ERDA-63-75
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Physical Research Program:

Research Contracts And Statistical Summary

Energy Research And Development Administration

Division Of
Physical Research

July 1, 1975

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FOREWORD

The physical research program consists of fundamental theoretical and experimental investigations designed to support the objectives of ERDA. 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 energy. The ultimate goal is to develop a scientific underlay for the overall ERDA effort and the fundamental principles of natural phenomena so that these phenomena may be understood and new principles formulated.

The Director of the Division of Physical Research reports to the Assistant Administrator for Solar, Geothermal and Advanced Energy Systems. The physical research program is organized into four functional subprograms: (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.

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INTRODUCTION AND SUMMARY STATISTICS

Approximately four-fifths of the total physical research program costs are associated with research conducted in ERDA-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 ERDA investment in facilities ranges from zero for some contractors to tens of millions of dollars for others, and the annual level of ERDA 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., solar energy, 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 ERDA-owned capital facilities.

4. They have large annual levels (several millions of dollars) of ERDA support.

The objective of the basic research program is to search for and discover new knowledge within the mission-oriented framework of ERDA. 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 ERDA's programs.

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

1. When the amount provided by ERDA is added to other funds available to the contractor, the effectiveness of the contractor's program, as well as the basic research effort of ERDA is increased.

2. ERDA receives the services, in basic research activities fundamental to ERDA'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 ERDA'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 the 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 1975. 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 1975 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 1975, 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

ERDA Budget Category	Amount	Scientific Man-Years	Graduate Students	Publications
High Energy Physics	$ 125,856	1,288	190	589
Nuclear Sciences	59,762	706	144	668
Materials Sciences	35,069	520	279	778
Molecular Sciences	28,220	486	345	970
TOTAL	$ 248,907	3,000	958	3,005

OFF-SITE CONTRACT RESEARCH

	Number of Agreements	ERDA Support FY 1975	Scientific Man-Years	Graduate Students	Publications
High Energy Physics	46	$ 22,904	419	346	847
Nuclear Sciences	80	16,394	321	337	691
Materials Sciences	92	6,584	97	268	397
Molecular Sciences	114	9,747	182	250	458
TOTAL	332	55,629	1,019	1,201	2,393

All off-site contracts were with educational and a few other non-profit research institutions. 278 were of the Special Research Support Agreement type ($18.1 million), while 54 were cost-reimbursement contracts ($37.5 million). According to the proposals upon which the 332 contracts are based, principal investigators planned to spend the $59.9 million available to them (a higher figure than the ERDA contribution since most off-site contractors tend to share in the total cost of a project) approximately as follows ($ in thousands):

Salaries and Wages	$ 27,885	47%
Equipment	3,934	6%
Materials and Supplies	9,925	17%
Other Direct Costs	3,131	5%
Indirect Costs	15,010	25%
TOTAL	$ 59,885	100%
Supported by ERDA (FY 1975)	$ 55,629	93%

FEDERALLY FUNDED RESEARCH AND DEVELOPMENT CENTERS

For purposes of this report, the following may be considered FFRDC's operated for ERDA (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.

Name of Laboratory, Contractor and Principal Staff*	Level of Physical Research Program Support - FY 1975 (in thousands)	
	Operations	Equipment
AMES LABORATORY, Iowa State University of Science and Technology, Ames, Iowa	$ 7,260	$ 467
Director ..... Robert Hansen		
Deputy Director ..... Velmer A. Fassel		
ARGONNE NATIONAL LABORATORY, University of Chicago and Argonne Universities Association, Argonne (Lemont), Illinois	37,119	1,405
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		
Biomedical & Environmental Research ..... Warren K. Sinclair		
Engineering Research and Development ..... Jack A. Kyger		
Energy & Environment ..... E. Gale Pewitt		
Services ..... Paul E. Neal		
Educational Affairs ..... Shelby A. Miller		
BROOKHAVEN NATIONAL LABORATORY, Associated Universities, Inc., Upton, Long Island, New York	41,137	1,172
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	35,775	13,801
Director ..... Robert R. Wilson		
Deputy Director ..... Edwin L. Goldwasser		
Associate Directors:		
Planning & Programming ..... James R. Sanford		
Administration ..... John McCook		
Technical Services ..... Henry Hinterberger		

*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.

Name of Laboratory, Contractor and Principal Staff	Level of Physical Research Program Support - FY 1975 (in thousands) Operations	Equipment
HOLIFIELD NATIONAL LABORATORY, Union Carbide Corp., Oak Ridge, Tennessee	$ 29,625	$ 1,310
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		
IDAHO NATIONAL ENGINEERING LABORATORY, Aerojet Nuclear Company, Idaho Falls, Idaho	201	11
President & General Manager .. C. K. Leeper		
LAWRENCE BERKELEY LABORATORY, University of California, Berkeley, California	28,506	1,221
Director ..... Andrew M. Sessler		
Deputy Director ..... Earl K. Hyde		
Associate Directors:		
Accelerator Division ..... Edward J. Lofgren		
Biology & Medicine Division. James L. Born		
Chemical Biodynamics Div. .. Melvin Calvin		
Energy & Environment Division ..... Jack M. Hollander		
Inorganic Materials Div. ... Victor Zackay		
Nuclear Chemistry Division . Glenn T. Seaborg		
Physics Division ..... Robert W. Birge		
Administration ..... George L. Pappas		
Engineering & Technical Services ..... Walter D. Hartsough		
Employee and Information Services Division ..... Ray K. Wakerling		
LAWRENCE LIVERMORE LABORATORY, University of California, Livermore, California	285	0
Director ..... Roger E. Batzel		
Deputy Director ..... Duane C. Sewell		
LOS ALAMOS SCIENTIFIC LABORATORY, University of California, Los Alamos, New Mexico	17,126	1,943
Director ..... Harold M. Agnew		
Deputy Director ..... Raemer E. Schreiber		
Associate Director for Research ..... Richard F. Taschek		
MOUND LABORATORY, Monsanto Research Corp., Miamisburg, Ohio	750	9
Director, Vice President, Monsanto Research Corp. .... Richard K. Flitcraft		
Director, Nuclear Operations . William T. Cave		

Name of Laboratory, Contractor and Principal Staff	Level of Physical Research Program Support - FY 1975 (in thousands) Operations	Equipment
OAK RIDGE ASSOCIATED UNIVERSITIES, Oak Ridge, Tennessee	$ 604	39
Executive Director ..... Philip L. Johnson Head, University Programs Office ..... Granvil C. Kyker Director, UNISOR Project ..... E. H. Spejewski Chairman, Special Training Division ..... Roger Cloutier		
PACIFIC NORTHWEST LABORATORY, Battelle Memorial Institute, Richland, Washington	1,439	156
Director ..... Edward L. Alpen*		
SANDIA LABORATORIES, Western Electric-Bell, Albuquerque, New Mexico and Livermore, California	377	1
President ..... Morgan Sparks Vice President, Research, Albuquerque ..... A. Narath Vice President, Livermore .... T. B. Cook, Jr.		
SAVANNAH RIVER PLANT, E. I. duPont; University of Georgia; Aiken, South Carolina	111	0
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	25,014	2,042
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.		

*Resigned in September 1975; J. W. Finnigan designated Acting Director.

Costs and Manpower
As of July 1, 1975

Laboratory	Total Costs (In thousands)	Number and Man-Years Scientific Employees Permanent	Visiting	Graduate Students	Number of Publications
Ames Laboratory	$ 7,727	116 - 72	0 - 0	151	240
Argonne National Laboratory	38,524	586 - 532	217 - 87	132	543
Brookhaven National Laboratory	42,309	417 - 368	190 - 62	64	372
Fermi National Accelerator Laboratory	49,576	260 - 249.5	488 - 244	0	84
Holifield National Laboratory	30,935	430 - 413	61 - 31	74	473
Idaho National Engineering Laboratory	213	5 - 4	0 - 0	0	2
Lawrence Berkeley Laboratory	29,727	405 - 371	296 - 68	314	545
Lawrence Livermore Laboratory	285	8 - 2	0 - 0	0	8
Los Alamos Scientific Laboratory	19,069	181 - 154.8	243 - 10.8	50	129
Mound Laboratory	759	16 - 11.5	0 - 0	0	7
Oak Ridge Associated Universities	643	8 - 4.5	216 - 13.6	74	330
Pacific Northwest Laboratory	1,595	38 - 18.3	6 - 2.6	0	16
Sandia Laboratories	378	10 - 6	7 - .5	0	14
Savannah River Laboratories	111	0 - 0	29 - 6.1	60	78
Stanford Linear Accelerator Center	27,056	285 - 259	107 - 9	39	164
TOTAL	$ 248,907	2,765 - 2,465.6	1,860 - 534.6	958	3,005

ARGONNE NATIONAL LABORATORY

Category	Total Costs (In thousands)	Number and Man-Years Scientific Employees Permanent	Visiting	Graduate Students	Number of Publications
High Energy Physics	$ 14,076	157 - 152	19 - 11	80	88
Nuclear Sciences	6,381	90 - 84	41 - 16	15	124
Materials Sciences	10,363	185 - 169	84 - 39	14	245
Molecular Sciences	7,704	154 - 127	73 - 21	23	86
TOTAL	$ 38,524	586 - 532	217 - 87	132	543*

* Includes 170 publications that resulted from collaborative efforts with other universities.

