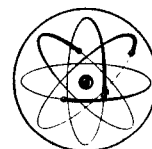


**PHYSICAL  
RESEARCH  
PROGRAM:**

**RESEARCH CONTRACTS AND  
STATISTICAL SUMMARY**

**DIVISION OF PHYSICAL RESEARCH**

**July 1, 1972**



**UNITED STATES ATOMIC ENERGY COMMISSION**

## PREFACE

In previous years, the Division of Physical Research has published separately the reports entitled "Research Contracts in the Physical Sciences" and "A Statistical Summary of the Physical Research Program." This report is a consolidated version of the information concerning the basic physical research program previously contained in these two reports.

The Director of the Division of Physical Research carries out his responsibilities for the direction of the physical research program through four Assistant Directors who manage the six scientific categories (subprograms) in the AEC budget for Physical Research, [viz., Assistant Directors for (1) high energy physics, (2) physics and mathematics (categories: medium energy physics, low energy physics, mathematics and computer sciences), (3) chemistry, and (4) metallurgy and materials]. A fifth Assistant Director (for Administration) assists in the coordination of the budgetary and non-technical aspects of the program, such as budget preparation, proposal and contract administration, reporting, travel, personnel, etc.

In December 1971, the Division of Research was redesignated the Division of Physical Research and the controlled fusion program was separated from the present division. It became the new Division of Controlled Thermonuclear Research.

TABLE OF CONTENTS

	<u>Page</u>
PREFACE .....	i
INTRODUCTION - PROGRAM DESCRIPTION	
High Energy Physics .....	1
Medium Energy Physics .....	1
Low Energy Physics .....	1
Mathematics and Computer Sciences .....	1
Chemistry .....	2
Metallurgy and Materials .....	2
MAJOR RESEARCH CENTERS AND RESEARCH CONTRACTS	
Federally Funded Research and Development Centers .....	3
Off-Site Contract-Research Program .....	3
Summary Statistics .....	4
FEDERALLY FUNDED RESEARCH AND DEVELOPMENT CENTERS	
Listing of FFRDC's and their Principal Staff .....	6
Costs and Manpower .....	8
Ames Laboratory .....	9
Argonne National Laboratory .....	9
Brookhaven National Laboratory .....	10
Lawrence Berkeley Laboratory .....	10
Los Alamos Scientific Laboratory .....	11
Oak Ridge National Laboratory .....	11
Other Laboratories .....	12
OFF-SITE CONTRACT-RESEARCH PROGRAM	
Types of Contracts .....	13
Terms of Contracts .....	13
Proposal Submission .....	13
Summary Proposal and Contract Statistics .....	14
Consolidated Budget of all Contracts .....	17
Consolidated Manpower Statistics .....	18
Number of Contracts by:	
Type of Organizations .....	19
AEC Field Offices .....	19
Type of Agreements .....	19
AEC Dollar Level .....	20
Percent AEC Contribution .....	20
Summary of Contracts by State .....	21
Contract Listing:	
High Energy Physics .....	25
Medium Energy Physics .....	27
Low Energy Physics .....	28
Mathematics and Computer Research .....	30
Chemistry .....	31
Metallurgy and Materials .....	38

## INTRODUCTION

The AEC-sponsored physical research program consists of theoretical and experimental investigations designed to support the objectives of the AEC's nuclear and non-nuclear energy efforts. The program is directed toward discovery of natural laws and new knowledge, and to improved understanding of the physical sciences as related to the development, use, and control of nuclear and other forms of energy. The ultimate goal is to develop a scientific underlay for the overall AEC effort and the fundamental principles of natural phenomena so that these phenomena may be understood and new principles formulated. Fundamental research is undertaken in the fields of physics, mathematics, chemistry, and metallurgy and materials, and is funded through the six budget program categories referred to in the preface.

### High Energy Physics

Research in high energy physics seeks to improve man's knowledge and understanding of the elementary particles which are the basic constituents of matter and of the forces which control their existence and interactions. The basic probe of this field is the high energy collision of elementary particles. Thus, the program supports experimental and theoretical studies of the phenomena which result when particles from high energy accelerators (i.e., energy greater than 1,000 MeV) interact with target particles, of the phenomena which result when two beams of high energy particles are caused to collide, of the phenomena associated with the extremely high energy particles present in cosmic rays, and of the methods and techniques of high energy accelerators and detection devices.

### Medium Energy Physics

Research in medium energy physics (50-1,000 MeV range) has as a primary objective studies of the basic laws which determine the structure of nuclei and the interaction of nuclear and subnuclear particles with each other. These studies are concerned with fundamental pi-meson-nucleon, meson-nucleus, and nucleon-nucleus interactions, the characteristics and correlations of nucleons bound within the nucleus, and the examination of nuclear interactions and nuclear structure.

### Low Energy Physics

Research in low energy physics encompasses charged particle physics, nuclear theory, neutron physics, and atomic and classical physics, including geophysics. The program is keyed to both the underlying science and techniques relating to AEC's programmatic needs (e.g., neutron and charged particles cross-section data important to reactor development, weapons, safeguards, and biomedical and environmental research programs) and to the AEC's long-range needs for knowledge of the fundamental physical laws governing nuclear and atomic interactions. It is also concerned with the more long-range aspects of non-nuclear energy research.

### Mathematics and Computer Sciences

The AEC's mathematics and computer research program is concerned with the investigation of the design principles of high-performance computing systems required by the continually increasing demand for greater computing capacity; with the development of systems for the automatic acquisition and processing of research experimental data; with the development of new methods of treating mathematical problems that arise in connection with AEC programs; and with improvements in programming languages and the system software needed for the effective use of the large computing system so extensively used in major AEC programs.

## Chemistry

The AEC's chemistry research program aims at advancing the frontiers of basic knowledge in the chemistry and chemical engineering sciences relevant to the AEC's responsibilities and the national nuclear and non-nuclear energy development. Primary emphasis is given to problems which are in nuclear-related areas. These include radiation, hot-atom, nuclear, heavy element, and isotopic effect and separation studies. Also included is work in the areas of high temperature, inorganic, structural, theoretical, physical, analytical, material and separations chemistry. These areas receive emphasis as support studies in generating new concepts significant to the future development of nuclear science and technology. Basic chemistry and chemical engineering studies relevant to the developing areas of non-nuclear energy and the fusion reactor concepts, as well as those related to the accompanying environmental effects fall within the purview of the chemistry research programs.

## Metallurgy and Materials

Fundamental research on matter in the condensed state is conducted under the metallurgy and materials research program. The aim of this research is to increase understanding of the science of materials, especially in those areas of direct interest to the AEC and nuclear technology. Investigations are concerned with providing knowledge of the basic structures and mechanisms that govern the properties and behavior of matter in the condensed state. Areas of research include neutron scattering, actinides, mechanical and thermal properties, radiation effects, superconductivity, diffusion, and liquids and include the fields of metallurgy, ceramics, solid state physics and other materials related areas of science.

## MAJOR RESEARCH CENTERS AND RESEARCH CONTRACTS

Approximately three-fourths of the total physical research program costs are associated with research conducted in AEC-owned, contractor (non-Federal)-operated, Federally Funded Research and Development Centers (FFRDC's). The major portion of these costs are spent at the well known multi-program "national" laboratories at Ames, Iowa; Argonne, Illinois; Brookhaven, New York; Los Alamos, New Mexico; Berkeley, California; and Oak Ridge, Tennessee; and at the comparable high energy physics research centers at Batavia, Illinois; and Stanford, California.

A little less than one-fourth of the costs are associated with the support of research conducted in other laboratories (designated "off-site"). Virtually all of the off-site research is conducted at educational institutions, and is based almost entirely on unsolicited proposals.\*

There is no clear line of demarcation between National Laboratories, other Federally Funded Research and Development Centers, and off-site laboratories. The AEC investment in facilities ranges from zero for some contractors to tens of millions of dollars for others, and the annual level of AEC support ranges from a few thousand dollars for some contractors, to tens of millions of dollars for others--the spectrum is broad with no significant breaks.

Some of the FFRDC's research and development activities include programs in, e.g., production; weapons, biomedical and environmental research, reactor development, or controlled thermonuclear research. These activities are funded from sources other than the Division of Physical Research. The physical research program at these FFRDC laboratories provides, in varying degrees, some of the basic investigations underlying the more applied or developmental activities of such laboratories. Other FFRDC's include laboratories that are engaged in research in a single, well-defined area. All FFRDC's have the following common characteristics:

1. They are operated for the Federal Government by universities, not-for-profit organizations or private industry.
2. They are treated as national facilities.
3. They represent large investments (several millions of dollars) in AEC-owned capital facilities.
4. They have large annual levels (several millions of dollars) of AEC support.

The objective of the basic research program is to search for and discover new knowledge within the mission-oriented framework of AEC. It is from this expanding reservoir of knowledge that developmental accomplishments are ultimately achieved. Thus, the off-site program complements the FFRDC's in the advancement of science in those disciplines that are fundamental to AEC's programs.

The off-site contract-research program has a number of distinct benefits:

1. When the amount provided by AEC is added to other funds available to the contractor, the effectiveness of the contractor's program, as well as the basic research effort of AEC, is increased.
2. AEC receives the services, in basic research activities fundamental to AEC's future capabilities, of highly qualified scientists who prefer employment at outside laboratories or who prefer to teach and to do research at educational institutions.
3. The contract-research program, by providing for the conduct of research at educational institutions, contributes to the training of scientists in fields relevant to AEC's programs.

\*The direct support provided under the physical research program for miscellaneous other activities, such as for other Federal agencies, National Academy of Science committees, conferences, book translations, etc., is of such type and modest extent that it is excluded from this report.

The following table summarizes the level of effort of the physical research program as of the end of Fiscal Year 1972. No attempt has been made to add the dollar levels of FFRDC's to those of the off-site program in this analysis since they are not arrived at on comparable bases. The funding levels of FFRDC's reflect the FY 1972 costs for operations and capital equipment while the dollar figures for the off-site program represent the contract amounts authorized, as opposed to costs incurred, for all contracts in effect as of the beginning of FY 1973, including funds provided for equipment regardless of who retains title. The figures for scientific man-years and publications are based on information provided in contract proposals and/or other information supplied by contractors.

AEC Budget Category	Total		Amount	FFRDC's		Off-Site		
	Scientific Man-Years <sup>a/</sup>	Publi- cations		Man- Years	Publi- cations	Contract Amount <sup>b/</sup>	Man- Years	Publi- cations
High Energy Physics ....	1,762	1,129	\$111,907	1,274	596	\$ 21,351	488	533
Medium Energy Physics ..	226	158	12,544	159	119	3,169	67	39
Low Energy Physics .....	481	801	17,077	292	358	9,160	189	443
Mathematics & Computers.	115	174	2,508	62	105	2,550	53	71
Chemistry .....	817	1,306	42,881	654	796	7,330	163	510
Metallurgy & Materials .	446	964	20,343	347	590	6,688	99	374
General Purpose Equipment .....	0	0	607	0	0	0	0	0
TOTAL .....	3,847	4,532	\$207,867	2,788	2,562	\$ 50,248	1,059	1,970

<sup>a/</sup>Does not include part time employment of 2,302 graduate students engaged in performing research.

<sup>b/</sup>Represents amount of AEC estimated support ceiling included in the latest extension of contracts in effect as of 6/30/72. (Contracts are usually written for one year and extended annually if necessary.)

On the following pages are presented a statistical analysis of the physical research program in more detail. Separate analyses are made for the research conducted at FFRDC's and for the off-site program. The analysis is based on information contained in proposals and other material supplied by the contractors; much of the data, especially for the FFRDC's and the larger of the off-site projects, was provided specifically for this report. Definitions used are:

Equipment: Any item individually costing more than \$200 (sometimes \$300) and that is expected to have an extended period of service, generally one year or more, in its original form. Title may vest in either the Government or in the contractor.

Publications: Usually refer to journal publications but includes letters such as appear in Physical Review Letters, and notes such as appear in Journal of the American Chemical Society, and other journals. Contributions to books are included if they represent summaries and evaluations of a limited area, e.g., contributions to the Annual Review of Nuclear Science. Also included are papers (not abstracts) that appear in published proceedings of technical meetings including international meetings, and installation reports that are available for sale.

Scientific Man-Year: A scientific man-year is the full-time equivalent of a research employee who has a B.S. degree, the equivalent, or better, and who is directly engaged in or supervising the activity. Ten scientific employees engaged on a half-time basis would constitute five man-years.

For the off-site contract-research (university) program, the following definitions are used:

Principal Investigators: Usually are members of the academic staff and includes professors, chairmen/heads of departments, associate professors, or assistant professors who direct the project.

Other Permanent Scientific Staff: Are generally professors, associate professors or assistant professors who work with the principal investigators. (The principal investigator and other professional staff usually divide their time between teaching and the research project.) Also includes visiting scientists, i.e., those at the faculty level but who do not have a position on the faculty of the educational institution where they are temporarily working.

Research Associates: Are generally working full-time on the research investigation and usually are in the post-doctoral category.

Research Assistants: Usually are graduate students working for their doctorate or masters degree.



FEDERALLY FUNDED RESEARCH AND DEVELOPMENT CENTERS

For purposes of this report, the following may be considered FFRDC's operated for AEC (including only those supported in whole or in part under the physical research program). The listing is consistent with "Federally Funded Research and Development Centers" as defined by the National Science Foundation and the Office of Science and Technology.

