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ABSTRACT

Presented is a summary of the Research and Development (R&D) expenditures of state public institutions for the fiscal year 1973. A comparison is presented in graph form of these expenditures for the fiscal years 1964, 1968, and 1973. A review, with comparison figures, is given related to distribution of R&D expenditures of state government agencies and state universities and colleges, by character of work (basic research, applied research, and development) and by field of science (life sciences, engineering, social sciences, physical sciences, and others). A table showing the distribution of R&D expenditures of state public institutions as compared with other state indicators (population, personal income, and total state government general expenditures) for fiscal year 1973 is presented. Other tables show comparison of R&D expenditures by state and performer, by state and source of funds, by state and character of work, and by state and field of science. (EB)

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# Reviews OF DATA ON SCIENCE RESOURCES

NATIONAL SCIENCE FOUNDATION, WASHINGTON, D.C. 20550 NSF 75-311 No. 23 May 1975

## R&D Expenditures of State Public Institutions, Fiscal Year 1973

### Introduction

The National Science Foundation (NSF) has the mission of conducting a continuing measurement of the national resources devoted to scientific activities. Data on funding and manpower are gathered by means of a series of surveys that cover the different performance sectors. The R&D activities of Federal agencies, industrial firms, and universities and colleges are covered on an annual basis, and those of nonprofit institutions are covered every few years. In the 1964-73 decade the R&D activities of State government agencies were also reported on three occasions.

The latest of these reports, *Research and Development in State Government Agencies, Fiscal Years 1972 and 1973* (NSF 75-303), provides data on State agency R&D funding and manpower. This report does not, however, combine such data with similar data on State universities and colleges, even though these institutions constitute another arm of the State government apparatus. Data on universities and colleges are collected and published in a separate NSF series covering all institutions of higher education. The latest report from this series is *Expenditures for Scientific Activities at Universities and Colleges, Fiscal Year 1973*, to be published at a later date.

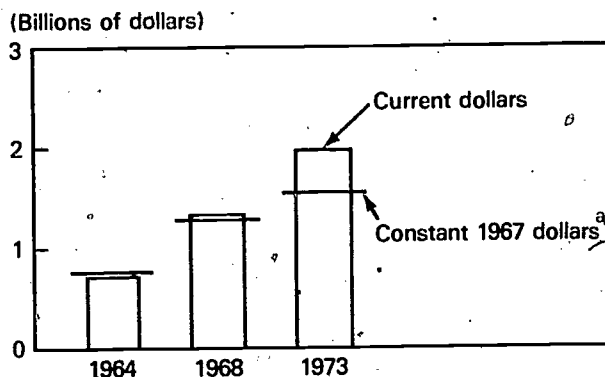
To close an analytic gap, the present study combines data for 1973 from both reports, showing State public R&D expenditures in the aggregate and by individual

States. A joint consideration of State agency and State university R&D efforts can be useful in assessing the factors that contribute to economic and social change within the States. These combined expenditures, representing funds that were disbursed by the budget offices of State agencies and universities, amounted to \$1,990 million in 1973 — or 6.5 percent of the national \$30,427 million R&D expenditure total.<sup>1</sup>

Between 1964, the first year comparable data were collected, and 1973, the average annual rate of growth was 11 percent (chart 1). When converted to constant dollars, the amounts reflect a 7-percent average annual increase, which contrasts with a constant dollar increase for overall national R&D expenditures of 1 percent per year.

<sup>1</sup>See National Science Foundation, *National Patterns of R&D Resources: Funds & Manpower in the United States, 1953-1974* (NSF 74-304) (Washington D.C. 20402: Supt. of Documents, U.S. Government Printing Office, 1974).

Chart 1. R&D expenditures of State public institutions, FY 1964, 1968, and 1973



<sup>a</sup>Based on GNP implicit price deflator. SOURCE: National Science Foundation

(Prepared in the Government Studies Group, Division of Science Resources Studies)

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The basic data are as follows:

|  | <i>R&amp;D expenditures<br/>(millions of dollars)</i> |                  |
|--|---|------------------|
|  | 1964  | 1973             |
| Total, State public institutions . . . . . | <u>\$710.5</u>  | <u>\$1,989.5</u> |
| State universities and colleges . . . . .  | 638.5   | 1,725.7          |
| State government agencies . . . . .        | 72.0  | 263.8            |

<sup>1</sup>Excludes sums directed to State universities and colleges by State government agencies for R&D performance.

The first category in the tabulation above shows R&D performance by State universities and colleges for all sponsors except State government agencies. The second category represents all the research and development sponsored by State government agencies in 1964 and 1973, respectively, whatever organizations may have performed the actual work.

### State Agency/State University Comparisons

The R&D operations of State government agencies and those of State universities are conducted under different conditions and with different points of view. An overlap between the two worlds occurs in the area of State university R&D performance under State agency sponsorship, but this area is not a large one. A trend is developing, however, toward increased cooperation between State and local governments and university departments, and one measure of this trend is the increasing dollar level of State agency R&D program performance by State universities, a figure which rose from \$8 million in 1964 to \$28 million in 1973.

The major difference in R&D emphases between State universities and State government agencies is that the former, aside from the teaching function, have the dual role of developing a knowledge base and contributing expertise to public service projects, while the latter are focused almost entirely on practical problems. The laboratories at the State agency level are mainly organized to find answers to needs that arise in program administration and for the most part are not geared to long-range or broadly based investigations.

Both State government agencies and State universities and colleges are primarily funded by the Federal Government, to the extent of 51 percent of the State agency R&D effort and 64 percent of the State university R&D effort in 1973. Beyond that point, however, State agencies are almost entirely funded by State appropriations for the remainder of their work, whereas State universities draw support from a number

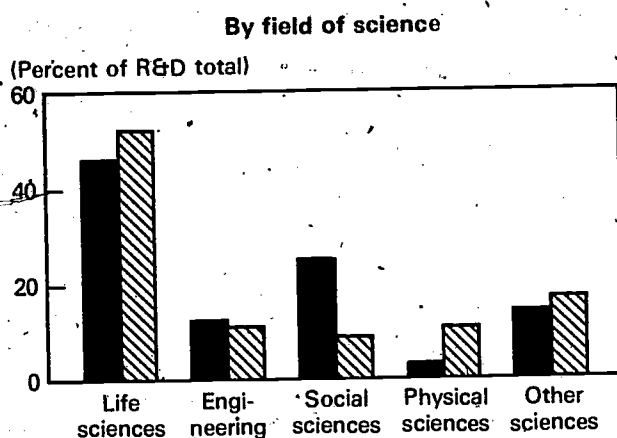
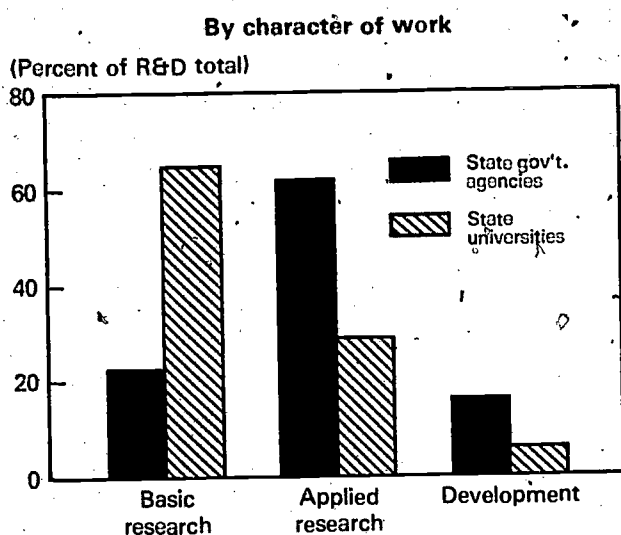
of sources. In 1973 the second most important R&D source for State universities was their own unrestricted funds that were derived from a variety of original sources, such as tuition, endowment, and general-purpose grants and appropriations. These funds were budgeted by the universities for R&D purposes and constituted an R&D source that is university-controlled. This source for the universities was closely followed in 1973 by funds from State government appropriations that were earmarked for R&D purposes: funds to agricultural experiment stations and funds from State agencies for R&D work. Most of the rest of the funding was provided by private industry and nonprofit organizations. Although small in the State university R&D total, these private sources played a more important part than in the case of State government agency R&D funding, where these sources were insignificant.