BROOKHAVEN NATIONAL LABORATORY

Category	Total Costs (In thousands)	Number and Man-Years Scientific Employees Permanent	Visiting	Graduate Students	Number of Publications
High Energy Physics	$ 25,288	184 - 173	70 - 24	29	126
Nuclear Sciences	6,188	76 - 65	42 - 6	7	87
Materials Sciences	5,027	58 - 46	39 - 12	17	91
Molecular Sciences	5,806	99 - 84	39 - 20	11	68
TOTAL	$ 42,309	417 - 368	190 - 62	64	372*

* Includes 103 publications that resulted from collaborative efforts with other universities.

HOLIFIELD NATIONAL LABORATORY

Category	Total Costs (In thousands)	Number and Man-Years Scientific Employees Permanent	Visiting	Graduate Students	Number of Publications
High Energy Physics	$ 350	6 - 5	1 - .5	0	12
Nuclear Sciences	15,375	204 - 199	36 - 15	7	196
Materials Sciences	9,921	136 - 128.5	20 - 13.5	3	147
Molecular Sciences	5,289	84 - 80.5	4 - 2	64	118
TOTAL	$ 30,935	430 - 413	61 - 31	74	473*

* Includes 138 publications that resulted from collaborative efforts with other universities.

LAWRENCE BERKELEY LABORATORY

Category	Total Costs (In thousands)	Number and Man-Years Scientific Employees Permanent	Visiting	Graduate Students	Number of Publications
High Energy Physics	$ 9,039	138 - 127	140 - 28	35	100
Nuclear Sciences	13,567	163 - 151	79 - 22	54	143
Materials Sciences	3,756	48 - 43	39 - 8	165	152
Molecular Sciences	3,365	56 - 50	38 - 10	60	150
TOTAL	$ 29,727	405 - 371	296 - 68	314	545*

* Includes 45 publications that resulted from collaborative efforts with other universities.

LAWRENCE LIVERMORE LABORATORY

Category	Total Costs (In thousands)	Number and Man-Years Scientific Employees Permanent	Visiting	Graduate Students	Number of Publications
Molecular Sciences	$ 285	8 - 2	0 - 0	0	8

LOS ALAMOS SCIENTIFIC LABORATORY

Category	Total Costs (In thousands)	Number and Man-Years Scientific Employees Permanent	Visiting	Graduate Students	Number of Publications
Nuclear Sciences	$ 17,194	139 - 124.9	129 - 8.3	47	99
Materials Sciences	514	10 - 8	3 - 0	1	8
Molecular Sciences	1,361	32 - 21.9	111 - 2.5	2	22
TOTAL	$ 19,069	181 - 154.8	243 - 10.8	50	129*

* Includes 45 publications that resulted from collaborative efforts with other universities.

PACIFIC NORTHWEST LABORATORY

Category	Total Costs (In thousands)	Number and Man-Years Scientific Employees Permanent	Visiting	Graduate Students	Number of Publications
Nuclear Sciences	$ 137	2 - 2	0 - 0	0	1
Materials Sciences	758	10 - 7.9	3 - 2.6	0	11
Molecular Sciences	700	26 - 8.4	3 - 0	0	4
TOTAL	$ 1,595	38 - 18.3	6 - 2.6	0	16*

* Includes 3 publications that resulted from collaborative efforts with other universities.

OTHER FFRDC LABORATORIES

Category	Total Costs (In thousands)	Number and Man-Years Scientific Employees Permanent	Visiting	Graduate Students	Number of Publications
AMES LABORATORY					
High Energy Physics .....$	471	13 - 6	0 - 0	7	15
Nuclear Sciences	669	9 - 6	0 - 0	11	9
Materials Sciences	4,617	64 - 41	0 - 0	79	123
Molecular Sciences	1,970	30 - 19	0 - 0	54	93
FERMI NATIONAL ACCELERATOR LABORATORY					
High Energy Physics	49,576	260 - 249.5	488 - 244	0	84
IDAHO NATIONAL ENGINEERING LABORATORY					
Nuclear Sciences	111	3 - 2	0 - 0	0	2
Molecular Sciences	102	2 - 2	0 - 0	0	0
MOUND LABORATORY					
Materials Sciences	113	2 - 1.5	0 - 0	0	1
Molecular Sciences	646	14 - 10	0 - 0	0	6
OAK RIDGE ASSOCIATED UNIVERSITIES					
Nuclear Sciences	140	3 - 3	6 - 2	3	7
Molecular Sciences	503	5 - 1.5	210 - 11.6	71	323*
SANDIA LABORATORIES					
Molecular Sciences	378	10 - 6	7 - .5	0	14
SAVANNAH RIVER LABORATORIES					
Molecular Sciences	111	0 - 0	29 - 6.1	60	78*
STANFORD LINEAR ACCELERATOR CENTER					
High Energy Physics	27,056	285 - 259	107 - 9	39	164

* Publications resulting from education-oriented university-laboratory faculty and student research participation.

OFF-SITE CONTRACT-RESEARCH PROGRAM

In conducting this program, ERDA typically uses a special research support agreement. Under this type of agreement, the ERDA 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, ERDA'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 ERDA 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 ERDA 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 ERDA.

Occasionally, no-fund contracts are used in the contract-research program when ERDA loans property to an outside organization as ERDA'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 that 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 ERDA 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 prerequisite for ERDA support, which, in the final analysis, is determined by the prospective quality of the proposed research, the relative interest of ERDA and the institution in the research, and availability of funds on the part of both ERDA and the contractor. Thus, ERDA 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 7½ 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 ERDA Headquarters.

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 ERDA Headquarters, Washington, D. C. 20545, or from an ERDA 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. ERDA supports open publication and wide dissemination as the normal and most desirable means for reporting the findings of fundamental research.

During Fiscal Year 1975, the Division of Physical Research received 365 formal unsolicited proposals for new research, representing requests for a total of $23.7 million. On hand at the beginning of FY 1975 pending reviews were 182 new proposals requesting $10.0 million, for a total of 547 proposals representing requests for $33.7 million ($ in millions):

	On Hand 7/1/74	Received in FY 1975	Total
High Energy Physics	18 - $ 1.1	34 - $ 2.0	52 - $ 3.1
Nuclear Sciences	55 - 3.4	45 - 6.3	100 - 9.7
Materials Sciences	36 - 1.5	125 - 6.5	161 - 8.0
Molecular Sciences	73 - 4.0	161 - 8.9	234 - 12.9
TOTAL	182 - $10.0	365 - $23.7	547 - $33.7

	Approved in FY 1975	Declined, Etc. in FY 1975	On Hand 6/30/75
High Energy Physics	1 - $ .1	22 - $ 1.1	29 - $ 1.9
Nuclear Sciences	12 - .5	45 - 3.9	43 - 5.3
Materials Sciences	14 - .7	116 - 5.4	31 - 1.9
Molecular Sciences	24 - 1.1	123 - 7.0	87 - 4.8
TOTAL	51 - $ 2.4	306 - $17.4	190 - $13.9

The severity of the competition for available funds for new research projects can be seen if new award amounts are compared with the requests received during the past 10 years ($ in millions):

Fiscal Year	On Hand at Beginning of Year	Received During Year	Approved During Year	Declined, etc. During Year	On Hand at End of Year
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
1975	182	365 - 23.7	51 - 2.4	306 - 17.4	190

Under ERDA'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 the early 1970's however, numbers of new projects started were sharply lower and terminations higher, resulting in a significant reduction in numbers of active contracts. Only 1975 shows a reversal of this trend. 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 1966-1975 ($ in millions):

Fiscal Year	New Contracts		Contract Terminations		No. of Contracts at End of Year	
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
1975	51	2.4	27	1.0	332	55.6

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, 1975, and supported by the ERDA Headquarters Division of Physical Research are listed on pp. 20-37 by ERDA 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 ERDA 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

Type	Division Total	High Energy Physics	Nuclear Sciences	Materials Sciences	Molecular Sciences
Cost Contracts	54	28	16	2	8
SRSA	278	18	64	90	106
TOTAL	332	46	80	92	114

ERDA OPERATIONS OFFICES ADMINISTERING THE BUSINESS ASPECTS OF THE AGREEMENTS

Operations Offices	Division Total	High Energy Physics	Nuclear Sciences	Materials Sciences	Molecular Sciences
Albuquerque	2	0	2	0	0
Chicago	191	26	43	63	59
Idaho	2	0	0	0	2
Nevada	1	0	0	0	1
Oak Ridge	66	6	25	13	22
Richland	17	2	6	3	6
San Francisco	51	12	4	13	22
Savannah River	2	0	0	0	2
TOTAL	332	46	80	92	114

CONSOLIDATED MANPOWER STATISTICS OF THE 332 OFF-SITE PROJECTS

(see definitions, p.2)