<u>Name of Laboratory, Contractor, and Principal Staff</u>	<u>Level of Physical Research Program Support - FY 1972</u>	
	<u>Operations</u>	<u>Equipment</u>
	(in thousands)	
AMES LABORATORY, Iowa State University of Science and Technology, Ames, Iowa	\$ 6,476	\$ 644
Director ..... Robert Hansen Deputy Director ..... Velmer A. Fassel		
ARGONNE NATIONAL LABORATORY, University of Chicago and Argonne Universities Association, Argonne (Lemont), Illinois	34,727	2,770
Director ..... R. B. Duffield Deputy Directors: For Research ..... M. V. Nevitt For Operations ..... R. V. Laney Associate Directors: High Energy Physics ..... B. Cork Physical & Biological Research ..... M. V. Nevitt (Acting) Educational Affairs ..... S. A. Miller Engineering Research & Development ..... J. A. Kyger		
BROOKHAVEN NATIONAL LABORATORY, Associated Universities, Inc., Upton, New York	35,934	4,228
Director ..... Maurice Goldhaber Deputy Director ..... George H. Vineyard Associate Directors: Life Sciences, Chemistry, & Safety ..... Victor P. Bond High Energy Physics ..... Ronald Rau Administration ..... Vincent R. O'Leary		
CAMBRIDGE ELECTRON ACCELERATOR, Massachusetts Institute of Technology and Harvard University, Cambridge, Massachusetts	2,156	387
Director ..... Karl Strauch		
LAWRENCE BERKELEY LABORATORY, University of California, Berkeley, California	29,688	1,551
Director ..... Edwin M. McMillan Associate Directors: Donner Laboratory of Biology & Medicine ..... James L. Born Inorganic Materials Research Division ..... Leo Brewer Chemical Biodynamics Lab. .. Melvin Calvin Nuclear Chemistry Division . Glenn T. Seaborg Physics Division ..... William A. Wenzel Administration ..... Harold A. Fidler Support ..... Elmer L. Kelly		

<u>Name of Laboratory, Contractor, and Principal Staff</u>	<u>Level of Physical Research Program Support - FY 1972</u> (in thousands)	
	<u>Operations</u>	<u>Equipment</u>
LAWRENCE BERKELEY LABORATORY (cont'd)		
Assistant to the Director, Physical Plant, Contracts, & Liaison ..... R. H. West		
LOS ALAMOS SCIENTIFIC LABORATORY, University of California, Los Alamos, New Mexico	\$ 7,239	\$ 1,762
Director ..... Harold Agnew		
Technical Associate Director . Raemer E. Schreiber		
Director, Meson Physics		
Division ..... Louis Rosen		
MOUND LABORATORY, Monsanto Research Corp., Miamisburg, Ohio	460	111
Project Director (President, Monsanto Research Corp.) ... H. K. Nason		
Director, Mound Lab. (Vice President Monsanto Research Corp.) ..... R. K. Flitcraft		
NATIONAL ACCELERATOR LABORATORY, Universities Research Association, Batavia, Illinois	12,749	10,349
Director ..... Robert R. Wilson		
Deputy Director ..... Edwin L. Goldwasser		
Associate Directors:		
Planning Advice ..... Thomas L. Collins		
Planning & Programming ..... James R. Sanford		
OAK RIDGE NATIONAL LABORATORY, Union Carbide Corp., Oak Ridge, Tennessee	26,338	1,881
Director ..... A. M. Weinberg		
Deputy Director ..... Floyd L. Culler		
Associate Directors:		
Administration ..... F. R. Bruce		
Basic Physical Sciences .... A. H. Snell		
Biomedical & Environmental Services ..... J. L. Liverman		
Reactor & Engineering ..... D. B. Trauger		
PACIFIC NORTHWEST LABORATORY, Battelle Memorial Institute, Richland, Washington	670	46
Director ..... Ronald S. Paul		
Associate Directors:		
R&D Group A ..... Edward L. Alpen		
R&D Group B ..... John M. Batch		
STANFORD LINEAR ACCELERATOR CENTER, Stanford University, Palo Alto, California	24,081	3,646
Director ..... W. K. H. Panofsky		
Deputy Director ..... Sidney D. Drell		
Associate Directors:		
Research Division ..... J. Ballam		
Technical Division ..... R. B. Neal		
Business Services ..... F. V. L. Pindar		
Administrative Services .... R. H. Moulton, Jr.		

Costs and Manpower  
As of July 1, 1972

<u>Laboratory</u>	<u>Total Costs</u> <u>(In thousands)</u>	<u>Scientific Man-Years</u>		<u>Number of</u> <u>Graduate Students</u>	<u>Number of</u> <u>Publications</u>
		<u>Permanent</u>	<u>Visiting</u>	<u>Engaged in Research</u>	
Ames Laboratory .....	\$ 7,120	74	2	191	273
Argonne National Laboratory ....	37,497	589	80	221	665
Brookhaven National Laboratory..	40,162	383	53	97	230
Cambridge Electron Accelerator..	2,543	112	0	0	15
Lawrence Berkeley Laboratory ...	31,239	401	90	266	423
Los Alamos Scientific Laboratory .....	8,975	87	6	20	59
Mound Laboratory .....	571	8	0	0	22
National Accelerator Laboratory.	23,098	197	11	8	97
Oak Ridge National Laboratory ..	28,219	374	25	51	609
Pacific Northwest Laboratory ...	716	8	1	1	19
Stanford Linear Accelerator Center .....	27,727	279	8	48	150
TOTAL .....	\$ 207,867	2,512	276	903	2,562

AMES LABORATORY

<u>Category</u>	<u>Total Cost (In Thousands)</u>	<u>Scientific Man-Years</u>		<u>Number of Graduate Students Engaged in Research</u>	<u>Number of Publications</u>
		<u>Permanent</u>	<u>Visiting</u>		
High Energy Physics .....	\$ 458	7	0	14	14
Medium Energy Physics .....	53	2	0	2	2
Low Energy Physics .....	588	4	1	12	8
Mathematics & Computers ....	139	3	0	0	11
Chemistry .....	2,921	23	1	101	108
Metallurgy & Materials .....	2,879	35	0	62	130
General Purpose Equipment ..	82	0	0	0	0
<b>TOTAL .....</b>	<b>\$ 7,120</b>	<b>74</b>	<b>2</b>	<b>191<sup>a/</sup></b>	<b>273<sup>b/</sup></b>

a/Includes 16 students engaged in research activities but whose salaries are not paid by Ames.

b/Includes 15 publications that resulted from collaborative efforts with universities.

ARGONNE NATIONAL LABORATORY

<u>Category</u>	<u>Total Cost (In Thousands)</u>	<u>Scientific Man-Years</u>		<u>Number of Graduate Students Engaged in Research</u>	<u>Number of Publications</u>
		<u>Permanent</u>	<u>Visiting</u>		
High Energy Physics .....	\$ 16,626	182	27	123	122
Medium Energy Physics .....	31	1	0	0	3
Low Energy Physics .....	4,664	85	13	59	116
Mathematics & Computers ....	1,187	30	1	9	41
Chemistry.....	8,846	177	17	14	199
Metallurgy & Materials .....	6,143	114	22	16	184
<b>TOTAL .....</b>	<b>\$ 37,497</b>	<b>589</b>	<b>80</b>	<b>221<sup>a/</sup></b>	<b>665<sup>b/</sup></b>

a/Includes 205 students engaged in research activities but whose salaries are not paid by ANL.

b/Includes 157 publications that resulted from collaborative efforts with universities.

BROOKHAVEN NATIONAL LABORATORY

<u>Category</u>	<u>Total Cost</u> (In Thousands)	<u>Scientific Man-Years</u>		<u>Number of</u> <u>Graduate Students</u> <u>Engaged in Research</u>	<u>Number of</u> <u>Publications</u>
		<u>Permanent</u>	<u>Visiting</u>		
High Energy Physics .....	\$ 25,087	193	17	57	32
Medium Energy Physics .....	218	2	0	1	0
Low Energy Physics .....	4,944	55	9	17	50
Mathematics & Computers ....	687	13	1	0	13
Chemistry .....	5,678	85	18	7	82
Metallurgy & Materials .....	3,134	35	8	15	53
General Purpose Equipment ..	414	0	0	0	0
TOTAL .....	\$ 40,162	383	53	97 <sup>a/</sup>	230 <sup>b/</sup>

a/Includes 92 students engaged in research activities but whose salaries are not paid by BNL.

b/Includes 62 publications that resulted from collaborative efforts with universities.

LAWRENCE BERKELEY LABORATORY

<u>Category</u>	<u>Total Cost</u> (In Thousands)	<u>Scientific Man-Years</u>		<u>Number of</u> <u>Graduate Students</u> <u>Engaged in Research</u>	<u>Number of</u> <u>Publications</u>
		<u>Permanent</u>	<u>Visiting</u>		
High Energy Physics .....	\$ 16,052	194	39	57	144
Medium Energy Physics .....	1,696	12	16	5	18
Low Energy Physics .....	263	10	0	2	12
Mathematics & Computers ....	129	5	0	0	3
Chemistry .....	11,014	152	27	115	178
Metallurgy & Materials .....	1,974	28	8	87	68
General Purpose Equipment ..	111	0	0	0	0
TOTAL .....	\$ 31,239	401	90	266 <sup>a/</sup>	423 <sup>b/</sup>

a/Includes 28 students engaged in research activities but whose salaries are not paid by LBL.

b/Includes 47 publications that resulted from collaborative efforts with other universities.

LOS ALAMOS SCIENTIFIC LABORATORY

<u>Category</u>	<u>Total Cost</u> <u>(In Thousands)</u>	<u>Scientific Man-Years</u>		<u>Number of</u> <u>Graduate Students</u> <u>Engaged in Research</u>	<u>Number of</u> <u>Publications</u>
		<u>Permanent</u>	<u>Visiting</u>		
Medium Energy Physics .....	\$ 8,975	87	6	20	59
TOTAL .....	\$ 8,975	87	6	20 <sup>a/</sup>	59 <sup>b/</sup>

a/Includes 13 students engaged in research activities  
but whose salaries are not paid by LASL.

b/Includes 8 publications that resulted from collaborative  
efforts with universities.

OAK RIDGE NATIONAL LABORATORY

<u>Category</u>	<u>Total Cost</u> <u>(In Thousands)</u>	<u>Scientific Man-Years</u>		<u>Number of</u> <u>Graduate Students</u> <u>Engaged in Research</u>	<u>Number of</u> <u>Publications</u>
		<u>Permanent</u>	<u>Visiting</u>		
High Energy Physics .....	\$ 316	7	1	4	22
Medium Energy Physics .....	1,571	28	5	15	37
Low Energy Physics .....	6,322	100	9	22	156
Mathematics & Computers .....	366	9	0	2	35
Chemistry .....	14,136	147	4	7	222
Metallurgy & Materials .....	5,508	83	6	1	137
TOTAL .....	\$ 28,219	374	25	51 <sup>a/</sup>	609 <sup>b/</sup>

a/Includes 51 students engaged in research activities  
but whose salaries are not paid by ORNL.

b/Includes 112 publications that resulted from collaborative  
efforts with universities.

OTHER LABORATORIES

<u>Category</u>	<u>Total Cost</u> <u>(In Thousands)</u>	<u>Scientific Man-Years</u>		<u>Number of</u> <u>Graduate Students</u> <u>Engaged in Research</u>	<u>Number of</u> <u>Publications</u>
		<u>Permanent</u>	<u>Visiting</u>		
CAMBRIDGE ELECTRON ACCELERATOR					
High Energy Physics .....	\$ 2,543	112	0	0	15
MOUND LABORATORY					
Low Energy Physics .....	190	3	0	0	13
Chemistry .....	286	3	0	0	7
Metallurgy & Materials .....	95	2	0	0	2
NATIONAL ACCELERATOR LABORATORY					
High Energy Physics .....	23,098	197	11	8	97
PACIFIC NORTHWEST LABORATORY					
Low Energy Physics .....	106	2	1	1	3
Metallurgy & Materials .....	610	6	0	0	16
STANFORD LINEAR ACCELERATOR CENTER					
High Energy Physics .....	27,727	279	8	48	150

## OFF-SITE CONTRACT-RESEARCH PROGRAM

In conducting this program, AEC typically uses a special research support agreement. Under this type of agreement, the AEC will contribute to the cost of performing the research, up to a specified amount (referred to as the "support ceiling"), in consideration for the performance of proposed research activities broadly defined in the agreement and in accordance with the provisions of the agreement.

When the special research support agreement is used for not-for-profit organizations other than educational institutions, AEC's commercial cost principles may be used in determining actual cost, or the contract provisions may be revised to provide for a lump-sum payment to the contractor in consideration for its commitment to perform particular research at a specified level of effort.

Very large projects, and in all cases those with an estimated cost in excess of \$500,000 annually, are financed by means of a cost-type contract which permits closer AEC surveillance of the work in accordance with appropriate contractual provisions not included in the special research support agreement. This type of contract is generally used for large-scale research programs performed in laboratories using equipment or facilities that are usually either partially or wholly AEC owned or controlled and/or for projects that do not lend themselves to accurate cost estimates. The total costs of the research may be shared by the contractor and AEC.

Occasionally, no-fund contracts are used in the contract-research program when AEC loans property to an outside organization as AEC's support to the research project or when the organization wishes to enter into a study contract in a certain area of research before it actually undertakes the research. Also, contracts are frequently extended without additional funds being added when the research project is being completed or terminated and additional time is required to bring the project to an orderly close.

In most cases, the contractor proposes to share in the cost of the work conducted under the contract. In order to support the maximum number of important and worthwhile projects within the limits of available funds and to have tangible evidence of a university's interest in the proposed research, it is AEC policy to encourage cost-sharing by the universities. Although sharing by the institution in the cost of the project is desirable, such sharing is not a pre-requisite for AEC support, which, in the final analysis, is determined by the prospective quality of the proposed research, the relative interest of AEC and the institution in the research, and availability of funds on the part of both AEC and the contractor. Thus, AEC will pay up to the full cost of a research project.

