## Index

Acheson, Dean, xiii, 75 Adams, Roger, 15(photo) AEC, see Atomic Energy Commission AFOSRD, see Air Force Office of Scientific Research and Development Agricultural research, 97-98 Aircraft industry, 1-2; creation of National Advisory Committee for Aeronautics, 2; failure of nuclearpowered aircraft development, 118-119; minimal federal assistance in development of, 109; NASA support for, 146-147, 170; SST program, 146-147; wind tunnels, 98 Air Force Office of Scientific Research and Development (AFOSRD), 98 Alamogordo, NM, 27 Aldrin, Edwin E. ("Buzz"), 147, 148(photo)

Allen, Ernest M., 82(photo), 87, 88(photo), 123 American Red Cross, 16-17 Ames Aeronautical Laboratory, 170 Antibiotics, 17 Apollo project, 104-108, 146-149 Applied Physics Laboratory (Johns Hopkins), 12, 14 Applied sciences: distributed to other directorates of NSF, 165; excluded from Bush proposal, 92-93; explicit directives to NSF, 141; Interdisciplinary Research Relevant to Problems of Our Society program, 141-142; Research Applied to National Needs program, 141-143 Argonne National Laboratory, 66-67; nuclear submarine development, 110; operated by University of

120, 135-140

Argonne National Laborator (con't) Bacher, Robert F., 61(photo), 68, 72, 116 Chicago, 67; reactor development, Battle of the Bulge, 14, 26 Bauman, Robert, 161–162 64, 112 Baxter, James Phinney, III, 9 Armstrong, Neil, 147, 148 Bell, Alexander, 100 Army, U. S.: and debate over postwar control of atomic power research, Bethe, Hans, 116 56, 59–60, 62; Explorer satellite, 101; Bettis Laboratory, 110 and Manhattan Project, 20, 24-25; "Bigger bang for the buck" concept, 152 and medical advances during World Bikini Atoll test, 74 War II, 17; Office of Ordnance Biological sciences: cell biology, 122, 173; Research (OOR), 98 human genome project, 189-190; Artillery, 11-14 NIH research divisions, 121; and Associated Universities, Inc., 67 NSF, 95; social sciences funded by Astronomy, see National Aeronautics NSF as, 97; see also Medical research; and Space Administration National Institutes of Health Bloch, Erich, 166 Atkinson, Richard C., 161-163, 166 Blood and blood derivatives, 16-17, 44 Atomic bomb: Manhattan Project, 18-35; and radiation effects, 122; Bohr, Niels, 44-45 Smyth report, 29-33; Soviet devel-Borden, William L., 75-76 opment of, 70-71; Trinity test, 27; Bowen, Harold G., 78-79 use at Hiroshima and Nagasaki, Bradbury, Norris, 66 27–29; see also Nuclear weapons Breit, Gregory, 10 Atomic Energy Act, 63, 109, 116 Briggs, Lyman J., 19, 21(photo) Atomic Energy Commission (AEC): Brobeck, William M., 69(photo) abolition under Energy Reorganiza-Bromley, D. Allan, 200 tion Act, 139; commercial power Brookhaven National Laboratory, 67 generation, 108-120, 135-140; control Brown, Harold, 116 of Manhattan Project, 68; debate Bryan, Richard, 181 over postwar control of research, Buckley, Oliver E., 72, 200 55-63; and development vs. renunci-Budget, 4; Bush's estimates for NSF, ation of nuclear weapons, 73; early 50(table); Bush's proposal for manacts, 68, 70; and hydrogen bomb, agement of, 51-52; cost of DOE 70-77; and ONR, 83; and Oppenfacilities cleanup, 182; cost of Manheimer investigation, 76-77; and hattan Project, 34(table); cost of research laboratories construction, particle accelerators, 83, 120, 185, 67; cost of space program, 104, 203-205 Atomic Energy for Military Purposes 147-148; cost of Superconducting (Smyth), 29, 31, 32(photo), Super Collider, 187-189; decreased 33(photo) resources for medical research, Atoms for Peace program, 115-116, 119, 173-174; decreases during Vietnam

War, 134, 141, 144; distribution of

total funds, 206-207, 211; for DOE, 155; early government grants for basic research, 66; "enough" funding question, 199-200, 202; funding from private industry, 211; future of, 206-211; geographical distribution of funds, 92-93, 96, 128, 143; for human genome project, 190; increases after Sputnik, 129; justifications for particle accelerators, 185, 187; for medical research after World War I, 85; NACA's early budget, 2; for NASA, 104; for NIH, 87, 89, 120-125, 126(table), 134, 176, 196, 198; for NRC, 85; for NSF, 94-95, 97, 127-130, 134, 141-142, 160-161, 200-201; proposal for increased involvement of university scientists in science policy, 207-210, 212-213

Bush, George, 183

Bush, Vannevar, 2-3, 7, 9, 34-41, 41(photo), 200; background of, 36-37; at Carnegie Institution, 36; letter to Truman, 47-48; and May-Johnson bill, 55-56, 58; at MIT, 36; at NACA, 37; and NSF proposal, 92-94; and origins of NDRC, 8, 20, 37; and OSRD, 37; personal characteristics, 35–36; Pieces of the Action, 37, 39, 41; and Policy Committee, 24; and postwar control of atomic research, 55-56, 58; Roosevelt's letter to, 3, 45-47; as science adviser to Roosevelt, 3, 34; Science: The Endless Frontier, 3, 35, 39-40, 44-54, 153; and Stimson, 30, 35; and Truman, 37, 39

