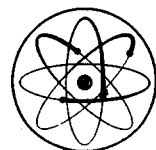


**PHYSICAL
RESEARCH
PROGRAM:**

**RESEARCH CONTRACTS AND
STATISTICAL SUMMARY**

DIVISION OF PHYSICAL RESEARCH

July 1, 1974



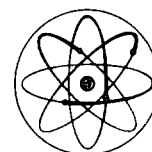
UNITED STATES ATOMIC ENERGY COMMISSION

**PHYSICAL
RESEARCH
PROGRAM:**

**RESEARCH CONTRACTS AND
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July 1, 1974



UNITED STATES ATOMIC ENERGY COMMISSION

FOREWORD

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.

In December 1971, the then Division of Research was redesignated the Division of Physical Research and the controlled fusion program separated from it to become a new Division of Controlled Thermonuclear Research. Prior to that time, the Division of Research published separately the reports entitled "Research Contracts in the Physical Sciences" and "A Statistical Summary of the Physical Research Program." On July 1, 1972, the first consolidated version of the information concerning the basic physical research program previously contained in these two reports was issued.

In July 1973, the Division of Physical Research was reorganized in order to provide an interdisciplinary programmatic orientation allowing improved focus on areas of common research objectives and to provide for better coupling of the physical research programs to the AEC's current and future missions. Under this reorganization, the six discipline-oriented budget categories previously comprising the program were restructured into four functional categories: (1) high energy physics, (2) nuclear sciences, (3) materials sciences, and (4) molecular sciences, each headed by an Assistant Director. A fifth Assistant Director (for Administration) assists in the coordination of the budgetary and administrative aspects of the program, such as budget preparation, proposal and contract administration, reporting, travel, personnel, etc. Certain functions of the former Division of Nuclear Education and Training were assigned to the Division of Physical Research in 1973 and have been incorporated into the nuclear sciences and molecular sciences categories.

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INTRODUCTION AND SUMMARY STATISTICS

Approximately four-fifths 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 Argonne, Illinois; Berkeley, California; Brookhaven, New York; Los Alamos, New Mexico; and Oak Ridge, Tennessee; and at the high energy physics research centers at Batavia, Illinois; and Stanford, California.

A little less than one-fifth 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., applied technology, biomedical and environmental research, reactor research and development, waste management and transportation, 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. 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 education and training of scientists in fields relevant to AEC's programs.

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 include 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 include professors, 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.

The direct funding provided under the physical research program for certain types of miscellaneous support activities, such as for other Federal agencies, National Academy of Science committees, university reactor sharing and fuel cycle assistance, special analyses, conferences, book translations, certain computers and general purpose equipment at some of the major research centers, etc., has been excluded from this report.

The following tables summarize the level of effort of the physical research program as of the end of Fiscal Year 1974. No attempt has been or should be 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 FY 1974 costs for operations and capital equipment while the dollar figures for the off-site program generally represent the contract amounts authorized, as opposed to cost incurred, for all contracts in effect as of the end of FY 1974, 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 reports and/or other information supplied by contractors. (\$ in thousands):

FFRDC's

<u>AEC Budget Category</u>	<u>Amount</u>	<u>Scientific Man-Years</u>	<u>Graduate Students</u>	<u>Publications</u>
High Energy Physics	\$ 125,663	1,214	173	621
Nuclear Sciences	54,741	689	107	687
Materials Sciences	27,585	436	304	689
Molecular Sciences	20,953	403	254	707
	<hr/>	<hr/>	<hr/>	<hr/>
TOTAL	\$ 228,942	2,742	838	2,704

OFF-SITE CONTRACT RESEARCH

	<u>Number of Agreements</u>	<u>AEC Support FY 1974</u>	<u>Scientific Man-Years</u>	<u>Graduate Students</u>	<u>Publications</u>
High Energy Physics	45	\$ 22,493	426	357	715
Nuclear Sciences	79	15,896	316	314	692
Materials Sciences	90	6,212	105	278	437
Molecular Sciences	101	7,649	171	282	492
	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>
TOTAL	315	\$ 52,250	1,018	1,231	2,336

All off-site contracts were with educational and a few other non-profit research institutions. 260 were of the Special Research Support Agreement type (\$15.4 million), while 55 were cost-reimbursement contracts (\$36.8 million). According to the proposals upon which the 315 contracts are based, principal investigators planned to spend the \$56.7 million available to them (a higher figure than the AEC contribution since most off-site contractors tend to share in the total cost of a project) approximately as follows (\$ in thousands):

Salaries and Wages	\$ 26,395	47%
Equipment	4,574	8%
Materials and Supplies	9,091	16%
Other Direct Costs	2,798	5%
Indirect Costs	13,842	24%
	<hr/>	
TOTAL	\$ 56,700	100%
	<hr/>	
Supported by AEC (FY 1974)	\$ 52,250	92%

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.

<u>Name of Laboratory, Contractor and Principal Staff*</u>	<u>Level of Physical Research Program Support - FY 1974</u> (in thousands)	
	<u>Operations</u>	<u>Equipment</u>
AMES LABORATORY, Iowa State University of Science and Technology, Ames, Iowa	\$ 6,229	\$ 610
Director Robert Hansen Deputy Director Velmer A. Fassel		
ARGONNE NATIONAL LABORATORY, University of Chicago and Argonne Universities Association, Argonne (Lemont), Illinois	34,071	3,257
Director Robert G. Sachs Deputy Directors: Research Michael V. Nevitt Operations Robert V. Laney Associate Directors: High Energy Physics Thomas H. Fields Physical Research Michael V. Nevitt (Acting) Biomedical & Environmental Research Warren K. Sinclair Engineering Research & Development Jack A. Kyger Energy & Environment Edward G. Pewitt Services Paul E. Neal Educational Affairs Shelby A. Miller		
BROOKHAVEN NATIONAL LABORATORY, Associated Universities, Inc., Upton, Long Island, New York	38,787	2,667
Director George H. Vineyard Associate Directors: Life Sciences, Chemistry, and Safety Victor P. Bond High Energy Physics R. Ronald Rau Administration Vincent R. O'Leary		
FERMI NATIONAL ACCELERATOR LABORATORY, Universities Research Association, Batavia, Illinois	28,898	15,175
Director Robert R. Wilson Deputy Director Edwin L. Goldwasser Associate Directors: Planning & Programming James R. Sanford Accelerator Division Paul J. Reardon		
IDAHO NATIONAL ENGINEERING LABORATORY, Aerojet Nuclear Company, Idaho Falls, Idaho	41	
President & General Manager . C. K. Leeper		

*Individuals listed are generally those with the rank of Associate Laboratory Director or higher, plus certain others who are involved with the physical research program.

<u>Name of Laboratory, Contractor and Principal Staff</u>	<u>Level of Physical Research Program Support - FY 1974 (in thousands)</u>	
	<u>Operations</u>	<u>Equipment</u>
LAWRENCE BERKELEY LABORATORY, University of California, Berkeley, California	\$ 27,264	\$ 1,714
Director Andrew M. Sessler		
Deputy Director Earl K. Hyde		
Associate Directors:		
Accelerator Division Edward J. Lofgren		
Biology & Medicine		
Division James L. Born		
Chemical Biodynamics Lab. . . Melvin Calvin		
Energy & Environment		
Division Jack M. Hollander		
Inorganic Materials Div. . . Leo Brewer		
Nuclear Chemistry Div. Glenn T. Seaborg		
Physics Division Robert W. Birge		
Administration George L. Pappas		
Laboratory Relations Harold A. Fidler		
Engineering & Technical		
Review Walter D. Hartsough		
LOS ALAMOS SCIENTIFIC LABORATORY, University of California, Los Alamos, New Mexico	12,338	2,188
Director Harold M. Agnew		
Deputy Director Raemer E. Schreiber		
Associate Director for		
Research Richard F. Taschek		
MOUND LABORATORY, Monsanto Research Corp., Miamisburg, Ohio	455	107
Director, Vice President, Monsanto Research Corp. ... Richard K. Flitcraft		
Director, Nuclear Operations. William T. Cave		
OAK RIDGE ASSOCIATED UNIVERSITIES, Oak Ridge, Tennessee	598	35
Executive Director Philip L. Johnson		
Head, University Programs		
Office Granvil C. Kyker		
Director, UNISOR Project E. H. Spejewski		
Chairman, Special Training		
Division Roger Cloutier		
OAK RIDGE NATIONAL LABORATORY, Union Carbide Corp., Oak Ridge, Tennessee	25,802	1,545
Director Herman Postma		
Deputy Director Floyd L. Culler		
Associate Directors:		
Administration F. R. Bruce		
Basic Physical Sciences ... A. Zucker		
Biomedical & Environmental. C. R. Richmond		
Advanced Energy Systems ... N. W. Rosenthal		
Reactor & Engineering D. B. Trauger		
PACIFIC NORTHWEST LABORATORY, Battelle Memorial Institute, Richland, Washington	789	32
Director Edward L. Alpen		
Associate Directors:		
Research & Development James J. Fuquay		
Research & Development D. L. Condotta		

<u>Name of Laboratory, Contractor and Principal Staff</u>	<u>Level of Physical Research Program Support - FY 1974</u> (in thousands)	
	<u>Operations</u>	<u>Equipment</u>
SAVANNAH RIVER PLANT, E. I. duPont; University of Georgia; Aiken, South Carolina	\$ 105	\$ -
Director, Savannah River Laboratory (DuPont) Clark H. Ice		
Director, Savannah River Ecology Laboratory (Univ. of Georgia) Michael H. Smith		
STANFORD LINEAR ACCELERATOR CENTER, Stanford University, Palo Alto, California	23,762	2,473
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, 1974