Most research contracts are written for terms of one year, renewable for additional annual terms. Sometimes contract terms may run somewhat more or less than one year (e.g., 9 or 15 months), usually for the purpose of establishing a different renewal date. There may also be cases where the contract may be written for several (usually three) years, but with the legal commitment for funding remaining on an annual basis. Occasionally, multi-year contracts with full funding are executed, generally where procurement of a major piece of equipment is involved, or where the nature of the research project is such that a clearly defined, fixed term can be established within which the entire research can be carried out.

In practice, contracts tend to run for several years, a few for as much as ten years or more. Most research projects are not of the type that can be completed in one year, or in any specified longer time period that can be estimated in advance with reasonable accuracy. This is informally recognized by the parties concerned, whenever a new research project is approved for support and the customary one year contract written.

Proposals for research contracts are usually initiated by the scientist interested in doing the work and are submitted through administrative channels of his institution to the appropriate division at the AEC Headquarters, depending on the scientific area of the proposed research project. Under the various divisions listed below are examples of the scientific areas falling within their cognizance:

### Division of Physical Research:

Physical Sciences, covering chemistry, metallurgy, ceramics, solid state physics, elementary particle physics, nuclear structure physics, atomic physics, and mathematics and computer research.



Division of Biomedical & Environmental Research:

Life Sciences, including medicine, biology, ecology and marine studies;  
Atmospheric radioactivity, fallout studies, and atmospheric sciences;  
Radiation and other instrumentation;  
Radiological and health physics.

Division of Controlled Thermonuclear Research:

Plasma physics as related to controlled thermonuclear processes;  
Fusion power and energy conversion technology.

Division of Applied Technology:

Isotopes Development, including technology and systems for production of isotopes, development of source materials and applications of radioisotopes;  
Peaceful nuclear explosives, including underground applications of nuclear explosions;  
General energy development, including non-nuclear technology concerned with all phases of energy production, conversion, transmission, and storage, and environmental effects thereof.

Division of Reactor Development and Technology:

General reactor technology, fast breeder reactor development, nuclear reactor safety, and environmental effects of central power station heat rejection and utilization.

Those interested in submitting proposals for research support under this program may obtain a copy of a "Guide for the Submission of Research Proposals" from AEC Headquarters, Washington, D. C., 20545, or from an AEC field office.

The contract-research program is not to be confused with AEC's program for Nuclear Education Assistance, including excess equipment grants, nuclear materials loans, etc. Requests for information and brochures concerning educational assistance should be directed to the Division of Nuclear Education and Training at AEC Headquarters.

Scientific reports on basic research investigations are usually published in the open literature. Special reporting of results in detail before they are ready for publication generally is not required of the contractors. AEC supports open publication and wide dissemination as the normal and most desirable means for reporting the findings of fundamental research.

Contract-research projects in effect as of July 1, 1972, and supported by the AEC Headquarters Division of Physical Research are listed on pp. 25-43, by AEC Budget Category, and including the name and location of the contractor, the name(s) of the principal investigator(s), a short descriptive title of the research, and the level of AEC support (i.e., contract amount authorized, as opposed to costs incurred and including funds provided for equipment) during the most recent funding period. The amounts listed are for one year unless otherwise indicated.

During Fiscal Year 1972 the Division of Physical Research received 200 formal unsolicited proposals for new research, representing requests for a total of \$8.7 million. On hand at the beginning of FY 1972 pending reviews were 166 new proposals requesting \$9.5 million, for a total of 366 proposals representing requests for \$18.2 million (\$ in millions):

	<u>On Hand 7/1/71</u>	<u>Received in FY 1972</u>	<u>Total</u>
High Energy Physics	29 - \$ 1.8	28 - \$ 1.7	57 - \$ 3.6
Medium Energy Physics	30 - 1.3	20 - 1.1	50 - 2.4
Low Energy Physics	64 - 4.8	39 - 1.4	103 - 6.2
Mathematics & Computers	12 - .4	18 - 1.0	30 - 1.4
Chemistry	18 - .8	29 - 1.2	47 - 1.9
Metallurgy & Materials	13 - .4	66 - 2.3	79 - 2.7
TOTAL	166 - \$ 9.5	200 - \$ 8.7	366 - \$18.2

	Approved in FY 1972	Declined, Etc. in FY 1972	On Hand 6/30/72
High Energy Physics	3 - \$ .10	34 - \$ 2.5	20 - \$ 1.0
Medium Energy Physics	5 - .14	21 - 1.0	24 - 1.2
Low Energy Physics	2 - .05	47 - 4.4	54 - 1.8
Mathematics & Computers	0 - -	28 - .8	2 - .6
Chemistry	3 - .10	28 - 1.2	16 - .6
Metallurgy & Materials	8 - .28	47 - 1.6	24 - .9
TOTAL	21 - \$ .67	205 - \$11.5	140 - \$ 6.1

Competition for available funds for new research projects has become increasingly severe in recent years, with new award amounts declining sharply since 1965:

Fiscal Year	On Hand at Beginning of Year	Received During Year	Approved During Year	Declined, etc. During Year	On Hand at End of Year
1965	184	336 - \$ 32.9	60 - \$ 6.1	276 - \$ 25.0	184
1966	184	366 - 33.8	58 - 5.1	331 - 39.9	161
1967	161	391 - 42.1	56 - 3.2	292 - 16.2	204
1968	204	358 - 41.7	58 - 2.2	356 - 36.4	148
1969	148	417 - 42.3	76 - 2.6	270 - 41.8	219
1970	219	412 - 46.6	31 - 1.5	421 - 68.7	179
1971	179	326 - 14.4	18 - .9	321 - 14.6	166
1972	166	200 - 8.7	21 - .7	205 - 11.5	140

At the beginning of Fiscal Year 1973 (July 1, 1972) there were 368 off-site research agreements in effect, at a total estimated level of effort of \$56.0 million, with the AEC contributing \$50.2 million; all with educational and a few other non-profit research institutions.

	(\$ in thousands)				
	Number of Agreements	Total Project Cost	Contractor Contribution	Percent of Total	AEC Contribution
High Energy Physics	43	\$ 23,603	\$ 2,252	10	\$ 21,351
Medium Energy Physics	16	3,412	243	7	3,169
Low Energy Physics	40	10,959	1,799	16	9,160
Mathematics & Computers	17	2,741	191	7	2,550
Chemistry	141	8,088	758	9	7,330
Metallurgy & Materials	111	7,202	514	7	6,688
TOTAL	368	56,005	5,757	10	50,248

Under AEC's annual review and renewal system, the yearly turnover rate, i.e., numbers of new projects approved and existing contracts terminated, until recently has tended to be in the 10-15% range, with an average of some 60 new contracts written and a corresponding number of old contracts terminating each year. In FY 1970, however, only 31 new projects were started, while 59 terminated, and in FY 1971 there were 18 new awards and 40 terminations. During FY 1972, the Division of Physical Research phased out 142 projects, while making only 21 new awards. New contracts, for administrative reasons, sometimes are written as separate new tasks under an existing contract; likewise, existing contracts occasionally may be split into two or more separate contracts. The following table illustrates the situation FY 1965-1972 (\$ in millions):

<u>Fiscal Year</u>	<u>New Contracts</u>	<u>Contract Terminations</u>	<u>No. of Contracts at End of Year</u>
1965	60 - \$ 6.1	59 - \$ 1.1	493 - \$ 65.8
1966	58 - 5.1	54 - 1.4	505 - 66.4
1967	56 - 3.2	41 - .9	516 - 71.0
1968	58 - 2.2	48 - 1.5	525 - 71.1
1969	76 - 2.6	58 - 1.2	543 - 71.1
1970	31 - 1.5	59 - 2.1	515 - 68.5
1971	18 - .9	40 - 1.5	484 - 61.7
1972	21 - .7	142 - 9.8	368 - 50.2

Again here, it is important to note that dollar figures pertaining to the off-site program represent contract amounts authorized, as opposed to costs incurred, and include funds provided for equipment, regardless of who takes title.

CONSOLIDATED BUDGET OF THE 368 PROJECTS  
INCLUDED IN THE PHYSICAL RESEARCH PROGRAM  
 As of July 1, 1972  
 (Dollars in Thousands)

Items of Expense

SRSA Projects	Total		High Energy Physics		Medium Energy Physics		Low Energy Physics		Math and Computers		Chemistry		Metallurgy and Materials	
	Total	%	Physics	%	Physics	%	Physics	%	Computers	%	Chemistry	%	Materials	%
Salaries and Wages .....	\$ 8,850	52.2	1,190	48.8	247	42.9	1,130	59.1	330	61.6	3,091	50.8	2,862	52.9
Equipment .....	903	5.3	89	3.6	93	16.1	65	3.4	5	.9	419	6.9	232	4.3
Materials and Supplies .....	2,431	14.3	512	21.0	76	13.2	171	8.9	23	4.3	874	14.4	775	14.3
Travel .....	402	2.4	104	4.3	43	7.5	52	2.7	12	2.2	119	1.9	72	1.3
Communications .....	29	.2	5	.2	2	.3	5	.3	0	0.0	7	.1	10	.2
Publication Costs .....	251	1.5	37	1.5	5	.9	28	1.5	8	1.5	94	1.5	79	1.5
Indirect Expenses .....	4,096	24.1	502	20.6	110	19.1	461	24.1	158	29.5	1,485	24.4	1,380	25.5
<b>TOTAL .....</b>	<b>\$16,962</b>	<b>100.0</b>	<b>2,439</b>	<b>100.0</b>	<b>576</b>	<b>100.0</b>	<b>1,912</b>	<b>100.0</b>	<b>536</b>	<b>100.0</b>	<b>6,089</b>	<b>100.0</b>	<b>5,410</b>	<b>100.0</b>
Contributed by Universities ..	2,107	12.4	453	18.6	144	25.0	278	14.5	25	4.7	693	11.4	514	9.5
Supported by AEC .....	14,855	87.6	1,986	81.4	432	75.0	1,634	85.5	511	95.3	5,396	88.6	4,896	90.5
Incl. Unexpended Balance of.	294		66		6		19		19		110		74	

Cost-Type Projects

Salaries and Wages .....	17,906	45.9	9,610	45.4	1,095	38.6	4,341	48.0	1,095	49.7	977	48.9	788	44.0
Equipment .....	2,720	7.0	1,122	5.3	621	21.9	561	6.2	80	3.6	173	8.7	163	9.1
Materials and Supplies .....	7,314	18.7	4,077	19.3	447	15.8	1,667	18.4	395	17.9	308	15.4	420	23.4
Travel .....	1,151	2.9	879	4.2	94	3.3	132	1.5	15	.7	19	.9	12	.7
Communications .....	140	.4	91	.4	7	.2	18	.2	7	.3	8	.4	9	.5
Publication Costs .....	282	.7	117	.5	6	.2	123	1.3	8	.4	7	.4	21	1.2
Indirect Expenses .....	9,529	24.4	5,268	24.9	566	20.0	2,205	24.4	605	27.4	506	25.3	379	21.1
<b>TOTAL .....</b>	<b>\$39,042</b>	<b>100.0</b>	<b>21,164</b>	<b>100.0</b>	<b>2,836</b>	<b>100.0</b>	<b>9,047</b>	<b>100.0</b>	<b>2,205</b>	<b>100.0</b>	<b>1,998</b>	<b>100.0</b>	<b>1,792</b>	<b>100.0</b>
Contributed by Universities ..	3,649	9.3	1,799	8.5	99	3.5	1,521	16.8	166	7.5	64	3.2	0	0.0
Supported by AEC .....	35,393	90.7	19,365	91.5	2,737	96.5	7,526	83.2	2,039	92.5	1,934	96.8	1,792	100.0
Incl. Unexpended Balance of.	31		5		0		26		0		0		0	

NUMBER OF SCIENTIFIC EMPLOYEES,  
RESEARCH ASSISTANTS & PUBLICATIONS  
UNDER THE PHYSICAL RESEARCH PROGRAM

<u>Category</u>	<u>Principal Investigators</u>		<u>Research Associates</u>		<u>Other Permanent Scientific Staff (Incl. Visitors)</u>		<u>Research Assistants</u>	<u>Publications</u>
	<u>No.</u>	<u>MY's</u>	<u>No.</u>	<u>MY's</u>	<u>No.</u>	<u>MY's</u>		
High Energy Physics .....	139	66	239	172	389	250	399	533
Medium Energy Physics ....	27	11	29	19	68	37	47	39
Low Energy Physics .....	70	25	112	97	255	67	273	443
Mathematics & Computers ..	21	6	38	17	49	30	79	71
Chemistry .....	133	41	147	113	16	9	263	510
Metallurgy & Materials ...	133	34	80	54	29	11	338	374
<b>TOTAL .....</b>	<b>523</b>	<b>183</b>	<b>645</b>	<b>472</b>	<b>806</b>	<b>404</b>	<b>1,399</b>	<b>1,970</b>

TYPE OF ORGANIZATIONS

<u>Projects with:</u>	<u>Division Total</u>	<u>High Energy Physics</u>	<u>Medium Energy Physics</u>	<u>Low Energy Physics</u>	<u>Math and Computers</u>	<u>Chemistry</u>	<u>Metallurgy and Materials</u>
State Institutions ....	198	24	6	24	7	78	59
Private Institutions ..	167	19	10	16	9	61	52
Municipal Institutions.	3	0	0	0	1	2	0
<b>TOTAL .....</b>	<b>368</b>	<b>43</b>	<b>16</b>	<b>40</b>	<b>17</b>	<b>141</b>	<b>111</b>

OPERATIONS OFFICES ADMINISTERING  
THE BUSINESS ASPECTS OF THE AGREEMENTS

<u>Operations Offices</u>	<u>Division Total</u>	<u>High Energy Physics</u>	<u>Medium Energy Physics</u>	<u>Low Energy Physics</u>	<u>Math and Computers</u>	<u>Chemistry</u>	<u>Metallurgy and Materials</u>
Chicago .....	216	25	8	21	9	81	72
Idaho .....	2	0	1	0	0	1	0
Nevada .....	1	0	0	0	0	1	0
Oak Ridge .....	79	5	4	8	2	36	24
Richland .....	20	2	1	3	1	9	4
San Francisco .....	47	11	2	8	5	10	11
Savannah River .....	3	0	0	0	0	3	0
<b>TOTAL .....</b>	<b>368</b>	<b>43</b>	<b>16</b>	<b>40</b>	<b>17</b>	<b>141</b>	<b>111</b>

