SCIENTIFIC RESEARCH AND DEVELOPMENT IN AMERICAN INDUSTRY

A STUDY OF MANPOWER AND COSTS

Bulletin No. 1148

UNITED STATES DEPARTMENT OF LABOR
BUREAU OF LABOR STATISTICS

in cooperation with

UNITED STATES DEPARTMENT OF DEFENSE

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UNITED STATES DEPARTMENT OF LABOR
LLOYD A. MASHBURN, Acting Secretary

BUREAU OF LABOR STATISTICS
EWAN CLAGUE, Commissioner

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LETTER OF TRANSMITTAL

UNITED STATES DEPARTMENT OF LABOR,
Bureau of Labor Statistics,
Washington, D. C., October 3, 1953.

The Secretary of Labor:

I have the honor to transmit herewith a report on industrial research and development in the United States, prepared by this Bureau in cooperation with the Department of Defense.

This is the final report on a survey of private companies and nonprofit agencies (other than educational institutions) engaged in research and development, which was conducted in 1952 by the Department of Defense, Research and Development Board, Walter G. Whitman, Chairman. Kenneth Colmen was mainly responsible for the planning and conduct of the survey and served as consultant in connection with the preparation of the report.

The report was prepared in the Bureau of Labor Statistics, Division of Manpower and Employment Statistics, by Helen Wood, Robert W. Cain, and Joseph H. Schuster. The Bureau wishes to express appreciation for the assistance received from the officials of private companies, professional societies, and Government agencies who reviewed the manuscript.

Ewan Clague, Commissioner.

Hon. Lloyd A. Mashburn,
Acting Secretary of Labor.

FOREWORD

This final report presents the findings of a nationwide survey of industrial research and development conducted by the Research and Development Board in mid-1952. The report was prepared by the Division of Manpower and Employment Statistics of the Bureau of Labor Statistics, United States Department of Labor. Its objective is to provide a comprehensive picture of industrial research resources in the United States.

I wish to express my appreciation for the cooperation received from all participating companies. In addition, the assistance and suggestions of the many individuals and organizations -- private and Government -- that aided in planning the study is acknowledged with thanks.

Walter H. Whelan

Chairman,
Research and Development Board

June 25, 1953.

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INTRODUCTION

Research and development in industry is by far the largest segment of the Nation's scientific research activity. In 1952, the national expenditures for scientific and engineering research and development totaled about 3 3/4 billion dollars, of which about 2 1/2 billion was for work done in laboratories and other facilities owned or operated by private industry. Both the total national outlay and the cost of the research performed by private business were more than 40 percent higher in 1952 than 1949--owing primarily to the emphasis on military technology which has characterized the current program of partial mobilization but also in part to the needs of an expanding civilian economy (table C-1).

The demand for scientific and engineering personnel and research facilities arising from both these sources created a need for more information about private industry's huge research resources, comparable to that already available regarding the much smaller research operations of universities and Government agencies. 1/ More accurate estimates were needed of the total national cost of industrial research, the amount of research performed by different industries, and the number of research engineers and scientists employed in these industries. Information on the cost of research per worker employed was also needed for use in estimating manpower requirements and determining whether proposed projects were feasible in view of the available resources of scientific and technical personnel. Other questions in which there was widespread interest were the extent of employment of supporting personnel and the effect on research staffs of calls to military service and other types of turnover.

In order to obtain information on these and related questions, the Research and Development Board conducted in mid-1952 a questionnaire survey of the research and development activities of private companies and nonprofit research agencies (other than colleges and universities). 2/ Nearly 2,000 concerns, including

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1/ The Engineering College Research Council of the American Society for Engineering Education conducted a survey of research in colleges and universities in 1950. The National Science Foundation publishes statistical data on the research activities of the Federal Government. One of the Foundation's most recent publications is Federal Funds for Science, I - Federal Funds for Scientific Research and Development at Nonprofit Institutions, 1950-1951 and 1951-1952. Washington: U. S. Government Printing Office, 1953. 48 pp.

2/ In addition to colleges and universities, such nonprofit research agencies as hospitals and museums were also excluded, inasmuch as their normal research activities are not industrial in character. The scope and method of the survey are described in detail in Appendix A.

almost all companies with large research programs, sent in usable questionnaires. These companies employed about 6 1/2 million persons and had sold nearly 100 billion dollars worth of goods and services during 1951. The number of firms with small research activities which were not reached by or failed to respond to the survey could not be determined exactly. However, the study covered most of the industrial research and development work in the United States--probably about 85 percent of the total, measured in terms of 1951 cost. 3/

A preliminary report giving highlights of the survey findings was issued at the beginning of 1953. The present report incorporates the data presented in this earlier publication and also includes much additional information, particularly with respect to the cost and employment experience of individual firms. Among the topics covered are the numbers of research engineers and scientists employed on both Government and nongovernment work; the employment of supporting personnel; the cost of research performed, on Government prime contracts and subcontracts and under company sponsorship; the relationship of research cost to value of sales; the average cost of research per employee, on Government-financed and company-financed projects; and, finally, the turnover rates among research engineers and scientists and the past and potential effects of military calls of such employees.

Information is presented for different industries and for companies of different sizes. Insofar as possible, the varying experience of individual companies in the same industry and size group is also analyzed.

Companies were asked in filling out the questionnaire to state the research specialty in which they were most competent, as well as the industry in which they belonged. Statistical data classified according to the companies' major research specialties and covering most of the major topics considered in the report are presented in Appendix D.

Throughout the report, the term "research" is used to denote both research and development. The difficulty in obtaining uniform interpretation of this term from companies in the survey is one of the limitations of the data which the reader should bear in mind. This matter is discussed in greater detail along with other limitations of the data and definitions of terms in Appendix A.

3/ The term "research cost," as used in this survey, refers to the "operating cost of research and development performed" (as defined in item 3 of the questionnaire, which is reproduced in Appendix B). The cost data obtained therefore exclude capital investment (except as reflected in depreciation charges) and also expenditures for any research services which the reporting companies purchased from other concerns. On the other hand, the figures include the cost of research performed by the given companies on funds provided by the Federal Government or other organizations.

SUMMARY OF FINDINGS

RESEARCH PERSONNEL

About 96,000 research engineers and scientists were employed in January 1952 by the nearly 2,000 companies in the study. Close to three-fourths were working for companies in six branches of manufacturing--the aircraft, electrical machinery, chemicals and allied products, professional and scientific instruments, machinery (except electrical), and petroleum refining industries. Over half were employed in the first three of these industry groups.

Large companies employed most of the engineers and scientists. Two out of three were on the staffs of companies with 5,000 or more employees.

Only 1.5 percent of the employees of the reporting companies were research engineers or scientists. This percentage is higher, of course, than would have been found if companies without research programs had been included in the survey.

Approximately half the research engineers and scientists were working on federally financed projects, almost all of which were sponsored by the Department of Defense or the Atomic Energy Commission. The number employed on Government contracts was more than 50 percent higher in January 1952 than in January 1951. Nevertheless, most industries achieved some increase in employment on company-financed research during the year.

The total number of supporting workers (including technicians and other laboratory assistants and clerical and administrative personnel) employed by companies in the survey was 143,000. Thus, the average ratio was 1.5 supporting workers per research engineer or scientist. However, this ratio varied widely among companies of different sizes, among industries, and from one company to another in the same industry and size group.

COST OF RESEARCH

The total cost of research performed by the reporting companies was nearly 2 billion dollars during 1951. The electrical machinery, aircraft, and chemicals industries, which were the leading employers of research personnel, also had the greatest dollar volume of research costs--altogether, more than 1 billion dollars.

The Federal Government paid for nearly half of the 1951 research and development cost. Among major industries, the Government's share of the research cost ranged from 85 percent in aircraft manufacturing down to a low 3 percent in petroleum refining.

Government-financed research accounted for about three-fifths of the total research cost in companies with fewer than 500 employees, compared with about one-half of the total for larger organizations. However, the large companies did far more research work for the Government than the small ones, because their total research capacity was so much greater.

Research cost represented about 2 percent of the total value of sales of the reporting companies during 1951. In the aircraft industry the proportion reached 13 percent, but in several others it was less than 1 percent. The proportion also varied greatly among companies in the same industry.

Average cost per research engineer or scientist in 1951 was $21,900 (total operating cost of research divided by the average number of research engineers and scientists employed). Of the branches of manufacturing with large research programs, the one with the lowest cost per research engineer or scientist was chemicals and allied products. At the other extreme was the motor vehicle industry, with an average cost about four times as great as that for chemicals and allied products. Figures for individual companies also varied widely.

Taking all research workers into account, including supporting personnel as well as engineers and scientists, average cost per research worker was $8,800. This cost ratio varied much less among industries and individual companies than the cost per research engineer or scientist.

TURNOVER OF PROFESSIONAL RESEARCH STAFF

The annual separation rate of research engineers and scientists was 13.9 per 100 employed during the year July 1950-June 1951, and about one-fifth higher during the last half of 1951. Separations for reasons other than military service accounted for most of the turnover in both periods. In the last half of 1951, the annual rate of military calls was only three out of every 100 research engineers and scientists.

Although military calls did not affect many research engineers and scientists in 1950 and 1951, they could cut more deeply in the future. One-fourth of the research engineers and scientists in the study were in the categories most liable to military service; 19 percent were in the Reserves or National Guard and another 6 percent were classified either 1A or 2A by Selective Service as of January 1952. Since then, considerable change in the proportion of professional research workers liable for military duty has probably taken place, since men are constantly leaving and others entering the Reserves and the various Selective Service categories.

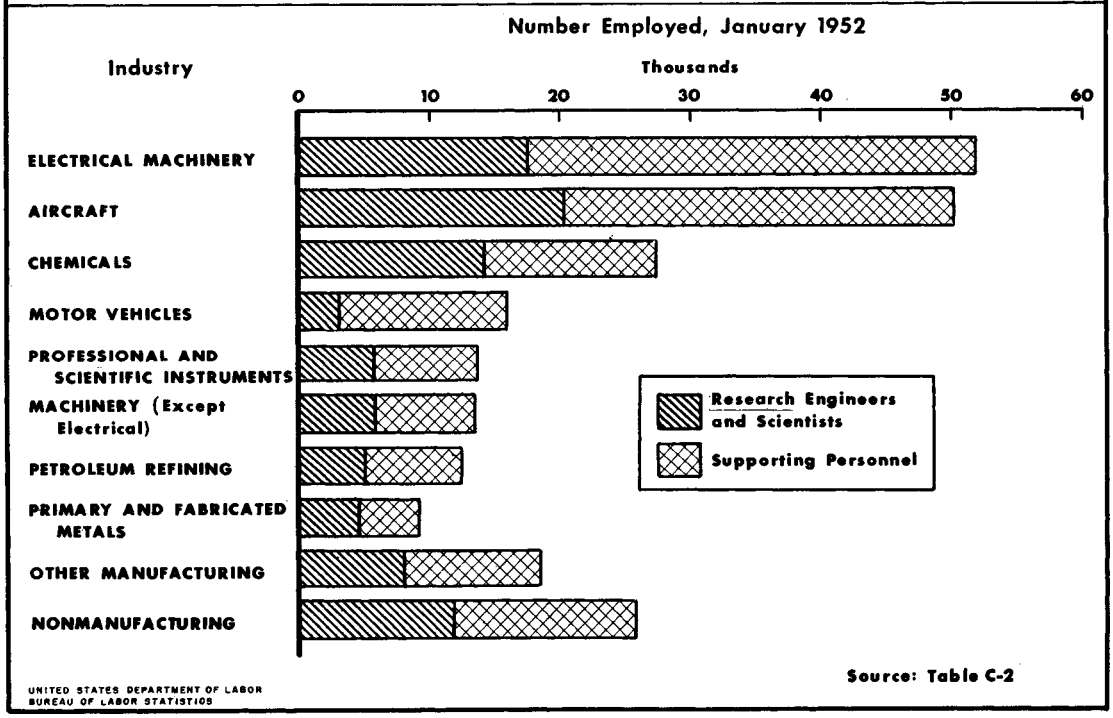
DISTRIBUTION OF EMPLOYMENT

Engineers and scientists engaged in industrial research and development work are concentrated, to a great extent, in a few industries and in large companies.

In January 1952 nearly three-fourths of the 95,700 professional research workers in the survey were employed in six branches of manufacturing--the aircraft, electrical machinery, chemicals and allied products, professional and scientific instruments, machinery (except electrical), and petroleum refining industries (chart 1). 4/ Over half were in the first three of these industry groups; more than one-fifth were in aircraft manufacturing alone. The mobilization program initiated in mid-1950 resulted in a great expansion of research

Chart 1

ELECTRICAL MACHINERY, AIRCRAFT, AND CHEMICALS INDUSTRIES EMPLOY LARGEST NUMBERS OF RESEARCH PERSONNEL



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Source: Table C-2

4/ It should be noted in connection with these and other figures classified by industry that each reporting company was placed, of necessity, in a single industry (Appendix A).

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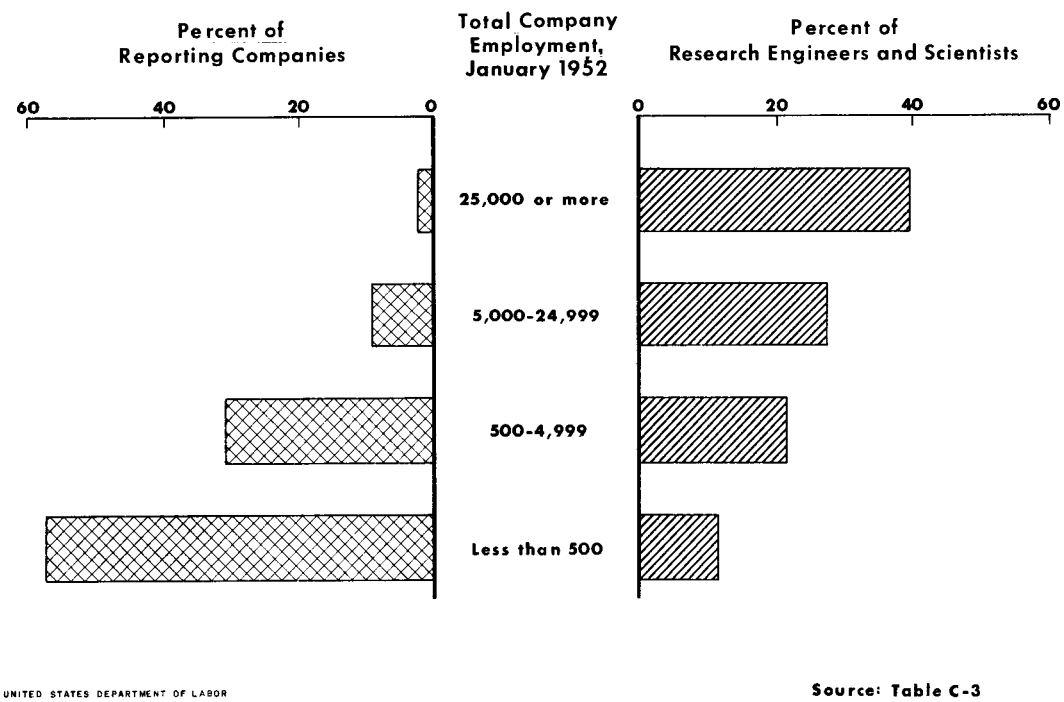
activities in the aircraft and electrical machinery industries, particularly the former. It also led to a rapid growth in the research staffs of the professional and scientific instruments industry. In the chemicals, petroleum refining, and machinery (except electrical) industries, the direct effect of the defense program has been much less, but these industries have long been among the leaders in the Nation's industrial research and development effort.

All other branches of manufacturing, besides the six just mentioned, together employed only 16 percent of the research engineers and scientists in the survey. Altogether, the proportion employed in manufacturing was 88 percent. The remaining 12 percent were in a variety of nonmanufacturing industries (table C-2).

The concentration of professional research personnel in large organizations is apparent when companies are classified according to their total employment in January 1952 (chart 2). Approximately 40 percent of the surveyed research engineers and scientists worked for the 44 largest companies, each of which had at least 25,000 employees. These companies represented only 2 percent of the 1,953 organizations in the study. Two-thirds of the research engineers and scientists were employed by the 222 companies (11 percent of the

Chart 2

A FEW LARGE COMPANIES EMPLOY MOST RESEARCH ENGINEERS AND SCIENTISTS



UNITED STATES DEPARTMENT OF LABOR
BUREAU OF LABOR STATISTICS

Source: Table C-3

total) with 5,000 or more employees. In contrast, only 4 percent worked for the 642 companies (33 percent of the total) with fewer than 100 employees (table C-3).

The concentration of research engineers and scientists in large companies was greatest in the aircraft, motor vehicle, and petroleum refining industries (table 1). In each of these three industries, about nine-tenths of the research engineers and scientists were working for companies with 5,000 or more employees. Concentration of personnel in large companies was characteristic also of all other major branches of manufacturing and of nonmanufacturing industries exclusive of commercial consulting firms and nonprofit research agencies. 5/

Organizations in these two last categories naturally tend to be much smaller than companies whose research and development programs are an adjunct to production or other operations. None of the consulting firms and nonprofit agencies in the study had as many as 5,000 employees, and nearly two-thirds of the professional research workers employed by such organizations worked for ones with fewer than 500 employees.

When the figures on employment of research engineers and scientists are classified according to the size of the companies' professional research staffs, a still greater concentration of research personnel in a few large organizations is shown. The 34 companies with the largest professional research staffs (500 or more) employed approximately 48 percent of all research engineers and scientists in the survey, whereas the proportion working for the 44 companies with the largest total employment (25,000 or more) was approximately 40 percent. This difference reflects the fact that some of the large companies had relatively small research programs. 6/ For example, one out of every eight companies with 5,000 or more employees had fewer than 15 research engineers and scientists; this group was made up principally of companies in the machinery (except electrical), textile, and food industries. On the other hand, some small companies had research staffs far above the overall average for concerns in their size group. This was true not only of commercial consulting and nonprofit research organizations but also of some manufacturing concerns which were devoting a great part of their resources to development work for the Armed Forces at the time of the survey.

5/ A similar pattern of concentration is noted when research engineers and scientists are classified by industry and size of professional research staff (table C-6).

6/ Table C-7 cross-classifies reporting companies and research engineers and scientists, by size of company and size of professional research staff.

Table 1. Percent distribution of research engineers and scientists, by industry and size of company, January 1952 1/

Industry	All reporting companies	Companies with total employment of --		
		Less than 500	500 to 4,999	5,000 or more
All industries	100.0	11.2	21.8	67.0
Manufacturing	100.0	6.9	20.8	72.3
Chemicals and allied products	100.0	9.6	24.0	66.4
Petroleum refining	100.0	2.5	10.7	86.8
Primary metal industries	100.0	5.2	15.1	79.7
Fabricated metal products	100.0	20.1	40.7	39.2
Machinery (except electrical)	100.0	6.8	39.4	53.8
Electrical machinery	100.0	7.8	22.7	69.5
Motor vehicles and equipment	100.0	2.5	10.5	87.0
Aircraft and parts	100.0	.8	9.0	90.2
Professional and scientific instruments	100.0	18.2	25.4	56.4
Other manufacturing	100.0	7.6	29.1	63.3
Nonmanufacturing	100.0	42.6	29.1	28.3
Commercial consulting firms	100.0	89.2	10.8	--
Nonprofit research agencies	100.0	37.8	62.2	--
Other nonmanufacturing	100.0	8.7	18.4	72.9

1/ See appendix table C-5 for figures underlying this table.

RESEARCH ENGINEERS AND SCIENTISTS AS PERCENT OF TOTAL EMPLOYMENT

One indication of the degree of emphasis on research activities in different industries and in companies of different sizes is provided by data on the average number of professional research workers employed per 100 employees of all types. In interpreting these figures, it should be borne in mind that the survey was limited to organizations engaged in research and development. The figures do not represent the ratio of professional research employment to total employment in any industry as a whole, since many companies do no research or development work. The date of the employment information, January 1952, is also of importance in this context. At that time, defense-related development work was at a very high level and mass production on defense contracts had hardly begun in many companies in the aircraft and other industries. In later stages of the defense program the ratio of research personnel to total employment undoubtedly declined somewhat.