<u>Laboratory</u>	<u>Total Costs</u> <u>(In thousands)</u>	<u>Number and Man-Years</u> <u>Scientific Employees</u>		<u>Graduate</u> <u>Students</u>	<u>Number of</u> <u>Publications</u>
		<u>Permanent</u>	<u>Visiting</u>		
Ames Laboratory	\$ 6,839	130 - 77	2 - .5	195	280
Argonne National Laboratory	37,328	637 - 500	218 - 95	125	560
Brookhaven National Laboratory	41,454	434 - 379	177 - 46.5	82	438
Fermi National Accelerator Laboratory ...	44,073	230 - 220	360 - 150	0	130
Idaho National Engineering Laboratory ...	41	5 - 2	0 - 0	0	0
Lawrence Berkeley Laboratory	28,978	393 - 364	295 - 67	254	407
Los Alamos Scientific Laboratory	14,526	119 - 102	141 - 22	24	102
Mound Laboratory	562	11 - 9	0 - 0	0	17
Oak Ridge Associated Universities	633	18 - 6.5	48 - 12.5	37	24
Oak Ridge National Laboratory	27,347	390 - 362	60 - 24.5	71	504
Pacific Northwest Laboratory	821	16 - 8.5	2 - 2	0	18
Savannah River Laboratories	105	0 - 0	28 - 6	24	69
Stanford Linear Accelerator Center	26,235	284 - 265	40 - 21	26	155
TOTAL	\$ 228,942	2,667 - 2,295	1,371 - 447	838	2,704

ARGONNE NATIONAL LABORATORY

<u>Category</u>	<u>Total Costs</u> (In thousands)	<u>Number and Man-Years</u> <u>Scientific Employees</u>		<u>Graduate</u> <u>Students</u>	<u>Number of</u> <u>Publications</u>
		<u>Permanent</u>	<u>Visiting</u>		
High Energy Physics	\$ 16,569	175 - 148	35 - 20	74	89
Nuclear Sciences	5,711	100 - 79	50 - 23	16	98
Materials Sciences	8,707	188 - 156	77 - 28	19	226
Molecular Sciences	6,341	174 - 117	56 - 24	16	147
TOTAL	\$ 37,328	637 - 500	218 - 95	125	560*

* Includes 144 publications that resulted from collaborative efforts with other universities.

BROOKHAVEN NATIONAL LABORATORY

<u>Category</u>	<u>Total Costs</u> (In thousands)	<u>Number and Man-Years</u> <u>Scientific Employees</u>		<u>Graduate</u> <u>Students</u>	<u>Number of</u> <u>Publications</u>
		<u>Permanent</u>	<u>Visiting</u>		
High Energy Physics	\$ 26,956	213 - 197	59 - 11.5	16	144
Nuclear Sciences	5,672	80 - 68	30 - 6	13	92
Materials Sciences	4,110	55 - 40.5	41 - 12	34	99
Molecular Sciences	4,716	86 - 73.5	47 - 17	19	103
TOTAL	\$ 41,454	434 - 379	177 - 46.5	82	438*

* Includes 120 publications that resulted from collaborative efforts with other universities.

LAWRENCE BERKELEY LABORATORY

<u>Category</u>	<u>Total Costs</u> (In thousands)	<u>Number and Man-Years</u> <u>Scientific Employees</u>		<u>Graduate</u> <u>Students</u>	<u>Number of</u> <u>Publications</u>
		<u>Permanent</u>	<u>Visiting</u>		
High Energy Physics	\$ 10,877	154 - 144	130 - 25	40	76
Nuclear Sciences	13,011	168 - 158	123 - 33	33	150
Materials Sciences	2,925	33 - 27	27 - 5	142	72
Molecular Sciences	2,165	38 - 35	15 - 4	39	109
TOTAL	\$ 28,978	393 - 364	295 - 67	254	407*

* Includes 52 publications that resulted from collaborative efforts with other universities.

LOS ALAMOS SCIENTIFIC LABORATORY

<u>Category</u>	<u>Total Costs</u> (In thousands)	<u>Number and Man-Years</u> <u>Scientific Employees</u>		<u>Graduate</u> <u>Students</u>	<u>Number of</u> <u>Publications</u>
		<u>Permanent</u>	<u>Visiting</u>		
Nuclear Sciences	\$ 14,088	113 - 99	120 - 21	23	100
Materials Sciences	100	2 - 2	1 - .5	1	2
Molecular Sciences	338	4 - 1	20 - .5	0	0
TOTAL	\$ 14,526	119 - 102	141 - 22	24	102*

* Includes 30 publications that resulted from collaborative efforts with other universities.

OAK RIDGE NATIONAL LABORATORY

<u>Category</u>	<u>Total Costs</u> (In thousands)	<u>Number and Man-Years</u> <u>Scientific Employees</u>		<u>Graduate</u> <u>Students</u>	<u>Number of</u> <u>Publications</u>
		<u>Permanent</u>	<u>Visiting</u>		
High Energy Physics	\$ 288	7 - 5.5	2 - .5	1	11
Nuclear Sciences	15,157	191 - 179	19 - 7.5	8	212
Materials Sciences	7,156	109 - 103	10 - 7.5	5	155
Molecular Sciences	4,746	83 - 74.5	29 - 9	57	126
TOTAL	\$ 27,347	390 - 362	60 - 24.5	71	504*

* Includes 132 publications that resulted from collaborative efforts with other universities.

PACIFIC NORTHWEST LABORATORY

<u>Category</u>	<u>Total Costs</u> (In thousands)	<u>Number and Man-Years</u> <u>Scientific Employees</u>		<u>Graduate</u> <u>Students</u>	<u>Number of</u> <u>Publications</u>
		<u>Permanent</u>	<u>Visiting</u>		
Materials Sciences	\$ 673	8 - 6	2 - 2	0	13
Molecular Sciences	148	8 - 2.5	0 - 0	0	5
TOTAL	\$ 821	16 - 8.5	2 - 2	0	18*

* Includes 4 publications that resulted from collaborative efforts with other universities.

OTHER FFRDC LABORATORIES

<u>Category</u>	<u>Total Costs</u> (In thousands)	<u>Number and Man-Years</u> <u>Scientific Employees</u>		<u>Graduate</u> <u>Students</u>	<u>Number of</u> <u>Publications</u>
		<u>Permanent</u>	<u>Visiting</u>		
<u>AMES LABORATORY</u>					
High Energy Physics	\$ 665	15 - 6.5	0 - 0	16	16
Nuclear Sciences	664	11 - 5.5	0 - 0	11	20
Materials Sciences	3,810	71 - 44	2 - .5	103	119
Molecular Sciences	1,700	33 - 21	0 - 0	65	125
<u>FERMI NATIONAL</u> <u>ACCELERATOR LABORATORY</u>					
High Energy Physics	44,073	230 - 220	360 - 150	0	130
<u>IDAHO NATIONAL ENGINEERING</u> <u>LABORATORY</u>					
Nuclear Sciences	41	5 - 2	0 - 0	0	0
<u>MOUND LABORATORY</u>					
Nuclear Sciences	277	5 - 4	0 - 0	0	3
Materials Sciences	104	2 - 2	0 - 0	0	3
Molecular Sciences	181	4 - 3	0 - 0	0	11
<u>OAK RIDGE ASSOCIATED</u> <u>UNIVERSITIES</u>					
Nuclear Sciences	120	2 - 2	6 - 2	3	12
Molecular Sciences	513	16 - 4.5	42 - 10.5	34	12
<u>SAVANNAH RIVER LABORATORIES</u>					
Molecular Sciences	105	0 - 0	28 - 6	24	69
<u>STANFORD LINEAR ACCELERATOR</u> <u>CENTER</u>					
High Energy Physics	26,235	284 - 265	40 - 21	26	155

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, some 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.

An examination of the age at termination of contracts that have terminated in recent years shows that about 15% had been in effect for less than 3 years, some 25% for 3 to 5 years, 30% for 5 to 10 years, and about 30% for 10 years or more, and that the average age at termination was $7\frac{1}{2}$ years.

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 Applied Technology:

General energy development, including non-nuclear technology concerned with all phases of energy production, conversion, transmission, and storage, and environmental effects thereof;
Applications of underground explosions, including nuclear and non-nuclear, for resource recovery and other applications;
Isotopes development, with emphasis on energy-related applications.

Division of Biomedical & Environmental Research:

Life Sciences, including medicine, biology, ecology and marine studies;
Atmospheric sciences;
Radiological and chemical physics;
Health protection and instrumentation technology;
Nuclear education and training; Faculty Institutes and fellowships and traineeships.

Division of Controlled Thermonuclear Research:

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

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 Reactor Research and Development:

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

Division of Waste Management and Transportation:

Volume reduction and solidification technology for radioactive waste;
Waste treatment technology;
Decontamination technology, developments for waste storage and disposal;
Packaging developments for shipment of radioactive materials.

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.

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.