TYPE OF AGREEMENTS

<u>Type</u>	<u>Division Total</u>	<u>High Energy Physics</u>	<u>Medium Energy Physics</u>	<u>Low Energy Physics</u>	<u>Math and Computers</u>	<u>Chemistry</u>	<u>Metallurgy and Materials</u>
Cost Contracts .....	63	26	9	17	4	4	3
SRSA .....	305	17	7	23	13	137	108
<b>TOTAL .....</b>	<b>368</b>	<b>43</b>	<b>16</b>	<b>40</b>	<b>17</b>	<b>141</b>	<b>111</b>

AGREEMENTS BY AEC DOLLAR LEVEL

<u>Dollar Level</u>	<u>Division Total</u>	<u>High Energy Physics</u>	<u>Medium Energy Physics</u>	<u>Low Energy Physics</u>	<u>Math and Computers</u>	<u>Chemistry</u>	<u>Metallurgy &amp; Materials</u>
0 .....	31	0	0	2	1	18	10
1 - 9,999 .....	2	0	0	0	0	2	0
10,000 - 19,999 .....	12	0	1	0	0	8	3
20,000 - 29,999 .....	55	0	1	1	4	25	24
30,000 - 39,999 .....	63	2	2	2	1	27	29
40,000 - 49,999 .....	36	1	1	4	3	16	11
50,000 - 59,999 .....	27	2	2	2	2	16	3
60,000 - 69,999 .....	21	0	1	4	2	5	9
70,000 - 79,999 .....	15	0	1	1	0	9	4
80,000 - 89,999 .....	9	1	0	2	0	2	4
90,000 - 99,999 .....	8	1	0	1	0	3	3
100,000 - 249,999 .....	41	12	4	8	1	7	9
250,000 - 499,999 .....	22	9	1	8	1	2	1
500,000 + .....	26	15	2	5	2	1	1
<b>TOTAL .....</b>	<b>368</b>	<b>43</b>	<b>16</b>	<b>40</b>	<b>17</b>	<b>141</b>	<b>111</b>

PERCENT OF AEC CONTRIBUTION TO THE TOTAL COST OF THE RESEARCH

<u>Percentage</u>	<u>Division Total</u>	<u>High Energy Physics</u>	<u>Medium Energy Physics</u>	<u>Low Energy Physics</u>	<u>Math and Computers</u>	<u>Chemistry</u>	<u>Metallurgy &amp; Materials</u>
0 - 9 .....	31	0	0	2	1	18	10
10 - 19 .....	0	0	0	0	0	0	0
20 - 29 .....	0	0	0	0	0	0	0
30 - 39 .....	2	1	0	0	0	1	0
40 - 49 .....	3	1	1	0	0	1	0
50 - 59 .....	6	2	0	3	0	1	0
60 - 69 .....	23	3	1	4	0	9	6
70 - 79 .....	40	8	2	8	2	11	9
80 - 89 .....	60	3	3	5	1	24	24
90 - 99 .....	27	1	0	1	3	10	12
100* .....	176	24	9	17	10	66	50
<b>TOTAL .....</b>	<b>368</b>	<b>43</b>	<b>16</b>	<b>40</b>	<b>17</b>	<b>141</b>	<b>111</b>

\*Includes a large number of contracts where the universities contribute to the cost of the research but do not estimate a specified amount.

SUMMARY OF OFF-SITE CONTRACTS BY STATE

<u>State and Contractor</u>	<u>Number of Contracts</u>	<u>FY 1972 Funding* (in 1000's)</u>
<u>Alabama</u>	<u>2</u>	<u>\$ 27</u>
Alabama A & M University, Normal	1	0
Alabama, University of, University	1	27
<u>Alaska</u>	<u>2</u>	<u>69</u>
Alaska, University of, College	2	69
<u>Arizona</u>	<u>3</u>	<u>148</u>
Arizona State University, Tempe	1	62
Arizona, University of, Tucson	2	86
<u>Arkansas</u>	<u>2</u>	<u>48</u>
Arkansas, University of, Fayetteville	2	48
<u>California</u>	<u>46</u>	<u>6,897</u>
California Institute of Technology, Pasadena	8	2,071
California, University of, Berkeley	3	213
California, University of, Davis	2	121
California, University of, Irvine	4	728
California, University of, Los Angeles	11	1,781
California, University of, Riverside	2	271
California, University of, San Diego	3	687
California, University of, Santa Barbara	2	227
California, University of, Santa Cruz	1	110
Southern California, University of, Los Angeles	3	125
Stanford University, Stanford	7	563
<u>Colorado</u>	<u>4</u>	<u>550</u>
Colorado State University, Ft. Collins	1	0
Colorado, University of, Boulder	3	550
<u>Connecticut</u>	<u>8</u>	<u>2,816</u>
The New England Institute, Inc., Ridgefield	1	42
Yale University, New Haven	7	2,774
<u>District of Columbia</u>	<u>5</u>	<u>122</u>
Georgetown University	1	39
George Washington University	1	21
Howard University	3	62
<u>Florida</u>	<u>8</u>	<u>473</u>
Florida State University, Tallahassee	4	332
Florida, University of, Gainesville	4	141
<u>Georgia</u>	<u>6</u>	<u>149</u>
Georgia Institute of Technology, Atlanta	4	117
Georgia, University of, Athens	2	32
<u>Hawaii</u>	<u>2</u>	<u>447</u>
Hawaii, University of, Honolulu	2	447
<u>Idaho</u>	<u>1</u>	<u>0</u>
Idaho State University, Pocatello	1	0

\*Dollar figures are based on obligations made specifically from FY 1972 funds, for operations and equipment, for the 368 contracts in effect as of July 1, 1972.



<u>State and Contractor</u>	<u>Number of Contracts</u>	<u>FY 1972 Funding (in 1000's)</u>
<u>Illinois</u>	<u>17</u>	<u>\$ 3,922</u>
Chicago, University of, Chicago	7	420
Illinois Institute of Technology, Chicago	2	127
Illinois, University of, Urbana	5	3,296
Northwestern University, Evanston	3	79
<u>Indiana</u>	<u>9</u>	<u>2,114</u>
Indiana University, Bloomington	1	177
Notre Dame, University of, Notre Dame	1	1,091
Purdue University, Lafayette	7	846
<u>Kansas</u>	<u>3</u>	<u>365</u>
Kansas State University, Manhattan	2	290
Kansas, University of, Lawrence	1	75
<u>Kentucky</u>	<u>1</u>	<u>12</u>
Kentucky, University of, Lexington	1	12
<u>Louisiana</u>	<u>2</u>	<u>65</u>
Southern University, Baton Rouge	2	65
<u>Maryland</u>	<u>15</u>	<u>2,149</u>
Johns Hopkins University, Baltimore	5	353
Maryland, University of, College Park	10	1,796
<u>Massachusetts</u>	<u>21</u>	<u>7,600</u>
Brandeis University, Waltham	3	245
Clark University, Worcester	2	49
Harvard University, Cambridge	3	1,528
Massachusetts Institute of Technology, Cambridge	8	5,295
Massachusetts, University of, Amherst	2	178
Northeastern University, Boston	1	0
Tufts University, Medford	1	280
Worcester Polytechnic Institute, Worcester	1	25
<u>Michigan</u>	<u>14</u>	<u>1,908</u>
Michigan State University, East Lansing	5	249
Michigan Technological University, Houghton	3	151
Michigan, University of, Ann Arbor	3	1,386
Wayne State University, Detroit	3	122
<u>Minnesota</u>	<u>8</u>	<u>1,287</u>
Minnesota, University of, Minneapolis	8	1,287
<u>Mississippi</u>	<u>1</u>	<u>20</u>
Mississippi, University of, University	1	20
<u>Missouri</u>	<u>4</u>	<u>205</u>
Washington University, St. Louis	4	205
<u>Montana</u>	<u>3</u>	<u>60</u>
Montana State University, Bozeman	2	26
Montana, University of, Missoula	1	34
<u>Nebraska</u>	<u>1</u>	<u>23</u>
Nebraska, University of, Lincoln	1	23
<u>Nevada</u>	<u>1</u>	<u>11</u>
Nevada, University of, Reno	1	11
<u>New Hampshire</u>	<u>1</u>	<u>28</u>
Dartmouth College, Hanover	1	28

<u>State and Contractor</u>	<u>Number of Contracts</u>	<u>FY 1972 Funding (in 1000's)</u>
<u>New Jersey</u>	<u>6</u>	<u>\$ 1,409</u>
Institute for Advanced Study, Princeton	1	50
Princeton University, Princeton	4	1,338
Rutgers University, New Brunswick	1	21
<u>New York</u>	<u>57</u>	<u>5,462</u>
Clarkson College of Technology, Potsdam	3	76
Columbia University, New York	8	923
Cornell University, Ithaca	12	800
New York, City University of, Brooklyn College	2	62
New York, City University of, Queens College	1	0
New York, State University of, Albany	2	64
New York, State University of, Buffalo	1	100
New York, State University of, Stony Brook	7	311
New York University, New York	2	1,029
Rensselaer Polytechnic Institute, Troy	7	198
Rochester, University of, Rochester	5	1,175
Rockefeller University, New York	1	530
Syracuse University, Syracuse	3	138
Yeshiva University, New York	3	56
<u>North Carolina</u>	<u>11</u>	<u>988</u>
Duke University, Durham	2	685
North Carolina State University, Raleigh	2	102
North Carolina, University of, Chapel Hill	6	201
Wake Forest University, Winston-Salem	1	0
<u>Ohio</u>	<u>14</u>	<u>781</u>
Case Western Reserve University, Cleveland	6	271
Cincinnati, University of, Cincinnati	1	45
Kent State University, Kent	1	40
Ohio State University, Columbus	5	425
Toledo, University of, Toledo	1	0
<u>Oklahoma</u>	<u>2</u>	<u>28</u>
Oklahoma, University of, Norman	2	28
<u>Oregon</u>	<u>7</u>	<u>270</u>
Oregon State University, Corvallis	5	154
Oregon, University of, Eugene	2	116
<u>Pennsylvania</u>	<u>23</u>	<u>3,194</u>
Carnegie-Mellon University, Pittsburgh	9	1,426
Lehigh University, Bethlehem	1	34
Lincoln University, Lincoln University	1	20
Pennsylvania State University, University Park	3	94
Pennsylvania, University of, Philadelphia	3	1,377
Pittsburgh, University of, Pittsburgh	4	185
Temple University, Philadelphia	2	58
<u>Puerto Rico</u>	<u>1</u>	<u>27</u>
Puerto Rico, University of, Mayaguez	1	27
<u>Rhode Island</u>	<u>4</u>	<u>510</u>
Brown University, Providence	4	510
<u>South Carolina</u>	<u>1</u>	<u>0</u>
South Carolina, University of, Columbia	1	0

<u>State and Contractor</u>	<u>Number of Contracts</u>	<u>FY 1972 Funding (in 1000's)</u>
<u>Tennessee</u>	<u>8</u>	<u>\$ 197</u>
Oak Ridge Associated Universities, Oak Ridge	1	40
Tennessee State University, Nashville	1	11
Tennessee, University of, Knoxville	5	146
Vanderbilt University, Nashville	1	0
<u>Texas</u>	<u>16</u>	<u>1,631</u>
Baylor University, Waco	1	20
Houston, University of, Houston	3	172
Rice University, Houston	3	640
Texas A & M University, College Station	5	210
Texas, University of, Austin	4	589
<u>Utah</u>	<u>5</u>	<u>179</u>
Associated Western Universities, Inc., Salt Lake City	1	20
Utah, University of, Salt Lake City	4	159
<u>Vermont</u>	<u>1</u>	<u>21</u>
Vermont, University of, Burlington	1	21
<u>Virginia</u>	<u>6</u>	<u>346</u>
Virginia Polytechnic Institute & State Univ., Blacksburg	2	42
Virginia, University of, Charlottesville	4	304
<u>Washington</u>	<u>9</u>	<u>1,210</u>
Washington State University, Pullman	2	54
Washington, University of, Seattle	6	1,148
Western Washington State College, Bellingham	1	8
<u>Wisconsin</u>	<u>6</u>	<u>1,872</u>
Marquette University, Milwaukee	1	34
Wisconsin, University of, Madison	5	1,838
<u>Wyoming</u>	<u>1</u>	<u>40</u>
Wyoming, University of, Laramie	1	40

HIGH ENERGY PHYSICS

- Brandeis University, Waltham, Massachusetts. Lawrence E. Kirsch and Howard J. Schnitzer, Research in Elementary Particle Physics. \$140,000.
- Brown University, Providence, Rhode Island. David Feldman and Anatole M. Shapiro, Experimental and Theoretical High Energy Physics. \$332,000.
- California Institute of Technology, Pasadena, California. Robert L. Walker, Experimental, Theoretical and Phenomenological Research. \$1,352,854.
- California, University of, Davis, California. Richard L. Lander, High Energy Particle Physics Research. \$75,000.
- California, University of, Irvine, California. Frederick Reines, Studies of Neutrino and Cosmic Ray Interactions. \$350,000.
- California, University of, Irvine, California. Jonas Schultz and Paul E. Condon, Elementary Particle Interactions. \$165,000.
- California, University of, Los Angeles, California. Harold K. Ticho and Donald H. Stork, Research in High Energy Physics. \$390,000.
- California, University of, Riverside, California. Robert T. Poe and Anne Kernan, High Energy Physics. \$205,000.
- California, University of, San Diego, California. Oreste Piccioni and Norman Kroll, Experimental and Theoretical Particle Physics. \$540,000.
- California, University of, Santa Barbara, California. David O. Caldwell, High Energy Physics Users. \$185,000.
- California, University of, Santa Cruz, California. Clemens A. Heusch, Experimental Elementary Particle Research. \$110,000.
- Carnegie-Mellon University, Pittsburgh, Pennsylvania. Roger B. Sutton, High Energy Physics Users and Theoretical Research. \$790,000.
- Colorado, University of, Boulder, Colorado. Uriel Nauenberg, High Energy Physics. \$100,000.
- Columbia University, New York, New York. Robert Serber and T. D. Lee, Theoretical High Energy Physics. \$300,000.
- Duke University, Durham, North Carolina. William D. Walker, Research in High Energy Physics. \$195,000.
- Florida State University, Tallahassee, Florida. Joseph E. Lannutti, Elementary Particle Physics. \$155,000.
- Harvard University, Cambridge, Massachusetts. R. Wilson, High Energy Physics Research. \$1,480,544.
- Harvard University, Cambridge, Massachusetts. Tai Tsun Wu, High Energy Collision Processes. \$25,000.
- Hawaii, University of, Honolulu, Hawaii. Vincent Z. Peterson and San Fu Tuan, Research in High Energy Nuclear Physics. \$422,000.
- Illinois, University of, Urbana, Illinois. A. Wattenberg, High Energy Physics Users; Theoretical Research. \$1,221,038.
- Indiana University, Bloomington, Indiana. Richard M. Heinz, Homer A. Neal, Shu-Yuan Chu and Archibald W. Hendry, Research in Experimental and Theoretical High Energy Physics. \$177,000.
- Institute for Advanced Study, Princeton, New Jersey. Roger F. Dasher, Problems in Particle Theory, \$50,000.