The average number of research engineers and scientists per 100 workers in all the reporting companies taken together was found to be 1.5 in January 1952 (table C-8). The aircraft industry, which employed the largest absolute number of research engineers and scientists, was also the branch of manufacturing with the highest relative number (4.3 per 100 employees). The three manufacturing industry groups which were, in absolute numbers, the next largest employers of professional research personnel also had comparatively high ratios, as follows: Professional and scientific instruments, 3.7 per 100 workers; chemicals, 3.0; and electrical machinery, 2.7. The industry groups with the lowest ratios were primary metals (0.3), motor vehicles (0.4), and nonmanufacturing industries other than consulting firms and nonprofit agencies (0.4). Commercial consulting firms and nonprofit research agencies, whose major activity is providing professional services, naturally had very much higher percentages of professional research workers than any other industry (24.5 and 47.2, respectively).

Each of these ratios is of course an average for all reporting companies in the given industry. The relative numbers of professional research workers employed by individual companies varied widely above and below the industry averages.

There were also wide differences in the ratio of engineering and scientific workers to total employment among companies in the same size group. Generally, however, the small companies in the survey had a higher ratio than the large companies. In manufacturing as a whole, companies with less than 500 employees had an average of 4.7 research engineers and scientists per 100 employees, compared with 1.7 for those with 500 to 4,999 employees and 1.2 for those with 5,000 or more employees. The percentage of professional research personnel had an inverse relationship to size of company in almost every major branch of manufacturing and also in most nonmanufacturing industries.

It should be emphasized, however, that these findings apply only to companies with research and development programs and that most small companies do no research and development work. A cross-section of all American industry would show that research engineers and scientists represent a higher proportion of total employment in large than in small companies. 7/

EMPLOYMENT ON GOVERNMENT CONTRACTS

Since the current program of partial mobilization began in mid-1950, the Government has initiated and financed a large volume of military research and development. About one-third of this Government-financed research has been conducted in laboratories owned and operated by Federal agencies. Most of the remaining two-thirds has been carried out by private industry. However, colleges and universities and other nonprofit institutions have also participated significantly in defense research.

Approximately half of the research engineers and scientists in this study were employed in January 1952 on projects sponsored by Federal agencies--in nearly every case the Department of Defense or the Atomic Energy Commission. The proportion of the professional research staff working on Government contracts was the same in nonmanufacturing as in manufacturing industries--49 percent in each of these two industry divisions (table 2). In absolute terms, however, manufacturing industries, as a group, employ many more research engineers and scientists on Government work than do nonmanufacturing industries.

The relative numbers of research engineers and scientists employed on Government work were naturally highest in the branches of manufacturing most directly related to the defense effort. In the aircraft industry, 92 percent of the professional research personnel in the study were working on Government-financed projects; in the professional and scientific instruments industry, 70 percent. Commercial consulting firms had also assigned a sizable majority (66 percent) of their professional research staffs to Government work.

7/ Companies with fewer than 500 employees account for approximately 35 percent of total manufacturing employment in the United States, according to unpublished reports of the Small Defense Plants Administration. However, findings of this survey of industrial research show that companies in this size class employed less than 10 percent of the research engineers and scientists in manufacturing concerns. Statistics on employment by size of company are not available for nonmanufacturing industries.

Table 2. Percent of research engineers and scientists employed on Government prime contracts and subcontracts, by industry and by size of company, January 1952

Item	Estimated total number of research engineers and scientists reported	Percent employed on --				
		All types of work	Government contracts			Non-government work
			Total	Prime contracts	Subcontracts	
	A. By industry					
All industries	1/ 95,694	100.0	48.9	43.4	5.5	51.1
Manufacturing	83,772	100.0	48.9	43.7	5.2	51.1
Chemicals and allied products	14,032	100.0	5.4	4.7	.7	94.6
Petroleum refining	4,954	100.0	4.5	3.9	.6	95.5
Primary metal industries	1,810	100.0	10.0	7.2	2.8	90.0
Fabricated metal products	2,562	100.0	39.9	23.2	16.7	60.1
Machinery (except electrical)	5,891	100.0	24.5	16.8	7.7	75.5
Electrical machinery	17,375	100.0	60.2	53.0	7.2	39.8
Motor vehicles and equipment	3,072	100.0	23.1	20.3	2.8	76.9
Aircraft and parts	20,235	100.0	92.1	86.3	5.8	7.9
Professional and scientific instruments	5,758	100.0	69.6	61.1	8.5	30.4
Other manufacturing	8,083	100.0	24.5	20.0	4.5	75.5
Nonmanufacturing	11,922	100.0	49.2	41.4	7.8	50.8
Commercial consulting firms	3,803	100.0	65.8	45.8	20.0	34.2
Nonprofit research agencies	3,421	100.0	53.0	50.1	2.9	47.0
Other nonmanufacturing	4,698	100.0	35.4	33.6	1.8	64.6
	B. By size of company					
All sizes of companies	1/ 95,694	100.0	48.9	43.4	5.5	51.1
Less than 500 employees	10,999	100.0	58.7	43.0	15.7	41.3
500 - 4,999 employees	20,499	100.0	47.9	38.6	9.3	52.1
5,000 or more employees	64,196	100.0	49.3	46.8	2.5	50.7

1/ Includes estimates for 134 companies that failed to report the number of research engineers and scientists employed. Although exact numbers are given, not all digits of the numbers are statistically significant.

The proportion of research engineers and scientists on Government contracts was lowest in the following industries: Food and kindred products (1 percent); paper (4 percent); petroleum refining (5 percent); and chemicals (5 percent). Characteristically, many companies in these industries prefer to finance their own research programs in order to insure secrecy of development and to take advantage of future production contracts. However, by independently undertaking research work of types needed by the Federal Government, these industries have participated in defense research to a greater extent than the percentages cited above would indicate. Furthermore, since the chemicals industry has a very large research staff, the actual number of research engineers and scientists employed on Government contracts was greater in this industry than in some others (for example, fabricated metal products) where the proportion on Government work was much higher.

The extent to which small business enterprises participate in Government contracts is a matter which has received considerable public attention. This survey indicates that the proportion of the professional research staff assigned to Government-financed projects was, on the average, slightly higher in small than in large companies. Firms with fewer than 500 employees reported that three-fifths of their research engineers and scientists were on Government work, whereas the figure for larger organizations was about one-half (table 2). However, the absolute number of research engineers and scientists on Government research projects was much greater in large than in small companies.

Most of the research work for Federal agencies was done on contracts let directly by these agencies. Forty-three percent of the research engineers and scientists in the survey were working on Government prime contracts, as compared with 6 percent who were on subcontracts.

Government research projects often require such expensive equipment and such large specialized staffs that only large companies can undertake them. However, many phases of such projects can be handled effectively by smaller organizations on a subcontract basis. As expected, the survey showed that the proportion of all research engineers and scientists working on Government subcontracts was higher in small than in large companies--15.7 percent in those with less than 500 employees, compared with 9.3 percent in those with 500 to 4,999 workers and 2.5 percent in still larger organizations. An unanticipated finding is the much higher proportion of research engineers and scientists working on Government prime contracts than on subcontracts even in organizations with less than 500 employees (table 2).

Commercial consulting firms had the highest proportion of professional research staff employed on Government subcontracts (20 percent). Nevertheless, such firms had more than twice as many professional research workers on Government prime contracts as on subcontracts.

In the fabricated metal products industry, subcontracts were of greater relative importance than in any other branch of manufacturing having a sizable amount of Government research. 8/ Seventeen percent of the research engineers and scientists in this industry were employed on Government subcontracts--owing to the substantial number of small firms in the industry and the high proportion of the research staffs of these small companies engaged in research work for the Government. The manufacturing industries which employed the largest absolute numbers of research engineers and scientists on subcontracts were those with the largest research staffs--aircraft and electrical machinery (table 2).

CHANGE IN EMPLOYMENT, JANUARY 1951 TO JANUARY 1952

Employment of research engineers and scientists rose substantially during 1951, a year of rapid expansion in the defense program. The companies in the survey increased their employment of professional research personnel by nearly one-fourth between January 1951 and January 1952--from an estimated 77,400 to about 95,700.

Every industry for which information is available expanded its research staff to some extent during the year (tables C-11 and C-12). As would be expected, however, the industries most intensively engaged in defense research reported the greatest increases in employment of research personnel, in both percentage and absolute terms (chart 3). In the aircraft industry, employment of research engineers and scientists increased by nearly 50 percent over the 12-month period. In the electrical machinery and professional and scientific instruments industries, it rose by 28 percent. The smallest relative increase (6 percent) occurred in the petroleum industry (table 3).

The part which the defense program played in the expansion of research staffs is shown still more clearly by figures on the change in employment on Government and nongovernment research work. The number of research engineers and scientists doing Government-financed research rose by 52 percent between January 1951 and January 1952 in all industries taken together, whereas the number on nongovernment research work increased by only 5 percent. Employment of research engineers and scientists on subcontracts rose relatively more (58 percent) than employment on prime contracts (51 percent), but the actual number of men added was much greater on prime contracts than on subcontracts (table C-13).

8/ See table C-9. It will be noted from this table that the average number of research engineers and scientists on Government subcontracts per 100 on all Government contracts was higher in the paper and the paint industries than in fabricated metal products. However, the total number of research engineers and scientists on Government contracts was very small in these industries.

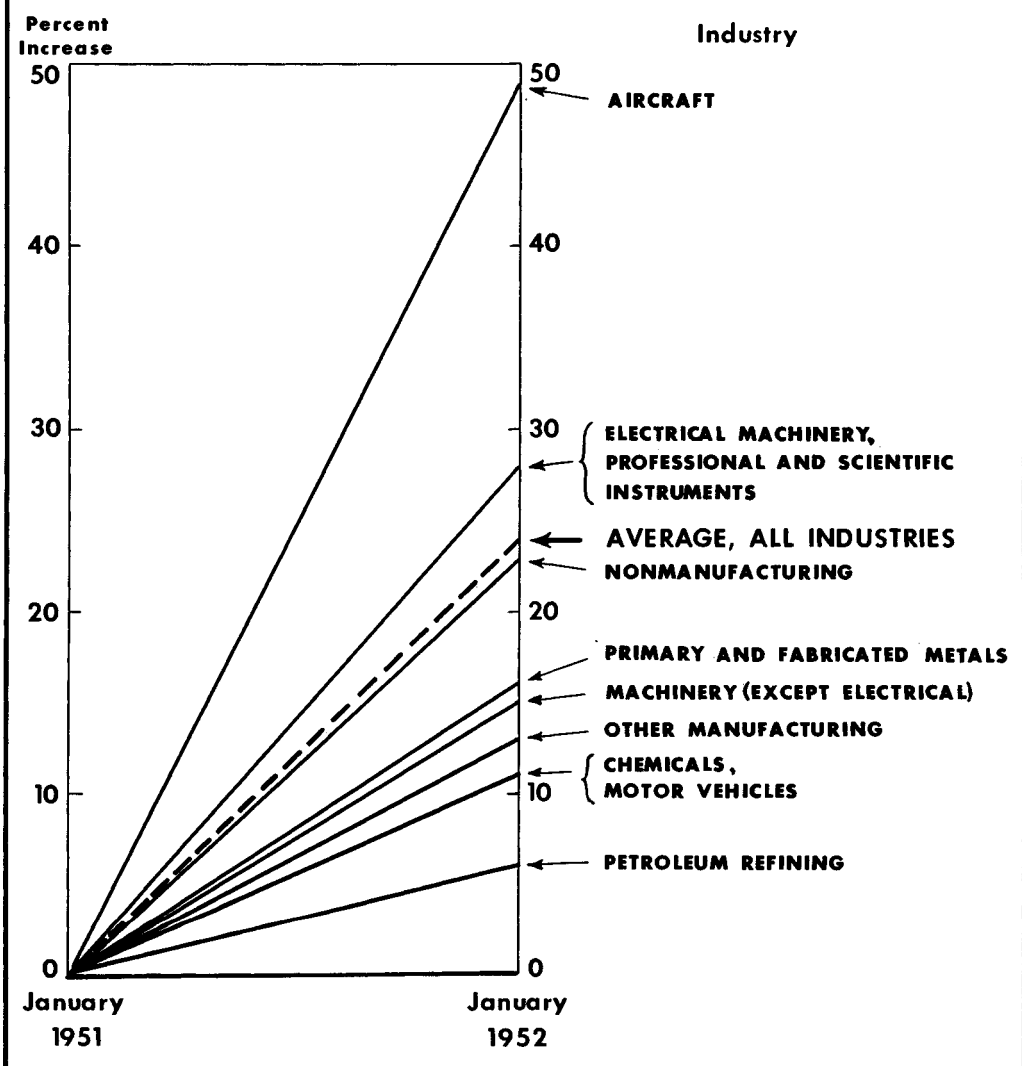
Table 3. Percent change in employment of research engineers and scientists on Government and nongovernment work, January 1951 to January 1952, by industry and by size of company

Item	All engineers and scientists		Engineers and scientists employed on --			
			Government contracts		Other work	
	Number reported, Jan.1952	Percent change, Jan. 1951 to Jan. 1952	Number reported, Jan.1952	Percent change, Jan. 1951 to Jan. 1952	Number reported, Jan.1952	Percent change, Jan. 1951 to Jan. 1952
	A. By industry					
All industries	1/95,694	23.7	1/45,445	52.0	1/50,249	5.1
Manufacturing	83,772	23.8	39,467	52.2	44,305	5.1
Chemicals and allied products	14,032	10.8	802	69.8	13,230	8.6
Petroleum refining	4,954	5.7	223	8.7	4,731	5.6
Primary metal industries	1,810	9.5	181	5.7	1,629	10.1
Fabricated metal products	2,562	20.8	1,022	44.6	1,540	8.4
Machinery (except electrical)	5,891	14.7	1,443	74.2	4,448	3.2
Electrical machinery	17,375	27.5	10,460	54.0	6,915	1.2
Motor vehicles and equipment	3,072	10.9	710	104.0	2,362	-2.5
Aircraft and parts	20,235	48.5	18,636	52.8	1,599	11.9
Professional and scientific instruments	5,758	28.3	4,139	44.2	1,619	-6.4
Other manufacturing	8,083	12.8	1,851	40.7	6,232	6.1
Nonmanufacturing	11,922	23.2	5,978	50.8	5,944	5.3
Commercial consulting firms	3,803	31.5	2,502	52.9	1,301	3.2
Nonprofit research agencies	3,421	24.9	1,813	31.2	1,608	18.4
Other nonmanufacturing	4,698	16.8	1,663	66.8	3,035	.3
	B. By size of company					
All sizes of companies	1/95,694	23.7	1/45,445	52.0	1/50,249	5.1
Less than 500 employees	10,999	33.4	6,085	58.9	4,914	11.3
500 - 4,999 employees	20,499	22.3	9,317	42.1	11,182	9.6
5,000 or more	64,196	23.0	30,043	54.8	34,153	4.2

1/ Includes estimates for 134 companies that failed to report the number of research engineers and scientists employed. Although exact numbers are given, not all digits of the numbers are statistically significant.

Chart 3.

EMPLOYMENT OF RESEARCH ENGINEERS AND SCIENTISTS INCREASED MOST IN DEFENSE INDUSTRIES DURING 1951



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Source: Table C-11

Despite the rapid expansion in employment on Government research contracts, most industries achieved some increase during the year in the number of research engineers and scientists working on company-financed research. In one industry, primary metals, the gain in employment on nongovernment research (10 percent) exceeded that on Government work (6 percent). The motor vehicle and professional and scientific instruments industries were the only ones that experienced a net decline in employment on nongovernment research--no doubt owing largely to a shifting of personnel to defense work for the Federal Government.

The relative increase in size of professional research staff during 1951 was greater in small than in large companies. Firms with fewer than 500 employees in January 1952 had increased their employment of research engineers and scientists by 33 percent during the preceding year. In contrast, organizations with 500 to 4,999 employees experienced a 22-percent increase in staff and those with 5,000 or more employees a 23-percent increase.

Since this survey was concerned with industrial research and development work only, the findings do not indicate the overall trend in employment of engineers and scientists during 1951. The large expansion in industrial research and development staffs which occurred during the year may well have been achieved in part by transfers of personnel from production work and other types of activities, as well as by an influx of new engineering and science graduates.

SUPPORTING PERSONNEL

DISTRIBUTION OF EMPLOYMENT

Research engineers and scientists are assisted by draftsmen, laboratory assistants, other technicians, skilled craftsmen, and administrative, clerical, and maintenance personnel. These "supporting personnel" include all employees, except the engineers and scientists, who do work connected with research and development programs (including a proportionate share of overhead personnel).

The companies in the study employed about 143,000 supporting workers--half again as large a number as the total of 95,700 research engineers and scientists. Nearly fifty-five percent of the supporting personnel, as of the engineers and scientists, were in three industries--electrical machinery, aircraft, and chemicals. In some industries, however, there were marked differences in the relative numbers of workers in these two occupational categories. For example, electrical machinery manufacturers were the largest employers of supporting workers, but the aircraft industry led in employment of research engineers and scientists (table C-2). The motor vehicle industry employed about three times as large a proportion of the supporting personnel in the survey as of the professional research workers.

The concentration of employment in the largest firms was even greater in the case of supporting workers than of their professional colleagues. Twenty-four percent of the supporting workers and 14 percent of the research engineers and scientists were employed by the seven reporting companies with 100,000 or more employees (table C-3). An analysis of the distribution of employment among companies with professional research staffs of different sizes shows the same high concentration of supporting personnel in a few organizations with very large programs (table C-4).

SUPPORT RATIOS

During the current period of manpower shortages in engineering and the sciences, the possibility of expanding supporting staffs in order to utilize professional personnel more efficiently has been widely discussed. The "support ratio"--that is, the number of supporting workers employed per research engineer or scientist--has become a matter of great interest and importance in research management. Detailed data on support ratios have therefore been compiled for companies that supplied information on the size of both their professional and their supporting staffs.

These data are of two types, which are useful for different purposes. The average support ratios, presented first, summarize the

experience of all companies in a given industry or size group. 9/ They would be the best measures to use, for example, in estimating overall requirements for supporting personnel in connection with defense planning. Companies interested in comparing their own support ratios with those of other companies in the same industry and size group will, however, find the median and quartile ratios most useful.

Average Support Ratios

The average support ratio for all companies in the survey was 1.5 in January 1952, but the support ratio varied widely among industries. Motor vehicle manufacturers had by far the highest average number of supporting workers per research engineer or scientist (5.2). The electrical machinery industry came next, with a ratio of 2.0. The industries with the lowest ratio (0.7) were those manufacturing transportation equipment other than motor vehicles and aircraft and those making "other chemical products" (table C-14).

When the companies were classified according to size, the average support ratio was found to increase from 0.9 for those with less than 500 employees to 1.3 for those with 500 to 4,999 employees and 1.6 for those with 5,000 or more employees. 10/ Statistical analyses show that the variations in the companies' support ratios were even more closely related to differences in company size than to industry differences. 11/ In general, firms with large staffs have apparently found it feasible to have greater specialization of personnel than is practicable in smaller organizations. The relatively low support ratios of the small companies probably also reflect the fact that such firms often contract out much of their subprofessional work to drafting firms and machine shops, since their volume of work does not warrant the maintenance of a staff to perform these service functions.

Ratios for January 1951, comparable to those for January 1952 already presented, show that the average support ratio for all reporting companies was the same (1.5) in both these months. In more than half of the industries for which separate figures are available, no change in the average ratios occurred over the year, and in all other

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9/ The average ratios were computed by dividing the aggregate number of supporting personnel on the payrolls of the given group of companies by the aggregate number of research engineers and scientists in their employ. Throughout the report, the terms "average" and "mean" denote statistics computed by this method.