During Fiscal Year 1974, the Division of Physical Research received 301 formal unsolicited proposals for new research, representing requests for a total of \$15.1 million. On hand at the beginning of FY 1974 pending reviews were 127 new proposals requesting \$7.8 million, for a total of 428 proposals representing requests for \$22.9 million (\$ in millions):

	<u>On Hand 7/1/73</u>	<u>Received in FY 1974</u>	<u>Total</u>
High Energy Physics	19 - \$ 1.4	24 - \$ 1.5	43 - \$ 2.9
Nuclear Sciences	44 - 2.1	57 - 3.2	101 - 5.3
Materials Sciences	27 - 1.1	103 - 4.3	130 - 5.4
Molecular Sciences	37 - 3.2	117 - 6.1	154 - 9.3
TOTAL	127 - \$ 7.8	301 - \$15.1	428 - \$22.9

	<u>Approved in FY 1974</u>	<u>Declined, Etc. in FY 1974</u>	<u>On Hand 6/30/74</u>
High Energy Physics	0 - \$ 0	25 - \$ 1.8	18 - \$ 1.1
Nuclear Sciences	4 - .2	42 - 1.7	55 - 3.4
Materials Sciences	9 - .3	85 - 3.6	36 - 1.5
Molecular Sciences	7 - .5	74 - 4.8	73 - 4.0
TOTAL	20 - \$ 1.0	226 - \$11.9	182 - \$10.0

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

<u>Fiscal Year</u>	<u>On Hand at Beginning of Year</u>	<u>Received During Year</u>	<u>Approved During Year</u>	<u>Declined, etc. During Year</u>	<u>On Hand at End of Year</u>
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
1973	140	222 - 11.1	21 - .9	214 - 8.5	127
1974	127	301 - 15.1	20 - 1.0	226 - 11.9	182

Under AEC's annual review and renewal system, the yearly turnover rate, i.e., numbers of new projects approved and existing contracts terminated, during the 1960's 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 recent years, however, numbers of new projects started have been sharply lower and terminations higher, resulting in a significant reduction in numbers of active contracts. 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, or several contracts may be combined into one. The following table illustrates the situation FY 1965-1974 (\$ 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
1973	21 - .9	57 - 2.5	330 - 51.1
1974	20 - 1.0	30 - 1.5	315 - 52.2

Again here, it is important to note that dollar figures pertaining to the off-site program generally represent contract amounts authorized, as opposed to costs incurred, and include funds provided for equipment regardless of who takes title. Contract research projects in effect as of July 1, 1974, and supported by the AEC Headquarters Division of Physical Research are listed on pp. 20-36 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) during the most recent funding period. The amounts listed are for one year unless otherwise indicated. A summary of contracts by State appears on pp. 16-19.

TYPE OF AGREEMENTS

<u>Type</u>	<u>Division Total</u>	<u>High Energy Physics</u>	<u>Nuclear Sciences</u>	<u>Materials Sciences</u>	<u>Molecular Sciences</u>
Cost Contracts	55	27	18	2	8
SRSA	260	18	61	88	93
TOTAL	315	45	79	90	101

AEC OPERATIONS OFFICES ADMINISTERING
THE BUSINESS ASPECTS OF THE AGREEMENTS

<u>Operations Offices</u>	<u>Division Total</u>	<u>High Energy Physics</u>	<u>Nuclear Sciences</u>	<u>Materials Sciences</u>	<u>Molecular Sciences</u>
Albuquerque	1	0	1	0	0
Chicago	186	27	43	62	54
Idaho	2	0	0	0	2
Nevada	1	0	0	0	1
Oak Ridge	62	5	24	13	20
Richland	18	2	7	4	5
San Francisco	44	11	4	11	18
Savannah River	1	0	0	0	1
TOTAL	315	45	79	90	101

CONSOLIDATED MANPOWER STATISTICS
OF THE 315 OFF-SITE PROJECTS
(see definitions, p.2)

	<u>Principal Investigators</u>		<u>Other Permanent Scientific Staff</u>		<u>Research Associates</u>		<u>Research Assistants</u>	<u>Number of 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	144	52	327	177	279	197	357	715
Nuclear Sciences	144	58	206	89	214	169	314	692
Materials Sciences	122	36	27	7	86	62	278	437
Molecular Sciences	119	42	111	34	137	95	282	492
TOTAL	529	188	671	307	716	523	1,231	2,336

CONSOLIDATED BUDGET OF THE 315 OFF-SITE PROJECTS
INCLUDED IN THE PHYSICAL RESEARCH PROGRAM
(Dollars in Thousands)

Items of Expense

SRSA Projects (260)	Total	%	High Energy Physics		Nuclear Sciences		Materials Sciences		Molecular Sciences	
				%		%		%		%
Salaries and Wages	\$ 8,904	50.6	\$ 1,407	50.0	\$ 2,423	50.6	\$ 2,551	51.2	\$ 2,523	50.4
Equipment	959	5.4	83	3.0	272	5.7	279	5.6	325	6.5
Materials and Supplies	2,528	14.4	549	19.4	688	14.4	672	13.5	619	12.4
Travel	537	3.1	128	4.5	211	4.4	84	1.7	114	2.3
Communications	54	.3	7	.2	9	.2	12	.2	26	.5
Publication Costs	241	1.4	42	1.5	53	1.1	73	1.5	73	1.5
Indirect Expenses	4,363	24.8	602	21.4	1,129	23.6	1,309	26.3	1,323	26.4
TOTAL	\$ 17,586	100.0	\$ 2,818	100.0	\$ 4,785	100.0	\$ 4,980	100.0	\$ 5,003	100.0

Supported by AEC (FY 1974) \$ 15,426 87.7 \$ 2,283 81.0 \$ 4,047 84.5 \$ 4,662 93.6 \$ 4,434 88.6

Cost-Type Projects (55)

Salaries and Wages	\$ 17,491	44.7	\$ 9,480	44.2	\$ 5,621	44.2	\$ 656	42.3	\$ 1,734	51.2
Equipment	3,615	9.2	1,681	7.8	1,485	11.7	202	13.0	247	7.3
Materials and Supplies	6,563	16.8	3,569	16.6	2,277	17.9	329	21.2	388	11.4
Travel	1,550	4.0	1,221	5.7	236	1.9	9	.6	84	2.5
Communications	145	.4	104	.5	21	.2	10	.7	10	.3
Publication Costs	271	.7	144	.7	90	.7	11	.7	26	.8
Indirect Expenses	9,479	24.2	5,270	24.5	2,979	23.4	333	21.5	897	26.5
TOTAL	\$ 39,114	100.0	\$ 21,469	100.0	\$ 12,709	100.0	\$ 1,550	100.0	\$ 3,386	100.0

Supported by AEC (FY 1974) \$ 36,824 94.2 \$ 20,210 94.1 \$ 11,849 93.2 \$ 1,550 100.0 \$ 3,215 95.0

SUMMARY OF OFF-SITE CONTRACTS BY STATE

<u>State and Contractor</u>	<u>Number of Contracts</u>	<u>FY 1974 Funding* (in 1000's)</u>
<u>Alabama</u>	<u>1</u>	<u>\$ 32</u>
Alabama, University of, University	1	32
<u>Alaska</u>	<u>2</u>	<u>147</u>
Alaska, University of, Fairbanks	2	147
<u>Arizona</u>	<u>3</u>	<u>88</u>
Arizona State University, Tempe	2	88
Arizona, University of, Tucson	1	0
<u>Arkansas</u>	<u>1</u>	<u>36</u>
Arkansas, University of, Fayetteville	1	36
<u>California</u>	<u>41</u>	<u>6,817</u>
Aerospace Corporation, Los Angeles	1	53
California Institute of Technology, Pasadena	6	2,027
California, University of, Berkeley	3	242
California, University of, Davis	2	150
California, University of, Irvine	5	745
California, University of, Los Angeles	10	1,294
California, University of, Riverside	2	304
California, University of, San Diego	3	950
California, University of, Santa Barbara	1	250
California, University of, Santa Cruz	1	182
Southern California, University of, Los Angeles	2	73
Stanford University, Stanford	5	547
<u>Colorado</u>	<u>4</u>	<u>725</u>
Colorado School of Mines, Golden	1	40
Colorado, University of, Boulder	3	685
<u>Connecticut</u>	<u>9</u>	<u>3,170</u>
Connecticut, University of, Storrs	2	71
The New England Institute, Inc., Ridgefield	1	21
Yale University, New Haven	6	3,078
<u>District of Columbia</u>	<u>5</u>	<u>107</u>
Georgetown University	1	39
George Washington University	1	28
Howard University	3	40
<u>Florida</u>	<u>8</u>	<u>505</u>
Florida State University, Tallahassee	4	359
Florida, University of, Gainesville	4	146
<u>Georgia</u>	<u>3</u>	<u>94</u>
Georgia Institute of Technology, Atlanta	2	73
Georgia, University of, Athens	1	21
<u>Hawaii</u>	<u>3</u>	<u>488</u>
Hawaii, University of, Honolulu	3	488
<u>Idaho</u>	<u>1</u>	<u>6</u>
Idaho State University, Pocatello	1	6

*Dollar figures are based on obligations made specifically from FY 1974 funds, for operations and equipment, for the 315 contracts in effect as of July 1, 1974.