	Principal Investigators		Other Permanent Scientific Staff		Research Associates		Research Assistants	Number of Publications
	No.	MY's	No.	MY's	No.	MY's		
High Energy Physics	153	52	314	182	266	185	346	847
Nuclear Sciences	160	57	187	105	198	159	337	691
Materials Sciences	121	34	23	5	67	58	268	397
Molecular Sciences	136	38	114	39	153	105	250	458
TOTAL	570	181	638	331	684	507	1,201	2,393

CONSOLIDATED BUDGET OF THE 332 OFF-SITE PROJECTS
INCLUDED IN THE PHYSICAL RESEARCH PROGRAM
(Dollars in Thousands)

Items of Expense

SRSA Projects (278)	Total	%	High Energy Physics	%	Nuclear Sciences	%	Materials Sciences	%	Molecular Sciences	%
Salaries and Wages	$ 10,249	51.0	$ 1,487	50.7	$ 2,781	49.5	$ 2,735	52.1	$ 3,246	51.5
Equipment	1,310	6.5	174	5.9	423	7.5	286	5.5	427	6.8
Materials and Supplies ...	2,596	12.9	471	16.0	724	12.9	668	12.7	733	11.6
Travel	621	3.1	156	5.3	254	4.5	81	1.5	130	2.1
Communications	83	.4	13	.5	9	.2	11	.2	50	.8
Publication Costs	265	1.3	37	1.3	66	1.2	66	1.3	96	1.5
Indirect Expenses	4,978	24.8	597	20.3	1,358	24.2	1,403	26.7	1,620	25.7
TOTAL	$ 20,102	100.0	$ 2,935	100.0	$ 5,615	100.0	$ 5,250	100.0	$ 6,302	100.0
Supported by ERDA (FY 1975)	$ 18,111	90.1	$ 2,439	83.1	$ 4,734	84.3	$ 4,976	94.8	$ 5,962	94.6
Cost-Type Projects (54)										
Salaries and Wages	$ 17,636	44.3	$ 9,520	44.1	$ 5,502	43.2	$ 721	44.8	$ 1,893	49.1
Equipment	2,624	6.6	1,412	6.5	997	7.8	111	6.9	104	2.7
Materials and Supplies ...	7,329	18.4	3,510	16.3	2,604	20.5	376	23.4	839	21.8
Travel	1,720	4.3	1,346	6.2	264	2.1	12	.8	98	2.5
Communications	220	.6	151	.7	46	.4	12	.8	11	.3
Publication Costs	222	.6	118	.5	76	.6	11	.6	17	.4
Indirect Expenses	10,032	25.2	5,543	25.7	3,230	25.4	365	22.7	894	23.2
TOTAL	$ 39,783	100.0	$ 21,600	100.0	$ 12,719	100.0	$ 1,608	100.0	$ 3,856	100.0
Supported by ERDA (FY 1975)	$ 37,518	94.3	$ 20,465	94.7	$ 11,660	91.7	$ 1,608	100.0	$ 3,785	98.2

SUMMARY OF OFF-SITE CONTRACTS

State and Contractor	Number of Contracts	FY 1975 Funding* (in 1000's)
Alabama	1	54
Alabama, University of, University	1	54
Alaska	3	205
Alaska, University of, Fairbanks	3	205
Arizona	2	149
Arizona State University, Tempe	2	149
Arkansas	1	39
Arkansas, University of, Fayetteville	1	39
California	48	7,704
Aerospace Corporation, Los Angeles	1	140
Atomics International, Canoga Park	1	206
California Institute of Technology, Pasadena	6	1,966
California, University of, Berkeley	3	254
California, University of, Davis	2	180
California, University of, Irvine	5	769
California, University of, Los Angeles	11	1,542
California, University of, Riverside	3	389
California, University of, San Diego	3	832
California, University of, Santa Barbara	2	338
California, University of, Santa Cruz	1	225
Physics International Company, San Leandro	1	53
Southern California, University of, Los Angeles	3	135
Stanford University, Stanford	6	675
Colorado	6	858
Colorado School of Mines, Golden	1	42
Colorado, University of, Boulder	4	786
Denver, University of/Colorado Seminary, Denver	1	30
Connecticut	7	2,805
Connecticut, University of, Storrs	2	80
Yale University, New Haven	5	2,725
Delaware	1	76
Delaware, University of, Newark	1	76
District of Columbia	5	127
Georgetown University	1	39
George Washington University	1	30
Howard University	3	58
Florida	9	576
Florida State University, Tallahassee	4	402
Florida, University of, Gainesville	5	174
Georgia	2	114
Georgia Institute of Technology, Atlanta	1	59
Georgia, University of, Athens	1	55
Hawaii	3	484
Hawaii, University of, Honolulu	3	484

*Dollar figures are based on obligations made specifically from FY 1975 funds, for operations and equipment, for the 332 contracts in effect as of July 1, 1975.

State and Contractor	Number of Contracts	FY 1975 Funding (in 1000's)
Idaho	1	8
Idaho State University, Pocatello	1	8
Illinois	15	3,816
Chicago, University of, Chicago	4	363
Illinois Institute of Technology, Chicago	1	0
Illinois, University of, Urbana	5	2,904
Northwestern University, Evanston	5	549
Indiana	8	2,304
Indiana University, Bloomington	1	346
Notre Dame, University of, Notre Dame	1	1,013
Purdue University, Lafayette	6	945
Iowa	1	80
Iowa, University of, Iowa City	1	80
Kansas	4	379
Kansas State University, Manhattan	3	304
Kansas, University of, Lawrence	1	75
Louisiana	4	123
Louisiana State University, Baton Rouge	3	104
Southern University, Baton Rouge	1	19
Maryland	12	1,793
Johns Hopkins University, Baltimore	4	288
Maryland, University of, College Park	8	1,505
Massachusetts	19	9,934
Boston University, Boston	1	73
Brandeis University, Waltham	3	255
Harvard University, Cambridge	3	1,374
Massachusetts Institute of Technology, Cambridge	8	7,598
Massachusetts, University of, Amherst	2	258
Tufts University, Medford	1	312
Worcester Polytechnic Institute, Worcester	1	64
Michigan	12	1,753
Michigan State University, East Lansing	5	320
Michigan Technological University, Houghton	1	50
Michigan, University of, Ann Arbor	3	1,237
Wayne State University, Detroit	3	146
Minnesota	8	1,435
Minnesota, University of, Minneapolis	8	1,435
Mississippi	1	26
Mississippi, University of, University	1	26
Missouri	4	313
Missouri, University of, St. Louis	1	53
Washington University, St. Louis	3	260
Montana	1	37
Montana, University of, Missoula	1	37
Nebraska	2	99
Nebraska, University of, Lincoln	2	99
Nevada	1	17
Nevada, University of, Reno	1	17

State and Contractor	Number of Contracts	FY 1975 Funding (in 1000's)
New Hampshire	2	$ 51
Dartmouth College, Hanover	2	51
New Jersey	6	1,462
Institute for Advanced Study, Princeton	1	15
Princeton University, Princeton	5	1,447
New Mexico	2	93
New Mexico State University, Las Cruces	1	8
New Mexico, University of, Albuquerque	1	85
New York	44	5,953
Clarkson College of Technology, Potsdam	1	22
Columbia University, New York	8	1,108
Cornell University, Ithaca	10	796
New York, City University of, Brooklyn College	2	99
New York, State University of, Albany	2	44
New York, State University of, Buffalo	1	34
New York, State University of, Stony Brook	5	437
New York University, New York	1	1,377
Rensselaer Polytechnic Institute, Troy	4	152
Rochester, University of, Rochester	7	1,326
Rockefeller University, New York	1	355
Syracuse University, Syracuse	2	203
North Carolina	6	1,060
Duke University, Durham	2	810
North Carolina State University, Raleigh	2	125
North Carolina, University of, Chapel Hill	2	125
Ohio	13	981
Case Western Reserve University, Cleveland	4	291
Cincinnati, University of, Cincinnati	1	45
Denison University, Granville	1	5
Kent State University, Kent	1	41
Ohio State University, Columbus	5	529
Ohio University, Athens	1	70
Oklahoma	2	22
Oklahoma State University, Stillwater	1	22
Oklahoma, University of, Norman	1	0
Oregon	6	227
Oregon State University, Corvallis	4	102
Oregon, University of, Eugene	2	125
Pennsylvania	21	3,548
Carnegie-Mellon University, Pittsburgh	7	1,586
Lehigh University, Bethlehem	1	41
Lincoln University, Lincoln University	1	0
Pennsylvania State University, University Park	4	152
Pennsylvania, University of, Philadelphia	4	1,498
Pittsburgh, University of, Pittsburgh	3	171
Temple University, Philadelphia	1	100
Rhode Island	4	562
Brown University, Providence	4	562
South Carolina	1	62
South Carolina, University of, Columbia	1	62
Tennessee	7	281
Tennessee State University, Nashville	1	22
Tennessee, University of, Knoxville	6	259

State and Contractor	Number of Contracts	FY 1975 Funding (in 1000's)
Texas	13	$ 1,377
Baylor University, Waco	1	18
Houston, University of, Houston	1	120
Rice University, Houston	2	530
Texas A & M University, College Station	6	265
Texas Southern University, Houston	1	23
Texas, University of, Austin	2	421
Utah	4	442
Associated Western Universities, Inc., Salt Lake City	1	320
Utah, University of, Salt Lake City	3	122
Vermont	1	24
Vermont, University of, Burlington	1	24
Virginia	4	421
Virginia Polytechnic Institute & State Univ., Blacksburg	2	94
Virginia, University of, Charlottesville	2	327
Washington	7	1,537
Washington, University of, Seattle	6	1,528
Western Washington State College, Bellingham	1	9
Wisconsin	7	2,196
Marquette University, Milwaukee	1	40
Wisconsin, University of, Madison	6	2,156
Wyoming	1	102
Wyoming, University of, Laramie	1	102

HIGH ENERGY PHYSICS

Brandeis University, Waltham, Massachusetts. Lawrence E. Kirsch and Howard J. Schnitzer, Research in Elementary Particle Physics. $165,000.