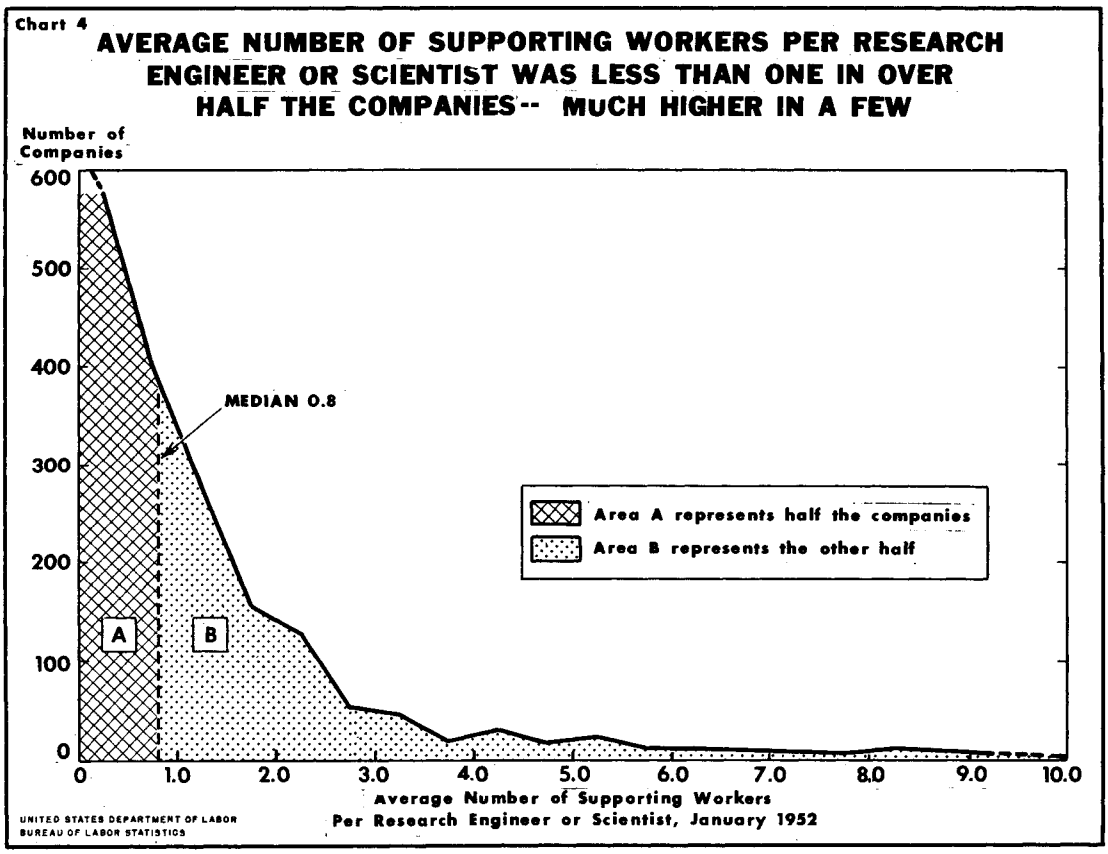
10/ A classification of the firms by size of professional research staffs shows a similar direct relationship between the support ratio and the size of the research program (table C-15).

11/ This conclusion is supported by analysis of variance tests. A memorandum describing the results of these tests has been prepared by the Bureau of Labor Statistics and will be available upon request.

industries, the increase or decrease was small. Apparently, there was no significant increase in utilization of supporting personnel during 1951, despite the shortage of engineers and scientists. In this survey, no information was obtained as to the number of companies which considered that they were already employing as many supporting workers as they could utilize efficiently, nor as to the number which would have liked to expand their supporting staffs but were unable to do so because of labor shortages.

Median and Quartile Support Ratios

The extremely wide range in the support ratios of individual companies is shown in chart 4. Half the companies in the survey reported that the number of supporting workers per research engineer or scientist in their employ was 0.8 or less, but a few firms had support ratios many times as high as this median figure. 12/



12/ The median ratio is the value for the middle company, in a ranking of the companies in order of the size of their support ratios.

The average support ratio for all firms in the survey, as indicated in the last section, was 1.5. There are two reasons why the average was so much larger than the median ratio: (1) The extremely high support ratios reported by a few companies; and (2) the fact that, in most industries, large companies usually had higher ratios than small companies. Both these factors raised the average ratios but did not affect the medians. They are responsible similarly for the substantial difference between the mean (or average) and the median ratios for practically every industry and company size group (table C-14).

The variation in support ratios among companies should be taken into account by any concern wishing to compare its own employment pattern with the survey findings. A ranking of the companies according to the size of their support ratios shows a relatively wide range in ratios even for concerns in the middle half of the distribution--from 0.3 (the lower quartile) to 1.5 (the upper quartile). The range between these two figures (the interquartile range) for companies in a particular industry and size group was somewhat narrower in most cases. Though influenced by both company size and industry, the support ratios in individual organizations apparently depended even more on factors such as varying company personnel policies, the exact nature of the research program, and the availability of technicians in the locality.

In a number of industries, companies with fewer than 500 employees had a lower-quartile support ratio of zero. This means that at least one-fourth of the companies in these categories reported no employment of supporting workers. 13/

13/ The companies which reported that they employed no supporting workers generally had very small research programs. In such organizations, the entire staff involved in research activities may have consisted of professional workers, or, if the company conducting the research program had some other major business, the assistance given the research staff by administrative and other overhead personnel may have been so slight as to be negligible when translated into "full-time equivalent" terms. However, erroneous reporting (misclassification of personnel or failure to count overhead personnel as supporting workers) apparently accounted for the "0" support ratio in some cases.

DISTRIBUTION OF RESEARCH COST

The two basic yardsticks used to gauge the size of a research program are dollars and numbers of employees. These two measures yield similar findings as to the relative magnitude of different programs, since personnel expenses form a sizable proportion of the total cost of research and development projects.

The electrical machinery, aircraft, and chemicals industries, which led in employment of research personnel, also had the highest total research costs (table C-16). They accounted for 54 percent of the total 1951 cost of research and development reported by the companies in this survey. Furthermore, they employed in January 1952, as previously noted, 54 percent of the research engineers and scientists.

In most individual industries, the cost and employment percentages did not agree as closely as these combined totals (table C-2). However, a wide difference was found only in the motor vehicle industry. In dollars, the research and development program of this industry amounted to about 11 percent of the total for all companies in the study and was nearly as large as that of the chemicals industry. Nevertheless, motor vehicle manufacturers employed only about one out of every 30 research engineers and scientists. The major reason for the higher proportion of total costs than of research engineers and scientists in this industry was its relatively high support ratio.

The concentration of research and development activity in the largest companies was greater when measured in terms of financial outlay than is indicated by the employment data (table C-17). The seven companies in the survey which employed 100,000 or more employees were responsible for 26 percent of the 1951 cost, compared with 14 percent of the research engineers and scientists employed in January 1952. In contrast, the 1,339 organizations with fewer than 1,000 employees accounted for only 12 percent of the cost and 18 percent of the research engineers and scientists (table C-3).

A classification of the companies by the size of their professional research staffs likewise shows a higher concentration of research costs than of employment in the largest organizations, although the differential is less. The 18 reporting companies with 1,000 or more research engineers and scientists accounted for 44 percent of the cost of research, compared with 37 percent of the engineering and scientific employment. Conversely, the 1,824 concerns with a total professional research staff of less than 125 did only 21 percent of the research, measured in dollars, but employed 29 percent of the research engineers and scientists (table C-4). The explanation of these findings, as of that for the motor vehicle industry, lies in the support ratios. Since the number of supporting workers employed

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per research engineer or scientist tended to be higher in large than in small organizations (p. 18), the large concerns had a higher percentage of the total cost than of the professional research personnel.

RESEARCH FINANCED BY FEDERAL GOVERNMENT

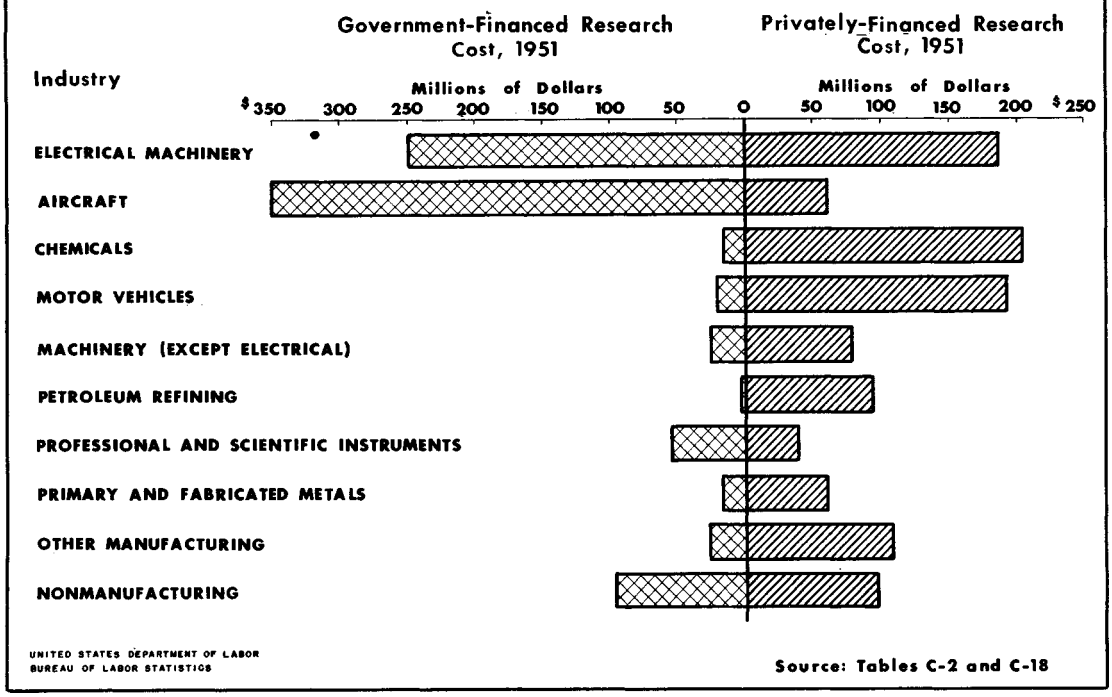
Government-Financed Research as Percent of Total Research Cost

The Federal Government paid for nearly half of the total cost of industrial research and development work performed in this country during 1951. This corresponds closely with the proportion of research engineers and scientists working on Government contracts at the beginning of 1952. About 97 percent of the cost of federally financed research was on work for the Department of Defense or the Atomic Energy Commission.

The predominance of Government-financed research in industries directly related to national defense, and above all in aircraft manufacturing, is evident from the cost data shown in chart 5 (as also from the information on employment of research engineers and scientists on page 10). Eighty-five percent of the aircraft industry's

Chart 5

AIRCRAFT AND ELECTRICAL MACHINERY INDUSTRIES LEAD IN GOVERNMENT-FINANCED RESEARCH--CHEMICALS AND MOTOR VEHICLES IN PRIVATELY-FINANCED RESEARCH



UNITED STATES DEPARTMENT OF LABOR
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Source: Tables C-2 and C-18

1951 research and development cost was on Government contracts. The Government also financed half or more of the research done by the professional and scientific instruments and electrical machinery industries and by commercial consulting and nonprofit research organizations (table 4). In contrast, the chemicals and petroleum industries themselves financed all but 7 percent and 3 percent, respectively, of their total research and development cost. These industries have, however, contributed to defense research to a greater extent than the percentages suggest, since part of their company-financed research activity has had a bearing on defense problems.

The motor vehicle industry also had a large research and development program financed to only a small extent by the Government. Only 9 percent of the cost of research in this industry during 1951 was on Government contracts. However, 23 percent of the industry's research and development engineers and scientists were employed on Government projects. This difference reflects the fact that, in the motor vehicle industry, the average cost of research per engineer or scientist was lower on Government than on other work (p. 34). 14/

Government-financed research was of somewhat greater relative importance in small than in large companies (table C-18). Nearly three-fifths of the cost of research performed by concerns with less than 500 employees was incurred on Government contracts, whereas in larger organizations the proportion was almost one-half. Nevertheless, the total dollar cost of Government research carried out by the companies with 5,000 or more employees far exceeded the total cost of the work done by the much greater number of smaller companies. 15/

When the data are classified according to the size of the companies' professional research staffs, the Government's share of the research and development cost was highest in large organizations, in percentage as well as absolute terms. Fifty-five percent of the cost of research done by companies with 500 or more research engineers and scientists was for work on Government contracts, compared

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14/ In certain industries, other than motor vehicles, lesser differences were found between the percent of research cost on Government contracts and the proportion of research engineers and scientists employed on such work (as may be seen by comparing the figures in tables 2 and 4). These differences can, in some instances, be traced to the same type of cost differential as was noted in the motor vehicle industry, but they were also due in part to other factors. The two sets of figures do not refer to exactly the same period of time. Furthermore, the two sets of data were, of necessity, based on somewhat different groups of companies, since some of those sending in questionnaires did not supply information on employment while others failed to furnish cost data.

15/ These findings agree closely with those regarding the employment of research engineers and scientists on Government contracts (p. 12).

Table 4. Cost of research on Government prime contracts and subcontracts as percent of total research cost, by industry and by size of company, 1951

Item	Estimated cost of research reported (millions)	Percent of research cost on --				
		All types of work	Government contracts			Non-government work
			Total	Prime contracts	Subcontracts	
	A. By industry					
All industries	1/$1,980	100.0	46.8	42.5	4.3	53.2
Manufacturing	1,791	100.0	46.4	42.4	4.0	53.6
Chemicals and allied products	221	100.0	7.1	6.5	.6	92.9
Petroleum refining	98	100.0	3.1	2.7	.4	96.9
Primary metal industries	37	100.0	9.5	7.0	2.5	90.5
Fabricated metal products	41	100.0	31.1	18.9	12.2	68.9
Machinery (except electrical)	104	100.0	23.8	16.6	7.2	76.2
Electrical machinery	437	100.0	57.0	53.7	3.3	43.0
Motor vehicles and equipment	214	100.0	9.4	9.1	.3	90.6
Aircraft and parts	411	100.0	85.1	79.2	5.9	14.9
Professional and scientific instruments	93	100.0	57.3	49.8	7.5	42.7
Other manufacturing	135	100.0	19.7	5.1	4.6	80.3
Nonmanufacturing	189	100.0	50.6	43.7	6.9	49.4
Commercial consulting firms	50	100.0	65.4	49.3	16.1	34.6
Nonprofit research agencies	39	100.0	53.2	50.3	2.9	46.8
Other nonmanufacturing	100	100.0	42.9	38.7	4.2	57.1
	B. By size of company					
All sizes of companies	1/ 1,980	100.0	46.8	42.5	4.3	53.2
Less than 500 employees	146	100.0	57.6	42.0	15.6	42.4
500 - 4,999 employees	346	100.0	49.9	40.9	9.0	50.1
5,000 or more employees	1,488	100.0	45.1	43.3	1.8	54.9

1/ Includes estimates for 181 companies that failed to report cost of research. Estimates are rounded to the nearest million.

with about forty percent or less of the cost reported by companies with smaller research staffs (table C-19). The high figure for large organizations resulted mainly from large Government research contracts in the aircraft and electrical machinery industries.

Even in small companies, Government-sponsored research was conducted mainly on contracts made directly with Federal agencies. In firms with less than 500 employees, the total cost of research on Government prime contracts was nearly three times as great as that of work on subcontracts (table 4). In companies with 500 to 4,999 employees, the corresponding ratio was about 5 to 1 and in those with 5,000 or more employees, nearly 25 to 1. 16/

The proportion of research cost in different industries incurred on Government subcontracts is shown in table 4. These data, like the figures on employment of research engineers and scientists, indicate that subcontracts were of greatest relative importance in the fabricated metal products industry and in commercial consulting organizations. They also show that the dollar value of research work done on subcontracts was greatest in the aircraft industry, which includes many small manufacturers of aircraft parts as well as large companies producing complete aircraft or engines.

Participation of Individual Companies in Government Research

The percentages cited so far are a measure of the extent to which the research and development facilities of different industries and of companies in different size groups were utilized on Government-sponsored research during 1951. To indicate how Government contracts were distributed among individual companies, information has been compiled also on the percentage of the total research cost of each company which was Government-financed.

About 40 percent of the companies in the survey did no Government research during 1951. In several industries, including chemicals and petroleum refining, the proportion of companies without Government research contracts exceeded 50 percent. At the other extreme were the aircraft manufacturers, more than half of which did research only on Government contracts during 1951. In three out of every four companies in this industry, Government-financed research accounted for 83 percent or more of the total 1951 cost of the company's research activities.

In most industries, however, there was wide variation among companies in the degree of participation in Government research. More than one-fourth of the electrical machinery companies, for

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16/ These findings also correspond with those based on information regarding employment of professional research personnel (p. 12).

example, did research only on Government contracts during 1951, whereas another fourth reported that the cost of their Government-sponsored research amounted to only 23 percent or less of their 1951 research cost. The variation was most extreme among the manufacturers of "other transportation equipment" and the commercial consulting firms. Over a fourth of the organizations in both these groups did no Government research at all, though a similar proportion conducted research only on Government contracts (table C-18).

RESEARCH COST AS A PERCENT OF SALES

Administrators in charge of research programs often rely in part on certain rule-of-thumb relationships in the planning and budgeting of their programs. The ratio of research cost to value of sales is one of the most important of these relationships.

The present report contains two types of data on this subject: (1) Overall percentages for different industries and for companies of different sizes; 17/ and (2) median and quartile ratios derived from percentages for individual companies. A businessman interested in comparing the ratio of research cost to value of sales in his own organization with comparable figures for other companies will find the median and quartile ratios most suited to his purpose. The overall percentages are, however, a better indication of the degree of emphasis on research and development in different industries--insofar as this can be determined from a survey limited to companies having research and development programs.

Average Ratios

The cost of research performed during 1951 by the companies in this survey amounted to about 2 percent of the total value of their sales (or services, in the case of research and consulting organizations not producing a physical product). The percent varied widely among industries. Aircraft companies had a far higher figure (13 percent) than any other branch of manufacturing, owing primarily to the many large Government research contracts in this industry and to the fact that, in 1951, mass production of military aircraft was just beginning. The next highest figure for a manufacturing industry (6 percent) was found in the electrical machinery and the professional and scientific instruments industries. These industries also had large defense contracts, but the proportion of research performed for the Government was considerably lower there than in aircraft manufac-

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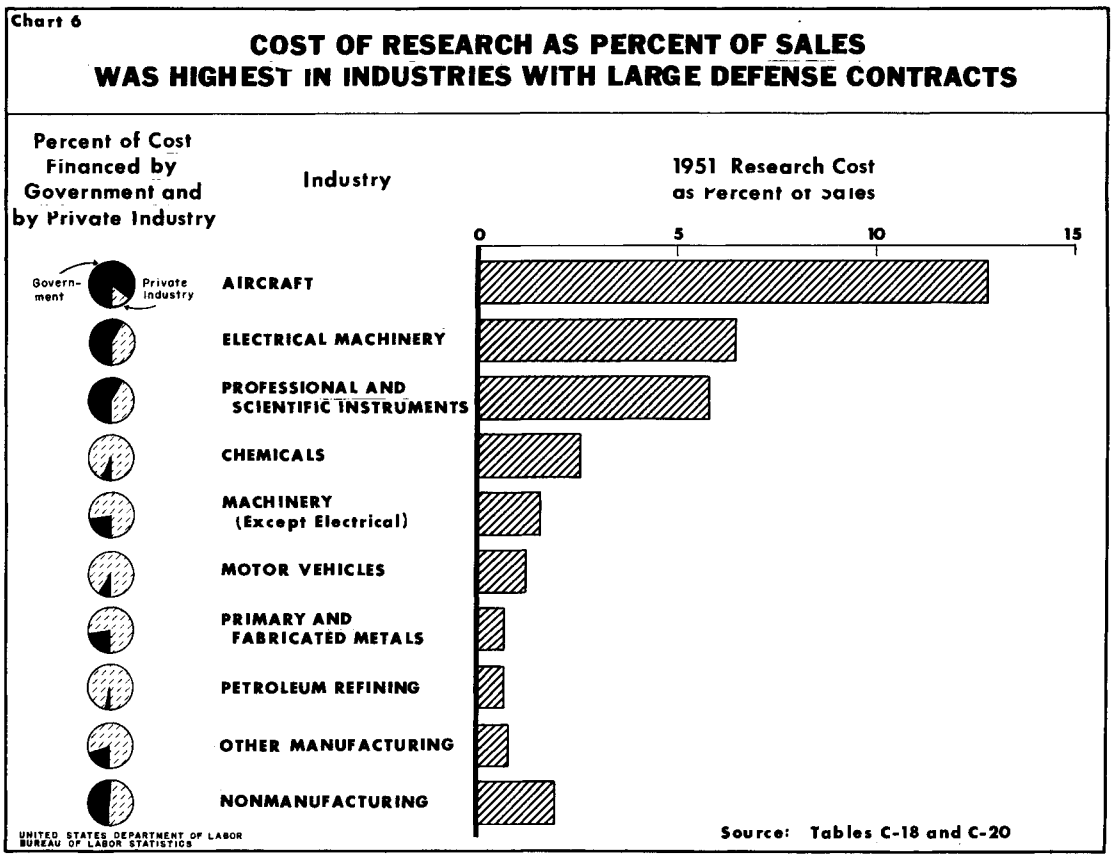
17/ The overall percentages were computed by dividing the total research cost for the companies in the specified industry or size group by the total value of their sales.

turing. At the low end of the scale were the petroleum refining, primary and fabricated metals, and "other" manufacturing industries, where research costs amounted to less than 1 percent of sales (chart 6). However, the total value of sales in these industries was so great that even this low percentage represented a sizable dollar volume of research (chart 5).