<u>State and Contractor</u>	<u>Number of Contracts</u>	<u>FY 1974 Funding (in 1000's)</u>
<u>Illinois</u>	<u>16</u>	<u>\$ 3,616</u>
Chicago, University of, Chicago	5	286
Illinois Institute of Technology, Chicago	2	135
Illinois, University of, Urbana	5	2,799
Northwestern University, Evanston	4	396
<u>Indiana</u>	<u>7</u>	<u>2,078</u>
Indiana University, Bloomington	1	207
Notre Dame, University of, Notre Dame	1	1,023
Purdue University, Lafayette	5	848
<u>Iowa</u>	<u>1</u>	<u>35</u>
Iowa, University of, Iowa City	1	35
<u>Kansas</u>	<u>3</u>	<u>374</u>
Kansas State University, Manhattan	2	310
Kansas, University of, Lawrence	1	64
<u>Louisiana</u>	<u>2</u>	<u>73</u>
Louisiana State University, Baton Rouge	1	50
Southern University, Baton Rouge	1	23
<u>Maryland</u>	<u>14</u>	<u>2,249</u>
Johns Hopkins University, Baltimore	5	323
Maryland, University of, College Park	9	1,926
<u>Massachusetts</u>	<u>16</u>	<u>8,823</u>
Brandeis University, Waltham	3	185
Clark University, Worcester	1	24
Harvard University, Cambridge	3	1,292
Massachusetts Institute of Technology, Cambridge	5	6,842
Massachusetts, University of, Amherst	2	150
Tufts University, Medford	1	300
Worcester Polytechnic Institute, Worcester	1	30
<u>Michigan</u>	<u>13</u>	<u>1,804</u>
Michigan State University, East Lansing	5	255
Michigan Technological University, Houghton	2	44
Michigan, University of, Ann Arbor	3	1,361
Wayne State University, Detroit	3	144
<u>Minnesota</u>	<u>7</u>	<u>1,343</u>
Minnesota, University of, Minneapolis	7	1,343
<u>Mississippi</u>	<u>1</u>	<u>23</u>
Mississippi, University of, University	1	23
<u>Missouri</u>	<u>5</u>	<u>247</u>
Washington University, St. Louis	5	247
<u>Montana</u>	<u>2</u>	<u>73</u>
Montana State University, Bozeman	1	31
Montana, University of, Missoula	1	42
<u>Nebraska</u>	<u>1</u>	<u>26</u>
Nebraska, University of, Lincoln	1	26
<u>Nevada</u>	<u>1</u>	<u>17</u>
Nevada, University of, Reno	1	17
<u>New Hampshire</u>	<u>2</u>	<u>42</u>
Dartmouth College, Hanover	2	42

<u>State and Contractor</u>	<u>Number of Contracts</u>	<u>FY 1974 Funding (in 1000's)</u>
<u>New Jersey</u>	<u>5</u>	<u>\$ 1,466</u>
Institute for Advanced Study, Princeton	1	120
Princeton University, Princeton	4	1,346
<u>New Mexico</u>	<u>1</u>	<u>65</u>
New Mexico, University of, Albuquerque	1	65
<u>New York</u>	<u>46</u>	<u>5,337</u>
American Physical Society, New York	1	33
Clarkson College of Technology, Potsdam	1	18
Columbia University, New York	7	896
Cornell University, Ithaca	8	775
New York, City University of, Brooklyn College	2	81
New York, State University of, Albany	3	82
New York, State University of, Buffalo	1	100
New York, State University of, Stony Brook	6	352
New York University, New York	1	1,166
Rensselaer Polytechnic Institute, Troy	4	94
Rochester, University of, Rochester	8	1,247
Rockefeller University, New York	1	298
Syracuse University, Syracuse	2	130
Yeshiva University, New York	1	65
<u>North Carolina</u>	<u>7</u>	<u>1,040</u>
Duke University, Durham	2	750
North Carolina State University, Raleigh	3	171
North Carolina, University of, Chapel Hill	2	119
<u>Ohio</u>	<u>10</u>	<u>858</u>
Case Western Reserve University, Cleveland	4	306
Cincinnati, University of, Cincinnati	1	45
Kent State University, Kent	1	37
Ohio State University, Columbus	4	470
<u>Oklahoma</u>	<u>1</u>	<u>60</u>
Oklahoma, University of, Norman	1	60
<u>Oregon</u>	<u>6</u>	<u>198</u>
Oregon State University, Corvallis	4	96
Oregon, University of, Eugene	2	102
<u>Pennsylvania</u>	<u>19</u>	<u>3,350</u>
Carnegie-Mellon University, Pittsburgh	8	1,526
Lehigh University, Bethlehem	1	37
Lincoln University, Lincoln University	1	16
Pennsylvania State University, University Park	2	67
Pennsylvania, University of, Philadelphia	3	1,452
Pittsburgh, University of, Pittsburgh	3	162
Temple University, Philadelphia	1	90
<u>Puerto Rico</u>	<u>1</u>	<u>35</u>
Puerto Rico, University of, Mayaguez	1	35
<u>Rhode Island</u>	<u>4</u>	<u>523</u>
Brown University, Providence	4	523
<u>Tennessee</u>	<u>6</u>	<u>209</u>
Tennessee State University, Nashville	1	0
Tennessee, University of, Knoxville	5	209

<u>State and Contractor</u>	<u>Number of Contracts</u>	<u>FY 1974 Funding (in 1000's)</u>
<u>Texas</u>	<u>15</u>	<u>\$ 1,668</u>
Baylor University, Waco	1	17
Houston, University of, Houston	2	170
Rice University, Houston	2	615
Texas A & M University, College Station	6	293
Texas Southern University, Houston	1	20
Texas, University of, Austin	3	553
<u>Utah</u>	<u>4</u>	<u>389</u>
Associated Western Universities, Inc., Salt Lake City	1	291
Utah, University of, Salt Lake City	3	98
<u>Vermont</u>	<u>1</u>	<u>19</u>
Vermont, University of, Burlington	1	19
<u>Virginia</u>	<u>3</u>	<u>344</u>
Virginia Polytechnic Institute & State Univ., Blacksburg	1	44
Virginia, University of, Charlottesville	2	300
<u>Washington</u>	<u>8</u>	<u>1,548</u>
Washington State University, Pullman	1	67
Washington, University of, Seattle	6	1,471
Western Washington State College, Bellingham	1	10
<u>Wisconsin</u>	<u>5</u>	<u>2,003</u>
Marquette University, Milwaukee	1	37
Wisconsin, University of, Madison	4	1,966
<u>Wyoming</u>	<u>1</u>	<u>100</u>
Wyoming, University of, Laramie	1	100

HIGH ENERGY PHYSICS

- Brandeis University, Waltham, Massachusetts. Lawrence E. Kirsch and Howard J. Schnitzer, Research in Elementary Particle Physics. \$157,000.
- Brown University, Providence, Rhode Island. David Feldman, Anatole M. Shapiro, and Robert E. Lenou, Jr., Experimental and Theoretical High Energy Physics. \$344,000.
- California Institute of Technology, Pasadena, California. Robert L. Walker, Experimental, Theoretical and Phenomenological Research. \$1,348,000.
- California, University of, Davis, California. Richard L. Lander, High Energy Particle Physics Research. \$105,000 (9 months).
- California, University of, Irvine, California. Frederick Reines, Studies of Neutrino and Cosmic Ray Interactions. \$383,000.
- California, University of, Irvine, California. Jonas Schultz and Paul E. Condon, Study of Elementary Particle Interactions. \$165,000.
- California, University of, Los Angeles, California. Harold K. Ticho and Donald H. Stork, Research in High Energy Physics. \$415,000.
- California, University of, Riverside, California. Robert T. Poe and Anne Kernan, High Energy Physics. \$233,000.
- California, University of, San Diego, California. Oreste Piccioni and Norman Kroll, Experimental and Theoretical Particle Physics. \$580,000.
- California, University of, Santa Barbara, California. David O. Caldwell, High Energy User Group. \$250,000.
- California, University of, Santa Cruz, California. Clemens A. Heusch, Experimental Elementary Particle Research. \$182,000.
- Carnegie-Mellon University, Pittsburgh, Pennsylvania. Roger B. Sutton, High Energy Physics Users and Theoretical Research. \$809,000.
- Colorado, University of, Boulder, Colorado. Uriel Nauenberg and David F. Bartlett, High Energy Physics. \$150,000.
- Columbia University, New York, New York. T. D. Lee, Theoretical High Energy Physics. \$290,000.
- Duke University, Durham, North Carolina. William D. Walker, Study of the Interactions between Elementary Particles and Nuclei, and Development of Detection Methods. \$185,000.
- Florida State University, Tallahassee, Florida. Joseph E. Lannutti, Elementary Particle Physics. \$205,000.
- Harvard University, Cambridge, Massachusetts. F. M. Pipkin, High Energy Physics Research. \$1,260,000.
- Harvard University, Cambridge, Massachusetts. Tai Tsun Wu, High Energy Collision Processes. \$17,000.
- Hawaii, University of, Honolulu, Hawaii. Vincent Z. Peterson and San Fu Tuan, Research in High Energy Nuclear Physics. \$437,000.
- Illinois, University of, Urbana, Illinois. A. Wattenberg, High Energy Physics Users; Theoretical Research. \$1,191,000.
- Indiana University, Bloomington, Indiana. Richard M. Heinz, Homer A. Neal, Shu-Yuan Chu, Archibald W. Hendry and Don B. Lichtenberg, Research in Experimental and Theoretical High Energy Physics. \$207,000.
- Institute for Advanced Study, Princeton, New Jersey. Roger F. Dashen and Stephen L. Adler, Problems in Particle Theory. \$120,000.

