciences. This would imply that Europe is placing too much faith in

the physical sciences, having failed to recognize that the rapid rate of advance seen in the post-war era is now slowing. However, an alternative conclusion could be that the high political visibility of health research is primarily responsible for the situation in which the agency responsible for supporting this one field (i.e. the National Institutes of Health) has a budget several times greater than that of the National Science Foundation (whose task it is to support all areas of natural science, engineering and social sciences). If so, a systematic appraisal of the country's social and economic needs might well indicate that the balance of efforts between physical and life sciences should be adjusted.

Acknowledgments

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Acknowledgements

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3. E. Mansfield, A. Romeo and L. Switzer, Research Policy, 12, 105 (1983).

Figure 1. Coverage of academic and related research in the six countries surveyed^a

	General university funds (GUF)	Academic separately budgeted research (ASBR) ^b	Academically related research (ARR)
USA	- institutional research funds in public doctorate-granting universities - faculty salary contribution by public universities to government-funded projects	- federally financed academic research (current and capital) - state and local government financed academic research (current and capital) - federal fellowship programmes	- academic research facilities provided by federally funded R&D centers (FFRDCs) - academically related research in university-administered FFRDCs - NIH intramural programs
JAPAN	- general finance for national and public university faculties (including 'toza' funding) - institutional research finance from government for private universities	- Monbusho research grants to national public and private universities - support for national and public university institutes - finance for 'joint-use' and inter-university research institutes - JSPS programs, fellowships and studentships - contract research from central and prefectural government agencies	- Monbusho intramural institutes - basic research in national agricultural and medical institutes - academically related research funded by STA (e.g. at RIKEN) - international subscriptions
UK	- UGC-funded universities - polytechnics and Scottish central institutions - the Open University	- academic grants from the five research councils (e.g. SERC) - government contract research - Royal Society and British Academy grants and fellowships	- intramural research council work financed by the 'Science Vote' - international subscriptions
FRG	- universities - integrated universities - theological, arts and teacher-training colleges	- academic grants from DFG and BMT - federal government contract research - separately budgeted finance from state ministries - federal fellowship and doctoral studentship programs	- Max Planck institutes (apart from the fusion field) - National Research Center support for academic central facilities and/or fundamental science - academically related 'blue list' institutes and similar establishments - basic research in federal agricultural laboratories - various national academy programs - international subscriptions
FRANCE	- universities - grandes écoles - various specialized doctorate-granting institutions	- separately budgeted Ministry of National Education funding - CNRS support for 'associated laboratories/teams' at universities - grants from INSERM, INRA, IFREMER and BRGM - other government grants and contracts (e.g. from MRE)	- intramural CNRS and INSERM research - basic research in INSERM, BRGM, IFREMER and INRA establishments - various academically related institutes (e.g. IPR and the Pasteur Institute) - international subscriptions
NETHERLANDS	- general funds for universities (including agricultural and technical) - conditional financing for universities	- grants from research councils (MWO/ZWO and STW) - independent academic research institutes - Institute/Foundation for Educational Research - government contract research	- intramural/academically related research financed by MWO/ZWO, STW and PNAW - Ministry of Education and Science Institutes - Institute of Applied Physics (TNO) - basic agricultural and health research in MAF and TNO institutes - other academically related research in government institutes - international subscriptions

NOTES:

- (a) Coverage relates only to the principal expenditure elements for each country and therefore excludes some minor categories of spending.
- (b) The generic term 'academic grants' in some cases covers not just project and program funding but also support for fellowships and doctoral studentships.

FIG 2. TRENDS IN EXPENDITURE PER CAPITA
(in 1987 \$ calculated using PPPs)