Brown University, Providence, Rhode Island. David Feldman, Anatole M. Shapiro, and Robert E. Lanou, Jr., Experimental and Theoretical High Energy Physics. $365,000.

California Institute of Technology, Pasadena, California. Robert L. Walker, Experimental, Theoretical and Phenomenological Research. $1,334,550.

California, University of, Davis, California. Richard L. Lander, High Energy Particle Physics Research. $130,000.

California, University of, Irvine, California. Frederick Reines, Studies of Neutrino and Cosmic Ray Interactions. $325,000.

California, University of, Irvine, California. Jonas Schultz and Paul E. Condon, Study of Elementary Particle Interactions. $143,000.

California, University of, Los Angeles, California. Harold K. Ticho and Donald H. Stork, Research in High Energy Physics. $420,000.

California, University of, Riverside, California. Robert T. Poe and Anne Kernan, High Energy Physics. $247,000.

California, University of, San Diego, California. Oreste Piccioni and Norman Kroll, Experimental and Theoretical Particle Physics. $507,440.

California, University of, Santa Barbara, California. David O. Caldwell, High Energy User Group. $310,000.

California, University of, Santa Cruz, California. Clemens A. Heusch, Experimental Elementary Particle Research. $225,000 (11 months).

Carnegie-Mellon University, Pittsburgh, Pennsylvania. Roger B. Sutton, High Energy Physics Users and Theoretical Research. $805,000.

Colorado, University of, Boulder, Colorado. Uriel Nauenberg and David F. Bartlett, High Energy Physics. $167,627.

Columbia University, New York, New York. T. D. Lee, Theoretical High Energy Physics. $310,000.

Duke University, Durham, North Carolina. William D. Walker, Study of the Interactions between Elementary Particles and Nuclei, and Development of Detection Methods. $190,000.

Florida State University, Tallahassee, Florida. Joseph E. Lannutti, Elementary Particle Physics. $210,000 (11 months).

Harvard University, Cambridge, Massachusetts. F. M. Pipkin and R. J. Glauber, High Energy Physics Research. $1,334,579.

Harvard University, Cambridge, Massachusetts. Tai Tsun Wu, High Energy Collision Processes. $39,000.

Hawaii, University of, Honolulu, Hawaii. Vincent Z. Peterson and San Fu Tuan, Research in High Energy Nuclear Physics. $420,000.

Illinois, University of, Urbana, Illinois. A. Wattenberg, High Energy Physics Users. $1,180,000.

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. $346,000.

Institute for Advanced Study, Princeton, New Jersey. Roger F. Dashen and Stephen L. Adler, Problems in Particle Theory. $15,000 (4 months).

HIGH ENERGY PHYSICS

Johns Hopkins University, Baltimore, Maryland. Gabor Domokos, Research in Theoretical Physics. $20,000 (5 months).

Maryland, University of, College Park, Maryland. George A. Snow, High Energy Accelerator and Colliding Beam User Group. $660,000.

Massachusetts Institute of Technology, Cambridge, Massachusetts. Martin Deutsch, High Energy Physics Research. $2,818,885.

Massachusetts, University of, Amherst, Massachusetts. Janice B. Shafer, High Energy Physics. $158,000.

Michigan, University of, Ann Arbor, Michigan. Daniel Sinclair, High Energy Physics Users and Theoretical Research. $836,351.

Minnesota, University of, Minneapolis, Minnesota. Stephen Gasiorowicz and Hans W. J. Courant, Theoretical and High Energy Physics Research. $335,000.

Northwestern University, Evanston, Illinois. Jerome L. Rosen and Donald H. Miller, High Energy Experimental Physics. $325,000.

Ohio State University, Columbus, Ohio. Thomas A. Romanowski, K. Tanaka and W. W. Wada, High Energy Physics. $335,000.

Oregon, University of, Eugene, Oregon. Michael J. Moravcsik, Theory of Elementary Particles. $104,000.

Pennsylvania, University of, Philadelphia, Pennsylvania. Alfred K. Mann, High Energy Physics Research. $1,364,939.

Physics International Company, San Leandro, California. Sidney D. Putnam, Linear Collective Ion Acceleration. $52,985.

Princeton University, Princeton, New Jersey. Frank Shoemaker, High Energy Physics Research. $1,162,682.

Purdue University, Lafayette, Indiana. Frank J. Loeffler, Masao Sugawara and Earle C. Fowler, Fundamental Particle Physics. $675,000.

Rochester, University of, Rochester, New York. A. C. Melissinos and S. Okubo, High Energy Physics Users and Theoretical Research. $845,000.

Rockefeller University, New York, New York. Rodney L. Cool and N. N. Khuri, Research in Experimental and Theoretical High Energy Physics. $355,000.

Stanford University, Stanford, California. David M. Ritson, High Energy Reactions. $314,000 (11 months).

Syracuse University, Syracuse, New York. K. C. Wali, Research Program in Elementary Particle Theory. $135,000.

Tennessee, University of, Knoxville, Tennessee. William M. Bugg, Elementary Particle Interactions. $95,000.

Texas, University of, Austin, Texas. E. C. G. Sudarshan and Yuval Ne'eman, Research in Elementary Particle Theory. $145,000.

Tufts University, Medford, Massachusetts. Allan M. Cormack, Experimental High Energy Physics Research. $312,000.

Washington, University of, Seattle, Washington. Jere J. Lord, High Energy Physics Studies of Particle Interactions in Heavy Elements. $43,000.

HIGH ENERGY PHYSICS

Wayne State University, Detroit, Michigan. Suraj N. Gupta, Quantum Theory of Fields. $29,000.

Wisconsin, University of, Madison, Wisconsin. Marvin E. Ebel, High Energy Physics Users and Theoretical Research. $1,418,430.

Yale University, New Haven, Connecticut. F. Gursey, V. W. Hughes and J. Sandweiss, High Energy Physics Users and Theoretical Research. $1,212,800.

NUCLEAR SCIENCES

Arkansas, University of, Fayetteville, Arkansas. Paul K. Kuroda, Nuclear Chemistry. $39,000.

Brown University, Providence, Rhode Island. Stavros Fallieros and Frank S. Levin, Nuclear Excitations and Reaction Mechanisms. $64,415.

California Institute of Technology, Pasadena, California. Felix Boehm, Research in Nuclear Spectroscopy, X-Rays, and Medium Energy Physics. $296,500.

California, University of, Berkeley, California. Paul B. Price, Jr., Astrophysical and Superheavy Element Studies with Nuclear Tracks in Solids. $78,000.

California, University of, Los Angeles, California. George J. Igo, Intermediate Energy Nuclear Physics Users Group. $185,000.

California, University of, Los Angeles, California. Roy P. Haddock and B. M. K. Nefkens, Particle Physics. $280,000.

Carnegie-Mellon University, Pittsburgh, Pennsylvania. Albert A. Caretto, Jr., High Energy Nuclear Reactions. $42,000.

Carnegie-Mellon University, Pittsburgh, Pennsylvania. Peter D. Barnes, Experimental Nuclear Physics. $235,000.

Carnegie-Mellon University, Pittsburgh, Pennsylvania. Morton Kaplan, Research in Nuclear Chemistry. $47,700.

Case Western Reserve University, Cleveland, Ohio. Harvey B. Willard, Medium Energy Nuclear Physics Research. $146,000.

Chicago, University of, Chicago, Illinois. Nathan Sugarman and Anthony Turkevich, Nuclear Chemistry Research. $195,000.

Colorado, University of, Boulder, Colorado. Ernest S. Rost and C. D. Zafiratos, Study of Fundamental Nuclear Interactions. $568,000.

Columbia University, New York, New York. L. James Rainwater, Research in Neutron Velocity Spectroscopy. $215,000.

Columbia University, New York, New York. W. W. Havens, Jr., Research Program in Neutron Spectroscopy. $145,000.

Columbia University, New York, New York. Herbert Goldstein, Relations between Neutron Cross Sections and Neutron Transport Phenomena. $51,165.

Columbia University, New York, New York. J. M. Miller, Study of Heavy-Ion Induced Nuclear Reactions. $115,000.

Denison University, Granville, Ohio. Ron R. Winters, Determination of Neutron Capture Cross Sections and Resonance Parameters. $4,835 (8 months).

Duke University, Durham, North Carolina. Henry W. Newson, E. G. Bilpuch, N. R. Roberson and R. L. Walter, Studies of Nuclear Structure using Neutrons and Charged Particles. $620,000.