Sources of support affect the scope and nature of the work undertaken. The Federal funds to State government agencies are mostly transferred under categorical grants on a matching basis, requiring some degree of financial commitment on the part of the States and the meeting of specified program requirements. All of the work of State government agencies, whether financed by Federal or State sources, is restricted to the achievement of specific State goals, even though these goals may fit into a Federal framework. On the other hand, Federal monies flowing into State universities and colleges are transferred under a variety of agreements: contracts, matching grants, and outright grants.

Most of the R&D work of State universities and colleges is comparatively unrestricted. Since so much of their effort is commissioned by Federal agencies, it is primarily addressed to issues of a national nature. Many federally supported programs are dependent on the extension of fundamental scientific knowledge across a broad front. Much work supported by university-controlled funds is also of this nature. Only a small portion of the university R&D total is derived from State-appropriated funds earmarked for R&D purposes. Thus, the R&D support given to universities tends to underwrite basic research rather than applied research or development.

In 1973 State universities and colleges reported 65 percent of their R&D expenditures as basic research, whereas State government agencies reported only 22 percent of their R&D expenditures in that category (chart 2). By contrast, the university share for applied research was 29 percent and the State government agency share was 62 percent.

**Chart 2. Distribution of R&D expenditures of State government agencies and State universities and colleges, FY 1973**



SOURCE: National Science Foundation

Between the two groups fields of science distribution showed some similarities and some marked differences. In the case of both State universities and State government agencies the life sciences (biology and clinical medical sciences) made up approximately one-half of the total (chart 2). The engineering sciences also received similar shares (11 percent and 12 percent). The chief difference was found in the social sciences, which accounted for only 9 percent of State university and college expenditures but 25 percent of State government agency R&D expenditures. Also, the physical sciences accounted for 11 percent of the State university and college total against 3 percent of the State government agency total.

The dominance of the life sciences stems primarily from the extensive concern with health on the part of

both Federal and State governments. The chief Federal sponsor of State university R&D work is the Department of Health, Education, and Welfare (HEW), and this agency also is the chief Federal sponsor of work at the State agency level. State agencies additionally place a large portion of their own funds in health R&D programs. In contrasting field-of-science areas, the high share for the social sciences in State government agency support is influenced by agency investment in education R&D programs, and the low share in State university support is partly a reflection of the far greater emphasis placed on other fields by sponsors of university R&D projects. As to the physical sciences, a sizable portion of the State university R&D effort is directed to work on defense, space, and atomic energy programs, all of which are closely involved with the physical sciences; such is not the case with State agencies.

### The Public Sector

R&D expenditures of State public institutions are concentrated to a degree among a few leading States. In 1973 California led by a significant margin with 15 percent of the total, and the five leading States — California, Texas, Michigan, New York, and Wisconsin — accounted for 38 percent. The share of the next ranking States, however, were fairly evenly distributed (table 1). The 25th State, Hawaii, still accounted for 1½ percent.

As might be expected, considerable correlation can be found between the leadership of States in public R&D expenditures and their relative rankings in State population, total personal income, and total State government general expenditures. The leading 15 States in public R&D expenditures included 11 that were among the leading 15 States in population, 10 that were among the leading 15 in total personal income, and 12 that were among the leading 15 in State government general expenditures.

This correlation is not quite as close, however, as in the case of State government agency R&D expenditures.<sup>2</sup> State university and college R&D activity, which is heavily dependent on Federal support, is somewhat less tied to the population and wealth of individual States than is the R&D activity of State agencies, although more populous and wealthy States are likely to foster the growth of State universities able to offer greater capabilities for R&D performance.

<sup>2</sup>See National Science Foundation, *Research and Development in State Government Agencies, Fiscal Years 1972 and 1973* (NSF 75-303) (Washington, D.C. 20402: Supt. of Documents, U.S. Government Printing Office, 1975.)

TABLE 1. DISTRIBUTION OF R&D EXPENDITURES OF STATE PUBLIC INSTITUTIONS AS COMPARED WITH OTHER STATE INDICATORS: FISCAL YEAR 1973