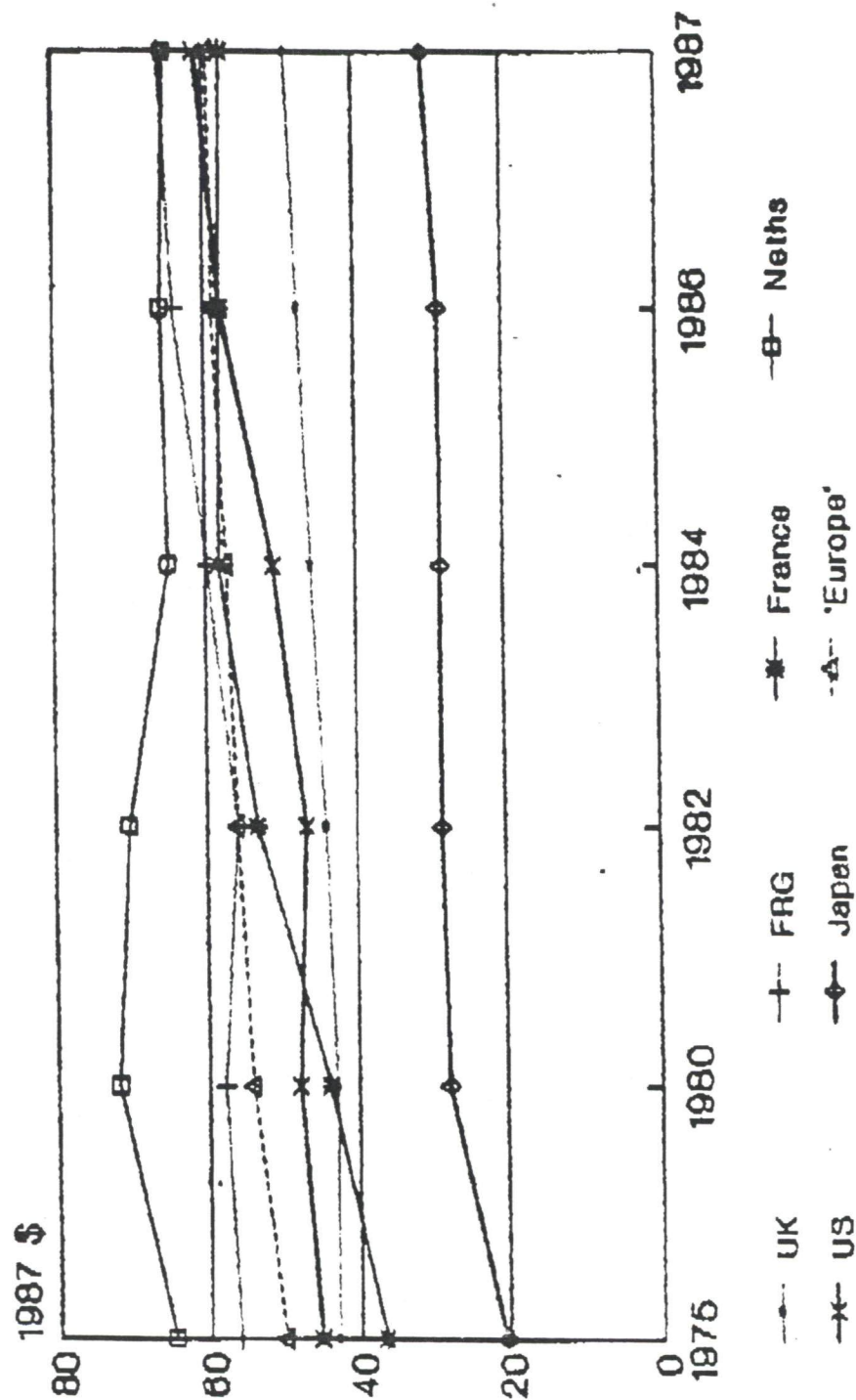
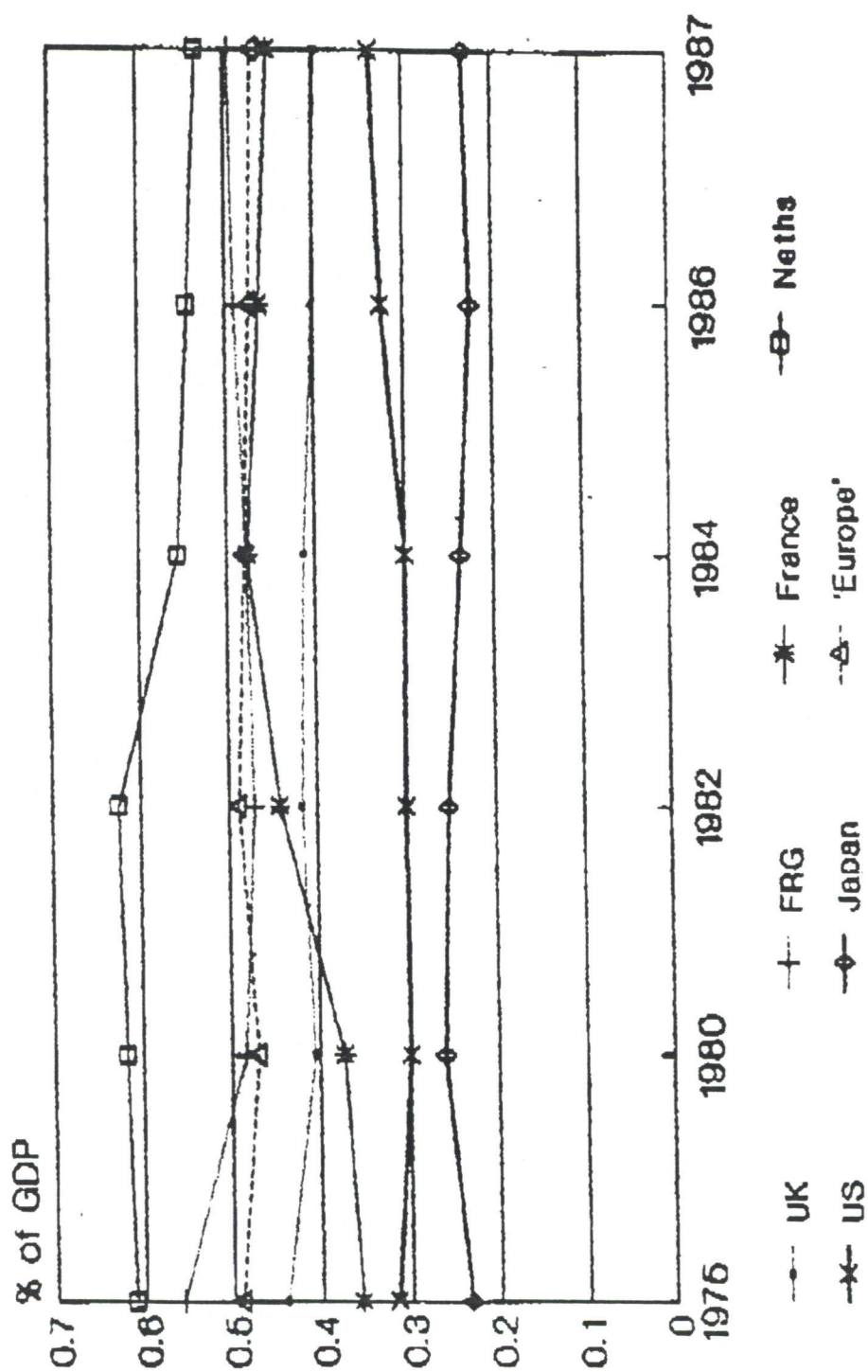