Florida State University, Tallahassee, Florida. Gregory R. Choppin, Research in Nuclear Chemistry. $45,000.

Florida State University, Tallahassee, Florida. Raymond K. Sheline, An Experimental Study of Nuclear Models. $105,000.

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. $59,000.

Houston, University of, Houston, Texas. John C. Allred, B. W. Mayes, II and Ed V. Hungerford, III, Pion Interactions at Medium Energies. $120,000.

Illinois, University of, Chicago, Illinois. Lester Winsberg, Recoil Study of Reactions Induced in Light Elements by High Energy Protons (3 to 300 GeV). $15,000.

Johns Hopkins University, Baltimore, Maryland. Leon Madansky and Y. K. Lee, Nuclear Moments and Nuclear Structure. $168,202.

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.

Louisiana State University, Baton Rouge, Louisiana. Edward Zganjar, Rotation Aligned Coupling and Axial Asymmetry in the Neutron Deficient Lanthanum Nuclei. $12,546.

Maryland, University of, College Park, Maryland. Harry D. Holmgren, Victor E. Viola, Jr. and Manoj Banerjee, Experimental and Theoretical Nuclear Science Research. $649,000.

Massachusetts Institute of Technology, Cambridge, Massachusetts. Fred J. Eppling, Nuclear Physics Research. $4,160,845.

Massachusetts, University of, Amherst, Massachusetts. Gerald A. Peterson, Fabrication of 180° Electron Scattering Facility for the Bates Linac. $100,000 (2 years).

Michigan State University, East Lansing, Michigan. William C. McHarris, Frederick M. Bernthal and Ray A. Warner, Nuclear Chemistry Research. $120,000.

Michigan, University of, Ann Arbor, Michigan. Glenn F. Knoll, Absolute Fission Cross Section Measurements. $88,005.

Michigan, University of, Ann Arbor, Michigan. W. C. Parkinson and R. S. Tickle, 83-Inch Cyclotron Research Program. $313,000 (18 months).

Minnesota, University of, Minneapolis, Minnesota. J. Morris Blair, George W. Greenlees and Norton M. Hintz, Experimental Nuclear Physics. $725,000.

Montana, University of, Missoula, Montana. Mark J. Jakobson, Total Pion Cross Section Measurements. $37,000.

New Mexico State University, Las Cruces, New Mexico. George R. Burleson, Experimental Measurement of Large-Angle Pion-Nucleus Scattering. $8,000 (5½ months).

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. $85,000.

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. $19,000.

New York, State University of, Buffalo, New York. Gregory Breit, The Theories of Nucleon-Nucleon Interactions, Nuclear Reactions and Atomic Hyperfine Structure. $33,601 (18 months).

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. $222,034.

New York, State University of, Stony Brook, New York. John M. Alexander, Nuclear Reaction Studies. $60,000.

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. $85,000.

Northwestern University, Evanston, Illinois. Kamal K. Seth, An Experimental Program in Medium Energy Physics. $35,000 (9 months).

Ohio University, Athens, Ohio. Raymond O. Lane, Neutron Studies of Light Nuclei. $70,000.

Oregon State University, Corvallis, Oregon. Walter D. Loveland, Studies of Low Energy Induced Nuclear Fission. $23,733.

Oregon State University, Corvallis, Oregon. T. Darrah Thomas, Research in Nuclear Chemistry. $65,121.

Pittsburgh, University of, Pittsburgh, Pennsylvania. Robert L. Wolke, Nuclear Chemistry Research. $38,000.

Princeton University, Princeton, New Jersey. Robert A. Naumann, Nuclear Chemistry Project. $90,500.

Purdue University, Lafayette, Indiana. Norbert T. Porile, Deexcitation Processes in Nuclear Reactions. $70,000.

Purdue University, Lafayette, Indiana. Patrick J. Daly, Radiochemical Investigations of Nuclear Properties. $55,000.

Rensselaer Polytechnic Institute, Troy, New York. Robert C. Block and Robert W. Hockenbury, High-Intensity Neutron Spectroscopy. $50,000.

Rensselaer Polytechnic Institute, Troy, New York. Daniel Sperber, Neutron and Gamma Emission from Highly Excited States and States with High Spin. $26,600.

Rice University, Houston, Texas. Gerald C. Phillips, Low- and Intermediate-Energy Nuclear Physics Studies. $355,000.

Rochester, University of, Rochester, New York. J. Bruce French and Daniel S. Koltun, Nuclear Structure Theory. $124,820.

Rochester, University of, Rochester, New York. H. Marshall Blann, Nuclear Reaction Mechanisms. $75,000.

Rochester, University of, Rochester, New York. John R. Huizenga, Studies of Nuclear Fission, Low-Energy Nuclear Reactions and Transuranic Nuclei. $124,730.

Southern University, Baton Rouge, Louisiana. Kuang-Hsiang Liu, Theoretical Nuclear Physics. $19,092.

Temple University, Philadelphia, Pennsylvania. W. Kenneth McFarlane, Experimental Investigation of Pion Decays at the Los Alamos Meson Physics Facility. $100,000.

Tennessee, University of, Knoxville, Tennessee. Joseph R. Peterson, Physical-Chemical Studies of the Transuranium Elements. $40,000.

Tennessee, University of, Knoxville, Tennessee. Carrol R. Bingham and Leo L. Riedinger, Nuclear Spectroscopic Studies. $14,902.

Texas A&M University, College Station, Texas. Ronald D. Macfarlane, Mass Spectrometry of Short-Lived Nuclear Species. $38,000 (6½ months).

Texas A&M University, College Station, Texas. Joseph B. Natowitz, Angular Momentum Effects in Nuclear Reactions. $38,000 (7 months).

Texas A&M University, College Station, Texas. Thomas T. Sugihara, Nuclear Spectroscopy. $33,000 (8 months).

NUCLEAR SCIENCES

Texas A&M University, College Station, Texas. Rand L. Watson, Ionization Phenomena. $30,000 (8 months).

Texas A&M University, College Station, Texas. L. C. Northcliffe, Study of the Neutron Spectrum from Proton Bombardment in the 300-700 MeV Energy Region. $100,000.

Texas, University of, Austin, Texas. T. A. Griffy, Taro Tamura and Peter J. Riley, Research in Nuclear Physics. $276,017.

Virginia Polytechnic Institute and State University, Blacksburg, Virginia. Richard A. Arndt and L. David Roper, Partial Wave Analyses of K-N, π-N and N-N Scattering. $46,000.

Virginia, University of, Charlottesville, Virginia. Ralph C. Minehart, Stanley E. Sobottka and Klaus O. H. Ziock, Experiments on the Nuclear Interactions of Pions. $240,000.

Washington University, St. Louis, Missouri. Demetrios G. Sarantites, Low Energy Nuclear Reactions and Spectroscopy. $43,400.

Washington University, St. Louis, Missouri. Franklin B. Shull, Edward S. Macias and Arthur C. Wahl, Cyclotron Nuclear Research. $171,459.

Washington, University of, Seattle, Washington. Fred H. Schmidt, Isaac Halpern and David Boulware, Experimental and Theoretical Nuclear Physics. $1,078,000.

Washington, University of, Seattle, Washington. Gene L. Woodruff, Delayed Neutron Spectra from Fast Fission. $57,825.

Western Washington State College, Bellingham, Washington. Edward F. Neuzil, Fission Studies on Elements Below Polonium. $9,170 (18½ months).

Wisconsin, University of, Madison, Wisconsin. H. T. Richards and L. W. Anderson, Research in Nuclear Physics and Atomic Collisions. $493,093.

Wisconsin, University of, Madison, Wisconsin. Henry H. Barschall and Robert R. Borchers, Charged Particle Production Induced by 14 MeV Neutrons. $95,791 (17 months).

Wyoming, University of, Laramie, Wyoming. Glen A. Rebka, Jr. and Raymond Kunselman, Pion-Nucleon Interactions and Mesonic Atoms. $102,000.

Yale University, New Haven, Connecticut. D. Allan Bromley, MP Tandem Van de Graaff Research Program. $977,049.

Yale University, New Haven, Connecticut. Vernon W. Hughes and Howard L. Schultz, Studies in Nuclear Physics. $451,600.

MATERIALS SCIENCES

Arizona State University, Tempe, Arizona. LeRoy Eyring, Solid State Chemistry of Rare Earth Oxides. $95,000.

Arizona State University, Tempe, Arizona. James T. Stanley, Study of Ferrite Formation in Neutron Irradiated Austenitic Stainless Steels. $53,578.

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. $178,025.

California, University of, Los Angeles, California. Alan J. Ardell, High Temperature Irradiation Damage and Precipitation Hardening in Ni-Base Alloys. $69,000.

California, University of, Los Angeles, California. Didier de Fontaine, Fourier Space Computer Simulation of Crystalline Imperfections. $35,000.

California, University of, Riverside, California. A. W. Lawson and Glen E. Everett, Electric and Magnetic Properties of Transition Metals and Their Compounds. $64,982.

California, University of, Riverside, California. Eugen Simanek, Theoretical Aspects of Superconductor Behavior. $77,000 (2 years).

California, University of, San Diego, California. John C. Wheatley, Research on the Properties of Materials at Very Low Temperatures. $209,987.