| State                           | State public R&D expenditures |                  | Population         |                  | Total personal income |                  | Total State government general expenditures |                  |
|---------------------------------|-------------------------------|------------------|--------------------|------------------|-----------------------|------------------|---|------------------|
|                                 | Rank                          | Percent of total | Rank               | Percent of total | Rank                  | Percent of total | Rank  | Percent of total |
| Total, all States (in millions) | \$1,990                       |                  | 1 <sup>2</sup> 210 |                  | 2 \$1,032,045         |                  | \$108,086                                   |                  |
| California .....                | 1                             | 15.5             | 1                  | 9.82             | 1                     | 10.86            | 2   | 10.6             |
| Texas .....                     | 2                             | 6.0              | 4                  | 5.62             | 6                     | 4.96             | 6   | 4.0              |
| Michigan .....                  | 3                             | 5.9              | 7                  | 4.31             | 7                     | 4.77             | 5   | 4.8              |
| New York .....                  | 4                             | 5.6              | 2                  | 8.70             | 2                     | 10.02            | 1   | 12.2             |
| Wisconsin .....                 | 5                             | 4.7              | 16                 | 2.18             | 16                    | 2.05             | 11  | 2.5              |
| Washington .....                | 6                             | 4.0              | 22                 | 1.63             | 20                    | 1.66             | 16  | 2.1              |
| Illinois .....                  | 7                             | 3.2              | 5                  | 5.35             | 3                     | 6.26             | 4   | 5.2              |
| Colorado .....                  | 8                             | 3.1              | 28                 | 1.16             | 26                    | 1.19             | 28  | 1.1              |
| North Carolina .....            | 9                             | 2.9              | 12                 | 2.51             | 14                    | 2.11             | 14  | 2.2              |
| Minnesota .....                 | 10                            | 2.8              | 19                 | 1.86             | 18                    | 1.86             | 12  | 2.3              |
| Indiana .....                   | 11                            | 2.7              | 11                 | 2.53             | 11                    | 2.53             | 19  | 1.8              |
| Florida .....                   | 12                            | 2.6              | 8                  | 3.66             | 9                     | 3.46             | 9   | 3.1              |
| Pennsylvania .....              | 13                            | 2.6              | 3                  | 5.67             | 4                     | 5.64             | 3   | 5.8              |
| Georgia .....                   | 14                            | 2.2              | 14                 | 2.28             | 17                    | 1.97             | 15  | 2.1              |
| Ohio .....                      | 15                            | 2.2              | 6                  | 5.11             | 5                     | 5.21             | 7   | 3.8              |
| Virginia .....                  | 16                            | 2.1              | 13                 | 2.29             | 12                    | 2.20             | 17  | 2.1              |
| Oregon .....                    | 17                            | 1.9              | 31                 | 1.06             | 29                    | 1.01             | 29  | 1.0              |
| Missouri .....                  | 18                            | 1.8              | 15                 | 2.27             | 13                    | 2.15             | 20  | 1.6              |
| Utah .....                      | 19                            | 1.8              | 36                 | .55              | 37                    | .45              | 37  | .6               |
| Iowa .....                      | 20                            | 1.7              | 25                 | 1.38             | 23                    | 1.37             | 26  | 1.2              |
| Kansas .....                    | 21                            | 1.6              | 30                 | 1.09             | 27                    | 1.12             | 33  | .9               |
| Arizona .....                   | 22                            | 1.6              | 32                 | .98              | 31                    | .90              | 32  | 1.0              |
| New Jersey .....                | 23                            | 1.6              | 9                  | 3.51             | 8                     | 4.11             | 10  | 3.0              |
| Maryland .....                  | 24                            | 1.5              | 18                 | 1.94             | 15                    | 2.10             | 13  | 2.2              |
| Hawaii .....                    | 25                            | 1.5              | 40                 | .40              | 38                    | .43              | 34  | .8               |
| Alabama .....                   | 26                            | 1.3              | 21                 | 1.69             | 25                    | 1.28             | 23  | 1.5              |
| Louisiana .....                 | 27                            | 1.2              | 20                 | 1.79             | 22                    | 1.40             | 18  | 1.9              |
| Oklahoma .....                  | 28                            | 1.1              | 27                 | 1.27             | 28                    | 1.08             | 25  | 1.2              |
| Kentucky .....                  | 29                            | 1.0              | 23                 | 1.59             | 24                    | 1.28             | 21  | 1.6              |
| Alaska .....                    | 30                            | 1.0              | 50                 | .16              | 49                    | .18              | 38  | .6               |
| Mississippi .....               | 31                            | 1.0              | 29                 | 1.09             | 32                    | .76              | 30  | 1.0              |
| Connecticut .....               | 32                            | 1.0              | 24                 | 1.47             | 19                    | 1.76             | 22  | 1.5              |
| New Mexico .....                | 33                            | 1.0              | 37                 | .53              | 39                    | .40              | 36  | .6               |
| Nebraska .....                  | 34                            | 1.0              | 35                 | .73              | 34                    | .72              | 39  | .6               |
| Massachusetts .....             | 35                            | .8               | 10                 | 2.77             | 10                    | 2.95             | 8   | 3.2              |
| Tennessee .....                 | 36                            | .8               | 17                 | 1.97             | 21                    | 1.58             | 24  | 1.5              |
| South Carolina .....            | 37                            | .6               | 26                 | 1.30             | 30                    | 1.01             | 27  | 1.2              |
| Arkansas .....                  | 38                            | .6               | 33                 | .97              | 33                    | .73              | 35  | .7               |
| Idaho .....                     | 39                            | .5               | 42                 | .37              | 42                    | .32              | 43  | .4               |
| Montana .....                   | 40                            | .5               | 43                 | .34              | 44                    | .31              | 44  | .4               |
| West Virginia .....             | 41                            | .5               | 34                 | .85              | 35                    | .67              | 31  | 1.0              |
| Rhode Island .....              | 42                            | .5               | 39                 | .46              | 36                    | .45              | 41  | .5               |
| Vermont .....                   | 43                            | .4               | 48                 | .22              | 48                    | .18              | 46  | .3               |
| Maine .....                     | 44                            | .4               | 38                 | .49              | 40                    | .39              | 40  | .5               |
| South Dakota .....              | 45                            | .4               | 44                 | .33              | 47                    | .29              | 47  | .3               |
| Wyoming .....                   | 46                            | .4               | 49                 | 1.7              | 50                    | .16              | 50  | .2               |
| North Dakota .....              | 47                            | .4               | 45                 | .31              | 45                    | .30              | 45  | .3               |
| Nevada .....                    | 48                            | .4               | 47                 | .26              | 46                    | .30              | 49  | .3               |
| Delaware .....                  | 49                            | .3               | 46                 | .27              | 43                    | .31              | 42  | .4               |
| New Hampshire .....             | 50                            | .2               | 41                 | .38              | 41                    | .35              | 48  | .3               |

<sup>1</sup>Provisional estimate of resident population as of July 1, 1973 (209,851,000).

<sup>2</sup>Both population and personal income totals include data for the District of Columbia. Therefore the shares of total shown for the States within these two categories do not add up quite to 100 percent since the District of Columbia is omitted.

SOURCES: U.S. Department of Commerce, Bureau of the Census, *Current Population Reports*, Series P-25, No. 520, July 1974; U.S. Department of Commerce, Bureau of Economic Analysis, *Survey of Current Business*, Volume 54, No. 4, April 1974; U.S. Department of Commerce, Social and Economic Statistics Administration, Bureau of the Census, *State Government Finances in 1973*, Series GF73, No. 3, August 1974.

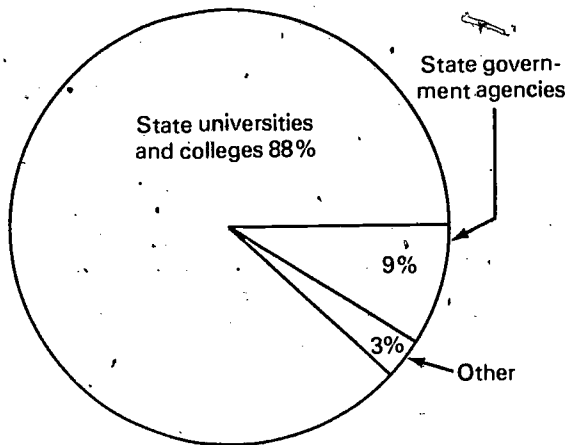
## Performers

When State public R&D expenditures are studied in terms of performers, the outstanding fact is the extent of the State university effort. In 1973, of the \$1,990 million total, the largest share by far — 88 percent — was assigned to State universities and colleges (chart 3). Only 9 percent was expended by State government agencies in direct performance of R&D work, and 3 percent was allotted to other performers (private firms, nonprofit organizations, local government agencies, including local universities and colleges, private

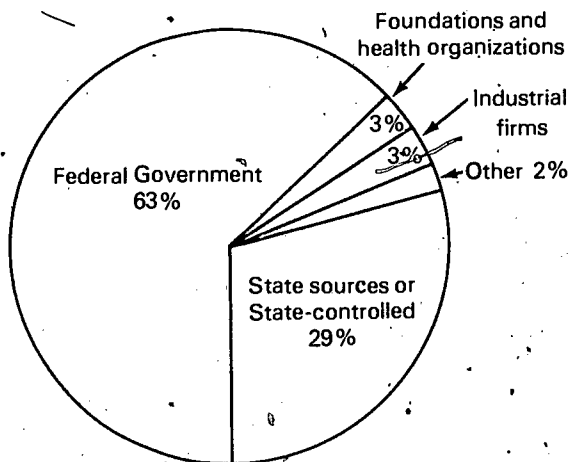
**Chart 3. Distribution of R&D expenditures of State public institutions, FY 1973**

**\$1,990 million**

**By performer**



**By source of funds**



SOURCE: National Science Foundation

universities and colleges, and local and multigovernmental agencies — all under grant or contract from State government agencies).