FIG 3 TRENDS IN EXPENDITURE AS % OF GDP



**FIGURE 4 RELATIVE EXPENDITURE PRIORITIES
FOR THE US (Breakdown by field, 1975-87)**

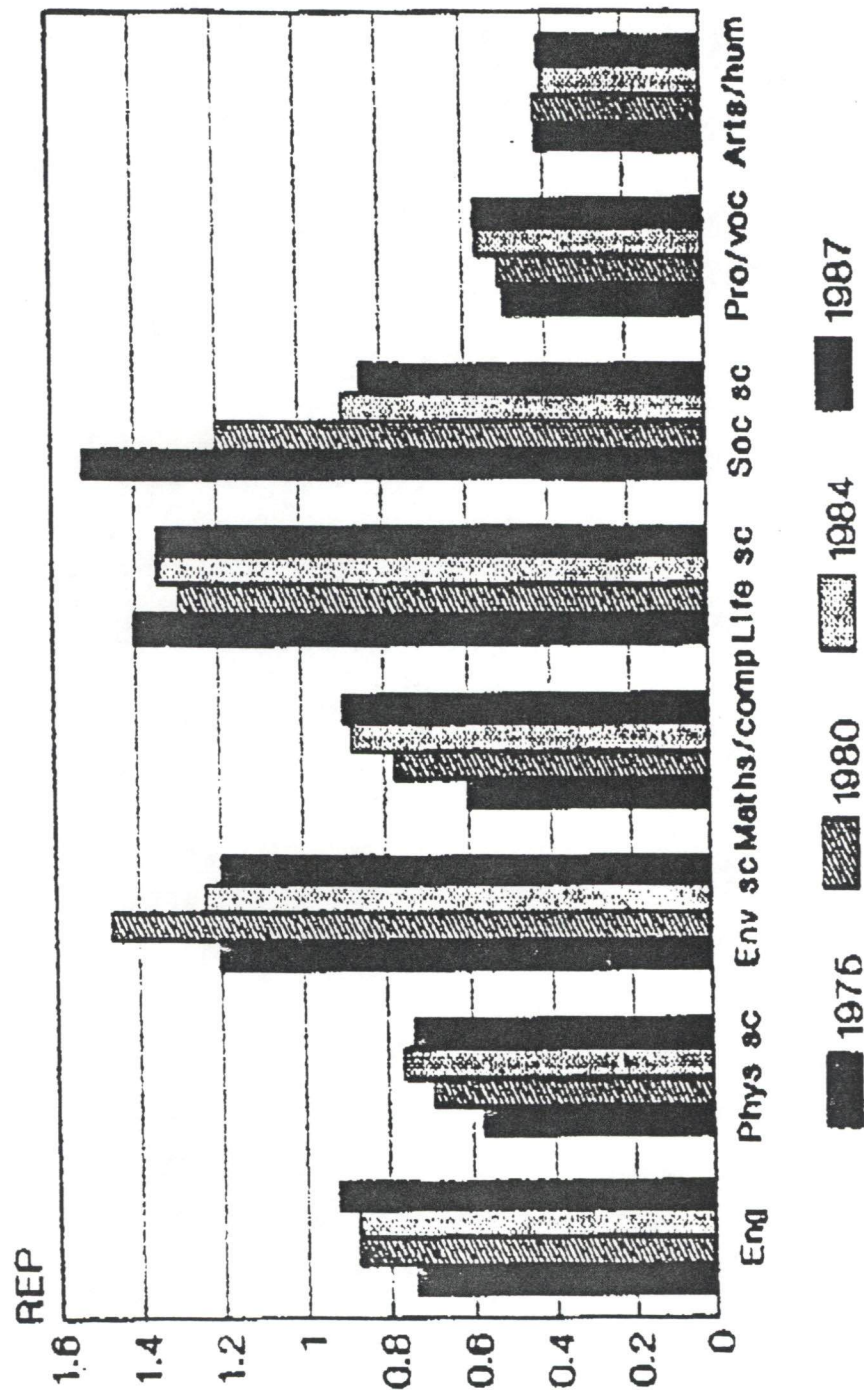
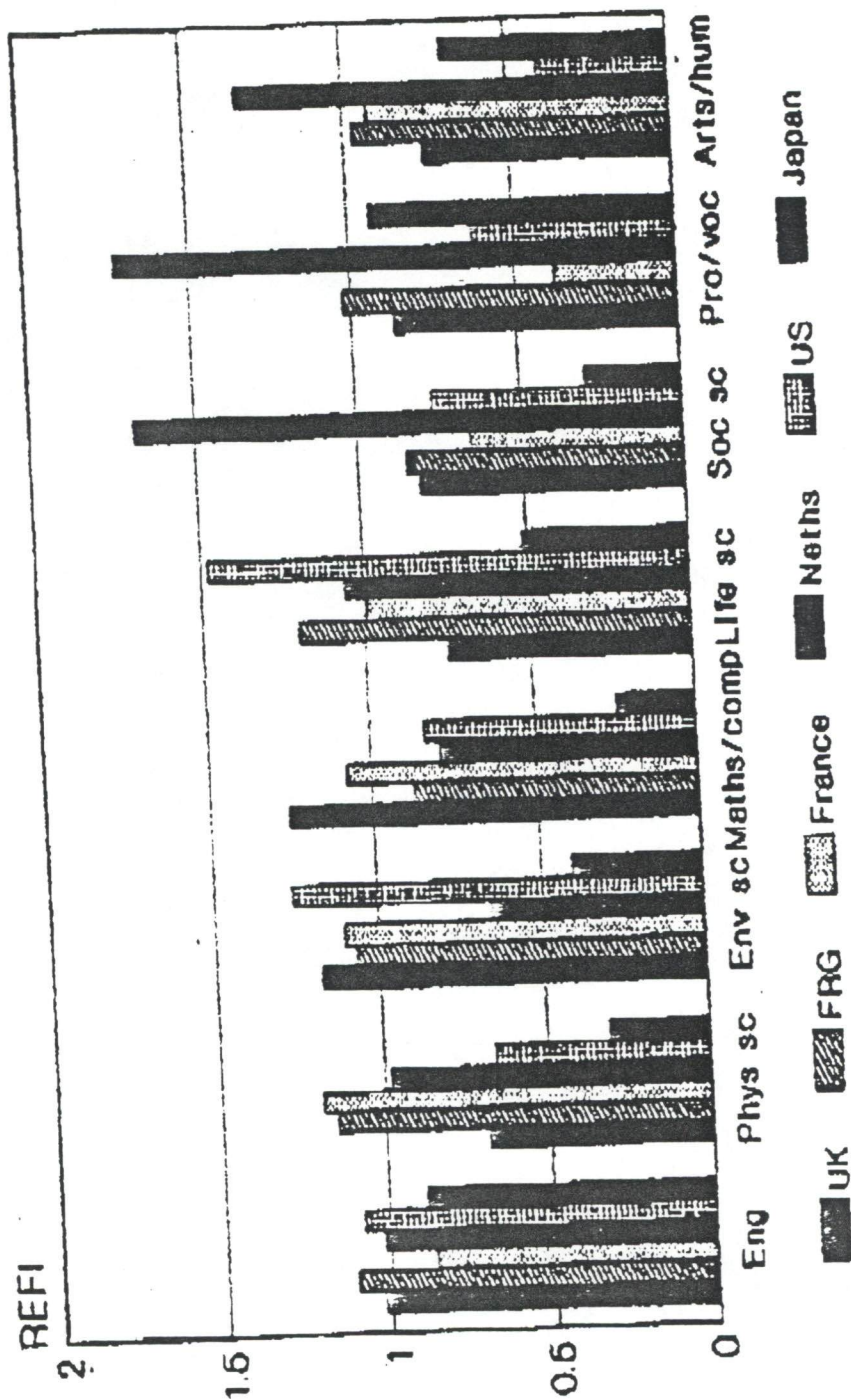
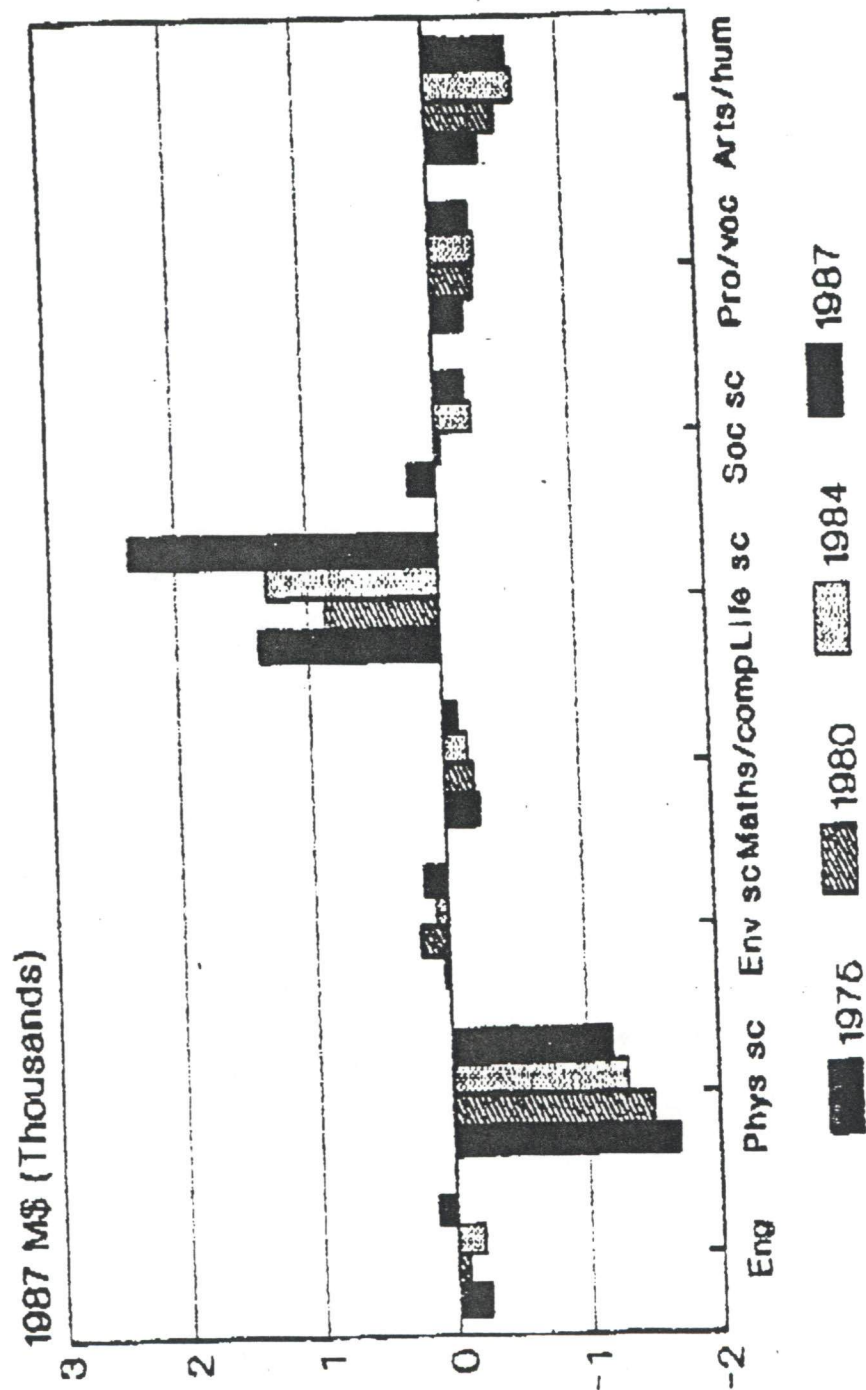