Caltech, 2 Cambridge Electron accelerator, 205 Campbell, Levin, 14 Carbide and Carbon Chemicals Corporation, 26 Carnegie Institution, 7, 10, 12, 36, 84 Carnegie-Mellon University, 83 Carpenter, Scott, 106(photo) Carter, Jimmy, 150, 151, 154-160 Cell biology, 122, 173 Chadwick, James, 29 Chaffee, Roger B., 172 Challenger disaster, 171-173, 191 Chernobyl, 180-181 Churchill, Winston, 38(photo) Clements, William, 186(photo) Clinton, Bill, 183, 200 Clinton Engineer Works, 25(photo), 26, 34(table), 67 CMR, see Committee on Medical Research Coe, C. P., 15(photo) Cohn, Edwin, 17 Cold War, 99–104, 112–113, 118, 132–133 Collins, George B., 69(photo) Colt, Samuel, 100 Columbia shuttle, 170-171 Columbia University, 18 Committee on Medical Research (CMR), 16-17, 85-86, 94 Communication satellites, 148–149, 191 Compton, A. H., 21(photo), 56, 64, 195 Compton Gamma-Ray Observatory (CGRO), 194-195 Compton, Karl T., 7, 15(photo) Computers, 36 ComSatCorp, 149 Conant, James B., 7, 15(photo), 21(photo), 61(photo); General Advisory Committee membership, 72; and May-Johnson bill, 55-56, 58; and Policy Committee, 24; and

postwar control of atomic research,

Cancer research, 85, 125

Conant, James B. (continued) 55-56, 58; and publication of the Smyth report, 29 Condon, Edward U., 57 Confrey, Eugene A., 124–125 Congress: ambivalence over DOD's involvement with educational institutions, 4; ambivalence toward medical research, 91; attempts at information gathering and regulation of science establishment, 152-153; attempts to assign supervision of governmental science agencies to NSF, 127; and Bush's proposal for a national science foundation, 50-51; creation of NASA, 101-102; creation of National Cancer Institute, 85; creation of NRC, 84; creation of NSF, 54, 92-93; creation of ONR, 79; criticism of NIH over fiscal responsibility, 123-125; criticism of NSF for funding ill-conceived projects, 129, 161; Daddario-Kennedy amendment to NSF charter, 140-143; Energy Reorganization Act, 139; loyalty tests, 89-90; Mansfield Amendment, 150; Military Appropriation Act, 67; and NIH application process, 173-174; Nuclear Waste Policy Act, 181; and postwar control of atomic research, 55-63; reestablishment of presidential science adviser and science office after Nixon resignation, 150; support for agricultural research, 97–98; support for weather research, 98; termination of supercollider funding, 188; Waste Policy Amendments Act, 181

Conlan, John B., 161–162 Cooper, Gordon, 106(photo) Cosmic Background Explorer (COBE), 195–196 Cuban Missile Crisis, 132

Daddario-Kennedy amendment to
NSF charter, 140–143
David, Edward E., 200
Davis, W. Kenneth, 115
Dean, Gordon E., 72, 76
DeLisi, Charles, 188–189
Department of Defense (DOD), 4; and educational institutions, 4, 150; fraction of total governmental R&D funds, 206; and Mansfield Amendment, 150; under Nixon administration, 150; rocket programs, 102; and Vietnam War, 134
Department of Energy (DOE), 4; budget for, 155; and Chernobyl acci-

Department of Energy (DOE), 4; budget for, 155; and Chernobyl accident, 180–181; cleanup of facilities, 182–184; conflicts over nuclear power, 156; creation and history under Carter administration, 154–160; fraction of total governmental R&D funds, 206, 207; human genome project, 189–190; management issues, 160, 182, 183, 190–191; radioactive waste disposal, 181–184; Reagan's attempts to abolish, 159, 160; Superconducting Super Collider, 184–189; Three Mile Island accident, 156–159, 183

Department of Health and Human Services (DHHS), 4

DHHS, *see* Department of Health and Human Services

Disarmament: debate over development vs. renunciation of nuclear weapons, 73–74; and Eisenhower's Atoms for Peace program, 116; "Operation candor," 74; Oppen-

heimer investigation, 74–77; test ban negotiations, 116–118 *Discovery* shuttle, 192(photo) Division of Research Grants (DRG), 91.