In every State except four, at least 80 percent of the State public R&D total was performed by State universities and colleges (table 2). In 1973, of the 900 or more State public institutions performing research and development in the United States, the 10 leading institutions were State universities, and these accounted for 27 percent of the State public R&D expenditure total.<sup>3</sup> The top performer was the University of Wisconsin—Madison with R&D expenditures amounting to \$84 million, followed by the University of Michigan (\$69 million), the University of California—San Diego (\$67 million), the University of California—Berkeley (\$57 million), the University of Minnesota (\$53 million), the University of Washington (\$53 million), the University of California—Los Angeles (\$52 million), the University of Illinois—Urbana (\$42 million), the University of Colorado (\$34 million), and Texas A&M University (\$34 million).

In 1973 New York was the only State in which State government agencies were responsible for most of the performance — they accomplished 51 percent of the total. In no other State was a high share of the R&D effort carried out by State government agencies. In only six other States — Maine, Alaska, Florida, Massachusetts, Kentucky and Illinois — did State government agencies perform as much as 15 percent of the public R&D expenditure total.

The chief State agency in New York was the Roswell Park Memorial Institute, which spent \$23 million, mainly for cancer research, making it the 25th largest State institutional R&D performer nationwide. All the higher ranking performers were State universities. As to nonuniversity performers, the next in rank were the New York Department of Health (\$7.4 million) and the New York Psychiatric Institute (\$7.1 million). Although these were important in the New York public R&D effort, they ranked 63rd and 65th among all State public institutions in 1973.

New York is in a unique category because the expenditures of New York State agencies for R&D purposes are unusually large. In 1973 they were almost twice those of California, the next State. This fact alone would tend to reduce the share of R&D perform-

<sup>3</sup>Data taken from National Science Foundation, *Expenditures for Scientific Activities at Universities and Colleges, Fiscal Year 1973*, to be published later.

ance on the part of State universities and colleges, which was 46 percent of the New York total in 1973. Another factor is the low level of State university R&D expenditures relative to other leading States (table 2). Although State university R&D expenditures were relatively low in New York, those of the private universities were relatively high, in fact, the highest of any State.<sup>4</sup>

### Sources of Funds

As previously mentioned, the Federal Government is the chief source of funds for both State government agencies and State universities and colleges (table 3). In 1973 Federal agencies provided 63 percent of the public agency support on an aggregate basis (chart 3). Most of this support was given to State universities and colleges, but approximately one-tenth was directed to State government agencies.

Within the Federal Government, the Department of Health, Education, and Welfare (HEW) accounted for approximately one-half of the Federal support total. The major funding source within HEW was the National Institutes of Health. The National Institute of Mental Health and the Office of Education also provided support. Other Federal funding sources were the National Science Foundation, the Department of Defense, the National Aeronautics and Space Administration, the Department of Agriculture (primarily through the Cooperative State Research Service), and the Atomic Energy Commission.

Funds controlled at the State level, which are divided into two categories, represented 29 percent of the total in 1973. The first category, which made up almost three-fifths of State-controlled funds, consisted of State government funds earmarked for R&D purposes that were appropriated to State universities, including affiliated agricultural experiment stations and medical schools, as well as funds appropriated to State agencies that were used for the performance of State agency R&D programs. The second category, which made up the remaining two-fifths, consisted of State universities' and colleges' own unrestricted funds that were budgeted by the institutions for R&D purposes.

<sup>4</sup> While 60 percent of all university and college R&D expenditures, public and private, was accounted for by State universities and colleges in 1973, the State universities and colleges in New York accounted for only 15 percent of the university and college total. At the same time New York was second only to California in the level of its combined public and private university and college R&D support. In 1973 four of the top 20 academic institutions in terms of R&D funding were located in New York State; all of them were private.

<sup>1</sup> Massachusetts was similar to New York in the low ratio of R&D performance on the part of its State universities and colleges to overall university and college R&D performance — 4 percent in the case of this State. In 1973 Massachusetts ranked third after California and New York in total R&D expenditures by universities and colleges.

TABLE 2. R&D EXPENDITURES OF STATE PUBLIC INSTITUTIONS, BY STATE AND PERFORMER: FISCAL YEAR 1973

[Dollars in thousands]

| State             | R&D total   | State universities and colleges | State government agencies | Other performers <sup>1</sup> |
|-------------------|-------------|---------------------------------|---------------------------|-------------------------------|
| Total, all States | \$1,969,511 | \$1,754,218                     | \$178,083                 | \$57,210                      |
| California        | 307,600     | 275,452                         | 24,023                    | 8,125                         |
| Texas             | 119,124     | 111,121                         | 4,575                     | 3,428                         |
| Michigan          | 118,324     | 111,946                         | 5,750                     | 628                           |
| New York          | 110,530     | 51,006                          | 55,925                    | 3,599                         |
| Wisconsin         | 92,645      | 89,102                          | 3,147                     | 396                           |
| Washington        | 78,848      | 69,321                          | 3,716                     | 5,811                         |
| Illinois          | 64,112      | 53,119                          | 9,334                     | 1,659                         |
| Colorado          | 61,346      | 56,204                          | 1,824                     | 3,318                         |
| North Carolina    | 57,597      | 53,762                          | 2,671                     | 1,164                         |
| Minnesota         | 56,469      | 53,701                          | 840                       | 1,928                         |
| Indiana           | 53,092      | 51,932                          | 1,014                     | 146                           |
| Florida           | 52,355      | 42,462                          | 9,388                     | 505                           |
| Pennsylvania      | 52,277      | 45,931                          | 5,161                     | 1,185                         |
| Georgia           | 44,742      | 42,268                          | 1,444                     | 1,030                         |
| Ohio              | 43,098      | 38,155                          | 2,007                     | 2,936                         |
| Virginia          | 40,808      | 34,331                          | 5,578                     | 899                           |
| Oregon            | 37,770      | 33,982                          | 1,439                     | 2,349                         |
| Missouri          | 36,119      | 34,461                          | 1,236                     | 422                           |
| Utah              | 34,889      | 33,306                          | 670                       | 913                           |
| Iowa              | 33,439      | 32,073                          | 980                       | 386                           |
| Kansas            | 32,715      | 31,277                          | 620                       | 818                           |
| Arizona           | 32,417      | 30,321                          | 904                       | 1,192                         |
| New Jersey        | 31,453      | 25,913                          | 2,502                     | 3,038                         |
| Maryland          | 30,594      | 27,717                          | 2,295                     | 582                           |
| Hawaii            | 29,110      | 26,859                          | 1,860                     | 391                           |
| Alabama           | 26,164      | 24,878                          | 407                       | 879                           |
| Louisiana         | 23,779      | 21,953                          | 1,506                     | 320                           |
| Oklahoma          | 21,588      | 19,633                          | 1,696                     | 259                           |
| Kentucky          | 20,713      | 17,124                          | 3,065                     | 524                           |
| Alaska            | 20,591      | 16,560                          | 3,931                     | 100                           |
| Mississippi       | 20,156      | 19,023                          | 582                       | 551                           |
| Connecticut       | 19,381      | 16,381                          | 2,698                     | 302                           |
| New Mexico        | 18,970      | 18,170                          | 740                       | 60                            |
| Nebraska          | 18,008      | 17,711                          | 285                       | 12                            |
| Massachusetts     | 15,412      | 10,570                          | 2,667                     | 2,175                         |
| Tennessee         | 15,163      | 12,356                          | 1,686                     | 1,121                         |
| South Carolina    | 12,889      | 10,975                          | 1,069                     | 845                           |
| Arkansas          | 11,032      | 10,185                          | 426                       | 421                           |
| Idaho             | 9,790       | 8,727                           | 1,018                     | 45                            |
| Montana           | 9,418       | 8,654                           | 726                       | 38                            |
| West Virginia     | 9,073       | 6,960                           | 1,080                     | 1,033                         |
| Rhode Island      | 9,058       | 8,855                           | 193                       | 10                            |
| Vermont           | 8,294       | 7,188                           | 755                       | 351                           |
| Maine             | 8,292       | 6,438                           | 1,661                     | 193                           |
| South Dakota      | 7,979       | 6,711                           | 636                       | 632                           |
| Wyoming           | 7,576       | 6,678                           | 777                       | 121                           |
| North Dakota      | 7,359       | 6,701                           | 423                       | 235                           |
| Nevada            | 7,343       | 6,449                           | 851                       | 43                            |
| Delaware          | 6,004       | 5,760                           | 165                       | 79                            |
| New Hampshire     | 4,006       | 3,856                           | 137                       | 13                            |