FIGURE 5 RELATIVE EUROPEAN FUNDING INDEX
Breakdown by Field in 1987



**FIGURE 6. US EXPENDITURE COMPARED WITH
'EUROPE' (per capita based divergence)**



**FIGURE 7. US EXPENDITURE COMPARED WITH
'EUROPE' (Divergence on GDP basis)**

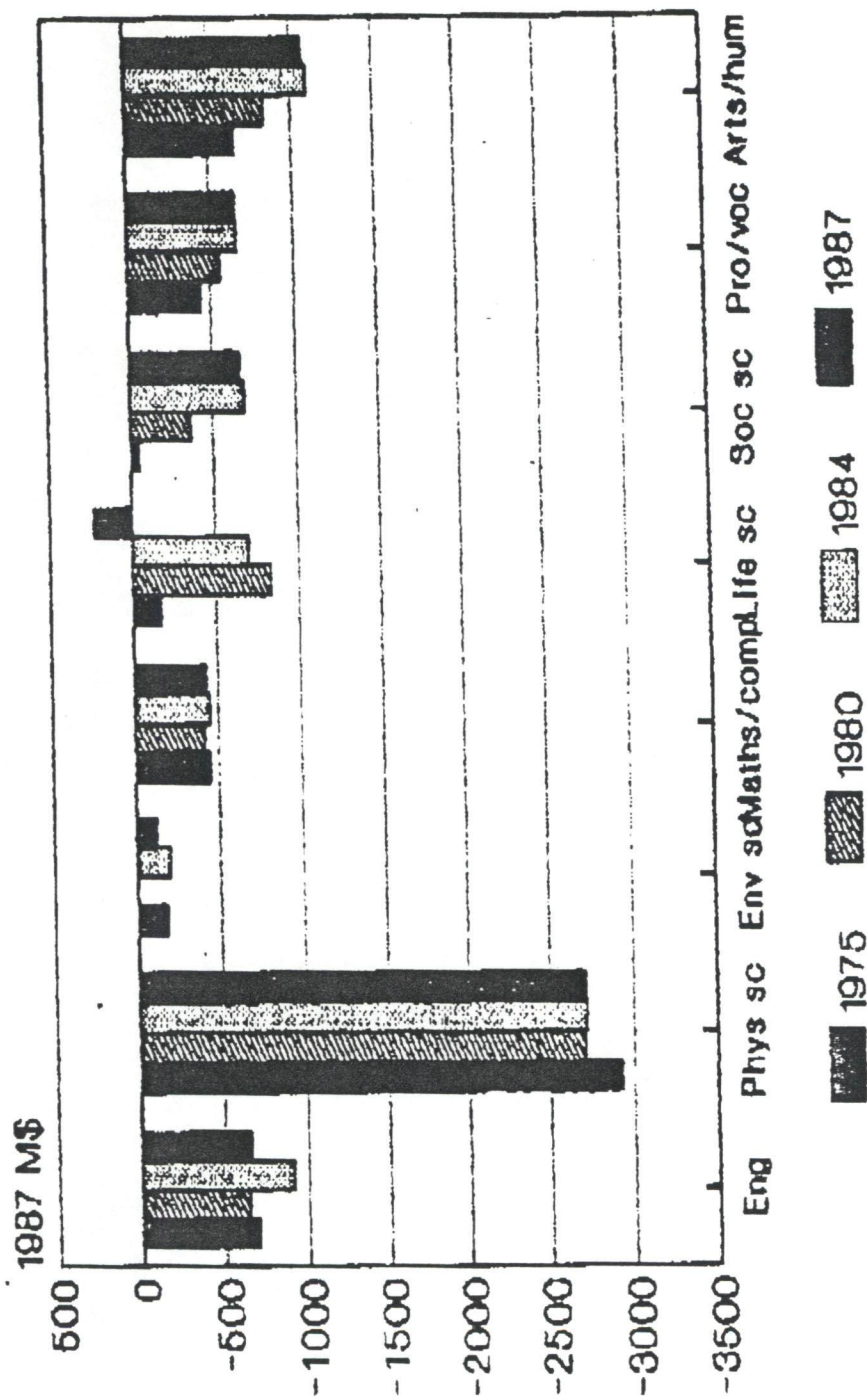


Table 1. Government funding of academic and related research (1987 \$millions)

		1975	1980	1982	1984	1985	1987	% change 1980-87
General university funds (GLF)	UK	1,333	1,368	1,407	1,400	1,461	1,487	10%
	FRG	2,037	2,040	1,928	1,992	2,047	2,125	4%
	France	533	746	931	996	966	966	28%
	Netherlands	624	686	706	620	613	591	-14%
	'Europe' subtotal	4,527	4,824	4,972	5,008	5,088	5,158	7%
	US	1,775	2,056	2,184	2,509	2,872	3,097	51%
	Japan	1,606	2,180	2,322	2,306	2,329	2,512	15%
Academic separately budgeted research (ASBR)	UK	339	435	448	513	540	585	35%
	FRG	577	569	576	591	689	730	24%
	France	626	713	840	935	962	964	39%
	Netherlands	102	144	141	152	177	191	33%
	'Europe' subtotal	1,645	1,861	2,012	2,190	2,368	2,500	33%
	US	6,928	7,468	7,365	7,807	9,244	9,693	32%
	Japan	483	771	792	828	824	888	15%
Academic- ally related research (ARR)	UK	744	633	638	688	703	726	15%
	FRG	889	934	954	1,077	1,165	1,182	27%
	France	770	907	1,131	1,272	1,271	1,262	39%
	Netherlands	158	190	162	166	170	175	-7%
	'Europe' subtotal	2,531	2,653	2,885	3,203	3,329	3,345	26%
	US	1,057	1,355	1,337	1,795	1,875	1,915	38%
	Japan	187	284	253	284	317	335	18%
Total	UK	2,417	2,422	2,493	2,601	2,704	2,797	16%
	FRG	3,473	3,563	3,456	3,661	3,921	4,037	13%
	France	1,929	2,365	2,911	3,203	3,219	3,212	36%
	Netherlands	884	1,018	1,008	937	980	968	-6%
	'Europe' subtotal	8,703	9,368	9,869	10,402	10,805	11,004	17%
	US	9,790	10,910	10,905	12,112	13,991	14,905	37%
	Japan	2,276	3,235	3,373	3,418	3,470	3,725	15%

* Spending in national currencies was converted to US dollars using OECD 'purchasing power parities' for 1987 calculated in early 1989.

Superseded by Figures 2 and 3

Table 2. Total government funding adjusted for country size

		1975	1980	1982	1984	1985	1987	% change 1980-87	
Expenditure per capita (1987 dollars)	ppp basis *	UK	43.0	43.0	44.3	46.0	47.6	49.1	14%
		FRG	56.2	57.9	58.1	59.8	64.2	66.0	14%
		France	36.6	43.9	53.4	58.3	58.1	57.7	32%
		Netherlands	64.7	72.0	70.4	66.0	65.9	65.3	-9%
		'Europe' *	50.1	54.2	56.1	57.3	59.0	59.5	10%
		US	46.3	47.9	46.9	51.1	57.9	61.1	28%
		Japan	20.4	27.7	28.5	28.8	28.6	30.6	10%
	OECD basis +	UK	40.9	40.9	42.1	43.8	45.3	46.7	14%
		FRG	77.1	79.4	76.9	82.1	88.1	90.5	14%
		France	45.2	54.3	66.1	72.1	71.8	71.4	32%
Expenditure as a percentage of GDP		Netherlands	76.5	85.1	83.3	76.8	77.9	77.2	-9%
		'Europe' *	59.9	64.9	67.1	68.7	70.8	71.5	10%
		US	46.3	47.9	46.9	51.1	57.9	61.1	28%
		Japan	30.1	40.9	42.1	42.1	42.2	45.2	10%
		UK	0.439	0.406	0.418	0.413	0.402	0.398	-2%
		FRG	0.556	0.484	0.472	0.479	0.490	0.496	2%
		France	0.355	0.373	0.443	0.477	0.462	0.453	21%
		Netherlands	0.611	0.618	0.625	0.556	0.543	0.532	-14%
		'Europe' *	0.490	0.470	0.489	0.481	0.474	0.470	0%
		US	0.315	0.299	0.300	0.300	0.325	0.336	12%
		Japan	0.233	0.260	0.254	0.238	0.225	0.232	-11%

* Converted to US dollars using OECD 'purchasing power parities' (PPPs).

+ Converted to US dollars using OECD official exchange rates (OERs).

* Unweighted average for the four European countries.