Division of Research Grants (DRG), 91, 121–125; creation of, 87; criticisms of application process, 173–174; criticisms of peer review system, 144–145; deluge of applicants, 173–174, 198–199; loyalty tests and revocation of awards without due process, 89–91; organization of, 121–122; reorganization under Confrey, 125; shift in grant system from individual to institutional grants, 122–123; small number of reviewers compared to NSF, 200; understaffing problems, 122–125, 144, 173–174

173–174
Dochez, A. R., 15(photo)
Doctorates in physics, number
awarded, 214
DOD, see Department of Defense
DOE, see Department of Energy
DRG, see Division of Research Grants
Dryden, Hugh L., 104, 147
Dubridge, Lee A., 72, 200
Dulles, John, 117
Duncan, Charles W., Jr., 159
DuPont Company, 26, 63
Duquesne Light and Power Company, 113
Dyer, Rolla, 15(photo), 86–87,

Economy: applied science programs as stimulus for, 141–142; economic benefits of basic research, 52
Edison, Thomas, 78, 100
Education, 3; and Bush's recommendations to the President, 47–49; and "enough" funding question, 202;

88(photo)

MACOS project, 162; NASA support for graduate students, 108; NSF support for graduate students, 96; number of doctorates awarded, 214; ONR support for graduate students, 82; and popular views of science, 100

Einstein, Albert, 18–19, 56

Eisenhower, Dwight: ambivalent position on hydrogen bomb, 74–75;
Atoms for Peace program, 115–116;
and debate over postwar control of atomic power research, 60, 62; Federal Council for Science and Technology, 152; and McCarthyism, 90, 96; NASA creation, 101–102; and nuclear power plant development, 113–114; "Operation candor," 74; and Oppenheimer investigation, 76; and supervision of governmental science agencies, 127; and test ban negotiations, 116–118

Endeavour shuttle, 193

Energy crisis, 135-140

Energy Research and Development Administration (ERDA), 139, 140, 154

Energy technologies, 139, 154–160; *see also* Department of Energy; Nuclear power

ERDA, *see* Energy Research and Development Administration Espionage, 59, 62, 76–77, 118

Extramural grant system, 85–87, 123

Farber, Sidney, 124 "Fat Man," 28(photo)

FCST, see Federal Council for Science and Technology

Federal Council for Science and Technology (FCST), 152

Fermi, Enrico, 19, 72
Feynman, Richard, 172
Fisk, James B., 72, 116
Fletcher, James C., 149
Folsom, Marion, 90–91
Ford, Gerald R., 139, 150, 151
Forrestal, James, 78–79
Fountain, L. C., 124
FSA, see Federal Security Agency
Funding, see Budget
Furer, J. A., 15(photo)

GAC, see General Advisory Committee Gagarin, Yuri, 104 Galileo airliner, 171 Gemini project, 108, 147 Genbank, 189 General Advisory Committee (GAC), 60-62, 210, 212; and development vs. renunciation of nuclear weapons, 73; dismantled under Carter administration, 155; functions of, 155, 156; members of, 61(photo); and particle accelerators, 120; recommendations of, 70 General Electric Company, 64, 67, 110 Geneva Conference (1958), 116-117 Gibbons, John H., 200 Glennan, T. Keith, 72, 102 Glenn, John, 106(photo), 182 Government science agencies: agencies listed, 4; arguments against central-

ization of, 153, 205; and Bush report,

3, 35, 39-40, 44-45, 153; management

issues (see Management issues); proposal for external advisory committees, 212–213, 216; proposal for increased involvement of university scientists, 207–210, 212–213; see also Budget; Grant system; specific agencies

GPS satellites, 191 Graham, William, 200

Grant system, 132; complex application process for medical research, 173-176; congressional review of NSF peer review system, 161-165; deluge of applicants for medical research, 173-174, 198-199; extramural grants for medical research, 85-87, 123; loyalty tests and revocation of awards, 89-91; and McCarthyism, 89-91, 96; Nixon's feuds with science establishment, 143-145; NSF peer review system, 95-96; NSF's use of large number of reviewers, 200; proposal for increased involvement of university scientists, 207-210; public access to review process, 144-146; Sunshine Law, 144-145; see also Peer review system

Gray, Gordon, 76, 77
Green, G. Kenneth, 69(photo)
Grissom, Virgil, 106(photo), 172
Groves, Leslie R., 24, 25(photo); and debate over postwar control of atomic research, 55, 60, 62; and May-Johnson bill, 55; and naval access to Manhattan Project, 79; and postwar creation of research labs, 63–64, 66–70; and publication of the Smyth report, 29
Grumbly, Thomas P., 183

