

**AAAS REPORT
XXVII**

**RESEARCH AND
DEVELOPMENT
FY 2003**

Intersociety
Working
Group

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
1200 New York Avenue, NW, Washington, DC 20005

The AAAS Board of Directors, in accordance with Association policy, has approved publication of this report as a contribution to the understanding of an important process. The interpretations and conclusions are those of the authors and do not purport to represent the views of the Board or the Council of the Association.

Printed in the United States of America

International Standard Serial Number 1041-8857
AAAS Publication Number 02-3A

Copyright © 2002 by the
American Association for the Advancement of Science
1200 New York Avenue, NW, Washington, DC 20005

Cover design by Jennifer Anne Kolansky

Printed on recycled, acid-free paper.

Intersociety Working Group

(see the Directory at the end of this report for contact information)

American Association for the Advancement of Science
American Astronomical Society
American Chemical Society
American Educational Research Association
American Geological Institute
American Geophysical Union
American Institute of Aeronautics and Astronautics
American Institute of Biological Sciences
American Institute of Physics
American Mathematical Society
American Physical Society
American Psychological Association
American Society of Mechanical Engineers International
Association of American Universities
Computing Research Association
Consortium for Oceanographic Research and Education
Consortium of Social Science Associations
Council of Professional Associations on Federal Statistics
Ecological Society of America
Industrial Research Institute
Institute of Electrical and Electronics Engineers
National Association of State Universities and Land-Grant Colleges

Contents

List of Tables	ix
Preface	xi
Committee on Science, Engineering and Public Policy	xv
General Notes	xvi

PART I: OVERVIEW

Highlights	3	
Chapter 1	R&D in the Federal Budget: Frequently Asked Questions <i>Albert H. Teich, AAAS</i>	5
Chapter 2	Political and Policy Context for the FY 2003 Budget <i>Elizabeth M. Flanagan and Paul W. Turner, AAAS</i>	15
Chapter 3	R&D Trends and Special Analyses <i>Kei Koizumi, AAAS</i>	25
Chapter 4	R&D and Innovation in Industry <i>F.M. Ross Armbrrecht, Jr., IRI</i>	35
Chapter 5	Education and Human Resources in the FY 2003 Budget <i>Jolene Kay Jesse, AAAS</i>	43
Overview Tables	53	

PART II: AGENCY R&D BUDGETS

Chapter 6	R&D in the FY 2003 Department of Defense Budget <i>Kei Koizumi, AAAS</i>	71
-----------	--	----

Contents

Chapter 7	National Science Foundation in the FY 2003 Budget <i>George L. Leventhal, AAU</i>	79
Chapter 8	National Institutes of Health in the FY 2003 Budget <i>Kei Koizumi, AAAS</i>	87
Chapter 9	The Department of Energy in the FY 2003 Budget <i>Michael S. Lubell, APS</i>	97
Chapter 10	NASA R&D in the FY 2003 Budget <i>Michael Beavin, AIAA</i>	105
Chapter 11	R&D in the U.S. Department of Agriculture <i>Elizabeth Allred, Eddie Gouge, and Mortimer Neufville, NASULGC</i>	115
Chapter 12	R&D in Selected Agencies <i>Elizabeth M. Flanagan and Paul W. Turner, AAAS</i>	121
Agency Tables		129
PART III: DISCIPLINARY ANALYSES		
Chapter 13	Physics in the FY 2003 Budget <i>Richard M. Jones and Audrey T. Leath, AIP</i>	167
Chapter 14	Astronomy in the FY 2003 Budget <i>Kevin B. Marvel, AAS</i>	173
Chapter 15	Atmospheric and Ocean Sciences in the FY 2003 Budget <i>Eugene W. Bierly and H. Frank Eden, AGU</i>	181
Chapter 16	Ocean Sciences in the FY 2003 Budget <i>Jennie Kopelson, CORE</i>	189

Contents

Chapter 17	Earth Sciences in the FY 2003 Budget <i>Margaret A. Baker and David Applegate, AGI</i>	197
Chapter 18	Biological and Ecological Sciences in the FY 2003 Budget <i>Ellen Paul, AIBS; and Nadine Lynn, ESA</i>	203
Chapter 19	Chemical Sciences in the FY 2003 Budget <i>Michael J. Eichberg, Laura M. Gerum, Heather N. Hill, Bradley R. Smith, Caroline Trupp Gil., ACS</i>	211
Chapter 20	Behavioral and Social Sciences Research in the FY 2003 Budget <i>Patricia Kobor, APA; Angela Sharpe and Howard Silver, COSSA; and Sandi Wurtz, AERA;</i>	219
Chapter 21	Federal Statistics in the FY 2003 Budget <i>Edward J. Spar, COPAFS</i>	227
Chapter 22	Mathematical Sciences in the FY 2003 Budget <i>Samuel M. Rankin, III, AMS</i>	237
Chapter 23	Computing Research in the FY 2003 Budget Request <i>Peter Harsha, CRA</i>	243
Chapter 24	National Nanotechnology Investment in the FY 2003 Budget Request <i>M.C. Roco, ASME International</i>	253
Chapter 25	Electrotechnology-Related Research in the FY 2003 Budget <i>Bill Williams and Russell Lefevre, IEEE-USA</i>	263
Chapter 26	Mechanical Engineering in the FY 2003 Budget <i>Michael Reischman, ASME International</i>	271