## HIGH ENERGY PHYSICS

- Johns Hopkins University, Baltimore, Maryland. Gabor Domokos, Research in Theoretical Physics. \$42,000.
- Maryland, University of, College Park, Maryland. George A. Snow and Robert Glasser, Properties of Elementary Particles. \$642,930.
- Massachusetts Institute of Technology, Cambridge, Massachusetts. Fred J. Epling, High Energy Physics Research. \$2,720,650.
- Massachusetts, University of, Amherst, Massachusetts. Janice B. Shafer, High Energy Physics. \$138,000.
- Michigan, University of, Ann Arbor, Michigan. Daniel Sinclair, High Energy Physics Users and Theoretical Research. \$780,992.
- Minnesota, University of, Minneapolis, Minnesota. Stephen Gasiorowicz and Hans W. J. Courant, Theoretical and High Energy Physics Research. \$270,000.
- Ohio State University, Columbus, Ohio. Thomas A. Romanowski, K. Tanaka and W. W. Wada, High Energy Physics. \$300,000.
- Oregon, University of, Eugene, Oregon. Michael J. Moravcsik, Theory of Elementary Particles. \$90,000.
- Pennsylvania, University of, Philadelphia, Pennsylvania. Sherman Frankel, High Energy Physics Research. \$1,322,299.
- Princeton University, Princeton, New Jersey. Frank Shoemaker, High Energy Physics Research. \$1,149,980.
- Purdue University, Lafayette, Indiana. Frank J. Loeffler and Masao Sugawara, Fundamental Particle Physics. \$570,000.
- Rochester, University of, Rochester, New York. A. C. Melissinos and S. Okubo, High Energy Physics Users and Theoretical Research. \$829,859.
- Rockefeller University, New York, New York. Rodney L. Cool and Abraham Pais, Research in Experimental and Theoretical High Energy Physics. \$530,000 (2 years).
- Stanford University, Stanford, California. David M. Ritson, High Energy Reactions. \$320,000.
- Syracuse University, Syracuse, New York. K. C. Wali, Research in Elementary Particle Theory. \$117,500.
- Tennessee, University of, Knoxville, Tennessee. William M. Bugg, Study of Elementary Particle Processes using Bubble Chamber Techniques. \$50,000.
- Texas, University of, Austin, Texas. E. C. G. Sudarshan and Yuval Ne'eman, Research in Elementary Particle Theory. \$150,000.
- Tufts University, Medford, Massachusetts. Allan M. Cormack, Experimental High Energy Physics Research. \$280,000.
- Washington, University of, Seattle, Washington. Jere J. Lord, High Energy Physics Studies of Particle Production in Nuclear Interactions. \$35,000.
- Wisconsin, University of, Madison, Wisconsin. D. Reeder, High Energy Physics Users and Theoretical Research. \$1,333,679.
- Yale University, New Haven, Connecticut. J. Sandweiss, High Energy Physics Users and Theoretical Research. \$1,112,000.

MEDIUM ENERGY PHYSICS

Associated Western Universities, Salt Lake City, Utah. Victor G. Beard, Research Participation at LAMPF. \$20,000 (8 months).

California Institute of Technology, Pasadena, California. Felix Boehm and Petr Vogel, Nuclear Spectroscopy and High Resolution Studies of Muonic X-Rays and Nuclear Gamma Rays. \$36,000 (4 months).

California, University of, Los Angeles, California. George J. Igo, Intermediate Energy Nuclear Physics Users Group. \$137,550 (15 months).

California, University of, Los Angeles, California. Roy P. Haddock and B. M. K. Nefkens, Particle Physics. \$333,682 (17 months).

Carnegie-Mellon University, Pittsburgh, Pennsylvania. Peter D. Barnes, Experimental Nuclear Physics. \$55,000.

Case Western Reserve University, Cleveland, Ohio. Harvey B. Willard, Medium Energy Nuclear Physics Research. \$62,470.

Houston, University of, Houston, Texas. John C. Allred and Clark Goodman, Pion Interactions at Medium Energies. \$75,000.

Maryland, University of, College Park, Maryland. Harry D. Holmgren, Experimental Study of the Structure of Nuclei and the Interactions of Intermediate Energy Particles. \$605,000.

Massachusetts Institute of Technology, Cambridge, Massachusetts. Fred J. Eppling, Intermediate Energy Physics Research. \$1,196,855.

Montana, University of, Missoula, Montana. Mark J. Jakobson, Total Pion Cross Section Measurements. \$34,000.

Rice University, Houston, Texas. Gerald C. Phillips, Nuclear and Extra-Nuclear Physics. \$175,000.

Temple University, Philadelphia, Pennsylvania. W. Kenneth McFarlane, Experimental Investigation of Pion Decays at the Los Alamos Meson Physics Facility. \$58,232.

Virginia, University of, Charlottesville, Virginia. Ralph C. Minehart, Stanley E. Sobottka and Klaus O. H. Ziock, Experiments on the Nuclear Interactions of Pions. \$101,270.

Washington, University of, Seattle, Washington. Isaac Halpern, Experimental and Theoretical Nuclear Physics. \$13,900 (4 months).

Wyoming, University of, Laramie, Wyoming. Glen A. Rebka, Jr. and Raymond Kunselman, Pion-Nucleon Interactions and Mesonic Atoms. \$40,091.

Yale University, New Haven, Connecticut. D. Allan Bromley, Medium Energy Physics Research Program. \$219,000.

LOW ENERGY PHYSICS

- Alaska, University of, College, Alaska. Eduard Berg and Hans Pulpan, Earth Tilts in Connection with Crustal Failure: A Study in Alaska. \$44,132.
- Alaska, University of, College, Alaska. Syun-Ichi Akasofu, A Study of Magnetospheric Substorms in Conjunction with the Vela Satellite Data. \$24,875.
- Arizona, University of, Tucson, Arizona. C. Y. Fan, To Measure Lamb Shift in Hydrogen-Like Atoms of Nuclear Charge  $Z \geq 3$ . \$22,532 (2 years).
- Brown University, Providence, Rhode Island. Stavros Fallieros and Frank S. Levin, Nuclear Excitations and Reaction Mechanisms. \$42,895.
- California Institute of Technology, Pasadena, California. Felix Boehm and B. Persson, Nuclear Spectroscopy and High Resolution Studies of Muonic X-Rays and Nuclear Gamma Rays. \$200,000.
- California, University of, Berkeley, California. Carson D. Jeffries, Dynamic Nuclear Polarization and Solid State Physics. \$85,734.
- California, University of, Berkeley, California. John H. Reynolds, Mass Spectroscopy Research. \$61,000.
- California, University of, Berkeley, California. Paul B. Price, Jr., Astrophysical and Superheavy Element Studies with Nuclear Tracks in Solids. \$66,000 (13 months).
- California, University of, Los Angeles, California. Byron T. Wright, Nuclear Structure Research. \$380,000.
- California, University of, Los Angeles, California. George C. Kennedy, Compressibility Measurements. \$60,000.
- California, University of, Santa Barbara, California. Robert M. Eisberg, Nuclear Structure Research. \$41,976.
- Carnegie-Mellon University, Pittsburgh, Pennsylvania. Peter D. Barnes, Experimental Nuclear Physics. \$30,305.
- Case Western Reserve University, Cleveland, Ohio. Harvey B. Willard and R. M. Thaler, Nuclear Physics Research. \$190,120 (20 months).
- Colorado, University of, Boulder, Colorado. Brian W. Ridley and Ernest S. Rost, Study of Fundamental Nuclear Interactions. \$411,495.
- Columbia University, New York, New York. W. W. Havens, Jr. and Edward Melkonian, Research Program in Neutron Spectroscopy. \$120,000.
- Columbia University, New York, New York. L. James Rainwater, Research in Neutron Velocity Spectroscopy. \$310,000.
- Columbia University/Lamont-Doherty Geological Observatory, Palisades, New York. Lynn R. Sykes and Klaus H. Jacob, A Comprehensive Study of the Seismotectonics of the Aleutian Arc. \$66,116 (9 1/2 months).
- Duke University, Durham, North Carolina. Henry W. Newson, Studies of Nuclear Structure Using Neutrons and Charged Particles. \$490,000.
- Illinois, University of, Urbana, Illinois. George H. Miley and Joseph T. Verdeyen, Advanced Methods for Nuclear Reactor-Gas Laser Coupling. \$56,243.
- Johns Hopkins University, Baltimore, Maryland. George E. Owen and Leon Madansky, Nuclear Moments and Nuclear Structure. \$160,000.
- Kansas State University, Manhattan, Kansas. James C. Legg, Atomic and Nuclear Research with Accelerators. \$279,500.

LOW ENERGY PHYSICS

Maryland, University of, College Park, Maryland. Manoj K. Banerjee and Gerard J. Stephenson, Jr., Theoretical Studies in Nuclear Reactions and Nuclear Structure. \$200,000.

Massachusetts Institute of Technology, Cambridge, Massachusetts. Fred J. Epling, Low Energy Research. \$769,940.

Michigan, University of, Ann Arbor, Michigan. W. C. Parkinson and R. S. Tickle, 83-Inch Cyclotron Research Program. \$555,084.

Michigan, University of, Ann Arbor, Michigan. Glenn Knoll, Absolute Neutron Cross Section Measurements. \$50,000.

Minnesota, University of, Minneapolis, Minnesota. J. Morris Blair, George W. Greenlees and Norton Hintz, Experimental Nuclear Physics. \$676,000.

New York, State University of, Buffalo, New York. Gregory Breit, The Theories of Nucleon-Nucleon Interactions, Nuclear Reactions and Atomic Hyperfine Structure. \$99,998.

New York, State University of, Stony Brook, New York. G. E. Brown, Andrew D. Jackson, Jr., Thomas T. S. Kuo, and Akito Arima, Research in Theoretical Nuclear Physics. \$160,000.

North Carolina State University, Raleigh, North Carolina. L. W. Seagondollar, Nuclear Structure Research at the Triangle Universities Nuclear Laboratory. \$73,701.

North Carolina, University of, Chapel Hill, North Carolina. Eugen Merzbacher, Studies of Nuclear Processes. \$76,378.

Oak Ridge Associated Universities, Oak Ridge, Tennessee. E. H. Spejewski, University Isotope Separator--Oak Ridge. \$40,000.

Rice University, Houston, Texas. G. C. Phillips, G. K. Walters and Neal F. Lane, Nuclear and Extra-Nuclear Physics. \$445,000.

Rochester, University of, Rochester, New York. J. Bruce French and Daniel S. Koltun, Nuclear Structure Theory. \$125,000.

Southern California, University of, Los Angeles, California. H. H. Forster, Nuclear Physics Research. \$125,000.

Southern University, Baton Rouge, Louisiana. Kuang-Hsiang Liu, Mohammed Ali A. Toosi, Zorawar Singh and Edgar T. Lynk, Experimental and Theoretical Nuclear Physics. \$46,000.

Texas, University of, Austin, Texas. S. A. A. Zaidi and Taro Tamura, Research in Nuclear Physics. \$388,837.

Washington, University of, Seattle, Washington. David Bodansky and David G. Boulware, Experimental and Theoretical Nuclear Physics. \$1,000,000.

Wisconsin, University of, Madison, Wisconsin. H. T. Richards and L. W. Anderson, Research in Nuclear Physics and Atomic Collisions. \$444,666.

Yale University, New Haven, Connecticut. D. Allan Bromley, Electron Linear Accelerator Program and Other Low Energy Physics Research. \$122,300.

Yale University, New Haven, Connecticut. D. Allan Bromley, MP Tandem Van de Graaff Research Program. \$796,131.