In all nonmanufacturing industries taken together, the ratio of research cost to sales or services was 1.8 percent, close to the average for all industries (tables C-20 and C-21). The overall ratio for nonmanufacturing organizations reflects primarily the situation in the telecommunications industry, which accounted for most of the research spending by nonmanufacturing concerns.

Nonprofit research agencies and commercial research services--with research costs amounting to 90 and 47 percent, respectively, of the total value of services rendered--were also included in the nonmanufacturing category. In both these types of organizations, research and development is the major business, not a supporting activity as in manufacturing and telecommunications. However, the total cost of the research performed by these organizations was too small to have much effect on the average ratio for all nonmanufacturing concerns.

Small companies tended to have a higher ratio of research cost to value of sales than large organizations. Those with fewer than 500 employees reported a research cost amounting to about 7 percent of their total sales, whereas the comparable figure for larger companies was about 2 percent. 18/ These data, of course, relate only to companies having industrial research programs. If the survey had covered all industrial concerns, including those without research activities, the finding would undoubtedly have been reversed, since relatively few small companies conduct research. 19/

Median and Quartile Ratios

The relationship between the cost of research in a particular company and that company's total value of sales is the net result of a great number of factors--for example, the products manufactured by the company, its degree of integration, the size of its defense contracts if any, its financial resources and competitive situation, and the policy of the management. The interplay of these factors leads to great variation among companies in the ratio of research cost to sales. One-fourth of the manufacturing companies in the study had ratios of 0.8 percent, or less, whereas another fourth had ratios of 5.6 percent or more. Thus, even if one considers only the companies in the middle half of the distribution, the ratios are found to have a wide range--from 0.8 to 5.6 percent (the upper and lower quartiles).

In some branches of manufacturing the interquartile range was narrower than this (table C-20). In petroleum refining, for example, the lower quartile was 0.4 percent and the upper quartile was 1.5 percent. On the other hand, in the professional and scientific instruments industry the range was from 3.4 to 20.0 percent; in aircraft and parts, from 3.2 to 18.8 percent, in electrical machinery, from 1.9 to 11.1 percent. The extremely wide range in ratios in these three industries undoubtedly reflects, to some degree, the contrasting situation in companies with large defense research contracts and those that did not hold such contracts.

18/ It will be recalled that research cost as a percent of sales for all companies in the survey taken together was also 2 percent. The total value of sales of companies with fewer than 500 employees was so small, relative to the sales of larger companies, that their experience had a negligible effect on the overall average.

19/ This survey included approximately 1 out of every 5 manufacturing companies with 500 or more employees but only about 1 out of 350 manufacturing concerns with fewer than 500 employees. In all size groups, the organizations in the survey are believed to represent the majority of all those conducting industrial research, although the coverage of large organizations was better than that of smaller organizations.

These findings show that no one figure adequately portrays the relationship between research cost and value of sales in an industry. The median ratios do, however, provide a more typical picture of the relationship, as it exists in individual companies, than do the averages discussed in the preceding section.

In manufacturing as a whole, the average and median percentages were the same (2 percent), but the two statistics differed markedly in some industries. In the professional and scientific instruments industry, for example, the average ratio was 6 percent, whereas the median ratio (which, by definition, was equalled or exceeded by the ratios for half of the reporting companies) was 8 percent. The reasons for this difference is made plain by the cost ratios for companies of various sizes. The small instrument manufacturers tended to have higher ratios of research cost to sales than the large ones, and there were so many small companies that their cost ratios largely determined the median. The few large companies, however, had a much greater total value of sales than the small firms, and their ratios, therefore, mainly determined the average.

In aircraft manufacturing, on the other hand, the statistical picture was reversed--the average ratio for the industry (13 percent) was more than half again as high as the median ratio of 8 percent. Here, the explanation lies in the very high ratios of research cost to sales in a few big aircraft companies holding large defense contracts and the lower ratios reported by the greater number of small companies.

For commercial consulting firms the median ratio of research cost to value of services was 77 percent. For nonprofit research agencies it was 100 percent, indicating that at least half the organizations in this category were engaged wholly in research during 1951. In contrast, the median ratio for companies in telecommunications and other nonmanufacturing industries was only about 3 percent. The total number of such companies in the study was very small, however, much smaller than the number of consulting and nonprofit organizations. Consequently, the latter organizations mainly determined the very high median ratio (67 percent) for all nonmanufacturing firms.

RESEARCH COST PER WORKER

Ratios of research cost to research personnel serve a variety of purposes. They are valuable to companies or Government agencies concerned with setting cost standards for their own research activities or those of their contractors. They can also be used to estimate the total cost of employing a specified number of research workers or, conversely, to estimate the personnel required to perform a research project of a given dollar size. Cost per research engineer or scientist is the ratio most useful for some purposes; other purposes are better served by cost data related to total research employment. This report, therefore, presents both kinds of information. As in preceding sections of the report, two types of statistics are given: (1) Average ratios for all companies in different industries and size groups--the figures best adapted for use, for example, in estimating personnel requirements, and (2) median and quartile ratios, which portray the cost experience of individual companies.

COST PER RESEARCH ENGINEER OR SCIENTIST 20/

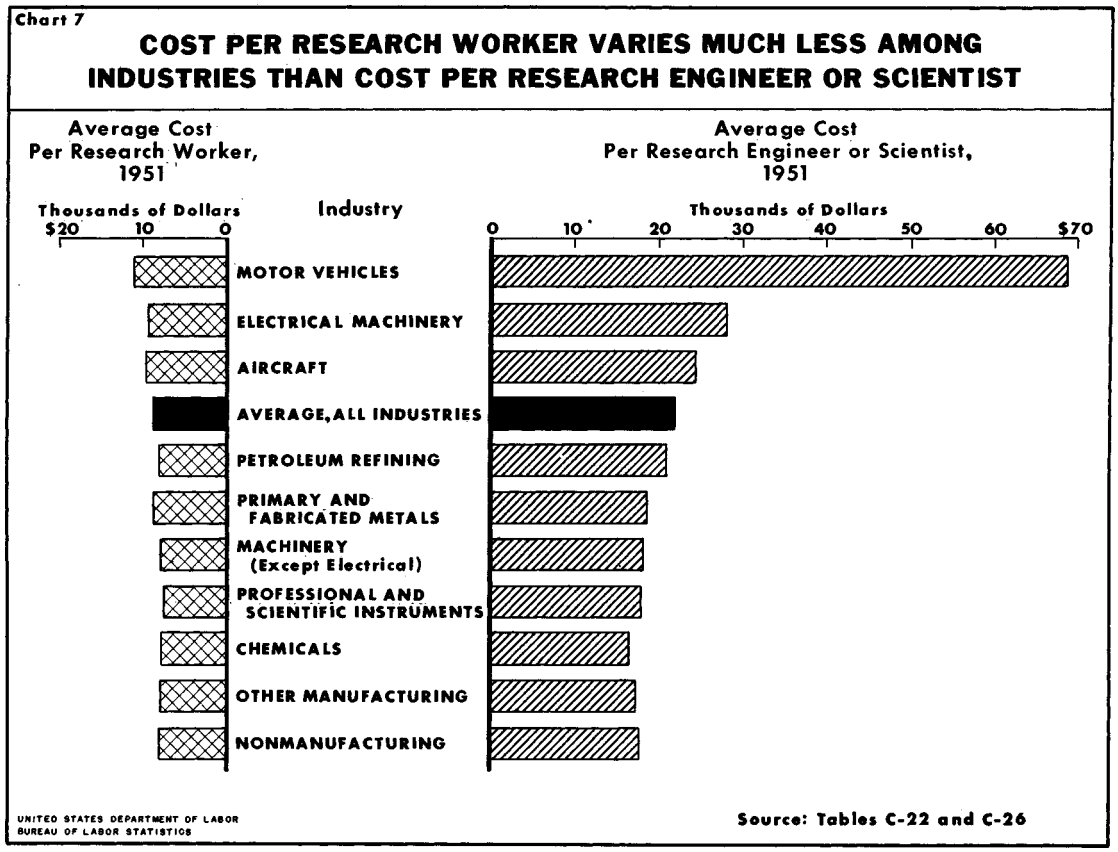
Average Cost Ratios

The average cost per research engineer or scientist was $21,900 in 1951 in all industries taken together. Of the nine branches of manufacturing shown in chart 7, the one with the lowest cost per research engineer or scientist ($16,500) was the chemicals industry.

The highest average cost--$68,600--was that for the motor vehicle industry. This was more than twice the $28,000 for the electrical machinery, the next highest ratio. Differing support ratios largely explain these variations in average cost. As noted earlier, the motor vehicle industry employed a much larger number of supporting workers, relative to the number of research engineers and scientists, than any other branch of manufacturing, whereas the chemicals industry had a rather low support ratio.

Commercial consulting firms and nonprofit research agencies had an average cost per research engineer or scientist of $15,100 and $12,400, respectively. In telecommunications and other nonmanufacturing industries, however, the average cost was $23,300, slightly above the $22,500 average for all manufacturing industries.

20/ Operating cost of all research and development divided by the average of the January 1951 and January 1952 employment of research engineers and scientists.

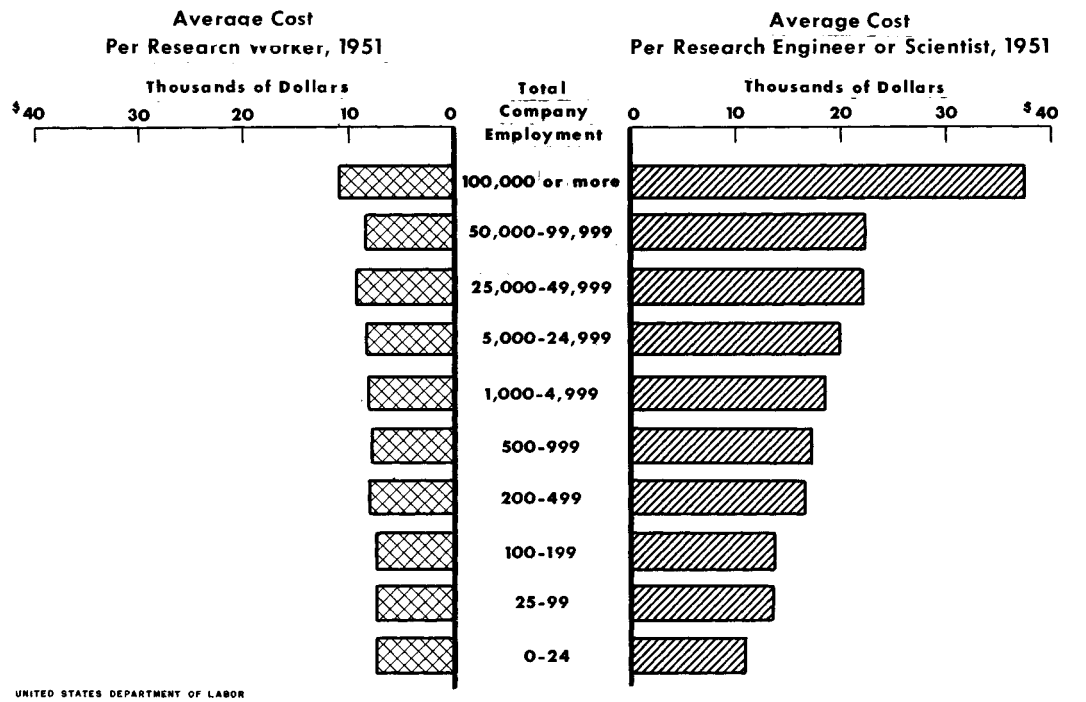


The cost per engineer or scientist also varied directly with the size of the company (chart 8). Thus, the average ratio for companies with less than 500 employees was $14,800, compared with $18,100 for those with 500 to 4,999 employees, and $24,300 for larger organizations (table C-23). A classification of the companies by the size of their research staffs shows a similar relationship--rising cost ratios with increasing research staffs (table C-23). Since support ratios tended to be higher in large than in small organizations, they help to account for the variation in cost among companies in different size groups as well as among those in different industries. 21/

21/ Statistical tests show that about 40 percent of the total variation in average cost per research engineer or scientist among the surveyed companies was accounted for by variation in the support ratio. The differences in average cost among industries and company size groups were also highly significant. A memorandum describing the analysis of covariance test on which these conclusions are based has been prepared by the Bureau of Labor Statistics and will be available upon request.

Chart 8.

LARGE COMPANIES HAVE HIGHER AVERAGE COST PER RESEARCH WORKER THAN SMALL COMPANIES



Median and Quartile Cost Ratios

Chart 9 depicts the survey findings with respect to average cost per research engineer or scientist in individual companies. A few companies reported an extremely high cost, exceeding $60,000 in some instances, but half of the companies had a cost of $13,500 or less.

This median figure was only three-fifths of the average cost per research engineer or scientist for all companies in the study ($21,900). Median cost was lower than average cost in practically every industry and company size group (table C-22). The reasons for these differences are the same as for the similar differences discussed in earlier sections of the report 22/--namely, that a few companies had very high costs and that, in general, large companies reported the highest cost figures.

In any comparison of the survey findings with the cost experience of a specific company, the wide range in cost per research engineer or scientist among the reporting companies should be borne in mind. When these companies are ranked in order of their average costs, the range for organizations in the middle half of the distribution is

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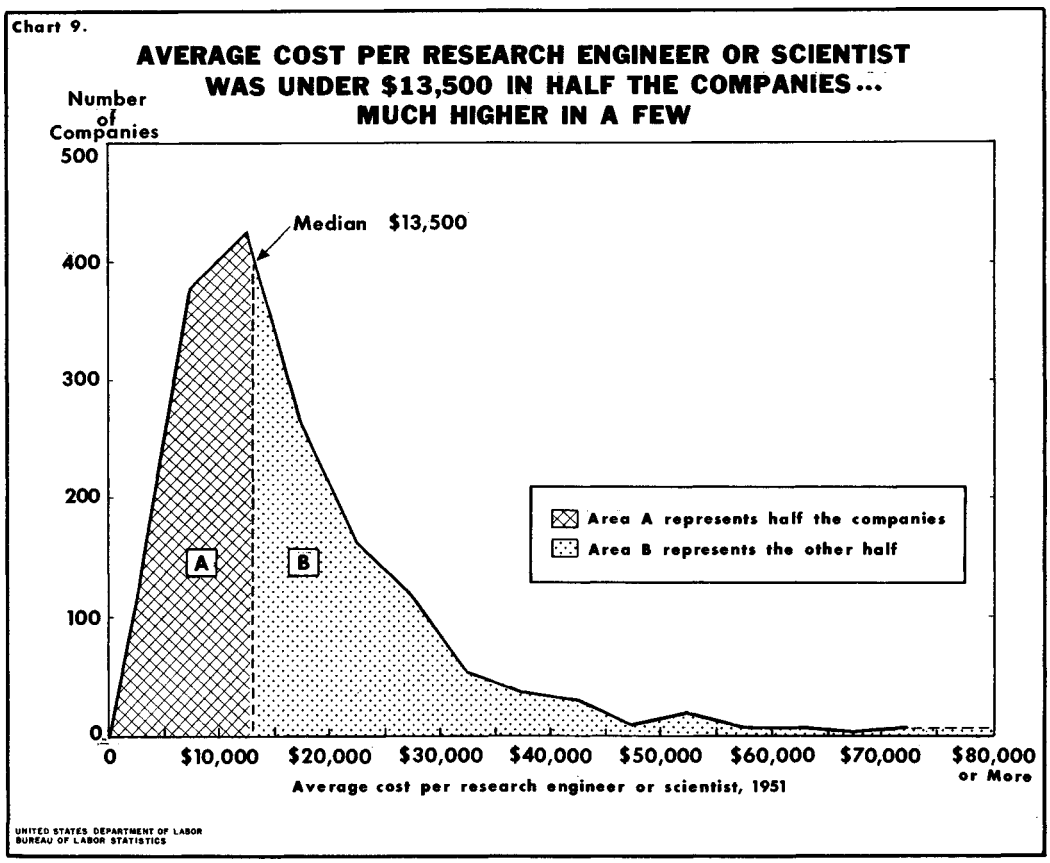
22/ See pp. 20 and 28.

found to be from $8,900 to $20,500 (the lower and upper quartiles). Comparable figures for different industries and company size groups are presented in table C-22. In some industries the interquartile range was narrower than it was for all companies in the survey, but in other industries it was wider. In the chemicals industry, for example, the range was from $7,500 to $16,100 and in petroleum refining from $12,500 to $19,700. In contrast, in the motor vehicle industry the lower quartile was $14,900 and the upper quartile $65,900.

Obviously, the cost per research engineer or scientist in individual companies is greatly influenced by other factors as well as industry and company size. Foremost among these other influences is the extent of utilization of supporting personnel, a particularly important factor in the motor vehicle industry. Other factors which contributed to the variation in costs include differences in annual charges for facilities, equipment and supplies, and wage and salary differentials.

COST PER RESEARCH ENGINEER OR SCIENTIST ON GOVERNMENT-FINANCED RESEARCH

The research which industry conducted for the Federal Government during 1951 cost $23,900 per research engineer or scientist employed. This average figure, which included work on both prime



contracts and subcontracts, was higher by $2,000 than the overall average for both Government and nongovernment work (table 5).

In some industries, Government-sponsored research involved a lower average cost and, in others, a higher average cost than the research financed by the companies themselves. In still other industries no significant difference was found. Aircraft manufacturers, for example, had an average cost per research engineer or scientist of about $24,000 on all their research work and also on Government contracts alone. In the chemicals industry, on the other hand, the cost figure for Government-sponsored research was slightly over $22,000, about $6,000 more than the average for all research activities in these industries. In sharp contrast are the findings for the motor vehicle industry, where the average cost per research engineer or scientist on Government work (approximately $34,000) was only half as great as the average for both Government and nongovernment projects.

The information obtained in connection with this survey does not provide a basis for any detailed analysis of the reasons for these differences. Since many of the companies in the survey had no Government contracts, the cost figures for Government research do not reflect the experience of all the companies included in the overall figures for both Government and nongovernment work. More important, however, is the fact that the types of research done for Government have often differed basically from those conducted by the same company on its own funds.

COST PER RESEARCH WORKER 23/

When research cost is related to total research employment (including supporting personnel as well as engineers and scientist), the result is a series of ratios which are not only lower but much less variable than the ratios discussed in the preceding sections.

The average cost per research worker for all companies was $8,800 in 1951. Among the industries shown in chart 7, average cost ranged from $7,500 for professional and scientific instruments manufacturers to $10,900 for motor vehicle companies. Data for companies of different sizes show a moderate increase in average costs, from

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23/ Operating cost of all research and development divided by the average of the January 1951 and January 1952 employment of all research workers.