HIGH ENERGY PHYSICS

- Johns Hopkins University, Baltimore, Maryland. Gabor Domokos, Research in Theoretical Physics. \$45,000.
- Maryland, University of, College Park, Maryland. George A. Snow, High Energy Accelerator and Colliding Beam User Group. \$665,000.
- Massachusetts Institute of Technology, Cambridge, Massachusetts. Martin Deutsch, High Energy Physics Research. \$2,861,000.
- Massachusetts, University of, Amherst, Massachusetts. Janice B. Shafer, High Energy Physics. \$150,000.
- Michigan, University of, Ann Arbor, Michigan. Daniel Sinclair, High Energy Physics Users and Theoretical Research. \$837,000.
- Minnesota, University of, Minneapolis, Minnesota. Stephen Gasiorowicz and Hans W. J. Courant, Theoretical and High Energy Physics Research. \$300,000.
- Northwestern University, Evanston, Illinois. Jerome L. Rosen and Donald H. Miller, High Energy Experimental Physics. \$301,896.
- Ohio State University, Columbus, Ohio. Thomas A. Romanowski, K. Tanaka and W. W. Wada, High Energy Physics. \$325,000.
- Oregon, University of, Eugene, Oregon. Michael J. Moravcsik, Theory of Elementary Particles. \$102,000.
- Pennsylvania, University of, Philadelphia, Pennsylvania. A. Mann, High Energy Physics Research. \$1,385,000.
- Princeton University, Princeton, New Jersey. Frank Shoemaker, High Energy Physics Research. \$1,123,000.
- Purdue University, Lafayette, Indiana. Frank J. Loeffler, Masao Sugawara and Earle C. Fowler, Fundamental Particle Physics. \$647,300.
- Rochester, University of, Rochester, New York. A. C. Melissinos and S. Okubo, High Energy Physics Users and Theoretical Research. \$818,000.
- Rockefeller University, New York, New York. Rodney L. Cool and Abraham Pais, Research in Experimental and Theoretical High Energy Physics. \$298,000.
- 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. \$130,000.
- Tennessee, University of, Knoxville, Tennessee. William M. Bugg, Elementary Particle Interactions. \$75,000.
- Texas, University of, Austin, Texas. E. C. G. Sudarshan and Yuval Ne'eman, Research in Elementary Particle Theory. \$135,000.
- Tufts University, Medford, Massachusetts. Allan M. Cormack, Experimental High Energy Physics Research. \$300,000.
- Washington, University of, Seattle, Washington. Jere J. Lord, High Energy Physics Studies of Particle Interactions in Heavy Elements. \$43,000.
- Wayne State University, Detroit, Michigan. Suraj N. Gupta, Quantum Theory of Fields. \$27,000.
- Wisconsin, University of, Madison, Wisconsin. D. Reeder and W. F. Fry, High Energy Physics Users and Theoretical Research. \$1,365,000.

HIGH ENERGY PHYSICS

Yale University, New Haven, Connecticut. J. Sandweiss, R. K. Adair, V. W. Hughes and F. Gursev,
High Energy Physics Users and Theoretical Research. \$1,207,000.

NUCLEAR SCIENCES

- Arkansas, University of, Fayetteville, Arkansas. Paul K. Kuroda, Nuclear Chemistry. \$36,000.
- Brown University, Providence, Rhode Island. Stavros Fallieros and Frank S. Levin, Nuclear Excitations and Reaction Mechanisms. \$48,991.
- California Institute of Technology, Pasadena, California. Felix Boehm, Research in Nuclear Spectroscopy, X-Rays, and Medium Energy Physics. \$300,000.
- California, University of, Berkeley, California. Paul B. Price, Jr., Astrophysical and Super-heavy Element Studies with Nuclear Tracks in Solids. \$74,000.
- California, University of, Los Angeles, California. George J. Igo, Intermediate Energy Nuclear Physics Users Group. \$160,000.
- California, University of, Los Angeles, California. Roy P. Haddock and B. M. K. Nefkens, Particle Physics. \$240,000.
- Carnegie-Mellon University, Pittsburgh, Pennsylvania. Albert A. Caretto, Jr., High Energy Nuclear Reactions. \$45,000.
- Carnegie-Mellon University, Pittsburgh, Pennsylvania. Peter D. Barnes, Experimental Nuclear Physics. \$155,000.
- Carnegie-Mellon University, Pittsburgh, Pennsylvania. Morton Kaplan, Research in Nuclear Chemistry. \$43,000.
- Case Western Reserve University, Cleveland, Ohio. Harvey B. Willard, Medium Energy Nuclear Physics Research. \$124,845.
- Chicago, University of, Chicago, Illinois. Nathan Sugarman and Anthony Turkevich, Nuclear Chemistry Research. \$150,000 (10 months).
- Clark University, Worcester, Massachusetts. Daeg S. Brenner, Research in Nuclear Spectroscopy. \$23,500.
- Colorado, University of, Boulder, Colorado. Robert A. Ristinen and Peter D. Kunz, Study of Fundamental Nuclear Interactions. \$491,300.
- Columbia University, New York, New York. L. James Rainwater, Research in Neutron Velocity Spectroscopy. \$240,000.
- Columbia University, New York, New York. W. W. Havens, Jr. and Edward Melkonian, Research Program in Neutron Spectroscopy. \$130,000.
- Columbia University, New York, New York. J. M. Miller, Study of Heavy-Ion Induced Nuclear Reactions. \$60,011.
- Duke University, Durham, North Carolina. Henry W. Newson, Studies of Nuclear Structure Using Neutrons and Charged Particles. \$565,387.
- Florida State University, Tallahassee, Florida. Gregory R. Choppin, Nuclear Chemistry. \$70,875 (21 months).
- Florida State University, Tallahassee, Florida. Raymond K. Sheline, An Experimental Study of Nuclear Models. \$112,000 (14 months).
- Florida, University of, Gainesville, Florida. M. Luis Muga, Development and Applications of Thin Film Detectors. \$34,000.
- Georgia Institute of Technology, Atlanta, Georgia. Richard W. Fink, Nuclear and X-Ray Spectroscopy with Radioactive Sources. \$50,000.
- Houston, University of, Houston, Texas. John C. Allred, B. W. Mayes, II and Peter A. M. Gram, Pion Interactions at Medium Energies. \$100,000.

NUCLEAR SCIENCES

- Illinois, University of, Chicago, Illinois. Lester Winsberg, Recoil Studies of Reactions Induced in Light Elements by High Energy Protons (3 to 300 GeV). \$14,000.
- Johns Hopkins University, Baltimore, Maryland. Leon Madansky and Y. K. Lee, Nuclear Moments and Nuclear Structure. \$160,000.
- Louisiana State University, Baton Rouge, Louisiana. R. W. Huggett and Paul N. Kirk, A Study of the Two-Body Dissociation of Light Nuclei in Nuclear Fields. \$50,000 (7 months).
- Maryland, University of, College Park, Maryland. Harry D. Holmgren, Experimental Intermediate Energy Nuclear Physics. \$722,074.
- Maryland, University of, College Park, Maryland. Glen E. Gordon, Victor E. Viola, Jr. and William B. Walters, Research in Nuclear Chemistry. \$116,000.
- Maryland, University of, College Park, Maryland. James J. Griffin and William M. MacDonald, Theoretical Studies in Nuclear Reactions and Nuclear Structure. \$220,000.
- Massachusetts Institute of Technology, Cambridge, Massachusetts. Fred J. Epling, Nuclear Physics Research. \$3,491,000.
- Michigan State University, East Lansing, Michigan. William C. McHarris and Frederick M. Bernthal, Nuclear Chemistry Research. \$116,000.
- Michigan, University of, Ann Arbor, Michigan. Glenn F. Knoll, Absolute Neutron Cross Section Measurements. \$75,000.
- Michigan, University of, Ann Arbor, Michigan. W. C. Parkinson and R. S. Tickle, 83-Inch Cyclotron Research Program. \$449,000.
- Minnesota, University of, Minneapolis, Minnesota. J. Morris Blair, George W. Greenlees and Norton M. Hintz, Experimental Nuclear Physics. \$713,000.
- Montana, University of, Missoula, Montana. Mark J. Jakobson, Total Pion Cross Section Measurements. \$42,330.
- New Mexico, University of, Albuquerque, New Mexico. Howard C. Bryant, Byron D. Dieterle, Christopher P. Leavitt and David M. Wolfe, Nucleon Physics Studies at Intermediate Energies. \$65,228 (14 months).
- New York, State University of, Albany, New York. Hassaram Bakhru, Nuclear Spectroscopy and Nuclear Reaction Work. \$25,000.
- New York, State University of, Albany, New York. Jagadish B. Garg, Measurement and Analysis of Neutron Cross Sections. \$17,960.
- New York, State University of, Buffalo, New York. Gregory Breit, The Theories of Nucleon-Nucleon Interactions, Nuclear Reactions and Atomic Hyperfine Structure. \$100,000.
- 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. \$190,000.
- New York, State University of, Stony Brook, New York. John M. Alexander, Nuclear Reaction Studies. \$46,800.
- North Carolina State University, Raleigh, North Carolina. L. W. Seagondollar, Nuclear Structure Research at the Triangle Universities Nuclear Laboratory. \$80,000.
- North Carolina, University of, Chapel Hill, North Carolina. Eugen Merzbacher, Studies of Nuclear Processes. \$81,000.
- Northwestern University, Evanston, Illinois. James T. Waber, Effect of Nuclear Shape on the Electronic Orbitals of Superactinide Elements. \$25,000 (2 years).