California, University of, San Diego, California. Harry Suhl and M. Brian Maple, The Response of Superconductors to Variations in Impurity Content and Applied Pressure. $115,000.

Carnegie-Mellon University, Pittsburgh, Pennsylvania. Robert F. Sekerka, Generalization of Internal Centrifugal Zone Growth of Metal-Ceramic Composites. $33,000.

Case Western Reserve University, Cleveland, Ohio. Ronald Gibala, Dislocation-Solute Atom Interactions in Alloys. $45,500.

Case Western Reserve University, Cleveland, Ohio. Terence E. Mitchell, Experiments in High Voltage Electron Microscopy. $60,463.

Case Western Reserve University, Cleveland, Ohio. Alexander R. Troiano, Elastic and Plastic Strains and the Stress Corrosion Cracking of Austenitic Stainless Steels. $39,500.

Chicago, University of, Chicago, Illinois. Stuart A. Solin, The Study of Phonons and Electronic Processes in Amorphous and Crystalline Solids. $45,000.

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. $21,708.

Colorado School of Mines, Golden, Colorado. David L. Olson and Walter L. Bradley, Liquid Lithium Corrosion Research. $42,000.

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. $50,575.

Columbia University, New York, New York. Charles F. Bonilla, High Temperature Transport Properties and Processes of Gases and Alkali Metals. $32,000.

Connecticut, University of, Storrs, Connecticut. James M. Galligan, Electron-Dislocation Interactions at Low Temperatures. $40,000.

Connecticut, University of, Storrs, Connecticut. John E. Morral, Cluster Carburizing. $39,607.

MATERIALS SCIENCES

Cornell University, Ithaca, New York. Che-Yu Li, Grain Boundary Sliding and Structure. $60,000.

Cornell University, Ithaca, New York. Lutgard C. DeJonghe, Reduction of Mixed Spinel Oxides. $40,650.

Cornell University, Ithaca, New York. Robert W. Balluffi, Structure and Properties of Grain Boundaries. $75,000.

Cornell University, Ithaca, New York. Richard H. Lance, Mechanical Behavior of Materials and Structural Elements at Elevated Temperatures. $70,000 (15 months).

Cornell University, Ithaca, New York. R. H. Silsbee and Raymond Bowers, Solid State Physics: Magnetic Phenomena. $115,800 (20 months).

Cornell University, Ithaca, New York. R. O. Pohl and A. J. Sievers, Experimental Phonon Physics. $138,009.

Cornell University, Ithaca, New York. Arthur L. Ruoff, Elastic and Plastic Deformation of Solids. $120,000.

Cornell University, Ithaca, New York. David N. Seidman, Defects in Metal Crystals. $160,163.

Cornell University, Ithaca, New York. James A. Krumhansl, Theory of Structure and Dynamics in Condensed Matter. $73,498.

Cornell University, Ithaca, New York. H. H. Johnson, Environment and Fracture. $59,000.

Dartmouth College, Hanover, New Hampshire. P. Bruce Pipes, Experimental Determination of the Temperature Dependence of Metallic Work Functions at Low Temperatures. $27,781.

Dartmouth College, Hanover, New Hampshire. Walter E. Lawrence, Theory of Electron Phonon Scattering Effects in Metals. $22,723.

Florida, University of, Gainesville, Florida. Robert E. Reed-Hill, Deformation Processes in Refractory Metals. $36,860.

Florida, University of, Gainesville, Florida. John J. Hren and Craig S. Hartley, Quantitative Analysis of Solute Segregation in Alloys by Transmission Electron Microscopy. $37,000.

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. $28,131.

Hawaii, University of, Honolulu, Hawaii. Murli H. Manghnani, Pressure Derivatives of Elastic Moduli in B.C.C. Transition Metals and Their Solid Solutions. $35,950.

Howard University, Washington, D. C. Arthur N. Thorpe, Radiation Damage in Optically Transparent Materials (Zircons). $17,196.

Illinois Institute of Technology, Chicago, Illinois. Harold Weinstock, Thermal and Electrical Measurements on Solids at Low Temperatures. $105,000 (15 months).

Illinois, University of, Urbana, Illinois. Robert J. Maurer, The Science of Materials. $1,429,649.

Kansas, University of, Lawrence, Kansas. Paul W. Gilles, High Temperature Chemistry. $75,000.

Lehigh University, Bethlehem, Pennsylvania. Michael R. Notis, Pressure Sintering and Creep Deformation - A Joint Modeling Approach. $40,500.

Marquette University, Milwaukee, Wisconsin. Robert N. Blumenthal, Defect Structures in Non-stoichiometric Oxides. $39,853.

MATERIALS SCIENCES

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. $19,397.

Massachusetts Institute of Technology, Cambridge, Massachusetts. W. D. Kingery and R. L. Coble, Basic Research in Crystalline and Noncrystalline Ceramic Systems. $335,000.

Massachusetts Institute of Technology, Cambridge, Massachusetts. James L. Gole, The Luminescence Process and New and Novel Electronic States - Scanning Chemical Reactions and Novel Products for Laser Induced Isotope Separation. $51,131.

Massachusetts Institute of Technology, Cambridge, Massachusetts. C. G. Shull, Low Temperature and Neutron Physics Studies. $111,274.

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. $79,900.

Michigan State University, East Lansing, Michigan. Harry A. Eick, An Investigation of Some Lanthanide Carbon, Nitrogen, Chalcogen, and Halogen Systems at Elevated Temperatures. $28,600.

Michigan State University, East Lansing, Michigan. Gerald L. Pollack, Properties of Rare-Gas Solids. $99,607 (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. $50,000.

Minnesota, University of, Minneapolis, Minnesota. William Zimmermann, Jr., Walter V. Weyhmann and Allen M. Goldman, Experimental Investigations in Solid-State and Low Temperature Physics. $168,460.

Minnesota, University of, Minneapolis, Minnesota. Thomas E. Hutchinson, "In Situ" Electron Microscope Investigation of the Nucleation and Growth of Sputtered Thin Films. $41,030.

Minnesota, University of, Minneapolis, Minnesota. William W. Gerberich, Analysis of the Ductile-Brittle Transition Temperature in Fe-Binary Alloys. $39,000.

New York, State University of, Stony Brook, New York. Patrick J. Herley and Carolyn M. Preece, Preparation, Characterization and use of Metal Hydrides for Fuel Systems. $55,000 (15 months).

New York, State University of, Stony Brook, New York. John C. Bilello, Applications of Micro-dynamics and Lattice Mechanics to Problems in Plastic Flow and Fracture. $50,000.

North Carolina State University, Raleigh, North Carolina. Lloyd R. Zumwalt, Sorption of Cesium by Graphites at High Temperatures. $44,811.

North Carolina, University of, Chapel Hill, North Carolina. James H. Crawford, Jr., Investigation of Defect Structures by Electric Polarization and Relaxation Methods. $39,500.

Northwestern University, Evanston, Illinois. M. Meshii, Effect of Point Defects on Mechanical Properties of Metals. $49,000.

Northwestern University, Evanston, Illinois. Donald H. Whitmore, Basic Research on Ceramic Materials for Energy Storage and Conversion Systems. $65,000.

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.

Ohio State University, Columbus, Ohio. Robert A. Rapp, Fundamental Studies of Metal Fluorination Reactions. $48,000.

MATERIALS SCIENCES

Oklahoma State University, Stillwater, Oklahoma. Geoffrey P. Summers, Electronic Structure of Defects in Oxides. $21,625.

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. $6,388 (6 months).

Pennsylvania State University, University Park, Pennsylvania. Peter A. Thrower, Studies of Mechanical Properties and Irradiation Damage Nucleation of HTGR Graphites. $39,200.

Pennsylvania State University, University Park, Pennsylvania. William B. White, Structure of Glasses Containing Transition Metal Ions. $40,000.

Pennsylvania State University, University Park, Pennsylvania. Richard C. Bradt and John H. Hoke, Ceramic Research. $32,642.

Pennsylvania, University of, Philadelphia, Pennsylvania. David P. Pope, Dislocation Mobilities in Ordered Alloys. $43,000.

Pittsburgh, University of, Pittsburgh, Pennsylvania. W. E. Wallace and V. U. S. Rao, Thermal, Structural and Magnetic Studies of Metals and Intermetallic Compounds. $98,000.

Purdue University, Lafayette, Indiana. Richard E. Grace, Transport and Thermodynamic Properties of Solids. $37,000.

Purdue University, Lafayette, Indiana. Alvin A. Solomon, High Temperature Effects of Internal Gas Pressures in Ceramics. $48,000.

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. $44,400.

Rensselaer Polytechnic Institute, Troy, New York. Norman S. Stoloff, Fatigue Behavior of BCC Metals. $31,300.

Rochester, University of, Rochester, New York. James C. M. Li, Diffusional Creep of Multicomponent Systems. $33,000.

Rochester, University of, Rochester, New York. Stephen J. Burns, The Materials and Mechanics of Rate Effects in Brittle Fracture. $33,000.

Southern California, University of, Los Angeles, California. Terence G. Langdon, Grain Boundary Sliding During High-Temperature Creep. $52,000.