Contents

Appendix 1: Methodology and Data Sources	283
Appendix 2: Definitions	285
Appendix 3: Related Publications	287
Intersociety Working Group Directory	288

List of Tables

Overview Tables

Table I-1.	R&D in the FY 2003 Budget by Agency	55
Table I-2.	Distribution of the FY 2003 Budget	56
Table I-3.	Historical Trends in R&D and Federal Outlays	57
Table I-4.	Major Functional Categories of R&D	58
Table I-5.	R&D by Character of Work	59
Table I-6.	Defense and Nondefense R&D by Character of Work	60
Table I-7.	“FS&T” Budget by Agency	61
Table I-8.	R&D Expenditures at Colleges and Universities	62
Table I-9.	R&D Funding by Congressional Appropriations Subcommittee	63
Table I-10.	Interagency Science and Technology Initiatives	64
Table I-11.	AAAS Analysis of the Outyear Projections for R&D in the FY 2003 Budget, FY 2002-2007	65
Table I-12.	Historical Tables: Federal R&D by Agency, FY 1992-2003	66

List of Tables

Agency Tables

Table II-1.	R&D in the FY 2003 Budget by Agency and Character of Work	131
Table II-2.	R&D in the Department of Defense	138
Table II-3.	DOD R&D by Military Departments and Agencies	139
Table II-4.	Department of Defense R&D by Character of Work	140
Table II-5.	Department of Defense Basic Research (“6.1”)	141
Table II-6.	Trends in Department of Defense R&D, FY 1965–FY 2003	142
Table II-7.	R&D in the National Science Foundation	143
Table II-8.	R&D in the Department of Health and Human Services	146
Table II-9.	R&D in the National Institutes of Health, by Institute	147
Table II-10.	National Institutes of Health by Funding Mechanism	148
Table II-11.	R&D in the Department of Energy	149
Table II-12.	R&D in the National Aeronautics and Space Administration	153
Table II-13.	R&D in the U.S. Department of Agriculture	157
Table II-14.	R&D in the Department of Commerce	158
Table II-15.	R&D in the Department of Transportation	159
Table II-16.	R&D in the Department of the Interior	160
Table II-17.	R&D in the Environmental Protection Agency	161
Table II-18.	R&D in the Department of Education	162
Table II-19.	R&D in the Department of Veterans Affairs	163

Note: Tables within chapters are not included in this list.

Preface

Scientific research and development (R&D) continue to be of vital importance to the United States in the 21st century. The federal government supports a significant proportion of the nation's R&D, and its policies profoundly affect the institutions in which this work is carried out. The President's annual budget submission and the congressional debate that ensues are the mechanisms through which policies and priorities for R&D are set. Since 1976, AAAS has published an annual report analyzing R&D in the proposed federal budget in order to make available to the scientific and engineering communities and to policymakers timely and objective information about the Administration's plans for the coming fiscal year.

This year marks the 27th in the series of AAAS R&D Reports. The effort was begun in 1976 in-house at AAAS by Willis H. Shapley, under the auspices of the Committee on Science, Engineering and Public Policy. Shortly thereafter, it became a collaborative effort, and it now involves contributors from 22 scientific, engineering, higher education, and industrial associations known collectively as the Intersociety Working Group (see the Directory at the end of this report for contact information for each association). This volume is one of several publications and activities of the AAAS R&D Budget and Policy Program. In addition to functioning as a stand-alone document, the report serves as background for the 27th Annual AAAS Colloquium on Science and Technology Policy, held in Washington, DC (April 11-12, 2002).

The second item in the R&D Program's annual series of three publications is the *AAAS Science and Technology Policy Yearbook*. This book contains most of the major Colloquium addresses, as well as both

original and previously published articles by leading figures in science and technology policy.

The third publication appears after Congress has completed its appropriations process. At that time, AAAS, in collaboration with the Intersociety Working Group, publishes its annual review of the impact of congressional decisions on R&D, *Congressional Action on Research and Development in the FY 2003 Budget*. These publications are supplemented by R&D Funding Updates on the AAAS R&D Web site (www.aaas.org/spp/R&D), which provide regularly updated information on R&D in the budget between the publication of this report and the *Congressional Action* report.