NUCLEAR SCIENCES

- Oregon State University, Corvallis, Oregon. Walter D. Loveland, Studies of Low Energy Induced Nuclear Fission. \$33,300 (18 months).
- Oregon State University, Corvallis, Oregon. T. Darrah Thomas, Research in Nuclear Chemistry. \$67,500.
- Pittsburgh; University of, Pittsburgh, Pennsylvania. Robert L. Wolke, Recoil Studies of Nuclear Reactions. \$34,900.
- Princeton University, Princeton, New Jersey. Robert A. Naumann, Research in Nuclear Chemistry. \$85,000.
- 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.
- Rensselaer Polytechnic Institute, Troy, New York. Daniel Sperber, Neutron and Gamma Emission from Highly Excited States and States with High Spin. \$33,900 (18 months).
- Rensselaer Polytechnic Institute, Troy, New York. Ivor L. Preiss, Nuclear Structure Studies. \$30,000.
- Rice University, Houston, Texas. Gerald C. Phillips, Low- and Intermediate-Energy Nuclear Physics Studies. \$490,000.
- Rochester, University of, Rochester, New York. J. Bruce French and Daniel S. Koltun, Nuclear Structure Theory. \$121,000.
- Rochester, University of, Rochester, New York. H. Marshall Blann, Nuclear Reaction Mechanisms. \$55,000.
- Rochester, University of, Rochester, New York. John R. Huizenga, Studies of Nuclear Fission, Low-Energy Nuclear Reactions and Transuranic Nuclei. \$98,000.
- Southern University, Baton Rouge, Louisiana. Kuang-Hsiang Liu and Zorawar Singh, Experimental and Theoretical Nuclear Physics. \$23,000.
- Temple University, Philadelphia, Pennsylvania. W. Kenneth McFarlane, Experimental Investigation of Pion Decays at the Los Alamos Meson Physics Facility. \$90,000.
- Tennessee, University of, Knoxville, Tennessee. Joseph R. Peterson, Physical-Chemical Studies of the Transuranium Elements. \$28,500.
- Texas A&M University, College Station, Texas. Ronald D. Macfarlane, Mass Spectrometry of Short-Lived Nuclear Species. \$65,000.
- Texas A&M University, College Station, Texas. Joseph B. Natowitz, Angular Momentum Effects in Nuclear Reactions. \$54,200.
- Texas A&M University, College Station, Texas. Thomas T. Sugihara, Nuclear Spectroscopy. \$40,200.
- Texas A&M University, College Station, Texas. Rand L. Watson, Ionization Phenomena. \$37,200.
- Texas A&M University, College Station, Texas. L. C. Northcliffe, Study of the Neutron-Proton Interaction in the 300-700 MeV Energy Region. \$75,000.
- Texas, University of, Austin, Texas. George W. Watt, Unusual Oxidation States of Transitional Elements. \$12,500.
- Texas, University of, Austin, Texas. Taro Tamura and Gerald W. Hoffman, Research in Nuclear Physics. \$405,000.

NUCLEAR SCIENCES

- Virginia, University of, Charlottesville, Virginia. Ralph C. Minehart, Stanley E. Sobottka and Klaus O. H. Ziock, Experiments on the Nuclear Interactions of Pions. \$220,000.
- Washington State University, Pullman, Washington. John B. Gruber, Spectroscopic Studies of Actinide Ions in Crystalline Solids. \$67,110.
- Washington University, St. Louis, Missouri. Arthur C. Wahl, Radiochemical Studies of the Fission Processes. \$30,000.
- Washington University, St. Louis, Missouri. Demetrios G. Sarantites, Low Energy Nuclear Reactions and Spectroscopy. \$38,200.
- Washington University, St. Louis, Missouri. Franklin B. Shull, The Cyclotron as an Instrument for Chemical Research. \$110,000.
- Washington University, St. Louis, Missouri. Edward S. Macias, Spectroscopy of Nuclear Systems. \$28,700.
- Washington, University of, Seattle, Washington. Fred H. Schmidt, Lawrence Willets and Isaac Halpern, Experimental and Theoretical Nuclear Physics. \$1,094,000.
- Washington, University of, Seattle, Washington. Gene L. Woodruff, Delayed Neutron Spectra from Fast Fission. \$55,200.
- Western Washington State College, Bellingham, Washington. Edward F. Neuzil, Fission Studies on Elements Below Polonium. \$9,750.
- Wisconsin, University of, Madison, Wisconsin. H. T. Richards and L. W. Anderson, Research in Nuclear Physics and Atomic Collisions. \$465,500.
- Wyoming, University of, Laramie, Wyoming. Glen A. Rebka, Jr. and Raymond Kunselmen, Pion-Nucleon Interactions and Mesonic Atoms. \$100,000.
- Yale University, New Haven, Connecticut. D. Allen Bromley, MP Tandem Van de Graaff Research Program. \$971,000.
- Yale University, New Haven, Connecticut. Vernon W. Hughes and Howard L. Schultz, Studies in Nuclear Physics. \$412,000.
- Yale University, New Haven, Connecticut. Robert Beringer, Heavy Ion Linear Accelerator Research Program. \$420,000.

MATERIALS SCIENCES

- The American Physical Society, New York, New York. F. L. Vook, A Summer Study on Radiation Effects on Materials. \$33,000 (8 months).
- Arizona State University, Tempe, Arizona. LeRoy Eyring, Solid State Chemistry of Rare Earth Oxides. \$55,000.
- Arizona State University, Tempe, Arizona. James T. Stanley, Study of Ferrite Formation in Neutron Irradiated Austenitic Stainless Steels. \$32,858.
- Arizona, University of, Tucson, Arizona. Carl T. Tomizuka, Impurity Diffusion in Solids. \$68,800 (2 years).
- Brown University, Providence, Rhode Island. Joseph Gurland and James R. Rice, A Combined Macroscopic and Microscopic Approach to the Fracture of Metals. \$80,000.
- California Institute of Technology, Pasadena, California. Pol Duwez, Studies of Alloy Structures and Properties. \$174,791.
- California, University of, Los Angeles, California. Alan J. Ardell, Particle Size Distribution Effects in Precipitation Hardening. \$65,000.
- California, University of, Los Angeles, California. Didier de Fontaine, Fourier Space Computer Simulation of Crystalline Imperfections. \$32,000.
- California, University of, Riverside, California. A. W. Lawson and Glen E. Everett, Electric and Magnetic Properties of Transition Metals and Their Compounds. \$71,490.
- California, University of, San Diego, California. John C. Wheatley, Research on the Properties of Materials at Very Low Temperatures. \$290,050.
- California, University of, San Diego, California. Huey-Lin Luo, New Materials by Low Temperature Condensation. \$80,000.
- Carnegie-Mellon University, Pittsburgh, Pennsylvania. Robert F. Sekerka, Generalization of Internal Centrifugal Zone Growth of Metal-Ceramic Composites. \$29,385.
- Case Western Reserve University, Cleveland, Ohio. Richard W. Hoffman, Solid State Physics. \$82,969.
- Case Western Reserve University, Cleveland, Ohio. Ronald Gibala, Dislocation-Solute Atom Interactions in Alloys. \$43,000.
- Case Western Reserve University, Cleveland, Ohio. Terence E. Mitchell, Experiments in High Voltage Electron Microscopy. \$55,432.
- Chicago, University of, Chicago, Illinois. Stuart A. Solin, The Study of Phonons and Electronic Processes in Amorphous and Crystalline Solids. \$42,000.
- Cincinnati, University of, Cincinnati, Ohio. John Moteff, Radiation Effects to BCC Refractory Metals and Alloys. \$45,000.
- Clarkson College of Technology, Potsdam, New York. Joseph L. Katz, Nucleation of Voids. \$18,344.
- Colorado School of Mines, Golden, Colorado. David L. Olson and Walter L. Bradley, Liquid Lithium Corrosion and Corrosion Research. \$40,000.
- Colorado, University of, Boulder, Colorado. Richard C. Mockler and William J. O'Sullivan, Critical Scattering of Laser Light by Bulk Fluids and Thin Fluid Films. \$44,000.
- Columbia University, New York, New York. Charles F. Bonilla, High Temperature Transport Properties and Processes of Gases and Alkali Metals. \$31,000.
- Connecticut, University of, Storrs, Connecticut. James M. Calligan, Electron-Dislocation Interactions at Low Temperatures. \$34,187.