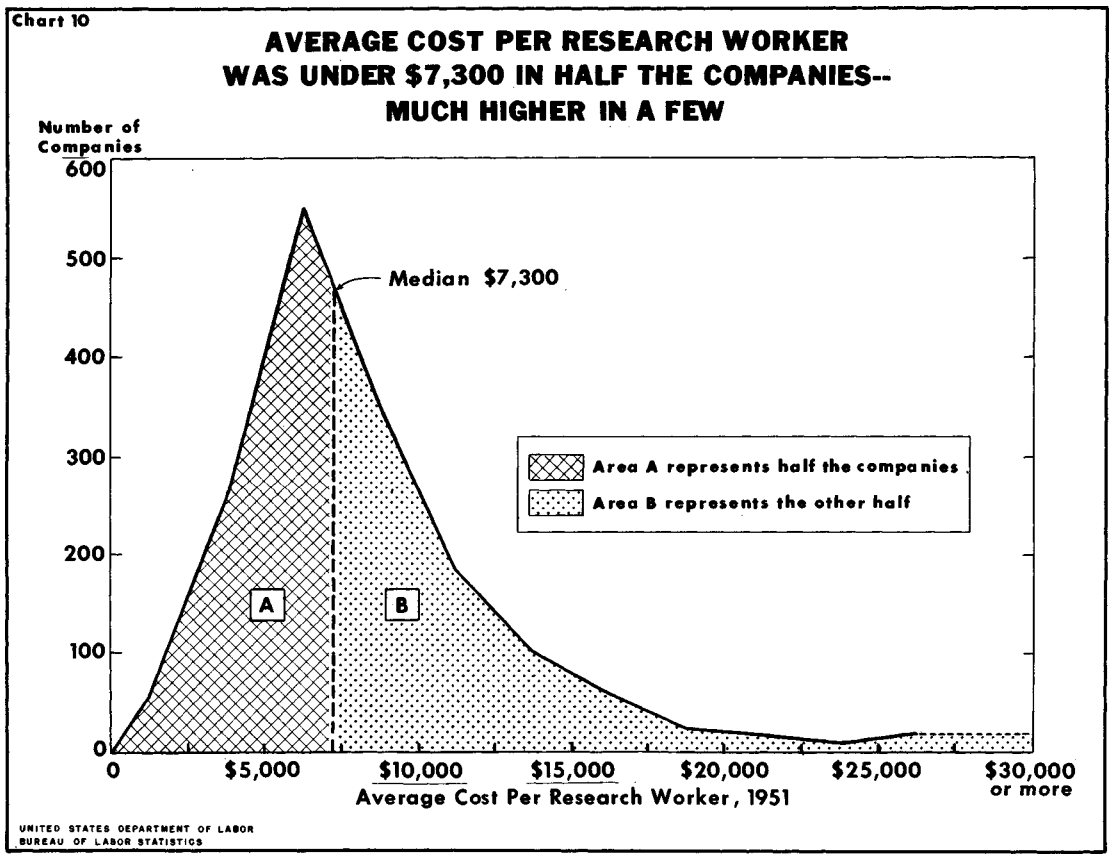
Table 5. Average cost per research engineer or scientist on all research and on Government-financed research, by industry, 1951 1/

Industry	All research	Government-financed research 2/
All industries	$21,900	$23,900
Manufacturing	22,500	24,500
Chemicals and allied products	16,500	22,400
Petroleum refining	20,900	15,800
Primary metal industries	21,500	20,300
Fabricated metal products	16,500	14,900
Machinery (except electrical)	18,300	21,700
Electrical machinery	28,100	29,400
Motor vehicles and equipment	68,600	34,200
Aircraft and parts	24,300	23,700
Professional and scientific instruments	17,900	19,800
Other manufacturing	17,100	17,100
Nonmanufacturing	17,800	20,100
Commercial consulting firms	15,100	15,700
Nonprofit research agencies	12,400	12,800
Other nonmanufacturing	23,300	32,300

1/ Figures rounded to the nearest $100.
2/ Source: tables C-24 and C-25.

$7,700 for companies with fewer than 500 employees to $8,000 for those with 500-4,999 employees and $9,200 for those with 5,000 or more employees. 24/

The findings with respect to cost per research worker in individual companies are summarized in chart 10. Half the companies in the study had a cost per research worker of $7,300 or less. This median figure was lower than the average cost of $8,800 for all reporting companies, but the two statistics were much nearer together than the median and average figures on cost per research engineer or scientist. The explanation of the latter finding is that only a very small number of companies had an exceptionally high cost per research worker, whereas considerably more were found to have an extremely high cost per research engineer or scientist.



24/ A classification of the companies by size of professional research staff showed a similar increase in average costs with the size of the organization. Average cost per research employee, by industry and size of company, is shown in table C-26; comparable data classified by size of professional research staff are presented in table C-27.

For the middle half of the companies, the range in cost per research worker was from $5,200 to $10,000. This interquartile range was less than half as great as the corresponding range in cost per research engineer or scientist. Similarly, in every industry and company size group, the figures on cost per research employee in individual companies varied much less than those on cost per research engineer or scientist. Cost ratios based upon all research employees, including supporting personnel as well as engineers or scientists, do not reflect the wide variation among companies in the utilization of supporting workers.

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TURNOVER OF PROFESSIONAL RESEARCH STAFF

During the past 3 years of partial mobilization, the rate of turnover of engineering and scientific personnel became a matter of grave concern to administrators of research programs and Government agencies responsible for defense manpower problems. On projects essential to the defense effort as well as nondefense projects, losses of professional personnel increased, owing to Reserve and Selective Service calls and to the many favorable employment opportunities open to engineers and scientists. Administrators reported also that replacements were difficult to obtain, because of the personnel shortages in these professions, and that the training of new employees is, at best, a wasteful and time-consuming process.

One of the major aims of the present survey was to provide information on the rate of turnover of professional research staffs and on how much of this turnover was due to withdrawals for military service. Figures on separations of research engineers and scientists were obtained for two periods--the 12 months following the outbreak of war in Korea (July 1950-June 1951) and the subsequent 6 months (July to December 1951). Data for the latter period have been converted to an annual rate basis to facilitate comparisons with data for the preceding year. Information was obtained also on the Reserve and Selective Service status of research staffs at the time of the study, in order to indicate their liability for future military duty.

ANNUAL SEPARATION RATE

The annual separation rate of research engineers and scientists during the last half of 1951 was 16.4 per 100 employed. 25/ Calls for military service were responsible for less than one-fifth of all the separations of research engineers and scientists from July to December 1951. The annual rate of military calls during this period was only 3.0 per 100 professional research workers. Reserve calls averaged 1.8 per 100 workers and Selective Service calls 1.2 per 100 (table C-28).

Factors other than calls to military duty caused the bulk of the separations during this period about 13.4 per 100 research engineers and scientists. These separations included quits, discharges, lay-offs, deaths, and retirements. Although no separate statistics

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25/ Separations include all terminations of employment initiated by either the employer or the employee during the period.

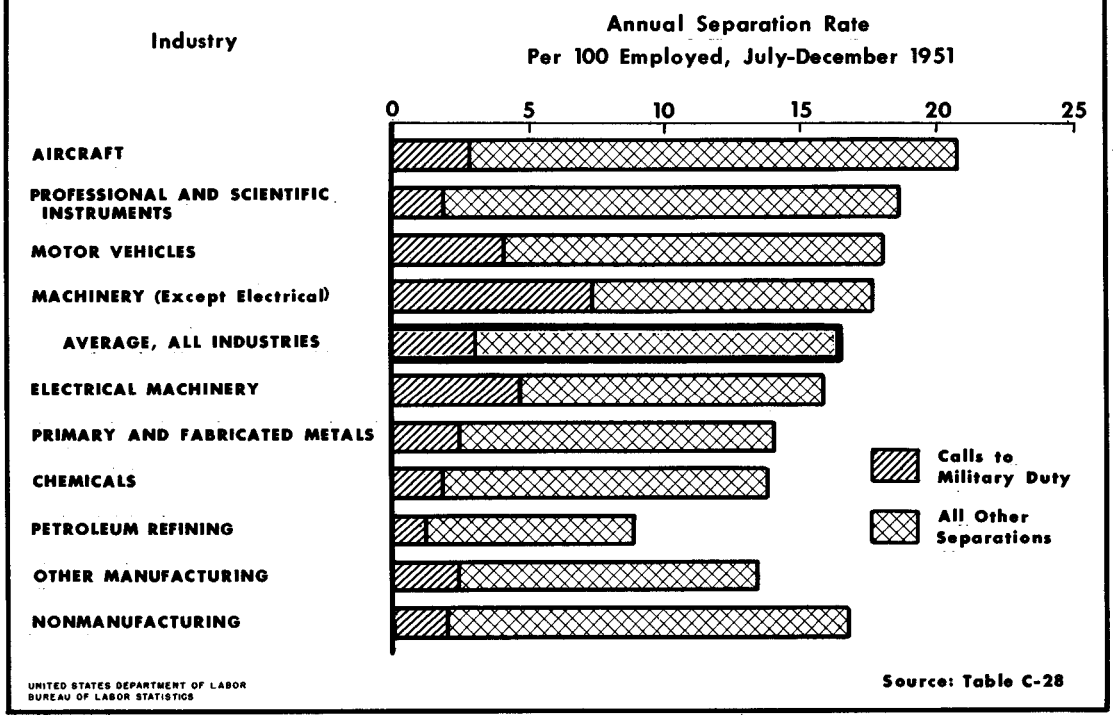
were collected on the reasons for separations (other than military calls), losses due to deaths and retirements accounted for a relatively small proportion of separations. 26/

Petroleum refining was the industry with the lowest separation rate (8.8 per 100 research engineers and scientists). In the aircraft industry, where the tremendous expansion in employment resulting from the defense program led to increased competition for scientific and technical personnel, the separation rate was 20.8 per 100. However, in certain industries with smaller research staffs, the average separation rate was even higher--nearly 25 per 100 in companies manufacturing photographic equipment and supplies and in nonprofit research agencies.

Although the differences among industries in the rate of personnel loss were due largely to factors other than the rate of military calls, separations for military service had a greater impact on some industries than others (chart 11). Companies manufacturing machinery (except electrical) had the highest annual rate of military

Chart 11

MILITARY CALLS ACCOUNTED FOR ONLY A SMALL PROPORTION OF THE SEPARATIONS OF RESEARCH ENGINEERS AND SCIENTISTS IN 1951



26/ Statistics on the white male population as a whole indicate that the annual rate of deaths and retirements is about 2 per 100 employed workers. See U. S. Department of Labor, Bureau of Labor Statistics, Bulletin No. 1001, Tables of Working Life, August 1950.

calls (7.2 per 100 engineers and scientists). The lowest rate (1.2 per 100) was found in the petroleum industry and the nonprofit research agencies.

There was no consistent relationship between the rate of personnel turnover and the size of a company. In some industries, the companies with the smallest number of employees had the highest turnover rate. However, in other industries, the medium-sized and large companies fared worse than the small ones (table C-29).

A comparison of these separation rates for the last half of 1951 with comparable figures for the preceding 12 months shows a marked increase in turnover among research engineers and scientists. The annual separation rate of 16.4 per 100 professional research workers for all the reporting companies during July-December 1951 was 18 percent higher than the rate of 13.9 during the year from July 1950 to June 1951. Personnel losses became more frequent in practically every industry and in companies of all sizes (tables C-28 and C-30). 27/

There was no change in the rate of Reserve calls between the two periods, taking all industries together. The rate of withdrawals due to Selective Service rose by 50 percent (from 0.8 to 1.2 per 100 engineers and scientists), but such separations were too few to be a major factor in the overall increase in personnel losses. Most of the increase was in separations for reasons other than military service--no doubt, mainly transfers to other more attractive employment.

LIABILITY FOR MILITARY SERVICE

Although Reserve and Selective Service calls did not cut deeply into the national supply of research engineers and scientists during the last half of 1950 or 1951, the future effect of military demands on such personnel could be more serious. As of January 1952, 19 percent of the engineers and scientists in the study were members of the Reserves or National Guard and were therefore liable for military service. Another 6 percent were classified 1A or 2A by Selective Service (available for service or granted temporary occupational deferments). The total number of men in these categories was approximately 24,000, out of the 95,700 engineers and scientists of both sexes in the study.

The relative numbers of professional research workers who were reservists or classified 1A or 2A as of January 1952 varied

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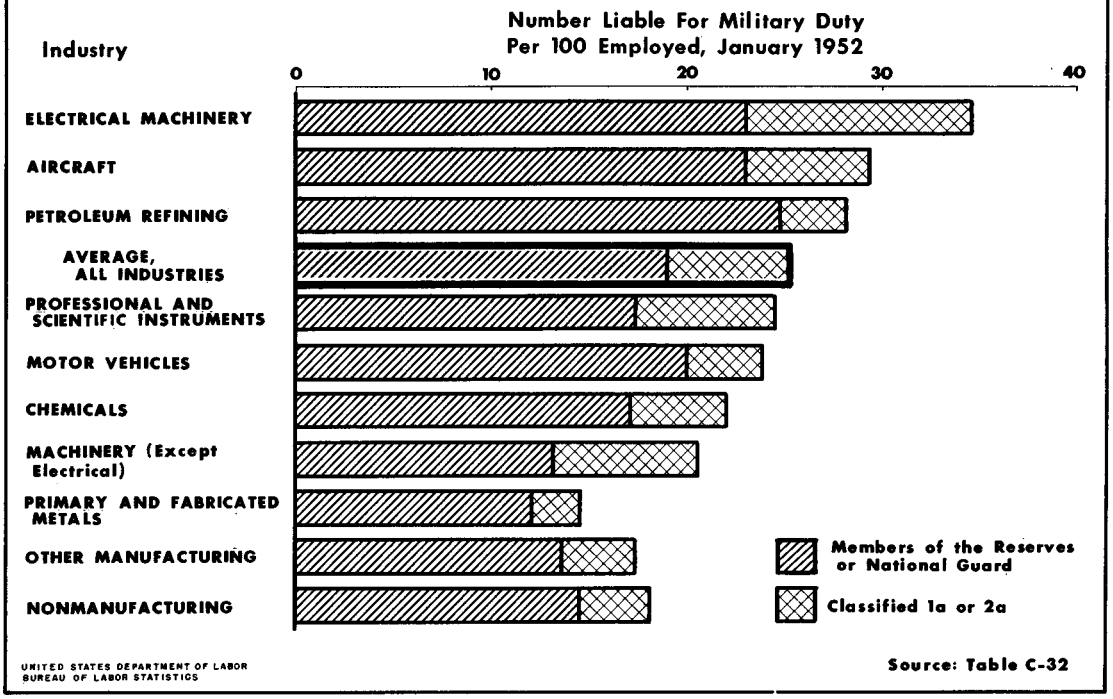
27/ Annual separation rates are also classified by size of professional research staff (table C-31).

considerably from one industry to another (chart 12). The proportion was highest in the two industries most extensively engaged in defense research--electrical machinery (35 percent) and aircraft (29 percent). Of the major industries shown in the chart, primary and fabricated metal products had the lowest proportion (15 percent) of the professional research staff in the categories most liable to military duty.

Chart 12

A SIZABLE PROPORTION OF RESEARCH ENGINEERS AND SCIENTISTS ARE LIABLE FOR MILITARY DUTY



In general, large companies were in a somewhat more vulnerable position than small ones with respect to the military status of their engineers and scientists. Twenty-nine percent of the professional research personnel employed by companies with 5,000 or more employees were members of the Reserves or classified 1A or 2A as of January 1952 (table C-32). The comparable figure for companies with 500-4,999 employees was 19 percent and for those with fewer than 500 employees, 15 percent. It is likely that large companies have, in the past several years, hired relatively more new graduates than smaller companies and that they therefore have a higher proportion of young men on their staffs. 28/

28/ Figures classified according to the size of the companies' professional research staffs likewise show that the proportion of research engineers and scientists liable to military service tended to be greater in large than in small organizations (table C-33).

It should be noted that all these data on the liability of research engineers and scientists to military service relate to the situation in January 1952. Since then, a considerable change in the proportion of professional research workers liable for military duty has probably taken place, since men are constantly leaving and others entering the Reserve and the various Selective Service categories. In early 1953, many reserve officers had to reapply for their commissions in order to keep their reserve status; a substantial number did not sign up again. Offsetting the reduction in reserve forces due to resignations, retirements, and deaths is the fact that many recent engineering and science graduates have been liable for military duty. Most men graduating from college are subject to the provisions of the Selective Service Act. In addition, a considerable number of male graduates have been commissioned in the Organized Reserves after completing Reserve Officers' Training Corps programs.

Under present legislation, nearly every young man has an obligation to serve for a total of 8 years, including both active duty and service in the Reserves. Thus, there is a strong likelihood the number of persons in the Reserves will increase in the future and will become an even more important problem in scientific manpower planning.

APPENDIX A

SCOPE AND METHOD OF SURVEY

SCOPE AND METHOD OF SURVEY

HOW THE SURVEY WAS MADE

This study of industrial research is based on a mail survey conducted from May to August 1952 by the Research and Development Board of the Department of Defense. Plans were developed and the questionnaire was drafted by the Board, in consultation with the Bureau of Labor Statistics, other Government agencies, and several companies with large research and development programs. The questionnaire is reproduced in Appendix B.

The Bureau of Labor Statistics prepared this report in cooperation with the Research and Development Board. The Bureau was responsible for the editing and coding of the returns and the planning and preparation of both the statistical tabulations and the analytical report.

In an effort to inventory all industrial research in the United States, a mailing list of more than 5,000 companies was compiled. It included all companies listed in the National Research Council's volume, Industrial Research Laboratories of the United States, 1950 and any additional firms included in lists of the following: The 1,000 largest manufacturing companies in the country, companies holding research and development contracts with the Department of Defense, the 100 largest Department of Defense production contractors; and other selected groups, such as engineering firms and consulting laboratories. Some additional companies having research programs were located through the wide publicity given to this survey by newspapers and technical and trade journals.

The mailing of survey schedules began in May 1952. Nonrespondents were sent follow-up letters in July 1952. By mid-October 1952, when the survey was closed, some 3,000 companies had responded. Of these, 1,953 submitted usable questionnaires. 29/ Some 1,000 replies were received from companies which said they had no research program. Several companies, including a few with large research programs, stated that they could not supply the requested data, either because of the cost of assembling the information or because they considered such data confidential.

Although 1,953 companies sent in usable schedules, not all of them supplied data on every item in the questionnaire. For example, 181 of the reporting companies failed to report their 1951 research

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29/ The criterion used in evaluating the usability of a completed schedule was that the company must have reported at least one of the following items: Cost of all research, number of research workers, or number of research engineers and scientists.

cost, 134 did not indicate the number of research employees in 1952, and 138 did not report the number of research engineers and scientists. Estimates were made of these three items for each of the nonreporting companies, and these estimates have been included in the data presented in charts 1, 2, and 5, and in tables 2, 3, 4, C-2, C-3, C-4, C-13, and D-3. The remaining charts and tables are based wholly on data actually reported by the companies in the survey.

PROBLEM OF DEFINITION

Scientific research and development work was defined as follows in the questionnaire: 30/

> Basic and applied research in the sciences (including medicine), and in engineering; and design, development, and testing of prototypes and processes. Excludes quality control, product testing, market research, sales promotion, sales service, and research in the social sciences and psychology.

The possible lack of uniformity in the interpretation of definitions is perhaps the most important limitation that must be taken into account in the analysis of the results of this survey. A particularly difficult problem in connection with the definition of research and development arose from the fact that in some industries the line of demarcation between development and production is often hazy. In the aircraft industry, for example, the production of new models may begin before all details of the design are final. Furthermore, in many industries it is often necessary to make engineering changes and adaptations in products. In such cases, it is almost impossible to determine precisely where developmental processes end and production work begins, and the companies' judgment on this matter may well have varied.

Even companies that could clearly differentiate research and development from related activities sometimes had difficulty in ascertaining the cost of their research programs and the number of their research employees. Many companies did not have accounting systems which could readily provide the requested cost data. Similarly, some respondents did not have exact records on personnel allocated to research and development work. This difficulty was encountered especially in companies where the research personnel were engaged intermittently in research and nonresearch activities. Another problem of definition arose from the fact that the companies were asked to include in their figures on research employment "a proportionate share of overhead personnel (administrative, clerical,

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30/ The questionnaire, which also contains definitions of other terms, is reproduced in Appendix B.

maintenance, etc.)." The extent to which overhead personnel were allocated to research and development work undoubtedly varied somewhat among the reporting companies. Still another possible source of difficulty was the fact that companies were asked to include in the employment figures the full-time equivalent (based on the company's average workweek) of employees engaged part-time in research work.

These difficulties in obtaining precise statistics on research and development activities were anticipated when the survey was planned. The survey questionnaire stipulated that reasonable estimates of research and development expenditures and manpower would be sufficient.

Despite these limitations, the findings of this survey are believed to give a satisfactory general picture of the scope and distribution of industrial research activities. The reader should, however, bear in mind the approximate nature of the figures, particularly those for the more detailed classifications of companies.

CLASSIFICATION OF DATA

In this survey, respondents were requested to supply information on a "company" basis. After consultations with industry representatives and other persons, it was judged that the only practicable way to obtain the needed data on research and development programs was to ask each company to submit one consolidated return. One reason for the decision was that in many companies, large as well as small, the major part of the research activity is organized and controlled at the company level. To avoid duplicate reporting and, at the same time, to reduce the work involved in filling out the questionnaire, each company was asked to exclude from its return all scientific research and development done by subsidiaries and affiliates--which were sent separate questionnaires.