MATHEMATICS AND COMPUTER RESEARCH

- California, University of, Los Angeles, California. Gerald Estrin, Research Program for the UCLA Variable Structure Computer System. \$250,000.
- Harvard University, Cambridge, Massachusetts. Garrett Birkhoff, Mathematical Problems in Nuclear Reactor Theory. \$22,500.
- Illinois, University of, Urbana, Illinois. C. W. Gear and W. J. Poppelbaum, Computer Systems Research. \$530,000.
- Illinois, University of, Urbana, Illinois. Bruce H. McCormick, Experiments with an Image Processing Computer. \$230,000.
- Johns Hopkins University, Baltimore, Maryland. Michael J. Flynn, Studies in the Organization of Computer Systems. \$68,422 (15 1/2 months).
- Kent State University, Kent, Ohio. Richard S. Varga, Use of Variational and Projectional Methods in Numerical Analysis. \$40,000.
- Maryland, University of, College Park, Maryland. Bertie E. Hubbard and Ivo Babuska, Studies of the Numerical Solution of Elliptic and Parabolic Boundary Value Problems. \$48,253.
- New York, City University of/Queens College, Flushing, New York. Sol Weintraub, Optimal Approximation and Differentiable Maps. \$42,436 (31 months).
- New York, State University of, Stony Brook, New York. Martin A. Leibowitz and Daniel Dicker, Research in Applied Mathematics. \$59,976 (2 years).
- New York University, New York, New York. Paul R. Garabedian, Courant Institute of Mathematical Sciences. \$1,028,993.
- New York University, Bronx, New York. Raphael Aronson, Investigations of Transfer Matrix Method. \$23,354 (19 months).
- Oregon State University, Corvallis, Oregon. Arvid T. Lonseth, Research in Applied Analysis. \$25,000 (12 1/2 months).
- Rice University, Houston, Texas. Edward A. Feustel, The Interchange of Essential Programs Between Dissimilar Computers. \$20,000.
- Southern California, University of, Los Angeles, California. Richard Bellman, New Methods in the Theory of Partial Differential Equations. \$52,000 (20 months).
- Stanford University, Stanford, California. George B. Dantzig, Robert B. Wilson and Richard W. Cottle, Stochastic Mathematical Programs. \$60,000.
- Stanford University, Stanford, California. William F. Miller, Programming Models and the Control of Computer Systems. \$34,998.
- Stanford University, Stanford, California. Gene H. Golub, Numerical Analysis with Emphasis on Least Square Problems. \$37,513 (9 months).

## CHEMISTRY

- Alabama, University of, University, Alabama. Lowell D. Kispert, ELDOR Investigations of Radiation Processes. \$27,000.
- Arizona State University, Tempe, Arizona. LeRoy Eyring, Solid State Chemistry of Rare Earth Oxides. \$62,000.
- Arkansas, University of, Fayetteville, Arkansas. Arthur Fry, Tracer and Isotope Effect Studies in Organic Chemistry. \$36,000 (18 months).
- Arkansas, University of, Fayetteville, Arkansas. Paul K. Kuroda, Nuclear Chemistry. \$48,000.
- Baylor University, Waco, Texas. Malcolm Dole, Radiation Chemistry in High Polymers. \$20,000 (13 months).
- Brandeis University, Waltham, Massachusetts. Henry Linschitz, Photochemical Reactions of Complex Molecules in Condensed Phase. \$79,310.
- Brandeis University, Waltham, Massachusetts. Saul G. Cohen, Effects of Mercaptans and Disulfides on Photochemical and High Energy Radiation Induced Reactions. \$25,500.
- Brown University, Providence, Rhode Island. E. F. Greene, Experimental Chemical Kinetics: A Study of Chemical Reactions by Means of Molecular Beams and Shock Wave Techniques. \$53,000.
- † California Institute of Technology, Pasadena, California. Frederick H. Shair, Diffusion of Molecular Species at Low Concentrations in Glow Discharge. \$20,311 (20 months).
- California Institute of Technology, Pasadena, California. Aron Kuppermann, Studies in Chemical Dynamics and Radiation Chemistry. \$115,000.
- California Institute of Technology, Pasadena, California. Jesse L. Beauchamp, The Application of Ion Cyclotron Resonance to the Study of Ion-Molecule Interactions. \$80,000 (2 years).
- California, University of, Davis, California. John W. Root, Recoil Studies in Chemical Dynamics. \$46,000.
- California, University of, Irvine, California. Frank S. Rowland, Radiochemistry Research. \$118,000.
- California, University of, Irvine, California. Max Wolfsberg, Theoretical Studies on Isotopic Mass Effects in Chemistry. \$95,042 (2 years).
- California, University of, Los Angeles, California. M. F. Nicol, Intra- and Intermolecular Energy Transfer Studies. \$65,069.
- California, University of, Los Angeles, California. M. A. El-Sayed, Phosphorescence-Microwave Multiple Resonance Spectroscopy of Polyatomic Molecules. \$55,000.
- ✓ California, University of, Los Angeles, California. Clifford S. Garner, Complex Ion Chemistry. \$27,500.
- Carnegie-Mellon University, Pittsburgh, Pennsylvania. Truman P. Kohman, Nuclear Chemistry and Geochemistry Research. \$50,000.
- Carnegie-Mellon University, Pittsburgh, Pennsylvania. Robert H. Schuler, Radiation Chemistry. \$365,000.
- Carnegie-Mellon University, Pittsburgh, Pennsylvania. Albert A. Caretto, Jr., High Energy Nuclear Reactions. \$46,800.
- Carnegie-Mellon University, Pittsburgh, Pennsylvania. Joe V. Michael, Reactions of Hydrogen Atoms. \$23,500.
- Carnegie-Mellon University, Pittsburgh, Pennsylvania. Morton Kaplan, Research in Nuclear Chemistry. \$45,000.

CHEMISTRY

- Chicago, University of, Chicago, Illinois. Clyde A. Hutchison, Jr., Paramagnetic Resonance Absorption. \$30,000.
- Chicago, University of, Chicago, Illinois. Edward Anders, Radiochemical and Geochemical Studies. \$49,000.
- Chicago, University of, Chicago, Illinois. Nathan Sugarman and Anthony Turkevich, Nuclear Chemistry Research. \$175,000.
- Chicago, University of, Chicago, Illinois. Ugo Fano, Basic Studies of Atomic Dynamics. \$52,000.
- Chicago, University of, Chicago, Illinois. Yuan Tseh Lee, The Dynamics of Chemical Reactions. \$75,127.
- Clark University, Worcester, Massachusetts. Daeg S. Brenner, Research in Nuclear Spectroscopy. \$22,000.
- Clarkson College of Technology, Potsdam, New York. Milton Kerker, Studies on Colloidal Particles: Scavenging of Aerosol Particles by a Falling Macroscopic Particle. \$31,000.
- Colorado State University, Fort Collins, Colorado. John C. Vaughan, Chemical Effects of the Nuclear Reaction  $N^{14}(n,p)C^{14}$  in Various Nitrogenous Compounds. \$12,000 (17 months).
- Columbia University, New York, New York. T. I. Taylor, Separation of Isotopes. \$36,870.
- Columbia University, New York, New York. J. M. Miller, Study of Heavy-Ion Induced Nuclear Reactions. \$60,000.
- Columbia University, New York, New York. Charles F. Bonilla, High Temperature Transport Properties and Processes of Gases and Alkali Metals. \$30,000.
- Cornell University, Ithaca, New York. Franklin A. Long, Mechanisms of Acid-Base Catalysis and Studies in Deuterium Oxide as Solvent. \$37,000 (17 months).
- Florida State University, Tallahassee, Florida. Gregory R. Choppin, Research in Nuclear Chemistry. \$38,400.
- Florida State University, Tallahassee, Florida. Russell H. Johnsen, Radiation Induced Effects in Organic Systems. \$42,000.
- Florida State University, Tallahassee, Florida. Raymond K. Sheline, An Experimental Study of Nuclear Models. \$90,000.
- Florida, University of, Gainesville, Florida. M. Luis Muga, Thin Film Detectors. \$38,400.
- Florida, University of, Gainesville, Florida. Robert J. Hanrahan, Radiation Chemistry of Hydrocarbon and Alkyl Halide Systems. \$35,000.
- George Washington University, Washington, D. C. Nicolae Filipescu, Lanthanide Ions as Sensitive Probes in Intermolecular Energy Transfer and Organic Photochemistry. \$21,000.
- Georgia Institute of Technology, Atlanta, Georgia. Richard W. Fink, Nuclear and X-Ray Spectroscopy with Radioactive Sources. \$58,680.
- Georgia Institute of Technology, Atlanta, Georgia. James A. Knight, Jr., Radiation Chemistry of Monosubstituted Aromatic Compounds. \$21,000.
- Georgia, University of, Athens, Georgia. Charles E. Melton, Radiolysis of Water in a Wide Range Radiolysis Source. \$32,000.
- Georgia, University of, Athens, Georgia. David M. Hercules, Photoelectron Spectroscopy. \$28,000 (18 months).

CHEMISTRY

- Houston, University of, Houston, Texas. Gerhard G. Meisels, Principal Processes in the Radiolysis of Gases by High Energy Electrons and Fission Recoils. \$70,001.
- Houston, University of, Houston, Texas. L. C. Witte, The Vapor Explosion - Heat Transfer and Fragmentation. \$26,728.
- Howard University, Washington, D. C. Peter Hambright, Kinetic, Magnetic and Mössbauer Studies on Porphyrin Systems. \$23,800.
- Howard University, Washington, D. C. Lue-Yung Chow Chiu, Theoretical Study of Fine and Hyperfine Structures and Their Effect on Radiative Interaction and Energy-Transfer Processes. \$18,000.
- T Idaho State University, Pocatello, Idaho. Joseph L. Thompson, Consequences of Radioactive Decay: Charge and Kinetic Energy of the Daughter Atom. \$10,000 (20 months).
- Johns Hopkins University, Baltimore, Maryland. Walter S. Koski and Joyce J. Kaufman, Studies in Hot Atom and Radiation Chemistry. \$55,276.
- Kansas State University, Manhattan, Kansas. Herbert C. Moser, Properties of Excited Species in the Frozen State as Studied by Photolysis, Low-Energy Electron Radiolysis and Bombardment with Energetic Tritium Atoms. \$8,229.
- Kansas, University of, Lawrence, Kansas. Paul W. Gilles, High Temperature Chemistry. \$75,000.
- T Kentucky, University of, Lexington, Kentucky. Charles E. Hamrin, Jr., Parametric Pumping. \$11,560.
- Lincoln University, Lincoln University, Pennsylvania. Saligrama C. SubbaRao, Tunneling in Proton Transfer Reactions. \$20,000.
- Maryland, University of, College Park, Maryland. Joseph Silverman, Radiation-Induced Effects in Polymers and Related Compounds. \$45,685.
- Maryland, University of, College Park, Maryland. Everett R. Johnson, The Radiation Induced Decomposition of Inorganic Salts. \$20,000.
- Maryland, University of, College Park, Maryland. Glen E. Gordon, Victor E. Viola, Jr., and William B. Walters, Research in Nuclear Chemistry. \$125,000.
- T Massachusetts Institute of Technology, Cambridge, Massachusetts. David N. Hume, Ultra-Microchemical Methods for Environmental Problems. \$45,000.
- T Massachusetts Institute of Technology, Cambridge, Massachusetts. James W. Dubrin, Hot Atom Chemistry. \$35,000.
- Michigan State University, East Lansing, Michigan. Harry A. Eick, An Investigation of Some Rare Earth Boron, Carbon, Nitrogen and Related Systems at Elevated Temperatures. \$30,200.
- Michigan State University, East Lansing, Michigan. James L. Dye, Properties of Solvated Electrons and Associated Species in Metal Solutions and Kinetics of Electron- and Proton-Transfer Reactions. \$35,000.
- Michigan State University, East Lansing, Michigan. Max T. Rogers, Electron Spin Resonance Studies of Radiation Effects. \$27,000.
- Michigan State University, East Lansing, Michigan. William G. McHarris and Frederick M. Bernthal, Nuclear Chemistry Research. \$120,000.
- Minnesota, University of, Minneapolis, Minnesota. Sanford Lipsky, The Contribution of Electronically Excited States to the Radiation Chemistry of Organic Systems. \$80,604 (17 months).
- Minnesota, University of, Minneapolis, Minnesota. Robert W. Carr, Jr., Studies in Chemical Reactivity. \$26,000.

CHEMISTRY

- Mississippi, University of, University, Mississippi. Theodore J. Kligen, Investigation of Gamma-Ray Induced Polymer Formation in the Carboranes. \$20,000.
- † Montana State University, Bozeman, Montana. J. A. Scanlan and E. H. Bishop, Natural Convection Heat Transfer Between Concentric Spheres. \$23,300 (16 months).
- Nebraska, University of, Lincoln, Nebraska. Edward P. Rack, Hot Atom Chemistry of Neutron Capture Reactions and Isomeric Transitions. \$23,000.
- Nevada, University of, Reno, Nevada. Richard D. Burkhart, A Measurement of Diffusion Coefficients of Short-Lived Species in Solution by Photochemical Space Intermittency. \$11,024.
- The New England Institute, Inc., Ridgefield, Connecticut. S. J. Tao, Positronium Chemistry. \$42,000.
- New York, City University of/Brooklyn College, Brooklyn, New York. Harmon L. Finston, Applications of Nuclear and Radiochemical Techniques in Chemical Analysis. \$25,000.
- New York, City University of/Brooklyn College, Brooklyn, New York. Takanobu Ishida, Studies of Carbon Isotope Fractionation. \$31,600.
- New York, State University of, Albany, New York. Hassaram Bakhru, Nuclear Spectroscopy and Nuclear Reaction Work. \$24,952.
- New York, State University of, Stony Brook, New York. John M. Alexander, Nuclear Reaction Studies. \$52,000.
- New York, State University of, Stony Brook, New York. Oliver A. Schaeffer, High Energy Nuclear Reactions with Matter and Nuclear Processes in Nature. \$53,000.
- North Carolina, University of, Chapel Hill, North Carolina. Richard C. Jarnagin, Organic Thin Films: Photoexcited Properties and Electron Energy Loss. \$16,707.
- † Northwestern University, Evanston, Illinois. Herman L. Pines, The Use of C-14 and Tritium in the Study of Catalyzed Reactions of Hydrocarbons and Alcohols. \$33,400 (3 years).
- Northwestern University, Evanston, Illinois. James T. Waber, Effect of Nuclear Shape on the Electronic Orbitals of Superactinide Elements. \$30,000.
- Notre Dame, University of, Notre Dame, Indiana. John L. Magee, Radiation Chemistry. \$1,091,216.
- † Ohio State University, Columbus, Ohio. Harold H. Nielsen and K. N. Rao, High Resolution Infrared Spectra of Tritium-Substituted and other Isotopic Molecules. \$23,000 (2 years).
- Ohio State University, Columbus, Ohio. Richard F. Firestone, Kinetics of Ionizing Radiation Induced Reactions in Organic Compounds. \$40,000.
- Ohio State University, Columbus, Ohio. Leon M. Dorfman, Pulse Radiolysis Studies of Fast Reactions in Molecular Systems. \$46,578 (14 months).
- Oregon State University, Corvallis, Oregon. Carroll W. DeKock, Gaseous Metal Halide Molecular Symmetries and Reactions with Small Molecules in Low Temperature Matrices, \$11,500.
- Oregon State University, Corvallis, Oregon. Walter D. Loveland, Studies of Low Energy Induced Nuclear Fission. \$21,703.
- Oregon State University, Corvallis, Oregon. T. Darrah Thomas, Research in Nuclear Chemistry. \$75,000.
- Oregon, University of, Eugene, Oregon. Richard M. Noyes, Diffusion Controlled Reactions and Exchange Reactions in Solution. \$25,574.