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3

X Table 2. Breakdown of academic and related research by field, 1987 (1987 \$4) *

	UK	FRG	France	Maths	'Europe'	US	Japan	Average +
Engineering	436 15.6%	505 12.5%	359 11.2%	112 11.7%	1,412 12.8%	1,966 13.2%	809 21.6%	14.3%
Physical sciences	565 20.2%	1,015 25.1%	995 29.7%	208 21.7%	2,743 24.9%	2,325 15.6%	543 14.5%	21.2%
Environmental sciences	188 6.7%	183 4.5%	172 5.3%	27 2.8%	570 5.2%	869 6.8%	135 3.7%	4.8%
Maths and computing	209 7.5%	195 3.9%	175 5.4%	34 3.5%	574 5.2%	596 4.0%	88 2.3%	4.4%
Life sciences	854 30.9%	1,483 36.7%	1,116 34.7%	313 32.7%	3,776 34.3%	7,265 48.9%	1,251 33.7%	36.3%
Social sciences (and psychology)	187 6.7%	210 5.2%	146 4.6%	99 10.4%	642 5.8%	754 5.1%	145 3.9%	6.0%
Professional and vocational	161 5.7%	203 5.0%	67 2.1%	82 8.5%	513 4.7%	490 3.3%	369 9.9%	5.8%
Arts and humanities	184 6.6%	251 6.2%	218 6.8%	83 8.6%	735 6.7%	411 2.8%	368 9.6%	6.8%
Multidisciplinary	6 0.2%	32 0.8%	3 0.1%	1 0.1%	42 0.4%	217 1.5%	28 0.8%	0.6%
Total	2,738 100%	4,037 100%	3,212 100%	968 100%	11,005 100%	14,904 100%	3,735 100%	100%

* Converted US dollars using OECD 'purchasing power parities'.

+ Unweighted average for the six countries.

Replaced by Figure 4

Table 4. Trends in relative expenditure priorities for the United States, 1975-87 *

	1975	1980	1982	1984	1986	1987	% change 1980-87
Engineering	0.74	0.87	0.91	0.87	0.91	0.92	6%
Physical sciences	0.58	0.69	0.70	0.76	0.75	0.74	7%
Environmental sciences	1.21	1.47	1.35	1.24	1.24	1.20	-18%
Maths/computer science	0.60	0.78	0.80	0.88	0.91	0.90	16%
Life sciences	1.40	1.30	1.32	1.35	1.35	1.35	4%
Social sci and psychology	1.52	1.20	1.01	0.89	0.85	0.85	-29%
Professionals/vocational	0.50	0.51	0.52	0.57	0.55	0.57	11%
Arts and humanities	0.42	0.42	0.43	0.40	0.40	0.41	-3%

Figures used
in Figure 4

* The relative expenditure priority for field A in country X is defined as the percentage share of spending by country X on field A divided by the average share of spending by all six countries on field A.

Table 5. Changing emphasis on different research support mechanisms, 1975-87

		1975	1980	1982	1984	1986	1987	% change 1980-87
ASBR/GUF index ASBR/(ASBR+GUF)	UK	0.203	0.243	0.241	0.268	0.270	0.282	16%
	FRG	0.221	0.224	0.230	0.229	0.252	0.256	14%
	France	0.540	0.489	0.477	0.484	0.504	0.510	4%
	Netherlands	0.141	0.173	0.185	0.197	0.224	0.244	41%
	'Europe'	0.267	0.280	0.288	0.304	0.319	0.327	16%
	US	0.796	0.784	0.772	0.757	0.763	0.762	-3%
ASBR/APR index ASBR/(ASBR+APR)	Japan	0.231	0.261	0.284	0.264	0.281	0.283	0%
	UK	0.313	0.407	0.412	0.427	0.435	0.446	10%
	FRG	0.402	0.387	0.376	0.354	0.388	0.382	-1%
	France	0.448	0.440	0.429	0.423	0.436	0.441	0%
	Netherlands	0.393	0.431	0.408	0.478	0.500	0.521	21%
	'Europe'	0.394	0.434	0.411	0.406	0.418	0.428	3%
	US	0.864	0.844	0.847	0.813	0.831	0.838	-1%
	Japan	0.721	0.731	0.754	0.744	0.722	0.726	-1%

Replaced by Figure 5

Table 6. Indicators of divergence in national research expenditures in 1987 derived from Relative European Funding Index (on a per Capita and PPP basis) *

		'European'					
		UK	FRG	France	Netherlands	US	Japan average +
Expenditure (1987 \$ per capita)	Engineering	7.7	8.2	6.5	7.6	8.1	6.6
	Physical sciences	9.9	16.6	17.2	14.2	9.5	6.4
	Environmental sciences	3.3	3.0	3.1	1.8	3.5	1.1
	Maths and computing	3.7	2.5	3.1	2.3	2.4	0.7
	Life sciences	15.2	24.2	28.1	21.4	29.9	10.3
	Social sci and psychology	3.3	3.4	2.6	6.8	3.1	1.2
	Professional/vocational	2.8	3.3	1.2	5.5	2.0	3.0
	Arts and humanities	3.2	4.1	3.9	5.6	1.7	2.9
	Multidisciplinary	0.1	0.5	0.1	0.0	0.9	0.2
Total		49.1	66.0	57.7	65.3	61.1	30.6
Relative European Funding Index (REFI)	Engineering	1.02	1.10	0.86	1.02	1.08	0.88
	Physical sciences	0.69	1.15	1.19	0.98	0.66	0.31
	Environmental sciences	1.18	1.07	1.10	0.65	1.26	0.40
	Maths and computing	1.26	0.87	1.08	0.79	0.84	0.25
	Life sciences	0.75	1.20	0.99	1.05	1.48	0.51
	Social sci and psychology	0.81	0.86	0.65	1.68	0.77	0.29
	Professional/vocational	0.87	1.03	0.37	1.73	0.62	0.94
	Arts and humanities	0.77	0.97	0.93	1.33	0.40	0.69
	Multidisciplinary	0.55	2.88	0.34	0.22	4.92	1.28
Total		0.83	1.11	0.97	1.10	1.03	0.51
Divergence from expected expenditure (1987 \$)	Engineering	10	50	-80	0	180	-110
	Physical sciences	-260	130	150	0	-1200	-1220
	Environmental sciences	30	10	20	-10	180	-210
	Maths and computing	40	-20	10	-10	-110	-270
	Life sciences	-290	250	-10	20	2360	-1210
	Social sci and psychology	-40	-40	-80	40	-230	-350
	Professional/vocational	-20	0	-110	30	-300	-30
	Arts and humanities	-80	-10	-20	20	-620	-160
	Multidisciplinary	0	20	-10	0	170	10
Total		-590	390	-100	80	380	-3530

* Converted to US dollars using OECD 'purchasing power parities'.