Guggenheim Fund, 2

Hafstad, Lawrence R., 110 Jewett, Frank B., 7, 15(photo) Johns Hopkins University, 12, 14, 194 Hanford Engineer Works, 26, 34(table), Johnson, Edwin C., 55 Harvard University, 16, 17, 205 Johnson, Leonard E., 111(photo) Hastings, A. Baird, 15(photo) Johnson, Lyndon B., 35, 125, 126(photo), Haworth, Leland J., 128, 143 133-134 Heart disease research, 125 Johnston, J. Bennett, 183 Herrington, John S., 182, 186(photo), Joint Committee on Atomic Energy: and commercial power generation, Hickenlooper, Bourke B., 65(photo) 109, 110; and development vs. High energy physics, see Particle accelrenunciation of nuclear weapons, 73; dismantled under Carter adminerators istration, 155; and Oppenheimer Hiroshima, 27-29, 135 Hobby, Oveta Culp, 90 investigation, 75-76 Hornig, Donald, 200 Joliot, Frédéric, 19 Hubble Space Telescope (HST), 193, 194(photo) Karman, Theodore von, 2 Human genome project, 189-190 Keefer, Chester S., 15(photo) Huntsville rocket program, 102 Keenan, Charles H., 69(photo) Hydrogen bomb, 66, 70-77, 112-113 Kennedy, J. F.: and Cold War, 118; Com-Hygienic Laboratory, 84-85 SatCorp, 149; and NIH, 125; and nuclear-powered aircraft program, Idaho Test Site, 110, 112 119; and space program, 104-107, IGY, see International Geophysical Year 146; and SST program, 146; Wiesner Immunization programs, 91–92 as science adviser to, 35, 152 Industrial laboratories, 53 Kenney, W. John, 79 Institutional Support Program (ISP), Keyworth, George A., II, 187, 200 Kilgore, Harvey, 92 Interdisciplinary Research Relevant to Killian, James R., 101, 200 Problems of Our Society program King, Mackenzie, 38(photo) (IRRPOS), 141-142 Kirschstein, Ruth L., 145 International Geophysical Year (IGY), Kistiakowsky, George B., 118, 200 Knapp, Edward A., 166 129 Iowa State University, 170 Knolls Atomic Power Laboratory, 110 IRRPOS, see Interdisciplinary Research Korean War, 74, 95, 99-100 Relevant to Problems of Our Soci-Kyle, William H., 30(photo) ety program ISP, see Institutional Support Program Landsat satellites, 149, 169(photo), 170 Lane, Neal, 200 Japan, 27-29

Lawrence Berkeley Laboratory, 190

Jet Propulsion Laboratory, 2, 102

Lawrence, Ernest O., 21(photo), 24, 31(photo), 65(photo), 66, 69(photo), 77, 116 Lawrence Livermore Laboratory, 119, 190 Lee, Phillip, 126(photo) Libby, Willard F., 72, 117 Lilienthal, David E., 61(photo), 65(photo), 68, 72, 73 Lindsay, Dale R., 123, 124 "Little Boy," 28(photo) Livingston, M. Stanley, 69(photo) Lofgren, Edward J., 69(photo) Logue, Joseph, 69(photo) Long, Franklin, 141 Los Alamos National Laboratory: containment systems research, 119; costs during war, 34(table); creation of, 26; human genome project, 189-190; hydrogen bomb, 66, 71, 73-74; postwar transition, 63-64, 66 Lovett, Robert A., 31 Loyalty tests, 89-91

MacArthur, Douglas, 77 McAuliffe, Christa, 171 McCarthyism, 77, 89-91, 96 McCone, John A., 113-114, 120 McCormack, James, 61(photo) McElroy, William D., 141-142 McMahon, J. Brien, 56-57, 63, 71, 74, 75 McMahon bill, 57-60, 63 McMillan, Edward M., 69(photo) MACOS project, 162 Magnuson, Warren, 92 Management issues: under Carter and Reagan administrations, 176-177; and Challenger disaster, 172; and DOE, 160, 182, 183, 190-191; under Ford and Carter administrations, 151-153;

ence establishment, 203-205; and overexpansion of NIH, 173-176; separation of review and management functions at NIH, 86-87 Manhattan Project, 3, 18-35; AEC control of, 68; atomic bomb used at Hiroshima and Nagasaki, 27-29; basic research preceding work of, 44-45; Bush's role, 34; change from OSRD to Army control, 24-25; costs of, 34(table); and creation of OSRD, 22-23; and debate over postwar control of atomic power research, 56; Einstein's letter to Roosevelt, 18-19, 56; feasibility studies, 19-23; Los Alamos National Laboratory, 26; name origin, 18; Navy excluded from, 78; Oak Ridge and Hanford plants, 25-26; origins of, 18-19; Policy Committee, 24; postwar transition, 63-70; Smyth report, 29-33; Trinity test, 27; Uranium Committee, 19-23, 21(photo) Manley, John H., 61(photo) Mansfield Amendment, 150 Marine Hospital Service (MHS), 84 Marshall, George, 24 Marston, Robert Q., 174 Massachusetts Institute of Technology, 7; biotech engineering, 165; and Bush, 36; particle accelerators, 205; radar development, 10, 14; and Wiesner, 35 Masur, Jack, 126(photo) Mathematics, and NSF, 92, 95 May, Alan Nunn, 59, 77 May, Andrew J., 55 May-Johnson bill, 55-60, 63 Medical research: as argument in favor

of federal involvement with

informal, personal style of early sci-

research, 4-5, 46; battle for control of funding among different agencies, 85-86; and Bush's recommendations to the President, 46-47; Congress's ambivalent attitude toward, 83-84; extramural grants, 85-86, 123; nontraditional applications, 123; omitted from NSF, 93-94; origin of NIH, 84-85; OSRD's work on antibiotics production, 17; OSRD's work on blood and blood derivatives, 16-17; private funding, 84; radioisotope studies, 122; shift in NIH's focus under Johnson administration, 125; and World War I, 85; and World War II, 2, 3; yellow fever research, 84; see also National Institutes of Health Mercury project, 102, 108 MHS, see Marine Hospital Service Military: auxiliary agencies, 98; buildup under Reagan administration, 160-161; and debate over postwar control of atomic power research, 56, 59-60, 62; and NSF, 93-94; OSRD as model of cooperation between civilian scientists and military personnel, 8; see also Army, U.S.; Navy, U.S.; Weapons development Military Appropriation Act, 67 Military Liaison Committee (MLC), 60, 62, 210, 212; and development vs. renunciation of nuclear weapons, 73; dismantled under Carter administration, 155; functions of, 155 Miller, Byron S., 63 Miller, Robert, 181 Mir space station, 193