Southern California, University of, Los Angeles, California. Ferdinand A. Kroger, Electrical and Mechanical Properties of Oxide Ceramics. $50,000.

Stanford University, Stanford, California. Craig R. Barrett and William D. Nix, Structure Dependence of High Temperature Deformation of Metals. $54,999.

Stanford University, Stanford, California. David A. Stevenson, Diffusion of Oxygen in Liquid Metal Systems. $28,000.

Tennessee, University of, Knoxville, Tennessee. E. E. Stansbury and C. R. Brooks, Application of Adiabatic Calorimetry to Metal Systems. $29,000.

Tennessee, University of, Knoxville, Tennessee. Joseph E. Spruiell, Microstructure-Property Relationships in Austenitic Stainless Steels. $28,000.

Utah, University of, Salt Lake City, Utah. Ronald S. Gordon, Impurity Effects on the Creep of Polycrystalline Magnesium and Aluminum Oxides at Elevated Temperatures. $33,000.

MATERIALS SCIENCES

Utah, University of, Salt Lake City, Utah. J. Gerald Byrne, Positron Lifetime Measurements as a Non-destructive Technique to Monitor Fatigue Damage. $50,000.

Vermont, University of, Burlington, Vermont. John S. Brown, Thermodynamic and Transport Properties of Interstitial Hydrogen Isotopes in Metal Systems. $23,626.

Virginia, University of, Charlottesville, Virginia. Robert V. Coleman, Electronic Properties of Metals, Alloys and Molecules. $87,000.

Washington, University of, Seattle, Washington. Robert L. Ingalls, Mössbauer Studies at High Pressure. $63,000 (18 months).

Washington, University of, Seattle, Washington. Douglas H. Polonis, A Study of Phase Transformations and Superconductivity. $36,143.

Wisconsin, University of, Madison, Wisconsin. Gerald L. Kulcinski, Void Nucleation and Growth in Heavy Ion and Electron Bombarded Pure Metals. $50,000.

MOLECULAR SCIENCES

The Aerospace Corporation, Los Angeles, California. Charles C. Badcock, The Important Parameters in Two-Photon Isotope Enrichment. $140,000 (2 years).

Alabama, University of, University, Alabama. Lowell D. Kispert, ELDOR Investigations of Radiation Processes. $54,217 (18 months).

Alaska, University of, Fairbanks, Alaska. Syun-Ichi Akasofu, Quiet-Time Magnetosphere and Magnetospheric Substorms Using Satellite Data. $41,000.

Alaska, University of, Fairbanks, Alaska. Hans Pulpan, Alaska Peninsula Telemetered Seismic Network: Phase III. $74,000.

Alaska, University of, Fairbanks, Alaska. Juergen Kienle, Search for Shallow Magma Accumulations at Augustine Volcano. $90,000.

Associated Western Universities, Inc., Salt Lake City, Utah. G. Victor Beard, Faculty and Student Research Participation. $320,000.

Atomics International, Canoga Park, California. H. L. Recht and S. I. Yosim, Molten Salt Interactions in Coal Processing. $205,628.

Baylor University, Waco, Texas. Malcolm Dole, Radiation Chemistry of High Polymers. $18,194.

Boston University, Boston, Massachusetts. Richard H. Clarke, Radiationless Energy Conversion of Photoexcited Triplet States of Organic Molecules. $72,731 (2 years).

Brandeis University, Waltham, Massachusetts. Henry Linschitz, Photochemical Reactions of Complex Molecules in Condensed Phase. $59,679.

Brandeis University, Waltham, Massachusetts. Saul G. Cohen, Effects of Mercaptans and Disulfides on Photochemical and High Energy Radiation Induced Reactions. $30,000.

Brown University, Providence, Rhode Island. E. F. Greene, A Study of Chemical Reactions by Means of Molecular Beam Techniques. $53,000.

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. $39,200.

California, University of, Berkeley, California. Carson D. Jeffries, Photo-Molecular Phenomena in Condensed Matter. $112,670 (13 months).

California, University of, Berkeley, California. John H. Reynolds, Isotopic Studies on Rare Gases in Terrestrial Samples and in Natural Nucleosynthesis. $63,000 (11 months).

California, University of, Davis, California. John W. Root, Nuclear Methods in High Energy and Radiation Chemistry. $50,000.

California, University of, Irvine, California. Frank S. Rowland, Research in Chemical Kinetics. $166,670.

California, University of, Irvine, California. Max Wolfsberg, Theoretical Studies on Isotopic Mass Effects in Chemistry. $100,000 (2 years).

California, University of, Irvine, California. Edward K. C. Lee, Kinetic and Spectroscopic Studies of Electronic Energy Transfer Processes. $34,000.

MOLECULAR SCIENCES

California, University of, Los Angeles, California. M. F. Nicol, Inter- and Intra-Molecular Energy Transfer Studies. $55,000.

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. $275,000.

California, University of, Los Angeles, California. Donald J. Cram, Multiheteromacrocycles that Complex Metal Ions. $63,066.

California, University of, Los Angeles, California. Orson L. Anderson, Nicholas Warren and Priscilla C. Perkins, Relationship of Rock Physics and Petrology to Geothermal Energy Technology. $45,000.

California, University of, Santa Barbara, California. Robert G. Rinker, Transport and Reaction in Supported Liquid. $28,000.

Carnegie-Mellon University, Pittsburgh, Pennsylvania. Robert H. Schuler, Radiation Chemistry. $400,000.

Carnegie-Mellon University, Pittsburgh, Pennsylvania. Joe V. Michael, Elementary Rate Constants for Hydrogen Atoms. $23,649.

Chicago, University of, Chicago, Illinois. Ugo Fano, Basic Studies of Atomic Dynamics. $69,851.

Chicago, University of, Chicago, Illinois. Michael D. Perlman, Methods in Probability and Statistical Inference. $53,000.

Colorado, University of, Boulder, Colorado. J. Norman Bardsley and David W. Norcross, Theoretical Research in Physics of Highly Ionized Heavy Atoms. $31,000.

Columbia University, New York, New York. Rhodes W. Fairbridge, Maps of North American Crustal Stability and Geothermal Potential. $75,000 (9 months).

Columbia University/Lamont-Doherty Geological Observatory, Palisades, New York. Lynn R. Sykes and Klaus H. Jacob, A Comprehensive Study of the Seismotectonics of the Eastern Aleutian Arc and Search for a Magma Chamber Under Pavlof Volcano. $174,903.

Delaware, University of, Newark, Delaware. James R. Katzer, Auger and Reaction Studies of Poisoning by Sulfur and Regeneration of Metal Synthesis Gas Catalyst. $76,000.

Denver, University of/Colorado Seminary, Denver, Colorado. Norman Bleistein, Analysis of the Inverse Problem in Acoustics and Electromagnetics and Analysis of the Scattering of Internal Gravity Waves. $29,500.

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.

Florida, University of, Gainesville, Florida. Thomas M. Reed, III, Experimental Studies of the Rates of Reactions Pertinent to the Generation of Hydrogen from Water by Multistep Thermochemical Closed Cycles. $30,000.

George Washington University, Washington, D. C. Nicolae Filipescu, Lanthanide Ions as Sensitive Probes in Intermolecular Energy Transfer and Organic Photochemistry. $30,000.

MOLECULAR SCIENCES

Georgia, University of, Athens, Georgia. L. B. Rogers, Fundamental Studies of Separation Processes. $55,000.

Harvard University, Cambridge, Massachusetts. Garrett Birkhoff, Mathematical Problems in Nuclear Reactor Theory. $15,000 (19 months).

Howard University, Washington, D. C. Peter Hambright, Kinetic, Magnetic and Mössbauer Studies on Porphyrin Systems. $21,000.

Howard University, Washington, D. C. Lue-Yung Chow Chiu, Theoretical Study of Radiative Interaction and Energy Transfer Processes of Molecular and Atomic Systems. $20,000.

Idaho State University, Pocatello, Idaho. Albert E. Wilson, Radiation Protection Training Program. $7,570.

Illinois, University of, Urbana, Illinois. George H. Miley and Joseph T. Verdeyen, Advanced Methods for Nuclear Reactor-Gas Laser Coupling. $80,000.

Illinois, University of, Urbana, Illinois. C. W. Gear, Mathematical Software Research. $199,550.

Iowa, University of, Iowa City, Iowa. William C. Stwalley, The Distribution of Energy in Bimolecular Chemiluminescent Reactions Involving Hydrogen Atoms. $80,000 (2 years).

Johns Hopkins University, Baltimore, Maryland. Dean W. Robinson, Far Infrared Chemical Lasers. $44,000.

Johns Hopkins University, Baltimore, Maryland. Walter S. Koski, Studies in Hot Atom and Radiation Chemistry. $56,000.

Kansas State University, Manhattan, Kansas. Herbert C. Moser, Properties of Excited Species in the Frozen State. $3,990.

Kansas State University, Manhattan, Kansas. James R. Macdonald and Patrick Richard, Atomic and Nuclear Research with Accelerators. $222,000.

Kansas State University, Manhattan, Kansas. James R. Macdonald and Patrick Richard, Fusion Related Atomic Physics. $78,000.