CHEMISTRY

Pennsylvania State University, University Park, Pennsylvania. F. W. Lampe, The Radiation Chemistry, Photochemistry and Mass Spectrometry of Silanes and Germanes. \$38,828.

Pennsylvania, University of, Philadelphia, Pennsylvania. David White, Rotational Ordering in the Solid Molecular Hydrogens. \$26,683.

Pittsburgh, University of, Pittsburgh, Pennsylvania. Robert L. Wolke, Recoil Studies of Nuclear Reactions. \$36,000.

Pittsburgh, University of, Pittsburgh, Pennsylvania. David W. Pratt, Microwave-Optical Double Resonance Spectroscopy. \$25,000.

Princeton University, Princeton, New Jersey. John Turkevich, Research in the Field of Catalysis. \$70,562.

► Princeton University, Princeton, New Jersey. R. C. Axtmann, Chemistry of Excited States of Nitrogen, Mössbauer Effect Applications and Interfacial Phenomena. \$42,000.

Princeton University, Princeton, New Jersey. Robert A. Naumann, Research in Nuclear Chemistry. \$75,000.

Puerto Rico, University of, Mayaguez, Puerto Rico. Rupert Lee, Hot-Atom and Radiation Chemistry. \$26,625.

Purdue University, Lafayette, Indiana. L. B. Rogers, Fundamental Studies of Separation Processes. \$52,000.

Purdue University, Lafayette, Indiana. Norbert T. Porile, Deexcitation Processes in Nuclear Reactions. \$60,000.

Purdue University, Lafayette, Indiana. Patrick J. Daly, Radiochemical Investigations of Nuclear Properties. \$45,000.

Purdue University, Lafayette, Indiana. James W. Cobble, Thermodynamics of Heavy Elements and Studies in Nuclear Chemistry. \$55,000.

T Rensselaer Polytechnic Institute, Troy, New York. Paul Harteck and Seymour Dondes, A Study of the Pulse Radiolysis of Gases. \$18,700 (20 months).

Rensselaer Polytechnic Institute, Troy, New York. Daniel Sperber, Neutron and Gamma Emission From Highly Excited States and States With High Spin. \$19,000.

Rensselaer Polytechnic Institute, Troy, New York. Ivor L. Preiss, Nuclear Structure Studies. \$32,000.

Rochester, University of, Rochester, New York. H. Marshall Blann, Nuclear Reaction Mechanisms. \$50,000.

Rochester, University of, Rochester, New York. John R. Huizenga, Studies of Nuclear Fission, Low-Energy Nuclear Reactions and Transuranic Nuclei. \$75,000.

Rochester, University of, Rochester, New York. Jacob Bigeleisen, Fundamental Studies in Isotope Chemistry. \$95,000.

Rutgers University, New Brunswick, New Jersey. Rolfe H. Herber, Studies in Nuclear and Radiochemistry. \$20,700.

T South Carolina, University of, Columbia, South Carolina. Edward E. Mercer, Chemistry of Ruthenium. \$15,000 (18 months).

Southern University, Baton Rouge, Louisiana. Curtis W. McDonald, Chelation of Transition Metals By Derivatives of 3-Nitroso-2-Pyridinol and 5-Nitroso-4-Pyrimidol. \$19,000.

CHEMISTRY

- ✓ Stanford University, Stanford, California. Thomas J. Connolly, Radiation-Induced Nucleation of Bubbles in Superheated Water. \$19,965.
- Syracuse University, Syracuse, New York. S. Alexander Stern, Separation of Krypton and Xenon from Reactor Atmospheres by Selective Permeation. \$20,000.
- Tennessee State University, Nashville, Tennessee. Rubye P. Torrey, Gaseous Ion Chemistry: Analytical Applications. \$11,000.
- Tennessee, University of, Knoxville, Tennessee. T. Ffrancon Williams, Research Concerning Ionic and Free Radical Reactions in Radiation Chemistry. \$50,309.
- T Tennessee, University of, Knoxville, Tennessee. Gleb Mamantov, Electrochemical Studies in Molten Fluorides and Other Halides. \$14,000 (2 years).
- Texas A & M University, College Station, Texas. Thomas T. Sugihara, Nuclear Spectroscopy. \$42,000.
- Texas A & M University, College Station, Texas. Ronald D. MacFarlane, On-Line Alpha and Proton Decay Spectrometry. \$66,500.
- Texas A & M University, College Station, Texas. Yi-Noo Tang, Reactions of High Energy Radioactive Atoms Resulting from Nuclear Transformations in the Systems of Silicon-Containing Compounds. \$21,000.
- Texas A & M University, College Station, Texas. Rand L. Watson, Ionization Phenomena. \$42,000.
- Texas A & M University, College Station, Texas. Joseph B. Natowitz, Angular Momentum Effects in Nuclear Reactions. \$38,000.
- Texas, University of, Austin, Texas. George W. Watt, Unusual Oxidation States of Transitional Elements. \$30,012.
- T Toledo, University of, Toledo, Ohio. H. Bradford Thompson, Molecular Structure Studies: A Gas Phase Electron Diffraction Unit Employing Counting Techniques. \$17,300 (15 months).
- Utah, University of, Salt Lake City, Utah. Leonard D. Spicer, Gas Phase Studies of the Kinetics and Mechanism of High Energy Sulfur Atom Reactions and Some Novel Aspects of Hot Halogen Reactions. \$30,000.
- T Vanderbilt University, Nashville, Tennessee. Thomas W. Martin, Studies in Radiation and Catalytic Chemistry by Mass Spectrometry, Flash Photolysis and Magnetic Techniques. \$20,000 (2 years).
- Virginia Polytechnic Institute and State University, Blacksburg, Virginia. Hans J. Ache, Reactions of Charged and Neutral Recoil Particles Following Nuclear Transformations. \$42,000.
- T Virginia Polytechnic Institute and State University, Blacksburg, Virginia. Alan F. Clifford, A. The Hydrogen Fluoride Solvent System, B. Mössbauer Studies on Rare Earth Compounds. \$10,000 (17 months).
- T Washington State University, Pullman, Washington. John P. Hunt, Inorganic Reaction Mechanisms in Aqueous and Non-Aqueous Solvents. \$20,000 (16 1/2 months).
- Washington State University, Pullman, Washington. John B. Gruber, Spectroscopic Studies of Actinide Ions in Crystalline Solids. \$53,500.
- Washington University, St. Louis, Missouri. Arthur C. Wahl, Radiochemical Studies of the Fission Processes. \$31,000.
- Washington University, St. Louis, Missouri. Demetrios G. Sarantites, Low Energy Nuclear Reactions and Spectroscopy. \$38,000.

CHEMISTRY

Washington University, St. Louis, Missouri. Peter P. Gaspar, Reaction Studies of Hot Silicon and Germanium Radicals. \$36,000.

Washington University, St. Louis, Missouri. Franklin B. Shull, The Cyclotron as an Instrument for Chemical Research. \$100,000.

Washington University of, Seattle, Washington. Albert L. Babb and Kermit L. Garlid, Dynamics of Solvent Extraction Systems. \$35,000.

Wayne State University, Detroit, Michigan. Larry Kevan, Radiolysis Studies on Reactive Intermediates. \$44,000.

Wayne State University, Detroit, Michigan. Edward C. Lim, Deuterium Isotope Effects in Electronic Relaxation of Large Polyatomic Molecules. \$39,995.

Western Washington State College, Bellingham, Washington. Edward F. Neuzil, Fission Studies on Elements Below Polonium. \$8,000.

T Wisconsin University of, Madison, Wisconsin. Walter J. Blaedel, Studies of Ion Exchange Membranes and Flow-Through Electrodes Applied to Continuous Analysis. \$12,000 (18 months).

Wisconsin University of, Madison, Wisconsin. John E. Willard, Studies in Hot Atom and Radiation Chemistry. \$125,597 (17 months).

Worcester Polytechnic Institute, Worcester, Massachusetts. Alfred A. Scala, The Vacuum Ultraviolet Photolysis and Radiolysis of Complex Organic Molecules. \$25,000.

Yale University, New Haven, Connecticut. R. James Cross, Jr., Research on High Energy Chemical Reactions. \$73,348 (14 months).

Yale University, New Haven, Connecticut. Robert Beringer, Heavy Ion Linear Accelerator Research Program. \$451,438.

Yeshiva University, New York, New York. William Spindel, Stable Isotope Studies. \$56,257 (2 years).

Yeshiva University, New York, New York. Marvin J. Stern, Isotope Effects on Rate and Equilibrium Processes. \$31,343 (2 years).

Yeshiva University, New York, New York. Max Lipsicas, A Nuclear Magnetic Resonance Study of the Hydrogen Gas-Liquid Critical Point. \$22,000 (16 months).



## METALLURGY AND MATERIALS

- Alabama A & M University, Normal, Alabama. Howard J. Foster, Theoretical Investigations of the Electronic Structure and Properties of Metals and Semiconductors. \$25,000 (18 months).
- Arizona, University of, Tucson, Arizona. Carl T. Tomizuka, Impurity Diffusion in Solids. \$86,400.
- Brown University, Providence, Rhode Island. Joseph Gurland, A Combined Macroscopic and Microscopic Approach to the Fracture of Metals. \$81,900.
- California Institute of Technology, Pasadena, California. Thad Vreeland, Jr., Dislocation Mobility and Density in Metallic Crystals. \$67,457.
- California Institute of Technology, Pasadena, California. Pol Duwez and C. C. Tsuei, Studies in Alloy Structure and Properties. \$220,000.
- California, University of, Los Angeles, California. Alan J. Ardell, Particle Size Distribution Effects in Precipitation Hardening. \$54,000.
- California, University of, Los Angeles, California. Didier deFontaine, Fourier Space Computer Simulation of Crystalline Imperfections. \$28,680.
- California, University of, Riverside, California. A. W. Lawson, Electric and Magnetic Properties of Transition Metals and Their Compounds. \$65,500.
- California, University of, San Diego, California. John C. Wheatley, Research on the Properties of Materials at Very Low Temperatures. \$147,179.
- California, University of, San Diego, California. Huey-Lin Luo, New Materials by Low Temperature Condensation. \$141,000 (18 months).
- Carnegie-Mellon University, Pittsburgh, Pennsylvania. Joseph O. Artman, Optical and Microwave Spectroscopy of Np and Co in Scheelites and other Crystalline Environments. \$20,831.
- Case Western Reserve University, Cleveland, Ohio. Richard W. Hoffman, Solid State Physics. \$83,000.
- Case Western Reserve University, Cleveland, Ohio. Ronald Gibala, Dislocation-Solute Atom Interactions in Alloys. \$40,000.
- Case Western Reserve University, Cleveland, Ohio. A. J. Dahm, Motion of Ions in Solid Helium. \$31,710.
- Case Western Reserve University, Cleveland, Ohio. Terence E. Mitchell, Experiments in High Voltage Electron Microscopy. \$54,000.
- Chicago, University of, Chicago, Illinois. Robert Gomer, Interactions on Metallic Surfaces. \$50,086 (18 months).
- Chicago, University of, Chicago, Illinois. Stuart A. Solin, The Study of Phonons in Amorphous and Crystalline Solids. \$39,000.
- Cincinnati, University of, Cincinnati, Ohio. John Moteff, Radiation Effects on BCC Refractory Metals and Alloys. \$45,000.
- Clark University, Worcester, Massachusetts. Christoph Hohenemser, Experimental Studies of Critical Point Behavior in Magnetically Ordered Solids using Nuclear Gamma-ray Spectroscopy, and Related Experiments. \$27,213 (15 months).
- Clarkson College of Technology, Potsdam, New York. Joseph L. Katz, Nucleation of Voids. \$19,687.
- Clarkson College of Technology, Potsdam, New York. Sigurds Aaraj, Transport and Magnetic Phenomena in Chromium and Iron Alloys. \$25,141.
- Colorado, University of, Boulder, Colorado. Richard Mockler and William O'Sullivan, Critical Scattering of Laser Light by Thin Fluid Films. \$38,675.