MLC, see Military Liaison Committee

Monitored Retrievable Storage (MRS) site, 181-182 Moon landing, 104-108, 146-149 Morse, Philip M., 65(photo) MRS site, see Monitored Retrievable Storage (MRS) site Murphree, Eger V., 72 Murphree, E. O., 21(photo) Murray, Thomas E., 72, 74 NACA, see National Advisory Committee for Aeronautics Nagasaki, 28-29, 135 NAHC, see National Advisory Health Council NASA, see National Aeronautics and Space Administration National Advisory Committee for Aeronautics (NACA), 2, 37, 51, 101, National Advisory Health Council (NAHC), 85 National Aeronautics and Space Act, 101-102 National Aeronautics and Space Administration (NASA), 4; accused of monopolizing scientific resources, 108; aircraft research, 170; Apollo project, 104-108, 146-149; Challenger disaster, 171-173, 191; communication satellites, 148–149, 191; cost of programs, 104, 147-148; debate over robotics vs. human instrumentation, 172; failed launches, 101-102, 191; fraction of total governmental R&D funds, 206, 207; and Gagarin's Vostok flight, 104; Gemini project, 108, 147; GPS satellites, 191; Landsat satellites,

169(photo), 170; management

issues, 172; Mercury project, 102, 108;

## NASA (continued)

nuclear-powered spacecraft, 119; origins and early history of, 99-108; rocket programs, 102; scientific satellites, 191-196; Soyuz linkup, 166; space shuttle, 149, 169(photo), 170-173, 191, 192(photo); and Sputnik, 100–101; SST program, 146–147; Vanguard satellite, 100-102; Viking program, 166-168; Voyager program, 147, 168; weather satellites, 191 National Bureau of Standards (NBS), 2, 12

National Cancer Institute (NCI), 85 National Defense Research Committee (NDRC), 7; Bush's role, 34, 37; creation of, 20; incorporation into OSRD, 37; and Manhattan Project, 20, 22; members of, 15(photo); origin of, 8; radar development, 10; radio proximity fuze development, 11, 14

National Institutes of Health (NIH), 4; budget for, 87, 89, 120-123, 125, 126(table), 134, 176, 196, 198; congressional criticisms on fiscal control, 124-125; creation and early history, 83-92; decline of morale, 173-176; Division of Research Grants (DRG) (see Division of Research Grants); fraction of total governmental R&D funds, 206, 207; grant system, 86-87, 124, 125, 143-146, 173-174; and hostility of Nixon administration, 143-146, 174; human genome project, 190; loyalty tests, 89-91; management issues, 86-87, 122-125, 173-175; and NSF, 94; origin of, 3; overexpansion of, 122-125, 143-145, 173-174, 198-199; overview of postwar development, 126; peer

review system, 86-87, 91; polio vaccine, 91-92; progress 1955-1965, 120-125; Research Grants Office (RGO), 87; shift in focus under Johnson administration, 125; shift in grant system from individual to institutional grants, 122-123

National laboratories: and Bush report, 51, 54; creation of, 63-70; DOE cleanup of, 182-184; see also specific laboratories

National Research Council (NRC), 84-85

National Science Foundation (NSF), 4, 125-130, 160-166; applied science programs, 141-143, 165; avoidance of national science policy issues, 127; budget for, 94-95, 97, 127-130, 134, 141-142, 160-161, 200-201, 206-207; burnout among directors, 166; Bush's proposal for, 49-54; congressional criticisms on specific projects, 129, 161; creation and early history, 92-97; Daddario-Kennedy amendment to charter, 140-143; damaged by politicalization of appointments, 142-143; delay in establishment of, 54; engineering directorates, 165-166; fraction of total governmental R&D funds, 206, 207; and geographical distribution of funds, 92-93, 96, 128; grant system, 93, 95-96, 127-128, 161-165, 200; increase in political control of, 140-141; and McCarthyism, 96; and NIH, 94; omission of medical and defense divisions, 93-94; origin of, 3; projects funded, 199, 201; tactfulness of directors, 127, 128

National security: AEC's relaxation of security rules in order to support

commercial power generation, 109; and debate over postwar control of atomic power research, 55–57, 59, 60, 61, 62; Eisenhower's ambivalent position on hydrogen bomb, 74–75; loyalty tests and revocation of awards without due process, 89–91; McCarthyism, 89–91, 96; nuclear test ban negotiations, 116–118; and Office of Science and Technology, 152; Oppenheimer investigation, 74–77; and Soviet development of atomic bomb, 70–71, 73; see also Cold War

Nautilus submarine, 110, 112

Naval Research Laboratory, 78, 79

Navy, U.S.: excluded from Manhattan

Project, 78; and medical advances
during World War II, 17; nuclear
submarine development, 110,
111(photo), 112–113, 135; Office of
Naval Research (ONR), 78–83; and
radio proximity fuze development,
12–13; Vanguard satellite, 100–101