In the statistical tabulations, the data have been classified in several ways--by industry, by the company's major research specialty, by size of company, and by size of the company's professional research staff. Though the conduct of the study was facilitated by the fact that only one consolidated return was submitted by each company, this created problems in connection with the classification of data by industry and research specialty, as indicated by the following discussion and by the discussion of the research specialty classification in Appendix D.

Industry

In Item 12 of the questionnaire, a list of 41 industries was provided, and each company was asked to check the one of these

industries which accounted for the largest portion of its total sales. The 41 industries have been consolidated into smaller numbers of industry groups in the tables and charts.

In comparing the findings of this study with other statistics classified by industry, it should be noted that, in most such statistics, the unit classified is an establishment rather than a company. Even where the classification is based on establishments, figures for particular industries generally include some "secondary products" within the purview of other industries. In the present study, this problem is greatly magnified, particularly in the case of large, multiestablishment companies with a number of different products or with integrated operations.

It should be noted also that a company's principal research field does not always correspond with its principal production field. For example, companies seeking greater diversification are likely to concentrate their research activities in new areas.

Size

Reporting companies were classified on the basis of two different size groupings: The size of the company (based on total company employment in January 1952); and the size of the company's professional research staff (based on number of research engineers and scientists in January 1952). The classification by size of company is a grouping widely used in analysis of economic data and probably the one of most interest to businessmen and business analysts. This size classification also facilitates the comparison of the results of the survey with findings from other surveys of industrial research and development.

The classification of data by the size of the company's professional staff directs attention to the scale of the company's research program. It is useful in analysis of data pertaining to research resources for the following reasons: (a) The number of research engineers and scientists employed is one of the most important factors determining a company's ability to perform research; and (b) within groups of companies classified according to the number of research engineers and scientists, there is likely to be greater homogeneity with respect to research and development programs than is the case among companies grouped according to other size criteria.

APPENDIX B

LETTERS AND SCHEDULE

RESEARCH AND DEVELOPMENT BOARD
WASHINGTON 25, D. C.

1 July 1952

Dear Sir:

The Research and Development Board, as you know, is undertaking a national mail survey of industrial research and development. Copies of the questionnaire for this project were sent you in May. We send them to you again with this letter because we have had no reply from you since our first mailing early in May, and we want to be sure you are counted.

Our purpose is to obtain statistics on the research and development practices and potential of American industry. In the course of the current defense effort, we have all observed that increasing demands for technical manpower and facilities create difficult problems. If we know more about the nation's research and development capacity and the effect of military calls on it, we can perhaps help ease some of these problems. We should be able to plan military research and development more intelligently when we know more about how you in industry use your research scientists and engineers. Should a greater national emergency suddenly be forced on us, we will need to know more than we do now about the location of specific research resources. In the course of the project, we may locate some facilities which even now are available and needed for military research and development projects.

Replies are already in from about 2500 companies. But the project will be more useful if we get a much larger return as soon as possible. So I hope that if you have not replied you will do so very soon. A reply does not obligate your company in any way, and your information will be kept in strict confidence. If your reply has been delayed because you can supply some, but not all, of the information we seek, send us what you can.

And, of course, if your reply has been sent recently, or if you have written us about the project and are waiting for our answer, forgive this duplication.

Sincerely,

Walter G. Whitman

WALTER G. WHITMAN, Chairman

RESEARCH AND DEVELOPMENT BOARD
WASHINGTON 25, D. C.

Dear Sir:

This is the second year of our current defense effort. In many ways it will be one of the most difficult. Among the pressing problems we face is the increasing demand for technical manpower and facilities which has been created by the expanded defense program.

The Research and Development Board of the Office of the Secretary of Defense is, therefore, vitally interested in determining industry's research and development capacity and the past and potential effect of military call-ups on this capacity. The Board also wishes to assist the military departments in locating possible contractors for research and development projects.

All industrial organizations known to perform scientific research and development are being asked to help by completing the accompanying questionnaire. While some of the requested information is now available, it is unstandardized, incomplete, and often inaccurate. If your company does no research or development, please complete only the tear sheet attached to the questionnaire.

Your reply, of course, will not obligate your company in any way. It will be kept in strict confidence, and published information will not permit identification of individual firms.

Sincerely,

Walter G. Whitman

WALTER G. WHITMAN
Chairman

SECURITY INFORMATION **CONFIDENTIAL** *(Classified Only When Data Is Entered)*

Budget Bureau No. 22-5204
Approval Expires 31 Aug 52

SURVEY OF INDUSTRIAL RESEARCH AND DEVELOPMENT

INSTRUCTIONS

This questionnaire is concerned with all scientific research and development[1] conducted by your company and its divisions. In order to avoid duplication, please exclude all subsidiaries and affiliates.

Since accounting procedures for scientific research and development vary widely among companies, reasonable estimates will be satisfactory. Please enter the word "none" where appropriate, rather than leaving a blank.

GENERAL *(Reasonable estimates will be sufficient)*

1. WHAT WAS THE TOTAL NUMBER EMPLOYED BY YOUR COMPANY IN ALL OF ITS ACTIVITIES IN JANUARY 1952?	
2. WHAT WERE YOUR COMPANY'S TOTAL SALES *(or total value of services, if more appropriate)* IN ALL OF ITS ACTIVITIES IN CALENDAR 1951?	$

COST INFORMATION *(Reasonable estimates will be sufficient)*

3. WHAT WAS THE TOTAL OPERATING COST OF ALL RESEARCH AND DEVELOPMENT PERFORMED WITHIN YOUR COMPANY IN CALENDAR 1951? *(Operating cost is the cost of direct labor and materials plus the proportionate share of overhead costs--administration, maintenance, rent, depreciation, etc.)*	$
4. HOW MUCH OF THIS TOTAL OPERATING COST WAS FOR RESEARCH OR DEVELOPMENT PERFORMED ON:	
PRIME CONTRACTS FROM THE FEDERAL GOVERNMENT	$
SUBCONTRACTS FROM OTHER COMPANIES FOR WORK FOR THE FEDERAL GOVERNMENT	$
TOTAL	$

MANPOWER INFORMATION *(Reasonable estimates will be sufficient)*

Questions 5 - 8 refer to the number engaged full time in research or development plus the full time equivalent (based on your current average work week) of those working part time.

5. HOW MANY OF YOUR COMPANY'S EMPLOYEES, INCLUDING A PROPORTIONATE SHARE OF OVERHEAD PERSONNEL *(administrative, clerical, maintenance, etc.)* WERE ENGAGED IN RESEARCH OR DEVELOPMENT:		
JANUARY 1951		
JANUARY 1952		
6. HOW MANY OF YOUR COMPANY'S ENGINEERS AND SCIENTISTS[2] WERE ENGAGED IN RESEARCH OR DEVELOPMENT:		
JANUARY 1951		
JANUARY 1952		
7. HOW MANY OF YOUR COMPANY'S ENGINEERS AND SCIENTISTS WERE ENGAGED IN RESEARCH OR DEVELOPMENT ON:	JANUARY 1951	JANUARY 1952
PRIME CONTRACTS FROM THE FEDERAL GOVERNMENT		
SUBCONTRACTS FROM OTHER COMPANIES FOR WORK FOR THE FEDERAL GOVERNMENT		
TOTAL		

8. ASSUMING THAT:
   a. NEW RESEARCH OR DEVELOPMENT DEFENSE CONTRACTS ARE AVAILABLE FOR PROJECTS ON WHICH YOUR COMPANY IS WILLING TO WORK,
   b. THERE IS NO CHANGE IN THE SIZE OF YOUR SCIENTIFIC RESEARCH AND DEVELOPMENT TECHNICAL STAFF, AND
   c. THE DEFENSE EFFORT CONTINUES AT THE PRESENT LEVEL,

   WHAT IS THE MAXIMUM NUMBER OF ENGINEERS AND SCIENTISTS YOUR COMPANY WISHES TO ASSIGN DURING THE REMAINDER OF CALENDAR 1952 TO NEW PRIME CONTRACTS OR SUBCONTRACTS FOR RESEARCH OR DEVELOPMENT FOR THE DEFENSE PROGRAM OF THE FEDERAL GOVERNMENT? *(Your answer will neither obligate your company in any way to accept contracts nor will it obligate the Federal Government in any way to offer contracts).*

9. HOW MANY OF YOUR COMPANY'S ENGINEERS AND SCIENTISTS PRIMARILY ENGAGED IN SCIENTIFIC RESEARCH OR DEVELOPMENT IN JANUARY 1952 HAD THE FOLLOWING MILITARY STATUS:	
MEMBERS OF MILITARY RESERVES OR NATIONAL GUARD	
CLASSIFIED 1-A *(available for induction)* OR 2-A *(deferred because of civilian employment)* *Only males between the ages of 18½ and 26 can be so classified*	

10. HOW MANY ENGINEERS AND SCIENTISTS PRIMARILY ENGAGED IN RESEARCH OR DEVELOPMENT LEFT THE EMPLOY OF YOUR COMPANY DURING THE FOLLOWING PERIODS *(exclude transfers within the company)*:

REASON FOR LEAVING	JULY 1950-JUNE 1951	JULY 1951-DEC 1951
MILITARY RESERVE CALL		
SELECTIVE SERVICE CALL		
ALL OTHER SEPARATIONS *(Resignation, dismissal, retirement, death, etc.)*		
TOTAL		

[1] *Basic and applied research in the sciences (including medicine), and in engineering; and design, development and testing of prototypes and processes. Excludes quality control, product testing, market research, sales promotion, sales service, and research in the social sciences and psychology.*

[2] *Individuals with at least a bachelor's degree in engineering or science, or the equivalent in experience or training.*

RDB FORM 148
1 MAY 52

(Classified Only When Data Is Entered) **CONFIDENTIAL** SECURITY INFORMATION

SECURITY INFORMATION **CONFIDENTIAL** *(Classified Only When Data Is Entered)*

CHECK LIST OF SPECIALTIES

The defense agencies wish to know the areas of research and development in which industrial organizations are qualified and, in addition, the areas in which they might wish to undertake additional defense work. The following check list of research and development specialties, while it does not strictly follow an industrial classification pattern, is in the form of greatest use to the defense agencies. Your response will neither obligate your company in any way to accept contracts nor will it obligate the defense agencies in any way to offer contracts.

11. IN THE COLUMNS HEADED: **QUALIFIED**

a. RATE ("A", "B", "C") THE THREE ***BROAD AREAS*** IN WHICH YOUR COMPANY HAS GREATEST COMPETENCE.

b. CHECK *(X)* ALL OTHER ***BROAD AREAS*** IN WHICH YOUR COMPANY IS QUALIFIED.

c. CHECK *(X)* UNDER ***EACH*** BROAD AREA THE ***SPECIALTIES*** IN WHICH YOUR COMPANY IS QUALIFIED.

IN THE COLUMNS HEADED: **NEW DEFENSE WORK**

CHECK *(X)* ALL ***SPECIALTIES*** IN WHICH YOUR COMPANY WISHES TO ASSIGN ANY OF ITS PRESENT STAFF OF ENGINEERS AND SCIENTISTS OR ITS PHYSICAL FACILITIES TO ***NEW*** DEFENSE CONTRACTS AT SOME TIME DURING CALENDAR 1952. ***(Refer to assumptions in Question 8.)***

QUALIFIED: BROAD AREAS	QUALIFIED: SPECIALTIES		NEW DEFENSE WORK: ENGINEERS AND SCIENTISTS	NEW DEFENSE WORK: FACILITIES *(Buildings and Equipment)*
☐ (01)		**AIRCRAFT ARMAMENT**		
	(01)	BOMBING SYSTEMS AND EQUIPMENT		
	(02)	FIRE CONTROL SYSTEMS		
	(03)	GUNS		
	(04)	MUNITIONS		
	(05)	TESTING AND EVALUATION		
☐ (02)		**AIRCRAFT EQUIPMENT**		
	(01)	AUTOMATIC CONTROL SYSTEMS		
	(02)	ELECTRICAL SYSTEMS		
	(03)	INSTRUMENTATION		
	(04)	MECHANICAL SYSTEMS		
	(05)	PARACHUTES		
	(06)	TESTING AND EVALUATION		
☐ (03)		**AIRCRAFT, PILOTED**		
	(01)	AERODYNAMICS AND STRUCTURES		
	(02)	CATAPULTS AND ARRESTING GEAR		
	(03)	HYDRODYNAMICS		
	(04)	PROPULSION		
	(05)	TESTING, AIRCRAFT FLIGHT		
	(06)	TESTING, PROPULSION SYSTEMS		
☐ (04)		**ATOMIC ENERGY**		
	(01)	PHYSICAL EFFECTS		
	(02)	RADIOLOGICAL INSTRUMENTATION		
	(03)	REACTORS		
	(04)	WEAPONS RESEARCH		
☐ (05)		**BASIC NATURAL SCIENCES**		
	(01)	BIOLOGY		
	(02)	CHEMISTRY		
	(03)	MATHEMATICS		
	(04)	PHYSICS		
☐ (06)		**BIOLOGICAL WARFARE**		
	(01)	AGENTS FOR CROPS, ANIMALS AND MAN		
	(02)	PROTECTION		
	(03)	METHODS OF DISSEMINATION		

QUALIFIED: BROAD AREAS	QUALIFIED: SPECIALTIES		NEW DEFENSE WORK: ENGINEERS AND SCIENTISTS	NEW DEFENSE WORK: FACILITIES *(Buildings and Equipment)*
☐ (11)		**GEOPHYSICS AND GEOGRAPHY**		
	(01)	ATMOSPHERE *(General)*		
	(02)	ATMOSPHERIC PHYSICS		
	(03)	CARTOGRAPHY		
	(04)	GEODESY		
	(05)	GEOLOGY		
	(06)	GEOMAGNETISM AND ELECTRICITY		
	(07)	HYDROLOGY		
	(08)	IONOSPHERE		
	(09)	METEOROLOGICAL EQUIPMENT		
	(10)	OCEANOGRAPHY		
	(11)	PHOTOGRAMMETRIC EQUIPMENT		
	(12)	PHOTO INTERPRETATION		
	(13)	SEISMOLOGY		
	(14)	SOIL MECHANICS		
	(15)	WEATHER FORECASTING		
☐ (12)		**GUIDED MISSILES**		
	(01)	AERODYNAMICS AND STRUCTURES		
	(02)	COUNTERMEASURES		
	(03)	GUIDANCE AND CONTROL		
	(04)	LAUNCHING AND HANDLING		
	(05)	PROPULSION AND FUELS		
	(06)	TARGET DRONES		
	(07)	TEST RANGE PROCEDURES AND INSTRUMENTATION		
	(08)	TEST AND TRAINING EQUIPMENT		
	(09)	WARHEADS AND FUZES		
☐ (13)		**MEDICAL SCIENCES**		
	(01)	ANTIBIOTICS		
	(02)	ATOMIC MEDICINE		
	(03)	AVIATION MEDICINE		
	(04)	BACTERIOLOGY		
	(05)	DENTISTRY		
	(06)	DISEASE		

☐ (07)		**CHEMICAL WARFARE**	
	(01)	AGENTS *(War Gases, Screening Smokes and Incendiaries)*	
	(02)	PROTECTION	
	(03)	MUNITIONS, WEAPONS & DISSEMINATION	
☐ (08)		**ELECTRONICS**	
	(01)	ACOUSTICS	
	(02)	ANTENNAS AND PROPOGATION	
	(03)	COMMUNICATION	
	(04)	COMPONENTS	
	(05)	ELECTRON TUBES	
	(06)	ELECTRONIC COUNTERMEASURES	
	(07)	INFRARED	
	(08)	INTERFERENCE REDUCTION	
	(09)	RADAR AND RELATED FIELDS	
	(10)	TEST EQUIPMENT	
☐ (09)		**EQUIPMENT AND SUPPLIES**	
	(01)	CLOTHING AND PERSONAL	
	(02)	ELECTRICAL	
	(03)	FOOD	
	(04)	HEAVY EQUIPMENT AND ENGINEERING CONSTRUCTION	
	(05)	MAINTENANCE EQUIPMENT AND UTILITIES	
	(06)	MARINE CRAFTS AND ASSOCIATED HYDRODYNAMICS	
	(07)	MECHANICAL	
	(08)	PHOTOGRAPHY AND OPTICS	
	(09)	PACKING, PACKAGING AND PRESERVATION	
	(10)	POWER UNITS	
	(11)	SHELTER	
	(12)	STORAGE	
	(13)	TOOLS, GENERAL PURPOSE	
☐ (10)		**FUELS AND LUBRICANTS**	
	(01)	PETROLEUM	
	(02)	SYNTHETIC LUBRICANTS AND HYDRAULIC FLUIDS	
	(03)	LIQUID PROPELLANTS *(Fuels and/or Oxidizers)*	
	(04)	EQUIPMENT FOR STORAGE, PROTECTION, AND DISTRIBUTION	
	(07)	IMMUNOLOGY	
	(08)	MEDICAL ASPECTS OF BIOLOGICAL AND CHEMICAL WARFARE	
	(09)	MEDICAL EQUIPMENT AND PROSTHETIC DEVICES	
	(10)	NEUROPSYCHIATRY	
	(11)	PHYSIOLOGY AND PATHOLOGY	
	(12)	SANITATION	
	(13)	SHOCK AND TRANSFUSION	
	(14)	SURGERY	
	(15)	TOXICOLOGY	
☐ (14)		**MATERIALS**	
	(01)	INORGANIC AND MINERAL	
	(02)	METALLURGY, EXTRACTIVE	
	(03)	METALLURGY, PHYSICAL	
	(04)	ORGANIC AND FIBROUS	
	(05)	PHYSICS OF METALS	
	(06)	PLASTICS	
☐ (15)		**NAVIGATION**	
	(01)	CELESTIAL	
	(02)	DEAD RECKONING	
	(03)	ELECTRONIC, COMMON USER	
	(04)	ELECTRONIC, SELF SUFFICIENT	
	(05)	GYRO AND INERTIAL	
	(06)	PILOTAGE AND BEACONS	
☐ (16)		**ORDNANCE**	
	(01)	DEGAUSSING NETS AND BOOMS	
	(02)	EXPLOSIVES AND PROPELLANTS, MOLECULAR	
	(03)	FIRE CONTROL	
	(04)	FUZES, FIRING, AND EXPLODING MECHANISMS	
	(05)	GUNS AND MOUNTS, LARGE CALIBER	
	(06)	LAND MINES AND GRENADES	
	(07)	PROJECTILES AND AMMUNITION DETAILS	
	(08)	ROCKETS AND ROCKET LAUNCHERS	
	(09)	SEA MINES AND DEPTH CHARGES	
	(10)	SMALL ARMS AND AUTOMATIC WEAPONS	
	(11)	TORPEDOES AND TUBES	
	(12)	VEHICLES, COMBAT	
	(13)	VEHICLES, NONCOMBAT	
	(14)	WARHEADS AND BOMBS	

(Classified Only When Data Is Entered) **CONFIDENTIAL** SECURITY INFORMATION

(THIS SECTION WILL BE DETACHED AS SOON AS YOUR COMPLETED QUESTIONNAIRE IS RECEIVED)

NAME OF COMPANY _____

NAME AND TITLE OF INDIVIDUAL COMPLETING QUESTIONNAIRE _____

BUSINESS ADDRESS *(City, Zone and State)* _____

PLEASE CHECK IF YOU WISH TO RECEIVE A COPY OF THE UNCLASSIFIED SUMMARY REPORT ☐

PLEASE CHECK IF YOUR COMPANY DOES NO RESEARCH OR DEVELOPMENT ☐

(Please Turn To Next Page)

INDUSTRIAL CLASSIFICATION

12. PLEASE CHECK *(X)* AMONG THE FOLLOWING LIST OF INDUSTRIES THE *ONE* THAT ACCOUNTED FOR THE LARGEST PORTION OF YOUR COMPANY'S TOTAL SALES *(or total value of services, if more appropriate)* IN ALL OF ITS ACTIVITIES IN CALENDAR 1951.