+ Unweighted average for the four European countries.

- Because of rounding to the nearest \$10 million, details may not sum to totals.

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Figures used in Figure 5

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Table 7. Indicators of divergence in US research expenditure for 1975-87 derived from 'Relative European Funding Index' *

		1975	1980	1982	1984	1986	1987	Change Since 1975
Calculated on a per capita basis using PPPs +	Engineering	-240	-90	-150	-200	10	140	230
	Physical sciences	-1700	-1500	-1550	-1310	-1220	-1200	300
	Environmental sciences	40	220	110	90	170	180	-40
	Maths and computing	-250	-220	-220	-150	-130	-110	110
	Life sciences	1380	870	730	1310	2000	2360	1480
	Social sci and psychology	220	-40	-240	-280	-290	-230	-150
	Professional/vocational	-240	-320	-350	-340	-330	-300	20
	Arts and humanities	-390	-520	-610	-650	-640	-620	-100
	Multidisciplinary	150	170	170	100	140	170	0
	Total divergence *	-1030	-1430	-2130	-1470	-260	380	1810
Calculated on a % of GDP basis	Engineering	-700	-640	-700	-910	-770	-660	-20
	Physical sciences	-2930	-2710	-2700	-2720	-2690	-2720	-10
	Environmental sciences	-180	0	-100	-200	-120	-120	-120
	Maths and computing	-450	-420	-420	-450	-440	-430	-10
	Life sciences	-170	-830	-960	-700	-100	230	1050
	Social sci and psychology	-50	-370	-590	-690	-690	-670	-300
	Professional/vocational	-440	-550	-600	-650	-680	-650	-90
	Arts and humanities	-650	-840	-950	-1100	-1090	-1070	-230
	Multidisciplinary	140	150	160	80	120	150	10
	Total divergence *	-5440	-6220	-8960	-7340	-6460	-6930	290

Figures
used in
Figure 6

Figure 7

* Expected expenditures were calculated using unweighted averages (i.e. not adjusted to take into account the differing sizes of countries).

+ National currencies were converted to US dollars using OECD 'purchasing power parities'.

* Because of rounding to the nearest \$10 million, details may not sum to totals.

THE WHITE HOUSE

WASHINGTON

July 13, 1990

File:
Watkins

Dear Jim:

This is a belated reply to your letter of June 6 concerning your thinking about DOE support of individual investigators.

I am entirely in agreement with your feelings here and I would certainly be supportive of an initiative on the part of DOE to bolster its support of such investigators, both in the university and in the private sector.

I should tell you that for 30 years prior to coming to Washington I was a loyal customer of DOE and was able to build the A. W. Wright Nuclear Structure Laboratory at Yale from scratch with DOE support beginning back in 1963. Over this extended period I had reason also to be involved with all the other Washington funding agencies while I served as Chairman of Yale's Physics Department responsible for some 5 to 7 million dollars worth a year in Federal grants and contracts. I can tell you that consistently over this period working with DOE was vastly more satisfying from the point view of a university researcher and administrator than was the case with any other Washington agency. The people with whom we dealt in the Office of Energy Research were uniformly of very high caliber and truly understood what the nature of a university was and should be. This was anything but the case in some of the other agencies.

I do believe that there is a level of pain in the community deeper than any I have seen in the post-war period.

In substantial measure this reflects the fact that both NSF and NIH have in response to perfectly reasonable requests from the community extended both the duration and magnitude of their grants and contracts so that they have established an out-year mortgage which this year has come home in a major way. Beyond that, it is important to emphasize that the usually used parameter--the so-called success rate--is very much open to manipulation. Over the past two years, for example, if we focus only on the investigators who were successful in having an NSF proposal funded, we find that on average these individuals submitted 1.9 proposals to NSF and that their success rate in the usual measure was 150 percent, i.e., 50 percent of the second proposals submitted by successful proposers were also funded.

Another manipulation comes in the reviewing and study group area. At NIH, for example, a few years ago something approaching 67 percent of all the proposals submitted were deemed excellent. Now the percentage exceeds 95 and I am quite confident that this does not reflect a startling increase in the quality of the proposals but rather an attempt on the part of people of good will to help the investigator where they believe help is required.

I am strongly in favor of increased emphasis within DOE in this area. Just to give a few numbers, in 1969, DOE and NSF jointly supported 90 small accelerator-based projects at American universities with then AEC the dominant supporter. Currently this number has shrunk to 11, with DOE supporting 5 and I am substantially worried that the production line in the academic world for producing bright young scientists in nuclear physics is slowly drying up. For the last many years my own old laboratory at Yale turned out more PhDs in experimental nuclear physics than did any other institution in the world, again with DOE support. While there has been a perfectly natural trend on the part of university faculty members and students to do some of their work at the facilities, primarily at the DOE national laboratories, it is still true that students tend to be attracted by activities that take place on the home campus and once attracted and given some training on that campus, they then can quite profitably, in many cases, go off to take advantage of the superb facilities that we have in the national laboratories. Lacking any home base, however, it is very difficult to attract the best students.

While the emphasis in much of the discussion has been on individual investigators, I would want to make a strong case for continued and perhaps emphasized DOE and NSF support of small groups of university researchers who have chosen to pool their resources and activities and function under block grants. This gives the researchers supported under such grants a degree of flexibility that is simply not possible with individual grants, and over a period of years makes it possible to build up a stable of highly skilled technical support personnel as well as a reservoir of equipment and instrumentation that again simply is not possible under the confines of an individual grant or contract.

One of the major problems faced by university researchers in the recent past has been the fact that with funding becoming increasingly tight individuals groups protected their most precious resource, namely their people, associates and students, while deferring any purchase of new equipment and instrumentation. That being the case, it is now almost universally true that universities have far less modern and far less extensive instrumentation for research than does the corresponding laboratory in the industrial world. This in itself is making it increasingly difficult to retain students in academia, following their education and training, where they are desperately needed as members of a faculty that is soon to unravel as the large group of individuals first given tenure in the late '50s and early '60s begin retiring as they are now doing.