NBS, see National Bureau of Standards
NCI, see National Cancer Institute

NDRC, see National Defense Research
Committee

Nevada Weapons Test Site, 181, 184 New Deal, 85 Newman, James R., 57, 63 Nichols, Kenneth D., 76 NIH, *see* National Institutes of Health Nimitz, Chester, 60, 62 Nixon, Richard: and energy crisis, 137–138; feuds with science establishment, 133–134, 143–144, 146, 174;

and NSF, 141, 143 Novello, Antonia C., 175(photo) NRC, see National Research Council; National Regulatory Commission NSF, see National Science Foundation Nuclear power: attempts to develop nuclear-powered aircraft, 118-119; breeder reactors, 137; Chernobyl accident, 180-181; commercial power generation, 108-120; debate over postwar control of research, 55-63; and energy crisis, 135-140; fusion reactors, 119-120; nuclear navy, 78-79, 110; nuclear-powered spacecraft, 119; public fears of, 135-140, 156-159; radioactive waste disposal, 137, 181-184; research facilities, 110; safety issues, 109, 113, 115, 180-181, 183-184; Shippingport reactor, 113-115, 114(photo), 135; Three Mile Island accident, 183

Nuclear Regulatory Commission (NRC), 139

Nuclear submarines, 110, 111(photo), 112–113, 135

Nuclear Waste Policy Act, 181

Nuclear weapons: debate over development vs. renunciation of, 73–74; and Eisenhower's Atoms for Peace program, 116; Oppenheimer investigation, 74–77; test ban negotiations, 116–118; transfer to ERDA control, 139–140; see also Atomic bomb; Hydrogen bomb

Oak Ridge Institute of Nuclear Studies, 67 Oak Ridge, TN, 25(photo), 26, 67 Office of Management and Budget (OMB), 141–142, 147 Office of Naval Research (ONR), 78–83 Office of Ordnance Research (OOR), 98 Office of Research and Invention

(ORI), 79

Office of Science and Technology ONR/AEC support for, 83; ONR support for, 83; Superconducting (OST), 152 Office of Science and Technology Pol-Super Collider, 184–189, 186(photo) icy (OSTP), 150, 152 Patents, 57, 62 Office of Scientific Research and Patterson, Robert R., 55, 59, 62 Development (OSRD), 3, 44-45; Patton, George, 14 books about, 9; Bush's role, 34; Pauling, Linus, 90 Pearl Harbor, 10, 17 Committee on Medical Research, 15(photo); creation of, 22-23; flexi-Peer review system: attacked by Nixon ble organization of, 8; incorporation administration, 143-144; congresof NDRC, 37; and Manhattan Prosional review of, 161-165; criticisms ject, 18, 22-25; medical research, of, 95–96, 128, 143–145, 161–165; in 16-17, 85-86; origin of, 7; and Roomedical research, 86-87, 91; as sevelt's letter to Bush, 45-46; model for other nations, 179; modiweapons development, 9-14 fications of system, 164-165; at NIH, O'Leary, Hazel, 183, 188 123, 125, 143-146, 173-176; at NSF, 93, Oliphant, M. L., 10 95-96, 127-128, 161-165; NSF's use of OMB, see Office of Management and large number of reviewers, 200; and Budget self-governing nature of science ONR, see Office of Naval Research establishment, 132; studies on fair-OOR, see Office of Ordnance Research ness of, 162-164 "Operation candor," 74 Penicillin, 17 Oppenheimer, J. Robert, 25(photo), PHS, see Public Health Service 61(photo); and debate over postwar Physical science, 92, 95; see also Particle control of atomic power research, accelerators 56; as GAC chairman, 70; investiga-Physics, doctorates awarded, 214 tion of, 74-77 Pieces of the Action (Bush), 37, 39, 41 ORI, see Office of Research and Inven-Pike, Sumner T., 61(photo), 68, 72 Piore, Emmanuel, 80 tion OSRD, see Office of Scientific Research Planetary probes, 166-168 and Development Plotkin, Martin, 69(photo) OST, see Office of Science and Technol-Plutonium, 23, 24, 26, 137 Polio vaccine, 91-92 OSTP, see Office of Science and Tech-Polk, Irving L., 69(photo) nology Policy Popular views of science, 100; public fears of nuclear power, 135-140, Paine, Thomas O., 149 156-159, 180-181; public skepticism Parran, Thomas, 85, 88(photo) of radioactive waste management, Particle accelerators, 66, 67, 120; and 181, 184; and space program, 100, DOE, 159; joint university projects, 104, 148, 171-173 203-205; justifications for, 185, 187; Potsdam Proclamation, 27, 29

Presidential powers: and debate over postwar control of atomic power research, 56-57, 59-60, 62; and NSF, 92-93; and NSF appointments, 140-141; and supervision of governmental science agencies, 127, 132 Presidential Science Office, 150 President's Science Advisory Committee (PSAC), 132-134, 150, 152 Press, Frank, 150, 200 Princeton-Pennsylvania accelerator, 203-205 Princeton University, 204–205 Project Mohole, 129 Proxmire, William, 161 PSAC, see President's Science Advisory Committee Public Health Service (PHS), 84-87, 89-91, 93-94