MATERIALS SCIENCES

- Connecticut, University of, Storrs, Connecticut. John E. Morral, Cluster Carburizing. \$37,015.
- Cornell University, Ithaca, New York. Che-Yu Li, Grain Boundary Sliding and Structure. \$40,000.
- Cornell University, Ithaca, New York. R. H. Silsbee and Raymond Bowers, Solid State Physics: Magnetic Phenomena. \$115,800.
- Cornell University, Ithaca, New York. R. O. Pohl and A. J. Sievers, Experimental Phonon Physics. \$136,000.
- Cornell University, Ithaca, New York. Arthur L. Ruoff, Elastic and Plastic Deformation of Solids. \$120,000.
- Cornell University, Ithaca, New York. Robert W. Balluffi and David N. Seidman, Defects in Metal Crystals. \$210,000.
- Cornell University, Ithaca, New York. James A. Krumhansl, Theory of Structure and Dynamics in Condensed Matter. \$60,000.
- Cornell University, Ithaca, New York. H. H. Johnson, Effect of Environment on Fracture Behavior. \$53,800.
- Cornell University, Ithaca, New York. Edward J. Kramer, A Study of the Interaction Between Magnetic Fluxoids and Crystal Defects in Type II Superconductors. \$39,673.
- Dartmouth College, Hanover, New Hampshire. P. Bruce Pipes, Experimental Determination of the Temperature Dependence of Metallic Work Functions at Low Temperatures. \$25,240.
- Dartmouth College, Hanover, New Hampshire. Walter E. Lawrence, Theory of Electron-Phonon Scattering Effects in Metals. \$16,671.
- Florida, University of, Gainesville, Florida. Robert E. Reed-Hill, Deformation Processes in Refractory Metals. \$36,927.
- Florida, University of, Gainesville, Florida. John J. Hren and Craig S. Hartley, Quantitative Analysis of Solute Segregation in Alloys by Transmission Electron Microscopy. \$39,000.
- Georgetown University, Washington, D. C. William D. Gregory, The Study of Very Pure Metals at Low Temperatures. \$39,000.
- Hawaii, University of, Honolulu, Hawaii. William Pong, Photoelectric Emission from Thin Films in the Vacuum Ultraviolet Region. \$27,836.
- Hawaii, University of, Honolulu, Hawaii. Murli H. Manghnani, Pressure Derivatives of Elastic Moduli in B.C.C. Transition Metals and Their Solid Solutions. \$22,675.
- 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 and Electrical Measurements on Solids at Low Temperatures. \$105,000 (15 months).
- Illinois Institute of Technology, Chicago, Illinois. Lawrence J. Broutman, The Strengthening and Toughening of Brittle Materials. \$30,000.
- Illinois, University of, Urbana, Illinois. Robert J. Maurer, The Science of Materials. \$1,375,000.
- Johns Hopkins University, Baltimore, Maryland. William F. Hartman, Acoustic Emission and the Portevin-Le Chatelier Effect. \$32,000.
- Kansas, University of, Lawrence, Kansas. Paul W. Gilles, High Temperature Chemistry. \$64,000.
- Lehigh University, Bethlehem, Pennsylvania. Michael R. Notis, Pressure Sintering and Creep Deformation - A Joint Modeling Approach. \$37,000.

MATERIALS SCIENCES

- Marquette University, Milwaukee, Wisconsin. Robert N. Blumenthal, Defect Structures in Non-stoichiometric Oxides. \$37,310.
- Maryland, University of, College Park, Maryland. R. J. Arsenault, An Investigation of Irradiation Strengthening of BCC Metals and Solid Solutions. \$46,000.
- Maryland, University of, College Park, Maryland. M. J. Marcinkowski, Alloy Strengthening Due to Atomic Order. \$28,948.
- Massachusetts Institute of Technology, Cambridge, Massachusetts. W. D. Kingery and R. L. Coble, Basic Research in Crystalline and Noncrystalline Ceramic Systems. \$300,000.
- Massachusetts Institute of Technology, Cambridge, Massachusetts. C. G. Shull, Low Temperature and Neutron Physics Studies. \$104,986.
- 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. \$85,000.
- Massachusetts, University of, Amherst, Massachusetts. Allan R. Hoffman, Ultrasonic Attenuation Studies of the Electronic Structure of Metals. \$41,045 (2 years).
- Michigan State University, East Lansing, Michigan. Harry A. Eick, An Investigation of Some Lanthanide Carbon, Nitrogen, Chalcogen, and Halogen Systems at Elevated Temperatures. \$25,000.
- Michigan State University, East Lansing, Michigan. Gerald L. Pollack, Properties of Rare-Gas Solids. \$43,524.
- Michigan Technological University, Houghton, Michigan. Donald E. Mikkola, Effect of Annealing on the Substructure of Cold Worked fcc Metals and Alloys. \$32,863 (2 years).
- Michigan Technological University, Houghton, Michigan. Dale F. Stein and Lloyd A. Heldt, A Study of Grain Boundary Segregation using the Auger Electron Emission Technique. \$44,000.
- Minnesota, University of, Minneapolis, Minnesota. William Zimmermann, Jr., Walter V. Weyhmann and Allen M. Goldman, Experimental Investigations in Solid-State and Low Temperature Physics. \$159,333.
- Minnesota, University of, Minneapolis, Minnesota. Thomas E. Hutchinson, "In Situ" Electron Microscope Investigation of the Nucleation and Growth of Sputtered Thin Films. \$39,120.
- Minnesota, University of, Minneapolis, Minnesota. William W. Gerberich, Analysis of the Ductile-Brittle Transition Temperature in Fe-Binary Alloys. \$36,335.
- Montana State University, Bozeman, Montana. R. T. Wimber, High-Temperature Oxidation of Iridium. \$31,440 (13 months).
- New York, State University of, Albany, New York. James W. Corbett and David Peak, Theory of Reaction Kinetics. \$39,000.
- New York, State University of, Stony Brook, New York. John C. Bilello, Applications of Microdynamics and Lattice Mechanics to Problems in Plastic Flow and Fracture. \$49,000.
- New York, State University of, Stony Brook, New York. Herbert Herman, Fatigue-Enhancement of Diffusion. \$14,968.
- North Carolina State University, Raleigh, North Carolina. Thomas S. Elleman, Diffusion of Gases in Solids. \$52,000 (16 months).
- North Carolina State University, Raleigh, North Carolina. Lloyd R. Zumwalt, Sorption of Cesium by Graphites as a Function of Strontium and Barium Concentration at High Temperatures. \$38,569.
- North Carolina, University of, Chapel Hill, North Carolina. James H. Crawford, Jr., Investigation of Defect Structures by Electric Polarization and Relaxation Methods. \$38,035.

MATERIALS SCIENCES

- Northwestern University, Evanston, Illinois. M. Meshii, Effect of Point Defects on Mechanical Properties of Metals. \$48,941.
- Ohio State University, Columbus, Ohio. Roger W. Staehle and Arun K. Agrawal, Corrosion, Stress Corrosion Cracking, and Electrochemistry of the Iron and Nickel Base Alloys in Caustic Environments. \$50,000.
- Oklahoma, University of, Norman, Oklahoma. Ronald R. Bourassa, Thermoelectric Size Effect in Noble Metals. \$60,000 (2 years).
- Oregon State University, Corvallis, Oregon. James R. Welty, Natural Convection Heat Transfer in Liquid Metals. \$23,624.
- Pennsylvania State University, University Park, Pennsylvania. Richard C. Bradt and John H. Hoke, Ceramic Research. \$26,119.
- Pennsylvania, University of, Philadelphia, Pennsylvania. David P. Pope, Dislocation Mobilities in Ordered Alloys. \$37,100.
- Pittsburgh, University of, Pittsburgh, Pennsylvania. Raymond S. Craig and W. E. Wallace, Thermal, Structural and Magnetic Studies of Metals and Intermetallic Compounds. \$97,000.
- Purdue University, Lafayette, Indiana. Richard E. Grace, Transport and Thermodynamic Properties of Solids. \$36,000.
- Rensselaer Polytechnic Institute, Troy, New York. Warren F. Savage and David J. Duquette, The Effect of Welding Variables on the Solidification Substructure, Mechanical Properties and Corrosion Behavior of Austenitic Stainless Steel Weld Metal. \$35,000.
- Rensselaer Polytechnic Institute, Troy, New York. Norman S. Stoloff, Fatigue Behavior of BCC Metals. \$29,300.
- Rochester, University of, Rochester, New York. James C. M. Li, Diffusional Creep of Multi-Component Systems. \$25,908.
- Rochester, University of, Rochester, New York. Stephen J. Burns, The Materials and Mechanics of Rate Effects in Brittle Fracture. \$35,000.
- Southern California, University of, Los Angeles, California. Terence G. Langdon, Grain Boundary Sliding During High-Temperature Creep. \$40,000.
- Stanford University, Stanford, California. Craig R. Barrett and William D. Nix, Structure Dependence of High Temperature Deformation of Metals. \$51,817.
- Stanford University, Stanford, California. David A. Stevenson, Diffusion of Oxygen in Liquid Metal Systems. \$36,000.
- Tennessee, University of, Knoxville, Tennessee. E. E. Stansbury and C. R. Brooks, Application of Adiabatic Calorimetry to Metal Systems. \$27,000.
- Tennessee, University of, Knoxville, Tennessee. Joseph E. Spruiell, Microstructure-Property Relationships in Austenitic Stainless Steels. \$30,000.
- Utah, University of, Salt Lake City, Utah. Ronald S. Gordon, Impurity Effects on the Creep of Polycrystalline Magnesium and Aluminum Oxides at Elevated Temperatures. \$29,163.
- Utah, University of, Salt Lake City, Utah. J. Gerald Byrne, Positron Lifetime Measurements as a Non-destructive Technique to Monitor Fatigue Damage. \$32,000.
- Vermont, University of, Burlington, Vermont. John S. Brown, Thermodynamic and Transport Properties of Interstitial Hydrogen Isotopes in Metal Systems. \$18,535.
- Virginia, University of, Charlottesville, Virginia. Robert V. Coleman, Electronic Properties of Metals, Alloys and Molecules. \$79,796.

MATERIALS SCIENCES

Washington, University of, Seattle, Washington. Robert L. Ingalls, Mössbauer Studies at High Pressure. \$35,000.

Washington, University of, Seattle, Washington. Douglas H. Polonis, A Study of Phase Transformations and Superconductivity. \$41,000.

Wisconsin, University of, Madison, Wisconsin. Gerald L. Kulcinski, Void Nucleation and Growth in Heavy Ion and Electron Bombarded Pure Metals. \$45,030.