NON-MANUFACTURING

- (01) ☐ COMMERCIAL CONSULTING FIRMS
- (10) ☐ NONPROFIT RESEARCH AGENCIES
- (30) ☐ BUSINESS TRADE ASSOCIATIONS

MINING:

- (20) ☐ COAL, METALLIC AND NONMETALLIC MINERALS
- (21) ☐ CRUDE PETROLEUM AND NATURAL GAS
- (22) ☐ RAILROADS
- (23) ☐ AIRLINES
- (24) ☐ PUBLIC UTILITIES
- (25) ☐ TELECOMMUNICATION, RADIO AND TELEVISION BROADCASTING
- (31) ☐ ALL OTHER NON-MANUFACTURING

MANUFACTURING

- (85) ☐ ORDNANCE AND ACCESSORIES
- (86) ☐ FOOD AND KINDRED PRODUCTS
- (87) ☐ TOBACCO
- (88) ☐ TEXTILE MILL PRODUCTS AND APPAREL
- (89) ☐ LUMBER AND WOOD PRODUCTS *(except furniture)*
- (90) ☐ FURNITURE AND FIXTURES
- (91) ☐ PAPER AND ALLIED PRODUCTS
- (92) ☐ PRINTING, PUBLISHING AND ALLIED INDUSTRIES

CHEMICALS AND ALLIED PRODUCTS:

- (40) ☐ INDUSTRIAL INORGANIC AND ORGANIC CHEMICALS
- (41) ☐ DRUGS AND MEDICINES
- (42) ☐ SOAP, CLEANERS, ETC.
- (43) ☐ PAINT, VARNISH, LACQUER AND INORGANIC PIGMENTS
- (44) ☐ OTHER CHEMICAL PRODUCTS

MANUFACTURING *(Cont'd)*

PRODUCTS OF PETROLEUM AND COAL:

- (50) ☐ PETROLEUM
- (51) ☐ COAL
- (93) ☐ RUBBER PRODUCTS
- (94) ☐ LEATHER AND LEATHER PRODUCTS
- (95) ☐ STONE, CLAY AND GLASS PRODUCTS
- (96) ☐ PRIMARY METAL INDUSTRIES
- (97) ☐ FABRICATED METAL PRODUCTS *(except ordnance, machinery, and transportation equipment)*
- (98) ☐ MACHINERY *(except electrical)*

ELECTRICAL MACHINERY, EQUIPMENT AND SUPPLIES:

- (60) ☐ COMMUNICATION EQUIPMENT
- (61) ☐ OTHER ELECTRICAL MACHINERY, EQUIPMENT AND SUPPLIES

TRANSPORTATION EQUIPMENT:

- (70) ☐ MOTOR VEHICLES AND MOTOR VEHICLE EQUIPMENT
- (71) ☐ AIRCRAFT AND PARTS
- (72) ☐ RAILROAD EQUIPMENT
- (73) ☐ OTHER TRANSPORTATION EQUIPMENT

PROFESSIONAL, SCIENTIFIC AND CONTROLLING INSTRUMENTS:

- (80) ☐ SCIENTIFIC INSTRUMENTS
- (81) ☐ PHOTOGRAPHIC EQUIPMENT AND SUPPLIES
- (82) ☐ OTHER PROFESSIONAL, SCIENTIFIC AND CONTROLLING INSTRUMENTS
- (99) ☐ ALL OTHER MANUFACTURING

INSTRUCTIONS FOR RETURNING QUESTIONNAIRE

1. Please place completed questionnaire in enclosed envelope marked "Security Information CONFIDENTIAL," and seal.

2. Place this sealed envelope in enclosed franked envelope addressed to Chairman, Research and Development Board, Washington 25, D. C.

3. Seal franked envelope and mail.

REMARKS

☆ U. S. GOVERNMENT PRINTING OFFICE . 1952 O—203715

APPENDIX C

STATISTICAL DATA CLASSIFIED BY INDUSTRY, SIZE OF COMPANY, AND SIZE OF PROFESSIONAL RESEARCH STAFF

C-1 Research and development expenditures in the United States and cost of research and development performed by Government, industry, and colleges and universities, 1941 to 1952
(millions of dollars)

Year	Total research expenditures	Government				Industry				Colleges and universities			
		Research expenditures		Cost of research performed		Research expenditures		Cost of research performed		Research expenditures		Cost of research performed	
		Amount	Percent	Amount	Percent	Amount	Percent	Amount	Percent	Amount	Percent	Amount	Percent
1941...	$ 900	$ 370	41	$200	22	$ 510	57	$ 660	73	$20	2	$ 40	5
1942...	1,070	490	46	240	22	560	52	780	73	20	2	50	5
1943...	1,210	780	64	300	25	410	34	850	70	20	2	60	5
1944...	1,380	940	68	390	28	420	30	910	66	20	2	80	6
1945...	1,520	1,070	70	430	28	430	28	990	65	20	2	100	7
1946...	1,780	910	51	470	26	840	47	1,190	67	30	2	120	7
1947...	2,260	1,160	51	520	23	1,050	47	1,570	69	50	2	170	8
1948...	2,610	1,390	53	570	22	1,150	44	1,820	70	70	3	220	8
1949...	2,610	1,550	59	550	21	990	38	1,790	69	70	3	270	10
1950...	2,870	1,610	56	570	20	1,180	41	1,980	69	80	3	320	11
1951...	3,360	1,980	59	700	21	1,300	39	2,300	68	80	2	360	11
1952...	3,750	2,240	60	800	21	1,430	38	2,530	68	80	2	420	11

Source: Research and Development Board, Department of Defense, April 1953.

C-2. Distribution of research employment and research cost, by industry 1/

Industry	Number of companies	Percent distribution			
		Employment, January 1952			Cost of research, 1951
		All research workers	Engineers and scientists	Supporting personnel	
Manufacturing	1,538	89.1	87.5	90.2	90.5
Food and kindred products	73	1.3	1.5	1.1	1.2
Textile mill products and apparel	49	.8	.8	.9	.8
Paper and allied products	49	.7	.9	.5	.6
Chemicals and allied products	276	11.5	14.6	9.4	11.2
Industrial organic and inorganic chemicals	85	7.3	8.7	6.3	7.2
Drugs and medicines	77	2.3	3.2	1.7	2.5
Soap, cleaners, etc.	19	.6	.9	.5	.7
Paint, varnish, etc.	32	.7	1.0	.5	.3
Other chemical products	63	.6	.8	.4	.5
Petroleum refining	49	5.2	5.2	5.2	4.9
Rubber products	33	1.4	1.8	1.1	1.2
Stone, clay, and glass products	38	1.5	1.3	1.7	1.1
Primary metal industries	50	1.6	1.9	1.4	1.9
Fabricated metal products	150	2.3	2.7	2.0	2.0
Machinery (except electrical)	184	5.6	6.2	5.3	5.3
Electrical machinery	236	21.8	18.2	24.3	22.1
Transportation equipment	105	27.9	24.6	30.1	31.9
Motor vehicles and equipment	26	6.7	3.2	9.0	10.8
Aircraft and parts	63	21.0	21.1	21.0	20.8
Other transportation equipment	16	.2	.3	.1	.3
Professional and scientific instruments	153	5.7	6.0	5.5	4.7
Photographic equipment and supplies	24	1.9	2.1	1.7	1.6
Other professional and scientific instruments	129	3.8	3.9	3.8	3.1
Other manufacturing	93	1.8	1.8	1.7	1.6
Nonmanufacturing	415	10.9	12.5	9.8	9.5
Commercial consulting firms	286	3.1	4.0	2.6	2.5
Nonprofit research agencies	39	2.7	3.6	2.1	2.0
Other nonmanufacturing	90	5.1	4.9	5.1	5.0
Total	—	100.0	100.0	100.0	100.0
Total number reported 2/	1,953	238,266	95,694	142,572	$1,980 (millions)

1/ The figures in this table are estimates covering all 1,953 companies in the survey. They include companies that failed to report one or more of the items shown in the table.

2/ Although the manpower estimates are given in exact numbers, not all digits of these numbers are statistically significant.

C-3. Distribution of research employment and research cost, by size of company 1/

Total company employment	Number of companies	Percent distribution			
		Employment, January 1952			Cost of research, 1951
		All research workers	Engineers and scientists	Supporting personnel	
0 - 24	308	0.6	1.0	0.4	0.5
25 - 99	334	2.3	3.1	1.7	1.9
100 - 199	177	1.4	1.9	1.1	1.1
200 - 499	303	4.5	5.4	3.8	3.8
500 - 999	217	5.4	6.3	4.8	4.7
1,000 - 4,999	392	14.2	15.2	13.6	12.8
5,000 - 24,999	178	26.3	27.3	25.6	23.9
25,000 - 49,999	29	16.4	17.2	16.0	16.6
50,000 - 99,999	8	9.1	8.9	9.2	8.7
100,000 or more	7	19.8	13.7	23.8	26.0
Total	--	100.0	100.0	100.0	100.0
Total number reported 2/	1,953	238,266	95,694	142,572	$1,980 (millions)

1/ The figures in this table are estimates covering all 1,953 companies in the survey. They include companies that failed to report one or more of the items shown in the table.

2/ Although the manpower estimates are given in exact numbers, not all digits of these numbers are statistically significant.

C-4. Distribution of research employment and research cost, by size of professional research staff 1/

Size of company's professional research staff	Number of companies	Percent distribution			
		Employment, January 1952			Cost of research, 1951
		All research workers	Engineers and scientists	Supporting personnel	
0 - 4	681	1.3	1.6	1.2	1.2
5 - 14	585	4.3	4.9	3.9	3.9
15 - 29	269	5.1	5.4	4.8	4.5
30 - 49	148	5.1	5.8	4.7	4.6
50 - 74	79	4.5	5.1	3.9	3.7
75 - 124	62	4.4	5.8	3.5	3.5
125 - 249	62	11.8	11.8	11.8	10.8
250 - 499	33	12.6	11.9	13.0	13.3
500 - 999	16	11.2	10.3	11.9	10.4
1,000 or more	18	39.7	37.4	41.3	44.1
Total	—	100.0	100.0	100.0	100.0
Total number reported 2/	1,953	238,266	95,694	142,572	$1,980 (millions)

1/ The figures in this table are estimates covering all 1,953 companies in the survey. They include companies that failed to report one or more of the items shown in the table.

2/ Although the manpower estimates are given in exact numbers, not all digits of these numbers are statistically significant.

C-5. Number of research engineers and scientists, by industry and size of company, January 1952

Industries	All reporting companies	Companies with total employment of--										
		0 to 24	25 to 99	100 to 199	200 to 499	500 to 999	1,000 to 4,999	5,000 to 24,999	25,000 to 49,999	50,000 to 99,999	100,000 or more	Not reported
All industries	1/ 91,585	801	2,785	1,583	4,819	5,746	13,827	24,353	15,674	8,482	11,600	1,915
Manufacturing	80,306	257	940	1,028	3,181	3,948	12,495	23,905	15,547	(2/)	(2/)	1,400
Food and kindred products	1,358	4	13	15	17	45	358	584	(2/)	--	--	(2/)
Textile mill products and apparel	734	--	11	5	33	(2/)	238	422	--	--	--	(2/)
Paper and allied products	847	(2/)	(2/)	--	35	(2/)	417	365	--	--	--	--
Chemicals and allied products	13,201	99	268	200	674	799	2,324	6,002	(2/)	(2/)	--	209
Industrial organic and inorganic chemicals	7,591	33	66	58	263	213	883	3,365	(2/)	(2/)	--	(2/)
Drugs and medicines	3,047	38	70	51	162	303	995	(2/)	--	--	--	(2/)
Soap, cleaners, etc	884	(2/)	21	32	(2/)	65	(2/)	674	--	--	--	(2/)
Paint, varnish, etc	910	(2/)	49	29	107	(2/)	143	(2/)	--	--	--	--
Other chemical products	769	21	62	30	(2/)	(2/)	(2/)	--	--	--	--	93
Petroleum refining	4,953	(2/)	31	(2/)	78	35	444	1,715	1,528	--	625	494
Rubber products	1,771	(2/)	19	18	73	15	111	737	--	(2/)	--	(2/)
Stone, clay, and glass products	1,210	(2/)	(2/)	27	30	44	77	538	(2/)	--	--	(2/)
Primary metal industries	1,719	--	(2/)	(2/)	52	63	195	394	492	--	(2/)	15
Fabricated metal products	2,491	9	79	174	217	156	814	683	(2/)	(2/)	--	108
Machinery (except electrical)	5,418	36	34	55	235	345	1,745	1,001	(2/)	(2/)	--	109
Electrical machinery	17,274	21	92	288	928	608	3,283	2,668	(2/)	--	(2/)	143
Transportation equipment	21,926	12	63	20	103	775	1,273	6,250	8,967	4,091	331	41
Motor vehicles and equipment	1,445	(2/)	(2/)	--	(2/)	(2/)	142	447	--	(2/)	331	(2/)
Aircraft and parts	20,235	(2/)	55	20	76	737	1,089	5,638	8,967	(2/)	--	(2/)
Other transportation equipment	246	--	(2/)	--	(2/)	(2/)	42	165	--	--	--	--
Professional and scientific instruments	5,716	43	260	149	572	770	659	1,960	(2/)	--	--	(2/)
Photographic equipment and supplies	1,954	6	(2/)	38	211	362	(2/)	--	(2/)	--	--	--
Other professional and scientific instruments	3,762	37	(2/)	111	361	408	(2/)	1,960	--	--	--	(2/)
Other manufacturing	1,688	21	55	42	134	264	557	586	13	--	--	16
Nonmanufacturing	11,279	544	1,845	555	1,638	1,798	1,332	448	127	(2/)	(2/)	515
Commercial consulting firms	3,428	479	1,270	467	794	(2/)	(2/)	--	--	--	--	52
Nonprofit research agencies	3,204	43	406	(2/)	725	1,313	(2/)	--	--	--	--	--
Other nonmanufacturing	4,647	22	169	(2/)	119	(2/)	451	448	127	(2/)	(2/)	463

1/ This table is based on reports from 1,815 companies. In addition, the study included 138 companies that failed to supply information on the number of research engineers and scientists employed in January 1952.

2/ Data withheld to avoid disclosing figures for individual companies, but these data are included in totals.

C-6. Number of research engineers and scientists, by industry and size of professional research staff, January 1952

Industry	All reporting companies	Companies with professional research staff of--									
		0 to 4	5 to 14	15 to 29	30 to 49	50 to 74	75 to 124	125 to 249	250 to 499	500 to 999	1,000 or more
All industries	1/ 91,585	1,440	4,590	5,053	5,334	4,629	5,386	10,787	11,223	9,689	33,454
Manufacturing	80,306	1,093	3,841	4,102	4,358	4,044	4,557	9,285	9,642	(2/)	(2/)
Food and kindred products	1,358	68	175	157	(2/)	(2/)	—	566	—	—	—
Textile mill products and apparel	734	57	102	163	(2/)	(2/)	(2/)	(2/)	—	—	—
Paper and allied products	847	38	117	125	375	(2/)	(2/)	—	—	—	—
Chemicals and allied products	13,201	184	662	441	890	746	1,393	1,975	2,524	(2/)	(2/)
Industrial organic and inorganic chemicals	7,591	53	167	84	346	223	808	(2/)	1,160	(2/)	(2/)
Drugs and medicines	3,047	(2/)	211	142	237	248	309	1,237	(2/)	—	—
Soap, cleaners, etc.	884	15	28	(2/)	(2/)	(2/)	—	(2/)	(2/)	—	—
Paint, varnish, etc.	910	21	86	78	(2/)	(2/)	(2/)	—	(2/)	—	—
Other chemical products	769	46	170	(2/)	174	(2/)	(2/)	—	—	—	—
Petroleum refining	4,953	37	82	52	105	(2/)	255	965	2,178	(2/)	—
Rubber products	1,771	20	109	136	(2/)	—	—	(2/)	—	(2/)	—
Stone, clay, and glass products	1,210	(2/)	114	88	—	(2/)	—	850	—	—	—
Primary metal industries	1,719	26	120	133	115	294	(2/)	(2/)	(2/)	—	—
Fabricated metal products	2,491	120	415	462	514	190	(2/)	(2/)	(2/)	—	—
Machinery (except electrical)	5,418	94	551	616	470	540	614	(2/)	—	—	(2/)
Electrical machinery	17,274	143	606	779	953	767	742	1,007	940	2,094	9,243
Transportation equipment	21,926	59	171	346	224	373	277	1,222	2,380	2,632	14,242
Motor vehicles and equipment	1,445	8	47	106	144	(2/)	(2/)	(2/)	(2/)	—	—
Aircraft and parts	20,235	40	91	151	(2/)	(2/)	(2/)	(2/)	(2/)	2,632	14,242
Other transportation equipment	246	11	33	89	(2/)	—	(2/)	—	—	—	—
Professional and scientific instruments	5,716	110	374	492	235	527	450	(2/)	(2/)	—	(2/)
Photographic equipment and supplies	1,954	12	55	(2/)	(2/)	(2/)	(2/)	—	(2/)	—	(2/)
Other professional and scientific instruments	3,762	98	319	(2/)	(2/)	(2/)	(2/)	(2/)	(2/)	—	(2/)
Other manufacturing	1,688	105	243	112	161	—	301	766	—	—	—
Nonmanufacturing	11,279	347	749	951	976	585	829	1,502	1,581	(2/)	(2/)
Commercial consulting firms	3,428	257	525	610	530	273	(2/)	818	(2/)	—	—
Nonprofit research agencies	3,204	16	51	103	185	(2/)	—	(2/)	988	(2/)	—
Other nonmanufacturing	4,647	74	173	238	261	(2/)	(2/)	(2/)	(2/)	—	(2/)

1/ This total is based on reports from 1,815 companies. In addition, the study includes 138 companies that failed to supply information on the number of research engineers and scientists employed as of January 1952.

2/ Data withheld to avoid disclosing figures for individual companies, but these data are included in totals.

C-7. Number of reporting companies and number of research engineers and scientists, by size of professional research staff and size of company, January 1952

Size of professional research staff	All reporting companies 1/	Companies with total employment of--			
		Less than 500	500 to 4,999	5,000 to 24,999	25,000 or more
	Number of companies				
Total	1,732	971	559	162	40
0 - 4	560	474	80	5	1
5 - 14	540	328	189	20	3
15 - 29	243	96	121	25	1
30 - 49	138	46	72	19	1
50 - 74	73	15	36	20	2
75 - 124	55	4	29	21	1
125 - 249	61	6	23	26	6
250 - 499	30	2	6	15	7
500 - 999	15	--	3	7	5
1,000 or more	17	--	--	4	13
	Number of research engineers and scientists				
Total	89,670	9,988	19,573	24,353	35,756
0 - 4	1,359	1,118	223	15	3
5 - 14	4,421	2,565	1,644	188	24
15 - 29	4,889	1,909	2,447	518	15
30 - 49	5,155	1,691	2,686	736	42
50 - 74	4,388	861	2,199	1,215	113
75 - 124	5,134	330	2,726	1,960	118
125 - 249	10,787	983	3,925	4,695	1,134
250 - 499	10,395	531	1,836	5,535	2,493
500 - 999	9,689	--	1,887	4,531	3,271
1,000 or more	33,453	--	--	4,960	28,493

1/ Excludes 221 companies that failed to report number of research engineers and scientists employed or total company employment.