<sup>1</sup> Private firms and individuals, private nonprofit organizations, local government agencies, universities, and colleges, private universities and colleges, and local and multigovernmental agencies performing research and development under grant or contract from State government agencies.

<sup>2</sup> Includes \$28,485 thousand performed for State government agencies.

<sup>3</sup> Research and development performed directly by State agency personnel.

TABLE 3. R&D EXPENDITURES OF STATE PUBLIC INSTITUTIONS, BY STATE AND SOURCE OF FUNDS:

FISCAL YEAR 1973

[Dollars in thousands]

| State             | R&D total   | Federal sources | State sources or State controlled |                        |                               | Foundations and health organizations | Industrial firms | Local government <sup>a</sup> sources | Other    |
|-------------------|-------------|-----------------|-----------------------------------|------------------------|-------------------------------|--------------------------------------|------------------|---------------------------------------|----------|
|                   |             |                 | Total                             | State government funds | State universities' own funds |                                      |                  |                                       |          |
| Total, all States | \$1,989,511 | \$1,249,155     | \$586,136                         | \$340,334              | \$245,802                     | \$59,670                             | \$52,605         | \$7,809                               | \$34,136 |
| California        | 307,600     | 234,959         | 57,780                            | 13,780                 | 44,000                        | 12,066                               | 2,184            | 253                                   | 358      |
| Texas             | 119,124     | 66,566          | 37,966                            | 28,870                 | 9,096                         | 6,225                                | 4,832            | 140                                   | 3,395    |
| Michigan          | 118,324     | 73,990          | 28,728                            | 12,552                 | 16,176                        | 6,274                                | 6,389            | 388                                   | 2,555    |
| New York          | 110,530     | 53,852          | 47,441                            | 43,154                 | 4,287                         | 2,488                                | 6,142            | 496                                   | 4,111    |
| Wisconsin         | 92,645      | 49,601          | 36,655                            | 19,066                 | 17,589                        | 2,649                                | 1,210            | 18                                    | 2,512    |
| Washington        | 78,848      | 60,372          | 13,447                            | 10,854                 | 2,593                         | 1,361                                | 1,557            | 335                                   | 1,776    |
| Illinois          | 64,112      | 38,602          | 21,883                            | 11,431                 | 10,452                        | 1,224                                | 777              | 560                                   | 1,066    |
| Colorado          | 61,346      | 48,008          | 5,957                             | 5,305                  | 652                           | 2,066                                | 4,391            | 431                                   | 493      |
| North Carolina    | 57,597      | 36,248          | 16,743                            | 15,235                 | 1,508                         | 2,181                                | 1,546            | 138                                   | 741      |
| Minnesota         | 56,469      | 32,183          | 17,670                            | 6,455                  | 11,215                        | 3,116                                | 1,283            | —                                     | 2,217    |
| Indiana           | 53,092      | 41,343          | 8,278                             | 1,063                  | 7,215                         | 904                                  | 1,754            | 576                                   | 237      |
| Florida           | 52,355      | 27,486          | 21,757                            | 5,958                  | 15,799                        | 1,277                                | 997              | 146                                   | 692      |
| Pennsylvania      | 52,277      | 35,306          | 13,253                            | 4,497                  | 8,756                         | 1,244                                | 1,451            | 52                                    | 971      |
| Georgia           | 44,742      | 18,942          | 22,440                            | 16,161                 | 6,279                         | 493                                  | 1,907            | 406                                   | 554      |
| Ohio              | 43,098      | 27,004          | 11,336                            | 8,999                  | 2,337                         | 1,655                                | 2,148            | 167                                   | 788      |
| Virginia          | 40,808      | 24,216          | 12,966                            | 10,127                 | 2,859                         | 1,344                                | 1,257            | 63                                    | 942      |
| Oregon            | 37,770      | 26,175          | 8,474                             | 6,102                  | 2,372                         | 1,320                                | 1,044            | 152                                   | 605      |
| Missouri          | 36,119      | 15,645          | 19,055                            | 6,654                  | 12,401                        | 287                                  | 677              | 15                                    | 440      |
| Utah              | 34,889      | 27,111          | 4,760                             | 2,673                  | 2,087                         | 824                                  | 850              | 1,108                                 | 236      |
| Iowa              | 33,433      | 20,962          | 10,494                            | 5,101                  | 5,393                         | 309                                  | 919              | 147                                   | 608      |
| Kansas            | 32,715      | 21,098          | 9,707                             | 5,573                  | 4,134                         | 566                                  | 804              | 282                                   | 258      |
| Arizona           | 32,417      | 18,189          | 11,218                            | 7,203                  | 4,015                         | 876                                  | 946              | 95                                    | 1,093    |
| New Jersey        | 31,453      | 16,406          | 13,197                            | 7,737                  | 5,460                         | 740                                  | 236              | 72                                    | 802      |
| Maryland          | 30,594      | 20,326          | 7,787                             | 7,300                  | 487                           | 956                                  | 1,546            | 4                                     | 75       |
| Hawaii            | 29,110      | 17,362          | 10,987                            | 10,932                 | 55                            | 363                                  | 65               | 130                                   | 203      |
| Alabama           | 26,164      | 18,790          | 6,000                             | 4,096                  | 1,904                         | 371                                  | 743              | 43                                    | 217      |
| Louisiana         | 23,779      | 9,609           | 12,659                            | 5,549                  | 11,110                        | 645                                  | 804              | —                                     | 62       |
| Oklahoma          | 21,588      | 12,199          | 7,341                             | 5,517                  | 1,824                         | 345                                  | 485              | —                                     | 1,218    |
| Kentucky          | 20,713      | 11,146          | 8,255                             | 3,390                  | 4,865                         | 662                                  | 409              | 142                                   | 99       |
| Alaska            | 20,591      | 13,956          | 5,126                             | 2,126                  | 3,000                         | 207                                  | 484              | —                                     | 818      |
| Mississippi       | 20,156      | 9,880           | 8,400                             | 4,908                  | 3,492                         | 662                                  | 720              | 380                                   | 114      |
| Connecticut       | 19,381      | 8,367           | 9,875                             | 2,394                  | 7,481                         | 545                                  | 107              | 47                                    | 440      |
| New Mexico        | 18,970      | 14,741          | 2,883                             | 1,682                  | 1,201                         | 182                                  | 653              | 13                                    | 498      |
| Nebraska          | 18,008      | 7,252           | 9,869                             | 6,328                  | 3,541                         | 362                                  | 431              | 36                                    | 58       |
| Massachusetts     | 15,412      | 11,061          | 3,529                             | 2,792                  | 737                           | 324                                  | 395              | 14                                    | 89       |
| Tennessee         | 15,163      | 12,373          | 1,511                             | 980                    | 531                           | 254                                  | 560              | 76                                    | 389      |
| South Carolina    | 12,889      | 6,010           | 5,770                             | 5,597                  | 173                           | 589                                  | 396              | 12                                    | 112      |
| Arkansas          | 11,032      | 5,743           | 4,635                             | 4,178                  | 457                           | 136                                  | 370              | —                                     | 148      |
| Idaho             | 9,790       | 4,284           | 5,035                             | 4,311                  | 724                           | 28                                   | 432              | 11                                    | —        |
| Montana           | 9,418       | 4,212           | 4,243                             | 2,659                  | 1,584                         | 112                                  | 801              | —                                     | 50       |
| West Virginia     | 9,073       | 6,373           | 2,284                             | 2,217                  | 67                            | 48                                   | 128              | —                                     | 240      |
| Rhode Island      | 9,058       | 7,662           | 1,044                             | 524                    | 520                           | 161                                  | 52               | 100                                   | 39       |
| Vermont           | 8,294       | 5,862           | 1,897                             | 737                    | 1,160                         | 228                                  | 139              | —                                     | 168      |
| Maine             | 8,292       | 5,138           | 2,802                             | 1,333                  | 1,469                         | 89                                   | 253              | 10                                    | —        |
| South Dakota      | 7,979       | 3,690           | 3,574                             | 2,976                  | 598                           | 81                                   | 219              | 38                                    | 377      |
| Wyoming           | 7,576       | 5,022           | 1,705                             | 1,705                  | —                             | 41                                   | 137              | 671                                   | —        |
| North Dakota      | 7,359       | 3,075           | 3,035                             | 2,944                  | 91                            | 97                                   | 285              | —                                     | 867      |
| Nevada            | 7,343       | 4,218           | 2,424                             | 1,502                  | 922                           | 149                                  | 448              | 42                                    | 62       |
| Delaware          | 6,004       | 3,639           | 1,573                             | 701                    | 872                           | 510                                  | 231              | —                                     | 51       |
| New Hampshire     | 4,006       | 2,901           | 768                               | 506                    | 262                           | 34                                   | 11               | —                                     | 292      |