MOLECULAR SCIENCES

- The Aerospace Corporation, Los Angeles, California. Seymour Siegel, The Kinetics of Two-Photon Isotope Separation. \$52,588.
- Alabama, University of, University, Alabama. Lowell D. Kispert, ELDOR Investigations of Radiation Processes. \$32,280.
- Alaska, University of, Fairbanks, Alaska. Syun-Ichi Akasofu, Magnetic Substorms. \$45,500 (14 months).
- Alaska, University of, Fairbanks, Alaska. Hans Pulpan, Alaska Peninsula Telemetered Seismic Network: Phase II. \$101,918 (20 months).
- Associated Western Universities, Inc., Salt Lake City, Utah. G. Victor Beard, Faculty and Student Research Participation. \$291,000.
- Baylor University, Waco, Texas. Malcolm Dole, Radiation Chemistry of High Polymers. \$16,820.
- Brandeis University, Waltham, Massachusetts. Henry Linschitz, Photochemical Reactions of Complex Molecules in Condensed Phase. \$117,120 (2 years).
- Brandeis University, Waltham, Massachusetts. Saul G. Cohen, Effects of Mercaptans and Disulfides on Photochemical and High Energy Radiation Induced Reactions. \$27,513.
- Brown University, Providence, Rhode Island. E. F. Greene, Experimental Chemical Kinetics: A Study of Chemical Reactions by Means of Molecular Beam Techniques. \$50,000.
- California Institute of Technology, Pasadena, California. Aron Kuppermann, Studies in Chemical Dynamics and Radiation Chemistry. \$118,000.
- California Institute of Technology, Pasadena, California. Jesse L. Beauchamp, Application of Ion Cyclotron Resonance Spectroscopy, Photoionization Mass Spectrometry and Photoelectron Spectroscopy to Study the Properties and Reactions of Ions in Gases. \$86,000 (2 years).
- California Institute of Technology, Pasadena, California. H. B. Keller, Numerical Analysis and Computing. \$55,000 (19 months).
- California, University of, Berkeley, California. Carson D. Jeffries, Dynamic Nuclear Polarization and Solid State Physics. \$107,600 (11 months).
- California, University of, Berkeley, California. John H. Reynolds, Mass Spectroscopy Research. \$60,000 (11 months).
- California, University of, Davis, California. John W. Root, Nuclear Methods in High Energy and Radiation Chemistry. \$45,000 (15 months).
- California, University of, Irvine, California. Frank S. Rowland, Radiochemistry Research. \$115,000.
- California, University of, Irvine, California. Max Wolfsberg, Theoretical Studies on Isotopic Mass Effects in Chemistry. \$49,203.
- California, University of, Irvine, California. Edward K. C. Lee, Kinetic and Spectroscopic Studies of Electronic Energy Transfer Processes. \$32,588.
- California, University of, Los Angeles, California. M. F. Nicol, Inter- and Intra-Molecular Energy Transfer Studies. \$61,000.
- 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. George C. Kennedy, Compressibility Measurements. \$60,000.
- California, University of, Los Angeles, California. Gerald Estrin, Methodology for Synthesis of Information Processing Systems. \$184,342 (8½ months).

MOLECULAR SCIENCES

- California, University of, Los Angeles, California. Donald J. Cram, Multiheteromacrocycles that Complex Metal Ions. \$59,920.
- Carnegie-Mellon University, Pittsburgh, Pennsylvania. Truman P. Kohman, Nuclear Chemistry and Geochemistry Research. \$38,000.
- Carnegie-Mellon University, Pittsburgh, Pennsylvania. Robert H. Schuler, Radiation Chemistry. \$380,000.
- Carnegie-Mellon University, Pittsburgh, Pennsylvania. Joe V. Michael, Elementary Rate Constants for Hydrogen Atoms. \$26,671.
- Chicago, University of, Chicago, Illinois. Edward Anders, Radiochemical and Geochemical Studies. \$49,000 (3 years).
- Chicago, University of, Chicago, Illinois. Ugo Fano, Basic Studies of Atomic Dynamics. \$54,000.
- Chicago, University of, Chicago, Illinois. Yuan Tseh Lee, The Dynamics of Chemical Reactions. \$40,000.
- Columbia University, New York, New York. Rhodes W. Fairbridge, Maps of North American Crustal Stability - Phase I. \$30,000.
- 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. \$114,589.
- Florida State University, Tallahassee, Florida. Russell H. Johnsen, Radiation Induced Effects in Organic Systems. \$42,000.
- Florida, University of, Gainesville, Florida. Robert J. Hanrahan, Radiation Chemistry of Hydrocarbon and Alkyl Halide Systems. \$36,000.
- George Washington University, Washington, D. C. Nicolae Filipescu, Lanthanide Ions as Sensitive Probes in Intermolecular Energy Transfer and Organic Photochemistry. \$28,000.
- Georgia Institute of Technology, Atlanta, Georgia. James A. Knight, Jr., Radiation Chemistry of Mono-substituted Aromatic Compounds. \$23,000.
- Georgia, University of, Athens, Georgia. Charles E. Melton, Radiolysis of Water in a Wide Range Radiolysis Source. \$20,995.
- Harvard University, Cambridge, Massachusetts. Garrett Birkhoff, Mathematical Problems in Nuclear Reactor Theory. \$15,000.
- Houston, University of, Houston, Texas. Gerhard G. Meisels, Principal Processes in the Radiolysis of Gases by High Energy Electrons and Fission Recoils. \$70,000.
- Howard University, Washington, D. C. Peter Hambright, Kinetic, Magnetic and Mössbauer Studies on Porphyrin Systems. \$20,000.
- 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. \$26,500 (18 months).
- Idaho State University, Pocatello, Idaho. Albert E. Wilson, Radiation Protection Program. \$6,000.
- Illinois, University of, Urbana, Illinois. George H. Miley and Joseph T. Verdeyen, Advanced Methods for Nuclear Reactor-Gas Laser Coupling. \$74,010.
- Illinois, University of, Urbana, Illinois. C. W. Gear, Mathematical Software Research. \$145,000 (10½ months).
- Iowa, University of, Iowa City, Iowa. William C. Stwalley, The Distribution of Energy in Bimolecular Chemiluminescent Reactions Involving Hydrogen Atoms. \$50,000.

MOLECULAR SCIENCES

- Johns Hopkins University, Baltimore, Maryland. Walter S. Koski, Studies in Hot Atom and Radiation Chemistry. \$55,000.
- Johns Hopkins University, Baltimore, Maryland. Michael J. Flynn, Studies in the Organization of Computer Systems. \$31,000.
- Kansas State University, Manhattan, Kansas. Herbert C. Moser, Properties of Excited Species in the Frozen State. \$9,630.
- Kansas State University, Manhattan, Kansas. James C. Legg, Atomic and Nuclear Research with Accelerators. \$300,000.
- Kent State University, Kent, Ohio. Richard S. Varga, Use of Variational and Projectional Methods in Numerical Analysis. \$36,659.
- Lincoln University, Lincoln University, Pennsylvania. Saligrama C. SubbaRao, Tunneling in Proton Transfer Reactions. \$16,075.
- Maryland, University of, College Park, Maryland. Joseph Silverman, Radiation-Induced Effects in Polymers and Related Compounds. \$45,000.
- Maryland, University of, College Park, Maryland. Bertie E. Hubbard and Ivo Babuska, Studies of the Numerical Solution of Elliptic and Parabolic Boundary Value Problems. \$61,795.
- Maryland, University of, College Park, Maryland. Everett R. Johnson, Radiation Induced Decomposition of Inorganic Salts. \$20,869.
- 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. \$39,000.
- Michigan State University, East Lansing, Michigan. Max T. Rogers, Electron Spin Resonance Studies of Radiation Effects. \$31,563.
- Minnesota, University of, Minneapolis, Minnesota. Sanford Lipsky, The Contribution of Electronically Excited States to the Radiation Chemistry of Organic Systems. \$63,097.
- Minnesota, University of, Minneapolis, Minnesota. Robert W. Carr, Jr., Studies in Chemical Reactivity. \$32,000.
- Mississippi, University of, University, Mississippi. Theodore J. Kligen, Investigation of Gamma-Ray Induced Polymer Formation in the Carboranes. \$23,000.
- Nebraska, University of, Lincoln, Nebraska. Edward P. Rack, Halogen Atom Reactions Activated by Radiative Neutron Capture and Isomeric Transition. \$26,000.
- Nevada, University of, Reno, Nevada. Richard D. Burkhart, A Measurement of Diffusion Coefficients of Short-Lived Species in Solution by Photochemical Space Intermittency. \$17,000.
- The New England Institute, Inc., Ridgefield, Connecticut. S. J. Tao, Positronium Chemistry. \$21,000.
- New York, City University of/Brooklyn College, Brooklyn, New York. Harmon L. Finston, Applications of Nuclear and Radiochemical Techniques in Chemical Analysis. \$27,000.
- New York, City University of/Brooklyn College, Brooklyn, New York. Takano Ishida, Studies of Carbon Isotope Fractionation. \$54,050.
- New York, State University of, Stony Brook, New York. Oliver A. Schaeffer, High Energy Nuclear Interactions with Matter and Nuclear Processes in Nature. \$51,000.
- New York, State University of, Stony Brook, New York. Martin A. Leibowitz and Daniel Dicker, Research in Applied Mathematics. \$69,976 (4 years).

MOLECULAR SCIENCES

- New York University, New York, New York. Paul R. Garabedian, Courant Institute of Mathematical Sciences. \$1,166,000.
- Northwestern University, Evanston, Illinois. Erwin H. Bareiss, Computational Complexity in Multidimensional Neutron Transport Theory Calculations. \$45,000.
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