METALLURGY AND MATERIALS

- Columbia University, New York, New York. Arthur S. Nowick, Defects in Crystals. \$74,837 (33 months).
- Cornell University, Ithaca, New York. R. H. Silsbee and Raymond Bowers, Solid State Physics: Magnetic Phenomena. \$130,885.
- Cornell University, Ithaca, New York. A. J. Sievers and R. O. Pohl, Experimental Phonon Physics. \$135,540.
- Cornell University, Ithaca, New York. Henri S. Sack, A Study of Imperfections in Crystals. \$39,040.
- Cornell University, Ithaca, New York. Arthur L. Ruoff, Elastic and Plastic Deformation of Solids. \$120,000.
- Cornell University, Ithaca, New York. Che-Yu Li, Grain Boundary Sliding and Structure. \$35,000.
- Cornell University, Ithaca, New York. Robert W. Balluffi and David N. Seidman, Defects in Metal Crystals. \$185,000.
- Cornell University, Ithaca, New York. James A. Krumhansl, Theoretical Phonon Physics. \$61,250.
- Cornell University, Ithaca, New York. B. W. Batterman, Studies of Low Temperature Phase Transformations in High Field Superconductors and the Phonon Spectrum and Mechanical Properties of Vanadium. \$22,989.
- Cornell University, Ithaca, New York. H. H. Johnson, Effect of Environment on Fracture Behavior. \$32,872.
- Cornell University, Ithaca, New York. Edward J. Kramer, A Study of the Interaction Between Magnetic Fluxoids and Crystal Defects in Type II Superconductors. \$37,609.
- Cornell University, Ithaca, New York. Paul S. Ho, An Electromigration Study of Void Kinetics in Metals. \$74,946 (2 years).
- Dartmouth College, Hanover, New Hampshire. John R. Merrill, Measurement of Electron Energy Band Structure in Conductors by Means of Magnetoplasma Waves and Electron Tunneling. \$28,041.
- Florida University of, Gainesville, Florida. Robert E. Reed-Hill, Deformation Processes in Hexagonal Metals. \$31,150.
- Florida University of, Gainesville, Florida. John J. Hren and Craig S. Hartley, Quantitative Analysis of Solute Segregation in Alloys by Transmission Electron Microscopy. \$36,000.
- Georgetown University, Washington, D. C. William D. Gregory, The Study of Very Pure Metals at Low Temperatures. \$39,000.
- Georgia Institute of Technology, Atlanta, Georgia. Stephen Spooner, Magnetic Phenomena at Metal Surfaces. \$80,795 (2 years).
- Georgia Institute of Technology, Atlanta, Georgia. Bruce G. LeFevre and Edgar A. Starke, Jr., A Study of the Structure and Mechanical Properties of Ordered Alloys. \$37,000.
- Hawaii University of, Honolulu, Hawaii. William Pong, Photoelectric Emission from Thin Films in the Vacuum Ultraviolet Region. \$25,025.
- Howard University, Washington, D. C. Arthur N. Thorpe, Radiation Damage in Optically Transparent Materials (Zircons). \$20,000.
- Illinois Institute of Technology, Chicago, Illinois. Harold Weinstock, Thermal Measurements on Solids Below 1°K. \$93,000.
- Illinois Institute of Technology, Chicago, Illinois. Lawrence J. Broutman, The Strengthening and Toughening of Brittle Materials. \$34,000.

## METALLURGY AND MATERIALS

- Illinois, University of, Urbana, Illinois. Robert J. Maurer, The Science of Materials. \$1,259,050.
- Johns Hopkins University, Baltimore, Maryland. William F. Hartman and James F. Bell, Acoustic Emission and the Portevin-le Chatelier Effect. \$27,025.
- Lehigh University, Bethlehem, Pennsylvania. Betzalel Avitzur, Forming of Composite Materials. \$34,000.
- Marquette University, Milwaukee, Wisconsin. Robert N. Blumenthal, Defect Structures in Non-stoichiometric Oxides. \$34,186.
- Maryland, University of, College Park, Maryland. R. J. Arsenault, An Investigation of Irradiation Strengthening of BCC Metals and Solid Solutions. \$43,000.
- Maryland, University of, College Park, Maryland. Ian L. Spain, The Galvanomagnetic Properties of Graphite in the Temperature Range 4-300°K. and Pressure Range 0-10,000 kg/cm<sup>2</sup>. \$31,203.
- Maryland, University of, College Park, Maryland. M. J. Marcinkowski, Alloy Strengthening Due to Atomic Order. \$35,000.
- Massachusetts Institute of Technology, Cambridge, Massachusetts. C. G. Shull, Low Temperature and Neutron Physics Studies. \$119,960.
- Massachusetts Institute of Technology, Cambridge, Massachusetts. W. D. Kingery and R. L. Coble, Basic Research in Crystalline and Noncrystalline Ceramic Systems. \$313,000.
- Massachusetts Institute of Technology, Cambridge, Massachusetts. Sow-Hsin Chen and Sidney Yip, Thermal Neutron Scattering Studies of Molecular Dynamics and Critical Phenomena in Fluids and Solids. \$97,000.
- Massachusetts, University of, Amherst, Massachusetts. Allan R. Hoffman, Ultrasonic Attenuation Studies of the Electronic Structure of Metals. \$40,373.
- Michigan State University, East Lansing, Michigan. Gerald L. Pollack, Properties of Rare-Gas Solids. \$37,165.
- Michigan Technological University, Houghton, Michigan. A. A. Hendrickson and Donald A. Koss, Structure and Properties of Solid Solutions. \$42,000.
- Michigan Technological University, Houghton, Michigan. Donald E. Mikkola, Effect of Annealing on the Substructure of Cold Worked fcc Metals and Alloys. \$31,000.
- Michigan Technological University, Houghton, Michigan. Dale F. Stein, A Study of Grain Boundary Segregation using the Auger Electron Emission Technique. \$78,056 (19 months).
- Minnesota, University of, Minneapolis, Minnesota. Richard A. Swalin, Diffusion Studies in Liquid Metals. \$60,794 (18 months).
- Minnesota, University of, Minneapolis, Minnesota. William Zimmermann, Jr., Lewis H. Nosanow, Walter V. Weyhmann and Allen M. Goldman, Experimental and Theoretical Studies in Solid State and Low Temperature Physics. \$179,913.
- Minnesota, University of, Minneapolis, Minnesota. Thomas E. Hutchinson, "In Situ" Electron Microscope Investigation of the Nucleation and Growth of Sputtered Thin Films. \$42,000.
- Minnesota, University of, Minneapolis, Minnesota. William W. Gerberich, Analysis of the Ductile-Brittle Transition Temperature in Fe-Binary Alloys. \$32,000.
- Montana State University, Bozeman, Montana. R. T. Wimber, High-Temperature Oxidation of Iridium. \$26,016.
- New York, State University of, Albany, New York. James W. Corbett, Theory of Reaction Kinetics. \$39,000.

METALLURGY AND MATERIALS

- New York, State University of, Stony Brook, New York. John C. Bilello, Slip Initiation and Microdynamics of Plastic Flow. \$32,000.
- New York, State University of, Stony Brook, New York. Herbert Herman, Fatigue-Enhancement of Diffusion. \$14,432.
- New York, State University of, Stony Brook, New York. Robb M. Thomson, Physical Theory of Brittle Fracture and Mechanical Properties. \$23,872 (14 1/2 months).
- North Carolina State University, Raleigh, North Carolina. Thomas S. Elleman, Diffusion of Gases in Solids. \$28,500.
- North Carolina, University of, Chapel Hill, North Carolina. Lawrence M. Slifkin, Atomic Diffusion and Point Defects in Crystals. \$37,912 (17 months).
- North Carolina, University of, Chapel Hill, North Carolina. James H. Crawford, Jr., Investigation of Defect Structures by Electric Polarization and Relaxation Methods. \$26,286.
- North Carolina, University of, Chapel Hill, North Carolina. Charles S. Smith, Jr., Pressure Variation of Single Crystal Elastic Constants. \$21,960.
- North Carolina, University of, Chapel Hill, North Carolina. Louis D. Roberts, The Properties of Metals and Alloys. \$60,000.
- Northeastern University, Boston, Massachusetts. Carl A. Shiffman, Calorimetric Studies of Superconductors. \$34,964 (18 months).
- Northwestern University, Evanston, Illinois. M. Meshii, Effect of Point Defects on Mechanical Properties of Metals. \$48,528.
- Ohio State University, Columbus, Ohio. David A. Rigney, Liquid Metals Research. \$37,972.
- Oklahoma, University of, Norman, Oklahoma. Robert J. Block, The Effects of Surface Coatings on the Plastic Deformation of Metal Single Crystals. \$29,666 (18 months).
- Oklahoma, University of, Norman, Oklahoma. Ronald R. Bourassa, Thermoelectric Size Effect in Noble Metals. \$28,266.
- Oregon State University, Corvallis, Oregon. James R. Welty, Natural Convection Heat Transfer in Liquid Metals. \$21,210.
- Pennsylvania State University, University Park, Pennsylvania. Arnulf Muan, Thermodynamic Properties of Solid Solutions at High Temperatures. \$27,301.
- Pennsylvania State University, University Park, Pennsylvania. Richard C. Bradt and John H. Hoke, Ceramic Research on Transformational Superplasticity and Ferroelectric Domain Boundaries. \$28,000.
- Pennsylvania, University of, Philadelphia, Pennsylvania. David P. Pope, Dislocation Mobilities in Ordered Alloys. \$28,000.
- Pittsburgh, University of, Pittsburgh, Pennsylvania. Raymond S. Craig and W. E. Wallace, Thermal, Structural and Magnetic Studies of Metals and Intermetallic Compounds. \$95,213.
- Pittsburgh, University of, Pittsburgh, Pennsylvania. William A. Soffa, Precipitation Hardening in Copper-Titanium Alloys. \$29,000.
- Purdue University, Lafayette, Indiana. Richard E. Grace, Transport and Thermodynamic Properties of Solids. \$36,212.
- Purdue University, Lafayette, Indiana. James R. Cost, Diffusion and Precipitation of Inert Gases in Metals. \$28,000.

METALLURGY AND MATERIALS

- Rensselaer Polytechnic Institute, Troy, New York. H. B. Huntington, Anisotropic Diffusion and Electromigration. \$52,500.
- Rensselaer Polytechnic Institute, Troy, New York. Norman S. Stoloff, Precipitation and Dispersion Hardening in Hexagonal Alloys. \$25,000 (11 months).
- Rensselaer Polytechnic Institute, Troy, New York. H. Michael Gilder, Effect of Hydrostatic Pressure on Self-Diffusion Rates in Hexagonal Metals. \$40,000.
- Rensselaer Polytechnic Institute, Troy, New York. Fritz V. Lenel, Research in Powder Metallurgy, \$29,000.
- Southern California, University of, Los Angeles, California. Young B. Kim, Materials Research on High-Field Superconductors. \$90,000 (18 months).
- Stanford University, Stanford, California. Craig R. Barrett and William D. Nix, Structure Dependence of High Temperature Deformation of Metals. \$43,000 (9 months).
- Stanford University, Stanford, California. Norman A. D. Parlee, Nitride Forming Reactions in Liquid Uranium Alloys. \$47,272.
- Syracuse University, Syracuse, New York. Richard W. Vook, In Situ Ultra High Vacuum High Energy Electron Diffraction Studies. \$30,444 (15 months).
- Temple University, Philadelphia, Pennsylvania. Leonard Muldawer and Henri Amar, Study of the IB-IIB Beta Phase Alloys. \$60,000 (2 years).
- Tennessee, University of, Knoxville, Tennessee. E. E. Stansbury and C. R. Brooks, Application of Adiabatic Calorimetry to Metal Systems. \$26,653.
- Tennessee, University of, Knoxville, Tennessee. J. E. Spruiell, Microstructure-Property Relationships in Austenitic Stainless Steel. \$19,000 (10 months).
- Texas, University of, Austin, Texas. Thomas H. Courtney, Elevated Temperature Morphological Stability of Metal Matrix Fiber Composites. \$20,488.
- Utah, University of, Salt Lake City, Utah. Ronald S. Gordon, Impurity Effects on the Creep of Polycrystalline Magnesium and Aluminum Oxides at Elevated Temperatures. \$25,000.
- Utah, University of, Salt Lake City, Utah. Abraham Sosin, The Fundamentals of Radiation Damage. \$74,358.
- Utah, University of, Salt Lake City, Utah. J. Gerald Byrne, Positron Lifetime Measurements as a Non-destructive Technique to Monitor Fatigue Damage. \$29,884.
- Vermont, University of, Burlington, Vermont. John S. Brown, Thermodynamic and Transport Properties of Interstitial Hydrogen Isotopes in Palladium. \$20,583.
- Virginia, University of, Charlottesville, Virginia. Robert V. Coleman, Electronic Properties of Metals and Alloys. \$73,000.
- Virginia, University of, Charlottesville, Virginia. Doris Kuhlmann-Wilsdorf, Investigations on the Behavior of Point Defects and Dislocations. \$68,000.
- Virginia, University of, Charlottesville, Virginia. John W. Mitchell, Dynamic Dislocation Phenomena in Single Crystals of Metals and Alloys. \$61,454 (18 months).
- Wake Forest University, Winston-Salem, North Carolina. Thomas J. Turner and George P. Williams, Jr., A Study of Atomic Mobilities in Crystalline Solids. \$36,504 (30 months).
- Washington, University of, Seattle, Washington. Robert L. Ingalls, Mossbauer Studies at High Pressure. \$34,000.

METALLURGY AND MATERIALS

Washington, University of, Seattle, Washington. Douglas H. Polonis, A Study of Phase Transformations and Superconductivity. \$36,678.

Wayne State University, Detroit, Michigan. Yeong-Wook Kim, Electron Paramagnetic Resonance Studies of Radiation Effects in Solids and Chemical Compounds. \$38,500.

Wisconsin, University of, Madison, Wisconsin. Gerald L. Kulcinski, Void Nucleation and Growth in Heavy Ion and Electron Bombarded Pure Metals. \$60,000.

Yale University, New Haven, Connecticut. Werner P. Wolf, The Study of Ideal Magnetic Crystals. \$80,000 (3 years).