<sup>1</sup> Of this total, \$1,115,591 thousand was directed to State universities and colleges and \$133,564 thousand was directed to State government agencies.

<sup>2</sup> Of this total, \$214,816 thousand represented State-appropriated funds that were provided directly to State universities and colleges, largely for work at agricultural experiment stations, and \$125,518 thousand represented State-appropriated funds to State agencies that were used for R&D purposes.

<sup>3</sup> Unrestricted funds from all sources except the Federal Government that State universities and colleges were free to spend for R&D purposes and that were so budgeted. These sources included endowment income, tuition and fees, general-purpose State or local government appropriations, and general-purpose grants from industry, foundations, health agencies or other outside sources.



**TABLE 4. R&D EXPENDITURES OF STATE PUBLIC INSTITUTIONS, BY FISCAL YEAR AND CHARACTER OF WORK: FISCAL YEAR 1973**

[Dollars in thousands]

| State                | R&D total   | Basic research | Applied research | Development |
|----------------------|-------------|----------------|------------------|-------------|
| Total, all States..  | \$1,989,511 | \$1,193,721    | \$659,875        | \$135,915   |
| California .....     | 307,600     | 187,451        | 102,954          | 17,189      |
| Texas .....          | 119,124     | 84,121         | 30,666           | 4,357       |
| Michigan .....       | 118,324     | 79,608         | 32,289           | 6,427       |
| New York .....       | 110,530     | 59,584         | 45,568           | 5,378       |
| Wisconsin .....      | 92,645      | 82,043         | 6,982            | 3,620       |
| Washington .....     | 78,848      | 47,431         | 28,086           | 3,331       |
| Illinois .....       | 64,112      | 40,010         | 23,482           | 620         |
| Colorado .....       | 61,346      | 31,816         | 25,604           | 3,926       |
| North Carolina ..... | 57,597      | 34,234         | 17,003           | 6,360       |
| Minnesota .....      | 56,469      | 23,721         | 29,261           | 3,487       |
| Indiana .....        | 53,092      | 33,948         | 10,911           | 8,233       |
| Florida .....        | 52,355      | 28,660         | 16,929           | 6,766       |
| Pennsylvania .....   | 52,277      | 30,949         | 17,417           | 3,911       |
| Georgia .....        | 44,742      | 19,067         | 22,871           | 2,804       |
| Ohio .....           | 43,098      | 26,717         | 15,834           | 547         |
| Virginia .....       | 40,808      | 23,155         | 15,481           | 2,172       |
| Oregon .....         | 37,770      | 21,451         | 12,761           | 3,558       |
| Missouri .....       | 36,119      | 25,261         | 6,163            | 4,695       |
| Utah .....           | 34,889      | 22,100         | 10,034           | 2,755       |
| Iowa .....           | 33,439      | 27,871         | 4,182            | 1,386       |
| Kansas .....         | 32,715      | 14,840         | 15,216           | 2,659       |
| Arizona .....        | 32,417      | 21,109         | 7,941            | 3,367       |
| New Jersey .....     | 31,453      | 17,660         | 10,084           | 3,709       |
| Maryland .....       | 30,594      | 21,190         | 8,517            | 887         |
| Hawaii .....         | 29,110      | 16,921         | 9,044            | 3,145       |
| Alabama .....        | 26,164      | 9,446          | 15,296           | 1,422       |
| Louisiana .....      | 23,779      | 16,014         | 7,421            | 344         |
| Oklahoma .....       | 21,588      | 12,588         | 7,091            | 1,909       |
| Kentucky .....       | 20,713      | 9,314          | 6,511            | 4,888       |
| Alaska .....         | 20,591      | 5,796          | 14,516           | 279         |
| Mississippi .....    | 20,156      | 9,262          | 9,274            | 1,620       |
| Connecticut .....    | 19,381      | 14,664         | 4,413            | 304         |
| New Mexico .....     | 18,970      | 10,388         | 4,845            | 3,737       |
| Nebraska .....       | 18,008      | 12,549         | 5,117            | 342         |
| Massachusetts .....  | 15,412      | 9,976          | 4,299            | 1,137       |
| Tennessee .....      | 15,163      | 4,310          | 9,573            | 1,280       |
| South Carolina ..... | 12,889      | 6,479          | 5,279            | 1,131       |
| Arkansas .....       | 11,032      | 6,749          | 3,479            | 804         |
| Idaho .....          | 9,790       | 3,174          | 3,702            | 2,914       |
| Montana .....        | 9,418       | 5,990          | 3,187            | 241         |
| West Virginia .....  | 9,073       | 4,861          | 2,974            | 1,238       |
| Rhode Island .....   | 9,058       | 6,208          | 1,964            | 886         |
| Vermont .....        | 8,294       | 3,744          | 3,397            | 1,153       |
| Maine .....          | 8,292       | 2,984          | 3,529            | 1,779       |
| South Dakota .....   | 7,979       | 3,209          | 3,950            | 820         |
| Wyoming .....        | 7,576       | 3,406          | 3,346            | 824         |
| North Dakota .....   | 7,359       | 1,414          | 5,812            | 133         |
| Nevada .....         | 7,343       | 3,713          | 2,491            | 1,139       |
| Delaware .....       | 6,004       | 4,608          | 1,066            | 330         |
| New Hampshire .....  | 4,006       | 1,851          | 2,063            | 92          |

Much smaller shares of total State public R&D funds were provided by private sources: foundations and health organizations, 3 percent of the total; industrial firms, 3 percent; "other" (private individuals and professional societies), 2 percent. Less than one-half of 1 percent was provided by local governments.