Kent State University, Kent, Ohio. Richard S. Varga, Use of Variational and Projectional Methods in Numerical Analysis. $40,500.

Lincoln University, Lincoln University, Pennsylvania. Saligrama C. SubbaRao, Tunneling in Proton Transfer Reactions. $16,075 (31 months).

Louisiana State University, Baton Rouge, Louisiana. Joseph Callaway and Ronald J. W. Henry, Electron Excitation Cross Sections for Multiply Charged Ions. $41,000.

Maryland, University of, College Park, Maryland. Joseph Silverman, Radiation-Induced Effects in Polymers and Related Compounds. $49,700.

Maryland, University of, College Park, Maryland. Ivo Babuska, Studies of the Numerical Solution of Elliptic and Parabolic Boundary Value Problems. $50,000.

Maryland, University of, College Park, Maryland. Everett R. Johnson, Radiation Induced Decomposition of Inorganic Salts. $20,869 (2 years).

Maryland, University of, College Park, Maryland. G. E. Gordon, W. H. Zoller and W. B. Walters, Nondestructive Determination of Trace Element Concentrations. $10,000.

Massachusetts Institute of Technology, Cambridge, Massachusetts. Elizabeth J. Campbell, Feasibility Study of a Collaboration between the Laboratory for Nuclear Science and the Information Processing Center at MIT. $6,400.

MOLECULAR SCIENCES

Massachusetts Institute of Technology, Cambridge, Massachusetts. Keiiti Aki, Seismological Investigation of Crack Formation in Hydraulic Rock Fracturing Experiments. $35,000.

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. $40,000.

Michigan State University, East Lansing, Michigan. Max T. Rogers, Electron Spin Resonance Studies of Radiation Effects. $32,000.

Minnesota, University of, Minneapolis, Minnesota. Sanford Lipsky, The Contribution of Electronically Excited States to the Radiation Chemistry of Organic Systems. $65,857.

Minnesota, University of, Minneapolis, Minnesota. Robert W. Carr, Jr., Studies in Chemical Reactivity. $35,393.

Minnesota, University of, Minneapolis, Minnesota. William R. Gentry, Reactions of Ions with Atomic and Molecular Free Radicals. $25,000.

Mississippi, University of, University, Mississippi. Theodore J. Klingen, Investigation of Gamma-Ray Induced Polymer Formation in the Carboranes. $26,000.

Missouri, University of, St. Louis, Missouri. Jacob J. Leventhal, Observation of Luminescent Spectra in Low Energy Ion-Neutral Collisions. $53,315.

Nebraska, University of, Lincoln, Nebraska. Edward P. Rack, Halogen Atom Reactions Activated by Nuclear Transformations. $29,000.

Nebraska, University of, Lincoln, Nebraska. Gerhard G. Meisels, Principal Processes in the Radiolysis of Gases with Fission Recoils and Gamma Rays. $70,000.

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.

New York, City University of/Brooklyn College, Brooklyn, New York. Harmon L. Finston, Applications of Nuclear and Radiochemical Techniques in Chemical Analysis. $40,000.

New York, City University of/Brooklyn College, Brooklyn, New York. Takanobu Ishida, Studies of Carbon Isotope Fractionation. $58,775.

New York, State University of, Stony Brook, New York. Oliver A. Schaeffer, High Energy Nuclear Interactions with Matter and Nuclear Processes in Nature. $50,000.

New York University, New York, New York. Paul R. Garabedian, ERDA Mathematics and Computing Laboratory. $1,376,689.

Northwestern University, Evanston, Illinois. Erwin H. Bareiss, Computational Complexity in Multidimensional Neutron Transport Theory Calculations. $75,000.

Notre Dame, University of, Notre Dame, Indiana. John L. Magee, Radiation Chemistry. $1,013,145.

Ohio State University, Columbus, Ohio. Richard F. Firestone, Kinetics of Ionizing-Radiation Induced Reactions. $45,000.

Ohio State University, Columbus, Ohio. Leon M. Dorfman, Pulse Radiolysis Studies of Fast Reactions in Molecular Systems. $51,142.

Oregon State University, Corvallis, Oregon. Carroll W. DeKock, Synthesis of New Rare Earth Metallocarboranes. $7,000.

Oregon, University of, Eugene, Oregon. Richard M. Noyes, Diffusion Controlled Reactions and Exchange Reactions in Solution. $20,574.

MOLECULAR SCIENCES

Pennsylvania State University, University Park, Pennsylvania. F. W. Lampe, The Radiation Chemistry of Volatile Silanes and Germanes. $40,000.

Pennsylvania, University of, Philadelphia, Pennsylvania. Daniel D. Perlmutter and Alan L. Myers, Thermochemical Process for Hydrogen Production by Water Decomposition. $60,000 (10 months).

Pennsylvania, University of, Philadelphia, Pennsylvania. David White, Rotational Ordering in the Solid Molecular Hydrogens. $30,000.

Pittsburgh, University of, Pittsburgh, Pennsylvania. David W. Pratt, Microwave-Optical Double Resonance Spectroscopy. $35,000.

Princeton University, Princeton, New Jersey. John W. Tukey and Geoffrey S. Watson, Research on Data Analysis in the Physical Sciences. $95,000.

Princeton University, Princeton, New Jersey. Herschel A. Rabitz, Inelastic Molecular Collisions - Application of Theoretical Methods to Problems Relevant to Laser Operations. $21,323.

Princeton University, Princeton, New Jersey. John Turkevich, Novel Energy Sources Based on Utilization of Catalysts in Atomic Energy. $77,000.

Purdue University, Lafayette, Indiana. George T. Tsao, A Fundamental Study of the Mechanism and Kinetics of Cellulose Hydrolysis by Acids and Enzymes. $60,000.

Rice University, Houston, Texas. G. K. Walters and Neal F. Lane, Energetics of Atomic and Molecular Interactions. $175,000.

Rochester, University of, Rochester, New York. Jacob Bigeleisen, Fundamental Studies in Isotope Chemistry. $90,000.

South Carolina, University of, Columbia, South Carolina. Milton W. Davis, Jr., The Use of Polyethers in the Treatment of Acidic High Activity Nuclear Wastes. $62,015 (2 years).

Southern California, University of, Los Angeles, California. Richard E. Bellman, Mathematical Problems in Medicine and Energy Processes. $32,500.

Stanford University, Stanford, California. George B. Dantzig, Robert B. Wilson, Richard W. Cottle and B. Curtis Eaves, Systems Optimization Research. $175,000.

Stanford University, Stanford, California. Gene H. Golub, Research in Numerical Analysis. $57,650.

Stanford University, Stanford, California. Michael J. Flynn, Studies of the Organization of Computer Systems. $44,960.

Syracuse University, Syracuse, New York. S. Alexander Stern, Separation of Krypton and Xenon from Reactor Atmospheres by Selective Permeation. $68,145 (2 years).

Tennessee State University, Nashville, Tennessee. Rubye P. Torrey, Gaseous Ion Chemistry: Analytical Applications. $21,800.

Tennessee, University of, Knoxville, Tennessee. T. Ffrancon Williams, Research Concerning Ionic and Free Radical Reactions in Radiation Chemistry. $52,000.

Texas A&M University, College Station, Texas. Yi-Noo Tang, Hot Atom Reactions Involving Multivalent and Univalent Species. $26,000.

Texas Southern University, Houston, Texas. Curtis W. McDonald, Solvent Extraction Studies using High-Molecular-Weight Amines. $23,170.

Utah, University of, Salt Lake City, Utah. Leonard D. Spicer, Dynamics and Mechanisms of Hot Chemistry Stimulated by Recoil Methods. $39,000.

Virginia Polytechnic Institute and State University, Blacksburg, Virginia. Hans J. Ache, Reactions of Charged and Neutral Recoil Particles. $48,275.

MOLECULAR SCIENCES

Washington University, St. Louis, Missouri. Peter P. Gaspar, Reaction Studies of Hot Silicon and Germanium Radicals. $45,000.

Washington, University of, Seattle, Washington. Bryan B. Valett, Faculty and Student Research Participation. $250,000 (13 months).

Wayne State University, Detroit, Michigan. Larry Kevan, Radiolysis Studies on Reactive Intermediates. $80,000.

Wayne State University, Detroit, Michigan. Edward C. Lim, Deuterium Isotope Effects in Electronic Relaxation of Large Polyatomic Molecules. $37,000.

Wisconsin, University of, Madison, Wisconsin. John E. Willard, Studies in Hot Atom and Radiation Chemistry. $71,882.

Wisconsin, University of, Madison, Wisconsin. Robert W. Conn, Inelastic Molecular Collisions - Application of Theoretical Methods to Problems Relevant to Laser Operations. $26,591.

Worcester Polytechnic Institute, Worcester, Massachusetts. Alfred A. Scala, The Gas Phase Radiolysis and Vacuum Ultraviolet Photolysis of Heterocyclic Organic Compounds. $64,000 (2 years).

Yale University, New Haven, Connecticut. James E. Bayfield and Vernon W. Hughes, Electron Transfer Experiments and Atomic Magnetism Values. $55,000.

Yale University, New Haven, Connecticut. R. James Cross, Jr., Research on High Energy Chemical Reactions. $28,500 (15 months).