Rabi, Isidor I., 61(photo), 72, 200 Radar, 9-11, 14, 44 Radiation Laboratory (Rad Lab), 10, 14, Radioactive waste disposal, 181–184 Radio broadcasting, 109 Radioisotope studies, 122 Radio proximity fuze, 11-14 RANN, see Research Applied to National Needs Raub, William F., 174 Reagan, Ronald: attempts to abolish DOE, 159, 160; and Challenger disaster, 172; and NSF funding, 160-161; and radioactive waste disposal, 181; and Star Wars, 215; and Superconducting Super Collider, 187, 188 Research Applied to National Needs (RANN), 141–143, 162 Research Grants Office (RGO), 87 RGO, see Research Grants Office

Richards, A. N., 7, 15(photo), 17
Rickover, Hyman G., 79, 110–113, 111(photo), 115
Rigley, John J., 111(photo)
Rockefeller Institute, 84
Roosevelt, Franklin Delano, 1, 2–3, 38(photo); Bush as science adviser to, 3, 34, 45–47; creation of NDRC, 8, 20; creation of Policy Committee for Manhattan Project, 24; death of, 27, 47; Einstein's letter to, 18–19, 56; letter to Bush requesting advice on postwar science promotion, 3, 45–47; and Stimson, 30
Rowe, Hartley, 61(photo), 72

Schirra, Walter, 106(photo)
Schlesinger, James, 154, 157, 159
Science adviser to the President: Bush as (*see* Bush, Vannevar); Killian as, 101; list of, 200; position reestablished under Ford, 150, 151; Press as, 150; relation to presidency after Nixon administration, 150; relation to presidency during Vietnam War, 133–134; relation to science establishment, 132; and supervision of governmental science agencies, 127; Wiesner as, 35, 104
Science advisory committees, proposal

for, 212–213
Science establishment: achievements
of, 4–5; agencies listed, 4; arguments
against centralization, 153, 205;
arguments justifying existence of,
4–5, 52; Bush's five principles, 51–52;
challenges of 1965–1975, 131–150;
"enough" funding question,
199–200, 202; factors in early success, 203–205; grant system (see
Grant system; Peer review system);

Science establishment (continued) Smith, Cyril S., 72 Smith, Harold W., 15(photo) hostile relationship with Nixon administration, 133-134, 143-146, Smith, Lyle, 69(photo) 149-150, 174; influence of Bush's Sci-Smyth, Henry D., 31(photo); as AEC ence: The Endless Frontier, 3, 35, 39, member, 72; Atomic Energy for Mili-47-54; and informal, personal mantary Purposes report, 29, 31, 32, 33; agement style, 203-205; manageand Oppenheimer investigation, 77; ment issues under Ford and Carter, and Princeton-Pennsylvania accel-151-153; origins of, 3; pressures due erator, 204-205 to expansion of, 205-206; proposal Social sciences: debate over NSF fundfor external advisory committees ing for, 96-97; excluded from Bush for government science agencies, proposal, 92-93; explicit directives 212-213, 216; proposal for increased to NSF, 141; MACOS project, 162 involvement of university scientists Social Security Act, 85 in science policy, 207-210, 212-213; Solar neutrino telescope, 197(photo) and recognition of long-term Soviet Union: atomic bomb developnature of basic research, 51-52; relament, 70-71; Chernobyl accident, tion to presidency, 132 (see also Pres-180-181; and debate over postwar idential powers); self-governing control of atomic energy, 59; and nature of, 132; status in 1995, Eisenhower's ambivalent position 179-180; strained relations with govon hydrogen bomb, 74-75; espiernment following Nixon adminisonage, 77; Gagarin's Vostok flight, tration, 150 104; Mir, 193; and NASA origins, Science in World War II, 9 99-104; and nuclear submarine Science: The Endless Frontier (Bush), 3, development, 112-113; and nuclear 35, 39-40, 44-54, 153; basic princitest ban negotiations, 116-118; and ples of program, 51-52; contents of, publication of the Smyth report on 49-54; proposal for a national the atomic bomb, 31; Soyuz linkup, research foundation, 49-51, 54 166; Sputnik, 100-101; U.S. spy Scientists Against Time (Baxter), 9 planes over, 118 Seaborg, Glenn T., 72 Soyuz linkup, 166 Seamans, Robert C., Jr., 104, 139 Space shuttle, 149, 169(photo), 170-173, Serber, Robert, 77 191, 192(photo); Challenger disaster, Shannon, James A., 124, 126(photo) 171-173, 191 Shepard, Alan, 106(photo) Space Telescope Science Institute Shippingport reactor, 113-115, (STSI), 193-194 Spedding, Frank H., 65(photo) 114(photo), 135 Simmons, James S., 15(photo) Spitzer, Lyman, Jr., 119 Sinsheimer, Robert, 189 Sputnik, 100-101, 128-129 Slaughter, John B., 166 SSC, see Superconducting Super Collider Slayton, Donald, 106(photo)