### Character of Work

In 1973, of the State public R&D expenditure total, 60 percent was directed to basic research, 33 percent to applied research, and 7 percent to development (table 4). The greater weight placed on basic research is a reflection of the nature of State university efforts. University research is closely related to the traditional academic role of pursuing knowledge for its own sake and provides, among other things, a method for the training of scientists and engineers.

State government agencies, on the other hand, are primarily interested in solving problems related to program administration, and most of the efforts they sponsor are applied in nature. Nonetheless, the State university effort was of sufficient magnitude in 1973 to make the State university applied research total almost four times the comparable total of State government agencies (table 5).

**TABLE 5. R&D EXPENDITURES OF STATE PUBLIC INSTITUTIONS, BY PERFORMER AND CHARACTER OF WORK: FISCAL YEAR 1973**

[Dollars in millions]

|                                       | Total   | Basic research | Applied research | Development |
|---------------------------------------|---------|----------------|------------------|-------------|
| Total..                               | \$1,990 | \$1,194        | \$660            | \$136       |
| State universities and colleges ..... | 1,754   | 1,140          | 516              | 98          |
| State government agencies .....       | 178     | 50             | 110              | 18          |
| Other performers <sup>1</sup> .....   | 57      | 4              | 34               | 19          |

<sup>1</sup>All performers that were under grant or contract from State government agencies except State universities and colleges.

## Functional Areas

More R&D work performed by the States in 1973 was in health than in any other area, whether accomplished by State universities or State government agencies. Approximately one-third of all State university and college research and development was addressed to medical and health-related problems. Approximately one-third of State agency R&D expenditures were also assigned to health purposes in 1973.

Another important area is that of natural resources, representing as much as one-fourth of the university R&D total.<sup>5</sup> Agricultural experiment stations have accounted for most of the work at the university level in this category. Approximately one-fifth of the State agency R&D effort was assigned to natural resources in 1973.

## Fields of Science

In 1973 the life sciences accounted for 51 percent of State public R&D expenditures. Engineering and the social sciences each accounted for 11 percent, the physical sciences for 10 percent, the environmental sciences for 8 percent, psychology for 3 percent, and mathematics for 2 percent (table 6):

The emphasis on the life sciences is related to the fact that a major portion of the State R&D effort is concerned with activity in the areas of health and natural resources, including agriculture. The remaining funds were rather evenly divided among a number of fields, largely reflecting the State university commitment to support of science as a whole.

## R&D Manpower

In 1973 approximately 44,000 scientists and engineers were engaged in research and development on a full-time-equivalent basis in public institutions at the

<sup>5</sup>See National Science Foundation, *Expenditures for Scientific Activities at Universities and Colleges, Fiscal Year 1973* appendix tables. Functional data were derived from fields of science data for this report: the health data mainly from the life sciences, excluding an estimated amount for the agricultural sciences, and the natural resources data from the agricultural and environmental sciences.

State level: 39,000<sup>6</sup> at State universities and colleges and 5,000 in the direct employ of State government agencies. The cost per scientist or engineer (S/E) man-year at State universities and colleges was approximately \$45,000. This figure compares with \$36,000 per S/E man-year in State government agencies. These averages include not only salaries of scientists and engineers but also all supporting costs; i.e., the salaries of technicians and other support personnel, as well as supplies and all other overhead items.

## State Agency/State University Interface

To date, State universities and colleges have not been extensively used by State government agencies to assist them in solving problems related to State government administration. In 1973 only 11 percent of the research and development sponsored by State government agencies (\$28.5 million) was performed by State universities and colleges. In 1964 and 1968 the amounts represented by State university work were approximately 10 percent of the total State government agency R&D effort.

State governments are now operating in an atmosphere that is increasingly conducive to R&D approaches. The cost squeeze on State budgets and the proliferating problems in environment, energy, and social services call for more technical inputs to policy-making and more efficient methods of delivering services that were previously used. An important question facing State agencies is how to coordinate their own R&D efforts with those of other performers for the most effective results.

State universities represent a rich source for problem solving that is only beginning to be tapped. In the past decade Federal grants to the States have grown many times over, and a number of them have represented the kinds of categorical programs — in areas like water resources, housing and urban development, vocational training, occupational safety, and energy conservation — that have tended to involve university faculty. As a result, better management of State agency/State

<sup>6</sup>This figure includes graduate students receiving compensation for part-time services as scientists and engineers.

TABLE 6. R&D EXPENDITURES OF STATE PUBLIC INSTITUTIONS, BY STATE AND FIELD OF SCIENCE: FISCAL YEAR 1973

[Dollars in thousands]