DOE took a major leadership position in this area a few years ago, at least in the nuclear physics field, and managed to provide a specific fund to improve the instrumentation in the laboratories that it supports at universities. This made all the difference in the world in the capability of these laboratories and, quite frankly, in their ability to attract the best students. I saw this very clearly in my own laboratory. I would think that expansion of such a program across the spectrum of activities in DOE aimed at individual investigators and small groups of investigators operating under block grants or contracts would bear handsome dividends.

In addition, a substantial expansion of DOE's support for individual and small group investigators in the basic energy sciences, particle physics, and nuclear physics, would assist in what I hope will be a government wide initiative to address the shortage of funds for such support in Fiscal year 1992. This is a period when we as a nation in our own self interest want to attract some of the brightest and best young people into academic careers to train the next generation of young scientists and engineers. The message that they are receiving from their mentors and from their own reading of the tea leaves at the present time, is not an encouraging one. We have been losing many of the people whom under normal circumstances we might have expected to stay in academic positions. Anything that DOE can do in this way will certainly gain my very strong support and it is my impression that Dick Darman and OMB will be very interested in initiatives in this area because they too recognize that this is a serious problem for the nation.

I congratulate you on this initiative as on so many others that you have undertaken since you have taken up the leadership of the Department of Energy.

With warmest best wishes, let me know whenever I can be of help,

Sincerely yours,

A handwritten signature in dark ink, appearing to read "D. Allan Bromley". The signature is fluid and cursive, with the first name "D. Allan" and last name "Bromley" clearly distinguishable.

D. Allan Bromley
Assistant to the President
for
Science and Technology

The Honorable James D. Watkins
Department of Energy
1000 Independence Avenue, Southwest
Washington, D.C. 20585

THE WHITE HOUSE

WASHINGTON

August 2, 1990

MEMORANDUM FOR C. BOYDEN GRAY

FROM: D. ALLAN BROMLEY *Daan*
SUBJECT: OSTP ASSOCIATE DIRECTORSHIP FOR
THE LIFE SCIENCES

Again, at Chase Untermeyer's suggestion, I am writing to request that an announcement of the President's intent to nominate Donald A. Henderson as the OSTP Associate Director for Life Sciences be made as soon as possible.

A number of open issues were left when Jim Wyngaarden resigned July 1 to accept the Foreign Secretaryship of the National Academy of Sciences and I would want to bring Henderson on as a consultant to pick them up as soon as possible prior to confirmation.

The announcement would again eliminate confusion and speculation.

Your help will be much appreciated.

cc: Chase Untermeyer

THE WHITE HOUSE

Sept 11, 1991

Mr. Campanillo said.

Panel Says Nation Har

WASHINGTON, Sept. 6 (AP) — If global warming caused by human activity makes the world significantly hotter, the United States should be able to adapt at a reasonable cost, a panel of the National Academy of Sciences said.

Dear Roger = (Porter)
I don't have the report caption yet
but here with the NVT article and
the Preface, findings and
Recommendations of the NAS
Ewan's subpanel.
Best regards
Alan

ing about these other costs," she wrote. The panel recommended diversifying water supplies, improving insulation in buildings and encouraging conservation of as many animal species as possible as "a natural protection against surprises and shocks, climatic or otherwise." change might force endangered species to migrate, the report said, "conservation efforts to give more attention to corridors for movement, to assisting species to overcome barriers, and to maintaining natural environments when their natural species are threatened." The panel is one of four working together on a National Academy of Sciences study of policy implications of concern about global warming, on "synthesis," another panel, one on "adaptation," and a report in April, saying the United States should take modest steps to limit production of greenhouse gases, despite uncertainty about the threat of global warming. Those who take sides in the debate, those who believe immediate action and those who believe such measures are too costly, praised the report and said it supported their arguments. Greenhouse gases, like carbon dioxide, methane and chlorofluorocarbons,

paperback—the sequel to Joshua

Joshua and the Children continue his million-copy bestselling series. When Joshua enters an ordi-

Joshua

Sensitive regions. Environmental Damage Likely But the Texas Land Commissioner.

Roger Porter

Strain on Developing Countries The report said it might be harder for developing countries to adapt to global warming. It encouraged "efforts to advance regional mobility of people, buildings are one to three decades."

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Weather Watch

THE WHITE HOUSE

Sept 11, 1991

Dear Roger - (Porter)

I don't have the report copied yet but here with the NVT article and the Preface, Findings and Recommendations of the NAS Evans's subpanel.
Best regards
Alan

Mr. Campanello said.

Panel Says Nation Has Ability to Adapt to Global Warming

WASHINGTON, Sept. 6 (AP) — If global warming caused by human activity makes the world significantly hotter, the United States should still be able to adapt at a reasonable cost, a panel of the National Academy of Sciences said.

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at with violence, he transforms by working through the child-like, rival factions plotting to good works, the way is paved; conclusion that turns into a on of hope.

trap heat around the earth. The academy's synthesis report said that growing amounts of industrial emissions were likely to increase temperatures by 2 to 9 degrees Fahrenheit by the middle of the next century.

The adaptation panel, headed by Paul E. Waggoner, distinguished scientist of the Connecticut Agricultural Experiment Station in New Haven, found no cause for alarm. "The historical evidence suggests that American farmers can keep up with the gradual climate change of the magnitude the panel assumes," the report said. "The capacity of humans to adapt is evident in the rapid technological, economic and political changes of the past 90 years," the panel said. "The average renewal period for machinery and equipment and the average age of buildings are one to three decades."

Strain on Developing Countries The report said it might be harder for developing countries to adapt to global warming. It encouraged "efforts to advance regional mobility of people."

The report said it might be harder for developing countries to adapt to global warming. It encouraged "efforts to advance regional mobility of people."

capital and goods," better preparations for disaster and famine relief and expansion of free-market economies, so that changing prices can serve as market signals that would encourage people to adapt to global warming.

The committee concluded that even low-lying cities would be able to survive global warming, but said there seemed to be little that humanity could do to help the marine environment adapt to climate change.

The report also finds a silver lining in the greenhouse effect, saying that a cooling of the same magnitude "would crush the upper Midwestern United States under ice."

"None of the projected effects of the warming would make large areas uninhabitable," the committee wrote. "So while we complain about the uncertainty of warming by greenhouse gases, we should not forget that it would make any effects from cooling, which was a subject of some scientific, public and Congressional concern in the early 1970's, less likely."

Roger Porter

JOSHUA

Sensitive Subjects. Environmental Damage Likely But the Texas Land Commissioner.

Worthen West