SST program, 146-147 Stalin, Josef, 27 Star Wars, 215 Stever, H. Guyford, 143, 161, 162, 200 Stewart, Irvin, 15(photo) Stewart, William, 126(photo) Stimson, Henry, 24, 30(photo), 35, 55 Stone, Robert S., 144, 174 Strauss, Lewis L., 61(photo), 72; as AEC commissioner, 68; and Bowen, 78; and nuclear power plant development, 113-114; and Oppenheimer investigation, 75, 76; opposition to nuclear test ban, 117; and ORI, 79; support for hydrogen bomb development, 74 STSI, see Space Telescope Science Institute Submarines, nuclear, 110-113, 111(photo), 135 Suits, C. Guy, 65(photo), 111(photo) Sulfa drugs, 17 Sunshine Law, 144-145 Superconducting Super Collider (SSC), 184-189, 186(photo) Symington, James W., 161, 163 Szilard, Leo, 19, 56

Tax breaks for industrial labs, 53
Teller, Edward, 74, 77, 117
Test ban treaty, 116–118
Thompson, Lewis R., 85
Three Mile Island accident, 156–159, 183
Tolman, R. C., 15(photo)
Trinity test, 27
Trivelpiece, Alvin W., 187
Truman, Harry S, 3; appointment of
AEC commissioners, 68; assumes
the presidency, 27, 47; and atomic
bomb, 27, 29; and Atomic Energy

Tape, Gerald F., 69(photo)

Act, 63; Bush as science adviser to, 34, 37, 39; Bush's letter to, 47–48; creation of ONR, 79; and debate over postwar control of atomic power research, 56–57, 63; and hydrogen bomb, 73–74; and National Science Foundation Act, 54 Tuve, Merle A., 10

Ulam, Stanley, 74 Universities, 2, 4, 49, 54; and Bush report, 49, 51-54; and criticisms of peer review system, 95-96; early government grants for basic research, 66; and grant system, 132 (see also Grant system; Peer review system); Institutional Support Program, 142; loyalty tests and revocation of awards, 89-91; management of national labs, 67; and Manhattan Project, 18, 24; and NASA, 108, 172, 191; and NIH, 121-122, 124; and NSF, 95-96, 142; and ONR, 78-83; and OSRD, 8, 14; and proposed modifications of funding allocation system, 207-210; restriction of DOD funding to, 150; and wartime medical advances, 16, 17; and wartime weapons development, 10, 12, 14; see also Education; Science establishment

ment
University of California at Berkeley, 66, 67, 83, 187
University of California at Santa Barbara, 165
University of Chicago, 24, 67, 83
University of Pennsylvania, 7, 204–205
Uranium, 19–24, 26, 116, 137
Uranium Committee, 19–23, 21
(photo)
Urey, H. C., 21(photo)

## 240 Index

V-1 bomb, 13 Webb, James E., 104 Van Allen belt, discovery of, 101 Weed, Lewis H., 15(photo) Vandenberg, Arthur, 55, 60, 62, 63 Westinghouse, 110 Vanguard satellite, 100-102 White, Edward H., II, 172 Van Slyke, Cassius J., 82(photo), 87, Whitman, Walter G., 72 88(photo), 90-91 Whitney, Eli, 100 Very Large Array (VLA) radio tele-Wiesner, Jerome B., 35, 104, 152, 200 scope, 197(photo) Wigner, Eugene P., 65(photo), 72 Vietnam War, 133, 134 Willey, Richard R., 124 Viking program, 166–168 Wilson, Carroll, 65(photo) VLA, see Very Large Array radio tele-Wilson, Robert R., 185, 187 Winne, Harry A., 111(photo) scope von Braun, Wernher, 102 WIPP, see Waste Isolation Pilot Plant von Neumann, John, 72 Wise, Abraham, 69(photo) Voyager program, 147, 168 World War I, 36, 84, 85 World War II, 1; atomic bomb used at Wallace, Henry, 24, 58 Hiroshima and Nagasaki, 27-29; Warner, John C., 61(photo), 72 Bush's role as architect of organized Waste Isolation Pilot Plant (WIPP), science and technology, 34; coordination of science and government, 181-182 Waste Policy Amendments Act, 181 2; Japanese surrender, 29; and man-Watergate, 161, 163 agement of medical research, 86; Waterman, Alan, 80, 81(photo), 94-95, Manhattan Project, 18–35 (see also Manhattan Project); medical 127, 142 Watkins, James D., 183 advances, 2, 3, 16-17; and origins of Watson-Watt, Sir Robert, 9 NDRC, 8; and origins of OSRD, 7; Waymack, William W., 61(photo), 68, Potsdam Proclamation, 27, 29; weapons development, 2, 3, 9-14, 44 Weapons development, 3, 213-216; World Wide Web, 191 atomic bomb (see Manhattan Pro-Worthington, Hood, 72 ject); and DOE, 159; fraction of total Wyngaarden, James B., 175(photo), 176, governmental R&D funds, 206; 190 hydrogen bomb, 66, 70-77; omitted from NSF, 93-94; OSRD's achieve-Yellow fever, 84 ments, 9-14; radar, 9-11, 14, 44; York, Herbert F., 118

radio proximity fuze, 11-14; Star

Wars, 215; and World War II, 2, 3

Weather Bureau, 98

Weather satellites, 191

York, Herbert F., 118 Yucca Mountain, 181, 184

Zinn, Walter, 64, 65(photo) Zuckert, Eugene M., 72