The overall structure of this report parallels that of recent editions. Part I, the overview, includes discussions of R&D's place in the federal budget, the political context of FY 2003 R&D proposals, analysis of major funding trends for FY 2003 including outyear projections for R&D, and analyses of funding for basic research and R&D in colleges and universities. Chapters on R&D in industry and funding for science, engineering, and mathematics education are also included in Part I. Although neither of these latter topics is concerned strictly with R&D in the federal budget, each deals with closely related funding and policy matters that help define the context within which federal R&D is discussed and debated. A set of overview tables appears at the end of this section.

The chapters in Part II examine the proposed R&D budgets of major federal agencies and departments. Tables detailing those budgets and the budgets of several smaller agencies and departments not featured in the chapters are included at the end of Part II. Finally, Part III consists of a set of cross-cutting analyses that look at the budget in terms of disciplines and areas of research.

Readers should be aware that the chapters in this report have been prepared largely independently of one another and under extremely tight deadline pressure. Although every effort has been made to assure a high quality product, some overlap and inconsistencies among the chapters are, unfortunately, inevitable.

On behalf of the members of the Intersociety Working Group, we would like to express our appreciation to the officers, members, and staffs of

the participating organizations for their support and assistance in preparing this report—particularly those who facilitated our efforts to put this unruly, multiple-authored volume into a common format and single typeface. Our thanks also to the AAAS Committee on Science, Engineering and Public Policy, which initiated the R&D Program and periodically reviews it and provides guidance to it. We are very grateful to individuals in the Office of Management and Budget, other federal agencies, on congressional staffs, and elsewhere who aided us in collecting the information and advised us on its interpretation.

Kei Koizumi
Paul W. Turner
Elizabeth M. Flanagan

April, 2002

Committee on Science, Engineering and Public Policy

Susan E. Cozzens (2004)
Chair
Georgia Institute of Technology

Reid G. Adler (2004)
Morgan, Lewis & Bockius LLP

Jane Alexander (2004)
Defense Advanced Research
Projects Agency

Richard N. L. Andrews (2003)
University of North Carolina
Chapel Hill

Robert E. Barnhill (2005)
University of Kansas

Radford Byerly, Jr. (2004)
Boulder, Colorado

Richard Florida (2003)
Carnegie Mellon University

Mae C. Jemison (2005)
The Jemison Group, Inc.

Kerri-Ann Jones (2003)
Maine Science & Technology
Foundation

David C. Mowery (2003)
University of California-Berkeley

Robert J. Spinrad (2005)
Palo Alto, CA

Skip Stiles (2004)
Genetic Resources
Communications Systems, Inc.

Michael L. Telson (2004)
Washington, DC

Floyd E. Bloom
(Board Representative)
Scripps Research Institute

Lydia Villa-Komaroff
(Board Representative)
Northwestern University

Alan I. Leshner
(Ex Officio) AAAS

Stephen D. Nelson
(Staff Officer) AAAS

*Terms expire on last day of Annual Meeting in year shown.

General Notes

BASIS OF BUDGET STATISTICS

Budget statistics are presented on three bases: (1) **budget authority**, corresponding to the funds appropriated each year; (2) **obligations**, indicating the amounts of contracts and grants entered into; and (3) **outlays**, representing the amounts actually expended (see Appendix 2: Definitions). Because budget decisions in the Executive Branch and in Congress are almost always made in budget authority, this metric most accurately reflects current changes in budget policies. Outlay trends lag a year or more behind decisions in budget authority, and obligations estimates are often adjusted to meet fiscal or budget strategy demands. We have, therefore, selected budget authority as the most meaningful measure of budget decisions and trends and used it in nearly all cases throughout the report.

BASIC RESEARCH, APPLIED RESEARCH, AND DEVELOPMENT

The allocation of agency budgets among basic research, applied research, and development is not an exact procedure; a certain arbitrariness is inevitably involved (see Appendix 2: Definitions). The severe time pressures under which these figures are compiled for OMB are also a problem. Nevertheless, there is presumably some consistency within each agency's estimates so that the trends are meaningful.

ROUNDING NUMBERS

Due to rounding in the tables, the detail may not add to the totals, and the percentage changes may not correspond exactly to the difference shown. Most figures are rounded to the nearest million; totals and percentage changes are calculated from unrounded figures. In the Overview and Agency Tables, subtotals are occasionally provided for additional detail. These subtotals are shown in italics to indicate that they do not add into the totals.

Please see Appendix 1: Methodology and Data Sources for more information.