| State             | R&D total   | Life sciences | Psychology | Physical sciences | Environmental sciences | Mathematics | Engineering | Social sciences | Other sciences |
|-------------------|-------------|---------------|------------|-------------------|------------------------|-------------|-------------|-----------------|----------------|
| Total, all States | \$1,989,511 | \$1,021,986   | \$64,041   | \$196,951         | \$156,504              | \$42,072    | \$226,665   | \$213,063       | \$68,229       |
| California        | 307,600     | 168,624       | 14,262     | 36,571            | 37,485                 | 5,251       | 25,104      | 16,812          | 3,491          |
| Texas             | 119,124     | 57,832        | 2,653      | 14,644            | 6,083                  | 2,778       | 17,933      | 9,975           | 7,226          |
| Michigan          | 118,324     | 52,208        | 6,000      | 7,254             | 3,948                  | 2,647       | 22,796      | 20,127          | 3,344          |
| New York          | 110,530     | 73,700        | 2,754      | 7,769             | 7,030                  | 3,117       | 5,256       | 8,444           | 2,460          |
| Wisconsin         | 92,645      | 32,932        | 4,728      | 10,730            | 13,369                 | 3,349       | 5,045       | 15,040          | 7,452          |
| Washington        | 78,848      | 47,219        | 1,721      | 5,173             | 9,467                  | 663         | 7,475       | 6,966           | 164            |
| Illinois          | 64,112      | 22,766        | 3,120      | 6,756             | 4,338                  | 3,971       | 12,540      | 8,325           | 2,296          |
| Colorado          | 61,346      | 24,707        | 2,705      | 8,177             | 3,974                  | 1,089       | 6,139       | 7,065           | 7,490          |
| North Carolina    | 57,597      | 33,889        | 992        | 1,652             | 1,208                  | 985         | 5,878       | 4,525           | 8,468          |
| Minnesota         | 56,469      | 34,331        | 1,036      | 3,991             | 971                    | 909         | 5,012       | 7,164           | 3,055          |
| Indiana           | 53,092      | 24,658        | 1,056      | 6,731             | 448                    | 1,473       | 6,899       | 9,580           | 2,247          |
| Florida           | 52,355      | 25,632        | 1,846      | 5,901             | 2,170                  | 1,437       | 6,275       | 9,033           | 61             |
| Pennsylvania      | 52,277      | 22,689        | 1,345      | 6,236             | 4,314                  | 264         | 7,264       | 7,342           | 2,823          |
| Georgia           | 44,742      | 19,123        | 1,199      | 5,277             | 595                    | 1,302       | 8,628       | 8,475           | 143            |
| Ohio              | 43,098      | 18,856        | 1,003      | 4,162             | 2,029                  | 588         | 7,744       | 8,030           | 686            |
| Virginia          | 40,808      | 21,801        | 454        | 4,473             | 2,327                  | 767         | 6,656       | 2,509           | 1,821          |
| Oregon            | 37,770      | 20,628        | 785        | 2,257             | 5,845                  | 383         | 1,727       | 6,077           | 68             |
| Missouri          | 36,119      | 25,254        | 353        | 1,306             | 885                    | 353         | 4,741       | 1,968           | 1,259          |
| Utah              | 34,889      | 18,333        | 1,659      | 3,090             | 2,582                  | 2,322       | 5,861       | 1,042           | -              |
| Iowa              | 33,439      | 19,811        | 331        | 4,524             | 266                    | 1,288       | 3,658       | 3,432           | 129            |
| Kansas            | 32,715      | 17,720        | 2,558      | 1,646             | 2,390                  | 592         | 3,508       | 3,377           | 924            |
| Arizona           | 32,417      | 11,968        | 1,112      | 8,413             | 4,000                  | 201         | 3,538       | 3,142           | 43             |
| New Jersey        | 31,453      | 13,443        | 1,178      | 3,043             | 2,970                  | 950         | 2,239       | 5,213           | 2,417          |
| Maryland          | 30,594      | 13,284        | 569        | 6,921             | 2,897                  | 1,974       | 3,367       | 1,390           | 202            |
| Hawaii            | 29,110      | 10,787        | 346        | 3,309             | 7,070                  | 58          | 2,261       | 4,694           | 585            |
| Alabama           | 26,164      | 18,719        | 953        | 686               | 1,346                  | 37          | 2,796       | 1,475           | 152            |
| Louisiana         | 23,779      | 15,051        | 481        | 2,380             | 2,133                  | 635         | 1,830       | 921             | 348            |
| Oklahoma          | 21,588      | 11,444        | 240        | 827               | 1,015                  | 406         | 2,750       | 1,126           | 3,780          |
| Kentucky          | 20,713      | 11,056        | 528        | 844               | 710                    | 75          | 2,319       | 3,702           | 1,479          |
| Alaska            | 20,591      | 7,842         | 67         | 4,984             | 5,247                  | 2           | 676         | 1,760           | 13             |
| Mississippi       | 20,156      | 15,111        | 225        | 962               | 168                    | 92          | 1,486       | 2,111           | 1              |
| Connecticut       | 19,381      | 12,468        | 824        | 574               | 930                    | 740         | 2,177       | 1,668           | -              |
| New Mexico        | 18,970      | 4,162         | 474        | 1,107             | 2,030                  | 142         | 7,316       | 2,920           | 819            |
| Nebraska          | 18,008      | 13,825        | 48         | 689               | 1,317                  | 128         | 1,169       | 832             | -              |
| Massachusetts     | 15,412      | 4,319         | 1,449      | 2,234             | 2,199                  | 266         | 2,205       | 2,680           | 60             |
| Tennessee         | 15,163      | 9,523         | 423        | 691               | 185                    | 57          | 2,374       | 1,878           | 32             |
| South Carolina    | 12,889      | 8,093         | 238        | 315               | 509                    | 99          | 830         | 2,363           | 442            |
| Arkansas          | 11,032      | 7,822         | 111        | 329               | 941                    | 94          | 586         | 1,104           | 45             |
| Idaho             | 9,790       | 6,524         | 2          | 317               | 282                    | 3           | 621         | 677             | 1,364          |
| Montana           | 9,418       | 5,444         | 88         | 718               | 946                    | 17          | 1,540       | 640             | 25             |
| West Virginia     | 9,073       | 5,042         | 203        | 69                | 302                    | 1           | 2,201       | 1,254           | 1              |
| Rhode Island      | 9,058       | 3,365         | 455        | 1,799             | 23                     | 474         | 1,618       | 1,324           | -              |
| Vermont           | 8,294       | 6,108         | 415        | 207               | 135                    | 5           | 98          | 1,201           | 125            |
| Maine             | 8,292       | 4,682         | 102        | 230               | 1,811                  | -           | 458         | 1,006           | 3              |
| South Dakota      | 7,979       | 3,862         | 174        | 66                | 1,501                  | 2           | 667         | 1,076           | 631            |
| Wyoming           | 7,576       | 3,370         | 137        | 1,568             | 1,503                  | 2           | 626         | 315             | 55             |
| North Dakota      | 7,359       | 6,030         | 2          | 161               | 401                    | 1           | 407         | 357             | -              |
| Nevada            | 7,343       | 2,706         | 136        | 3,414             | 572                    | 1           | 120         | 394             | -              |
| Delaware          | 6,004       | 1,441         | 329        | 927               | 1,424                  | 51          | 1,438       | 394             | -              |
| New Hampshire     | 4,006       | 1,782         | 172        | 847               | 213                    | 31          | 823         | 138             | -              |

university work arrangements is a subject of increasing interest.<sup>7</sup>

Nonetheless, in 1973 only 1.6 percent of the total State university R&D effort was devoted to work for State agencies. A recent report of the Council of State Governments pointed out that State university professors and State agency administrators had different operating philosophies that had worked in the past as a barrier to effective interchange between the two groups.<sup>8</sup> The State administrator requires specific results from a research or development project that he can use as a plan for action, and he needs to show measurable benefits from his expenditures. The academic researcher is more interested in advancing knowledge *per se* and often wishes to continue with a problem over a long period. Instances have also occurred where university professors working under State grants or contracts have arrived at politically

unpalatable conclusions and have had support withdrawn.

At the present time, however, the recognition is growing in both State government and State university circles that university expertise could be further extended into the public service sphere with benefit to both groups.<sup>9</sup> In a number of States new institutional links are being established to make university competence available to State agencies, and efforts are being made to reduce or eliminate the obstacles to effective work between the two groups. Instances of such activities continue to grow, and the adjustments to be made by both sides are becoming increasingly apparent and attainable. Although the Federal Government will undoubtedly continue to lead as a source of State university R&D support, a few years hence a larger portion of that support may well be provided by State government agencies for the performance of research and development to implement State programs.

<sup>7</sup> D.C. Spriesterbach, Margery E. Hoppin, and John McCrone, "University Research and the New Federalism," *Science*, Vol. 186 (October 25, 1974).

<sup>8</sup> The Council of State Governments, *Power to the States: Mobilizing Public Technology*, Lexington, Ky., May 1972.

<sup>9</sup> *Ibid.*; M. Frank Hersman, *Resident Resources for Problem-Solving in the 1970's*, speech at the North Dakota Summit Conference for State Officials, Grand Forks, N.D., March 11, 1974.

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