C-8. **Average number of research engineers and scientists per 100 employees, by industry and size of company, January 1952**

Industry	All reporting companies	Companies with total employment of--		
		Less than 500	500 to 4,999	5,000 or more
All industries	1.5	7.5	1.9	1.2
Manufacturing	1.6	4.7	1.7	1.4
Food and kindred products	.5	1.7	.7	.4
Textile mill products and apparel	.5	1.7	.4	.5
Paper and allied products	.6	1.3	.7	.5
Chemicals and allied products	3.0	5.3	3.2	2.8
Industrial organic and inorganic chemicals	3.0	5.1	3.1	2.9
Drugs and medicines	3.0	5.8	4.0	2.3
Soap, cleaners, etc.	2.6	6.1	2.8	2.4
Paint, varnish, etc.	3.5	5.7	2.1	3.6
Other chemical products	2.8	4.5	2.4	--
Petroleum refining	1.0	4.3	3.9	.9
Rubber products	1.4	4.1	.6	1.5
Stone, clay, and glass products	.8	3.1	.6	.8
Primary metal industries	.3	4.5	.7	.2
Fabricated metal products	.7	4.4	.9	.4
Machinery (except electrical)	1.1	3.3	1.3	.9
Electrical machinery	2.7	5.3	2.6	2.6
Transportation equipment	2.4	4.7	2.7	2.3
Motor vehicles and equipment	.4	5.8	.6	.3
Aircraft and parts	4.3	5.4	5.1	4.2
Other transportation equipment	.4	1.2	.4	.3
Professional and scientific instruments	3.7	7.5	3.2	3.4
Photographic equipment and supplies	3.4	10.4	7.7	2.5
Other professional and scientific instruments	3.9	6.8	2.5	4.4
Other manufacturing	.9	3.4	1.3	.6
Nonmanufacturing	1.1	24.2	6.7	.3
Commercial consulting firms	24.5	29.3	10.5	--
Nonprofit research agencies	47.2	44.1	49.2	--
Other nonmanufacturing	.4	6.1	2.0	.3

C-9. Average number of research engineers and scientists on Government contracts per 100 employed, by industry and size of company, and average number on Government subcontracts per 100 on all Government contracts, January 1952

Industry	Number of engineers and scientists on Government contracts per 100 employed				Number of engineers and scientists on Government subcontracts per 100 on all Government contracts
	All reporting companies	Companies with total employment of --			
		Less than 500	500 to 4,999	5,000 or more	
All industries	48.9	58.7	47.9	49.3	12.4
Manufacturing	48.9	59.6	46.4	50.7	11.3
Food and kindred products	.7	4.3	1.0	.1	--
Textile mill products and apparel	10.2	40.0	16.4	3.3	15.7
Paper and allied products	3.5	--	3.4	3.8	51.9
Chemicals and allied products	5.4	10.3	6.2	4.3	14.8
Industrial organic and inorganic chemicals	6.8	13.4	5.7	6.4	6.2
Drugs and medicines	.9	7.5	1.0	.1	20.8
Soap, cleaners, etc.	3.9	2.3	26.3	.3	37.3
Paint, varnish, etc.	9.4	13.8	17.0	6.2	53.6
Other chemical products	10.3	8.5	10.5	--	3.4
Petroleum refining	4.5	22.8	2.5	3.8	13.7
Rubber products	19.3	53.3	46.3	15.7	28.2
Stone, clay, and glass products	6.9	--	19.8	2.2	11.3
Primary metal industries	10.0	58.0	13.3	4.8	28.8
Fabricated metal products	39.9	76.7	37.3	16.0	46.5
Machinery (except electrical)	24.5	48.0	31.7	16.0	35.8
Electrical machinery	60.2	89.0	69.8	54.1	12.4
Transportation equipment	86.6	70.0	91.9	86.2	6.5
Motor vehicles and equipment	23.1	8.6	28.2	21.6	11.5
Aircraft and parts	92.1	85.0	98.4	91.4	6.3
Other transportation equipment	41.9	62.5	60.3	32.3	21.2
Professional and scientific instruments	69.6	74.8	57.2	76.3	12.5
Photographic equipment and supplies	79.9	88.2	76.2	--	15.0
Other professional and scientific instruments	67.7	71.2	47.1	76.3	12.0
Other manufacturing	68.8	71.5	75.7	58.8	15.7
Nonmanufacturing	49.2	57.8	56.8	28.1	19.4
Commercial consulting firms	65.8	64.3	83.3	--	32.7
Nonprofit research agencies	53.0	50.9	54.5	--	7.4
Other nonmanufacturing	35.4	22.0	48.0	28.1	10.6

C-10. Average number of research engineers and scientists on Government contracts per 100 employed, by industry and size of professional research staff, January 1952

Industry	All reporting companies	Companies with professional research staff of —									
		0 to 4	5 to 14	15 to 29	30 to 49	50 to 74	75 to 124	125 to 249	250 to 499	500 to 999	1,000 or more
All industries	48.9	29.1	37.3	41.3	38.9	38.7	32.1	44.4	38.0	49.9	63.8
Manufacturing	48.9	29.5	35.4	37.9	34.7	37.1	30.9	40.3	35.1	48.4	66.6
Food and kindred products	.7	4.6	2.1	0	1.4	(1/)	—	0	—	—	—
Textile mill products and apparel	10.2	26.5	27.3	14.7	(1/)	(1/)	(1/)	(1/)	—	—	—
Paper and allied products	3.5	2.9	2.9	6.9	4.1	(1/)	(1/)	—	—	—	—
Chemicals and allied products	5.4	11.8	7.4	10.4	10.9	4.0	6.9	2.1	5.8	(1/)	(1/)
Industrial organic and inorganic chemicals	6.8	22.5	5.5	1.5	11.3	2.9	7.9	(1/)	(1/)	(1/)	(1/)
Drugs and medicines	.9	6.5	4.4	0	0	(1/)	0	.6	(1/)	—	—
Soap, cleaners, etc.	3.9	0	0	(1/)	(1/)	(1/)	—	(1/)	(1/)	—	—
Paint, varnish, etc.	9.4	21.4	9.6	9.4	(1/)	(1/)	(1/)	—	(1/)	—	—
Other chemical products	10.3	7.1	14.5	5.5	15.5	(1/)	(1/)	—	—	—	—
Petroleum refining	4.5	16.7	7.5	—	12.4	(1/)	0	3.0	6.5	(1/)	—
Rubber products	19.3	23.1	46.2	39.7	(1/)	—	—	(1/)	—	(1/)	—
Stone, clay, and glass products	6.9	4.2	5.5	35.2	—	(1/)	—	2.4	—	—	—
Primary metal industries	10.0	17.4	33.3	31.0	6.1	9.9	(1/)	(1/)	(1/)	—	—
Fabricated metal products	39.9	43.4	45.6	30.9	48.8	76.3	(1/)	—	(1/)	—	—
Machinery (except electrical)	24.5	30.0	22.0	21.1	26.1	19.3	38.9	46.2	—	—	(1/)
Electrical machinery	60.2	58.3	65.5	67.8	66.6	74.5	52.5	97.0	77.8	(1/)	49.7
Transportation equipment	86.6	57.8	60.9	57.5	40.2	76.7	85.6	88.9	71.6	90.8	90.7
Motor vehicles and equipment	23.1	50.0	23.4	23.6	32.3	(1/)	(1/)	(1/)	(1/)	—	—
Aircraft and parts	92.1	65.4	81.3	84.8	(1/)	100.0	(1/)	99.1	100.0	90.8	90.7
Other transportation equipment	41.9	45.5	56.5	51.7	(1/)	—	(1/)	—	—	—	—
Professional and scientific instruments	69.6	53.9	62.1	52.5	67.7	49.9	35.1	(1/)	(1/)	—	(1/)
Photographic equipment and supplies	79.9	62.5	87.3	(1/)	(1/)	(1/)	(1/)	—	(1/)	—	—
Other professional and scientific instruments	67.7	53.1	56.8	53.0	60.8	42.3	43.8	(1/)	—	—	(1/)
Other manufacturing	68.8	12.3	50.2	61.6	59.0	—	69.8	82.8	—	—	—
Nonmanufacturing	49.2	27.9	46.9	49.6	56.3	50.8	37.9	68.9	53.8	(1/)	(1/)
Commercial consulting firms	65.8	33.3	56.8	65.3	89.8	76.9	(1/)	67.8	(1/)	—	—
Nonprofit research agencies	53.0	—	28.2	52.5	24.9	(1/)	—	(1/)	44.3	(1/)	—
Other nonmanufacturing	35.4	15.3	21.8	2.0	14.6	(1/)	31.5	(1/)	(1/)	—	(1/)

1/ Data are not shown for fewer than three companies.

C-11. Percent change in employment of research engineers and scientists, January 1951 to January 1952, by industry and size of company

Industry	All reporting companies	Companies with total employment of--		
		Less than 500	500 to 4,999	5,000 or more
All industries	23.7	33.4	22.3	23.0
Manufacturing	23.8	33.8	21.9	23.8
Food and kindred products	7.2	6.8	13.5	4.6
Textile mill products and apparel	2.4	-14.0	2.9	4.5
Paper and allied products	6.9	4.8	6.3	8.0
Chemicals and allied products	10.8	15.2	13.8	9.8
Industrial organic and inorganic chemicals	11.9	20.0	13.0	11.3
Drugs and medicines	10.7	29.1	15.1	9.9
Soap, cleaners, etc.	6.6	5.9	27.8	3.9
Paint, varnish, etc.	3.5	8.6	3.2	2.0
Other chemical products	14.4	11.1	16.1	—
Petroleum refining	5.7	15.5	6.2	5.6
Rubber products	10.4	15.5	22.3	9.4
Stone, clay, and glass products	6.0	7.8	14.2	5.4
Primary metal industries	9.5	38.6	6.2	8.9
Fabricated metal products	20.8	36.3	19.2	17.2
Machinery (except electrical)	14.7	22.0	18.9	11.4
Electrical machinery	27.5	63.7	19.4	27.0
Transportation equipment	45.0	45.6	37.9	45.7
Motor vehicles and equipment	10.9	-2.8	8.0	11.2
Aircraft and parts	48.5	66.7	41.7	49.0
Other transportation equipment	27.5	14.3	25.9	28.9
Professional and scientific instruments	28.3	39.2	41.3	18.0
Photographic equipment and supplies	21.4	58.0	66.1	5.2
Other professional and scientific instruments	32.6	33.6	31.7	30.0
Other manufacturing	33.9	30.1	44.0	23.5
Nonmanufacturing	23.2	33.1	23.9	10.3
Commercial consulting firms	31.5	36.9	.8	—
Nonprofit research agencies	24.9	30.4	21.8	—
Other nonmanufacturing	16.8	14.6	46.4	10.3

C-12. Percent change in employment of research engineers and scientists, January 1951 to January 1952, by industry and size of professional research staff

Industry	All reporting companies	Companies with professional research staff of --									
		0 to 4	5 to 14	15 to 29	30 to 49	50 to 74	75 to 124	125 to 249	250 to 499	500 to 999	1,000 or more
All industries	23.7	5.3	21.7	22.3	20.0	20.0	27.4	19.0	15.4	27.7	29.3
Manufacturing	23.8	6.6	21.9	21.8	16.4	18.0	26.9	17.0	14.6	27.1	31.1
Food and kindred products	7.2	6.5	11.1	4.0	19.1	(1/)	--	0	--	--	--
Textile mill products and apparel	2.4	0	8.5	-7.5	(1/)	(1/)	(1/)	(1/)	--	--	--
Paper and allied products	6.9	5.6	2.6	5.0	9.0	(1/)	(1/)	--	--	--	--
Chemicals and allied products	10.8	7.0	16.2	13.1	8.5	10.2	16.0	8.2	10.2	(1/)	(1/)
Industrial organic and inorganic chemicals	11.9	8.2	22.8	18.3	5.2	17.4	9.2	(1/)	17.2	(1/)	(1/)
Drugs and medicines	10.7	16.7	17.7	11.8	13.9	2.9	30.9	7.8	(1/)	--	--
Soap, cleaners, etc.	6.6	0	16.7	(1/)	(1/)	(1/)	--	(1/)	(1/)	--	--
Paint, varnish, etc.	3.5	0	4.9	6.8	(1/)	(1/)	(1/)	--	(1/)	--	--
Other chemical products	14.4	2.2	14.9	14.3	10.8	(1/)	(1/)	--	--	--	--
Petroleum refining	5.7	2.8	18.8	2.0	15.4	(1/)	6.7	6.7	5.8	(1/)	--
Rubber products	10.4	-4.8	18.5	10.6	(1/)	--	--	(1/)	--	(1/)	--
Stone, clay, and glass products	6.0	3.2	12.9	6.0	--	(1/)	--	5.6	--	--	--
Primary metal industries	9.5	0	24.7	20.9	17.3	6.5	(1/)	(1/)	(1/)	--	--
Fabricated metal products	20.8	12.5	39.7	9.5	16.3	31.0	(1/)	(1/)	(1/)	--	--
Machinery (except electrical)	14.7	19.0	10.2	18.9	6.6	6.7	27.9	19.8	--	--	(1/)
Electrical machinery	27.5	11.7	30.9	35.2	24.6	45.3	29.7	19.3	20.2	28.4	27.2
Transportation equipment	45.0	-6.3	23.9	44.8	8.2	26.0	103.7	52.6	26.2	66.1	45.7
Motor vehicles and equipment	10.9	-11.1	6.8	6.0	2.1	(1/)	(1/)	(1/)	(1/)	--	--
Aircraft and parts	48.5	5.3	42.2	109.7	(1/)	27.9	(1/)	59.6	40.2	66.1	45.7
Other transportation equipment	27.5	-31.2	10.0	32.8	(1/)	--	(1/)	--	--	--	--
Professional and scientific instruments.	28.3	3.8	38.9	45.1	50.6	17.4	23.6	(1/)	(1/)	--	(1/)
Photographic equipment and supplies	21.4	0	41.0	(1/)	(1/)	(1/)	(1/)	--	(1/)	--	(1/)
Other professional and scientific instruments	32.6	4.3	38.5	44.9	47.0	7.6	17.8	(1/)	--	--	(1/)
Other manufacturing	33.9	5.1	27.2	47.4	37.6	--	81.3	25.4	--	--	--
Nonmanufacturing	23.2	1.5	20.5	24.6	39.0	35.7	30.3	32.6	15.6	(1/)	(1/)
Commercial consulting firms	31.5	2.8	24.2	26.6	61.1	97.8	(1/)	21.2	(1/)	--	--
Nonprofit research agencies	24.9	-11.1	9.8	25.6	5.1	3.0	--	(1/)	17.3	(1/)	--
Other nonmanufacturing	16.8	0	13.1	19.6	32.5	(1/)	26.2	(1/)	(1/)	--	(1/)

1/ Data are not shown for fewer than three companies.

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C-13. Percent change in employment of research engineers and scientists on Government prime contracts and subcontracts, January 1951 to January 1952, by industry

Industry	Engineers and scientists employed on Government contracts					
	Total		Prime contracts		Subcontracts	
	Number reported, Jan.1952	Percent change, Jan. 1951 to Jan. 1952	Number reported, Jan.1952	Percent change, Jan. 1951 to Jan.1952	Number reported, Jan.1952	Percent change, Jan. 1951 to Jan. 1952
All industries	1/45,445	52.0	1/39,713	51.0	1/ 5,732	57.6
Manufacturing	39,467	52.2	34,863	51.7	4,604	57.5
Chemicals and allied products	802	69.8	683	81.2	119	45.6
Petroleum refining	223	8.7	192	34.6	31	-50.8
Primary metal industries	181	5.7	129	21.2	52	-19.0
Fabricated metal products	1,022	44.6	547	36.0	475	56.5
Machinery (except electrical)	1,443	74.2	926	53.3	517	130.2
Electrical machinery	10,460	54.0	9,163	53.0	1,297	84.9
Motor vehicles and equipment	710	104.0	628	106.8	82	90.9
Aircraft and parts	18,636	52.8	17,462	53.1	1,174	49.4
Professional and scientific instruments	4,139	44.2	3,630	45.2	509	29.5
Other manufacturing	1,851	40.7	1,503	40.5	348	50.5
Nonmanufacturing	5,978	50.8	4,850	46.3	1,128	67.6
Commercial consulting firms	2,502	52.9	1,684	42.1	818	70.1
Nonprofit research agencies	1,813	31.2	1,679	31.4	134	29.2
Other nonmanufacturing	1,663	66.8	1,487	67.6	176	88.4

1/ These figures are estimates covering all 1,953 companies in the survey. Although exact numbers are given, not all digits of the numbers are statistically significant.

C-14. Average number of supporting personnel per research engineer or scientist, by industry and size of company, January 1952

Industry	All companies					Companies with fewer than 500 employees				
	Number of companies reporting	Mean */	Median	Lower quartile	Upper quartile	Number of companies reporting	Mean */	Median	Lower quartile	Upper quartile
All industries	1/ 1,735	1.5	0.8	0.3	1.5	921	0.9	0.5	0.1	1.3
Manufacturing	1,398	1.5	.8	.3	1.5	640	1.0	.7	.2	1.4
Food and kindred products	67	1.0	.6	.3	1.0	17	.8	.5	0	1.0
Textile mill products and apparel	46	1.6	1.0	.4	1.7	12	.5	.4	0	1.0
Paper and allied products	48	.9	.6	.3	1.0	11	1.0	.5	.5	1.0
Chemicals and allied products	243	.9	.6	.2	1.0	152	.7	.4	0	1.0
Industrial organic and inorganic chemicals	75	1.1	.6	.3	1.0	47	.7	.3	0	.7
Drugs and medicines	68	.8	.6	.1	1.0	39	.5	.3	0	1.0
Soap, cleaners, etc.	17	.8	.5	.2	.8	10	.7	.3	0	.7
Paint, varnish, etc.	29	.8	.7	.2	1.0	22	.8	.7	0	1.0
Other chemical products	54	.7	.5	.2	1.0	34	.7	.4	0	1.0
Petroleum refining	46	1.5	1.0	.5	1.5	17	1.8	.8	.3	1.1
Rubber products	31	.9	.9	.4	1.3	14	.5	.7	.3	1.0
Stone, clay, and glass products	35	1.9	.9	.5	1.7	13	.7	.4	0	1.3
Primary metal industries	43	1.1	.7	.4	1.0	8	.5	.4	0	.8
Fabricated metal products	137	1.1	1.0	.4	1.8	60	1.0	.7	.3	1.5
Machinery (except electrical)	166	1.3	1.0	.4	1.9	63	1.0	.7	.2	1.4
Electrical machinery	217	2.0	1.0	.5	2.0	114	1.3	1.0	.3	2.0
Transportation equipment	100	1.7	1.3	.5	2.6	25	1.8	1.5	.3	2.8
Motor vehicles and equipment	24	5.2	2.3	1.0	5.0	4	.4	(2/)	(2/)	(2/)
Aircraft and parts	62	1.5	1.2	.6	2.4	19	2.2	1.5	.1	3.0
Other transportation equipment	14	.7	.4	.3	1.0	2	(2/)	(2/)	(2/)	(2/)
Professional and scientific instruments.	139	1.4	.8	.3	1.5	96	1.1	.6	.2	1.5
Photographic equipment and supplies ..	20	1.2	1.0	.2	1.5	14	.6	1.0	.3	1.3
Other professional and scientific instruments	119	1.4	.7	.3	1.5	82	1.3	.6	.2	1.5
Other manufacturing	80	1.4	.9	.3	1.5	38	.9	.8	.3	1.5
Nonmanufacturing	337	1.2	.5	0	1.1	281	.8	.5	0	1.0
Commercial consulting firms	226	1.0	.5	0	1.0	212	.8	.5	0	1.0
Nonprofit research agencies	31	.9	.5	.4	1.0	27	.7	.5	4	1.0
Other nonmanufacturing	80	1.6	.6	.3	1.3	42	.9	.5	0	1.0

See footnotes at end of table.

C-14. Average number of supporting personnel per research engineer or scientist, by industry and size of company, January 1952 --Continued

Industry	Companies with 500 to 4,999 employees					Companies with 5,000 or more employees				
	Number of companies reporting	Mean */	Median	Lower quartile	Upper quartile	Number of companies reporting	Mean */	Median	Lower quartile	Upper quartile
All industries	545	1.3	0.9	0.4	1.8	200	1.6	1.1	0.6	1.9
Manufacturing	516	1.3	.9	.4	1.8	188	1.6	1.1	.7	2.0
Food and kindred products	31	.8	.5	.3	1.0	15	1.2	.9	.5	1.0
Textile mill products and apparel	22	1.3	.7	.4	1.3	10	1.9	1.7	1.3	2.1
Paper and allied products	28	.9	.6	.3	.9	9	.9	.7	.2	1.4
Chemicals and allied products	62	.8	.7	.4	1.1	22	1.0	.8	.7	1.1
Industrial organic and inorganic chemicals	18	.8	.8	.4	1.2	9	1.1	1.0	.7	1.8
Drugs and medicines	20	.8	.7	.6	.9	7	.9	(2/)	(2/)	(2/)
Soap, cleaners, etc.	3	.8	(2/)	(2/)	(2/)	3	.8	(2/)	(2/)	(2/)
Paint, varnish, etc.	4	.7	(2/)	(2/)	(2/)	3	.7	(2/)	(2/)	(2/)
Other chemical products	17	.7	.5	.4	1.4	--	--	--	--	--
Petroleum refining	9	1.6	.9	.3	1.0	17	1.5	1.2	.9	1.6
Rubber products	11	1.2	1.3	.6	1.5	4	.9	(2/)	(2/)	(2/)
Stone, clay, and glass products	13	.9	.8	.6	1.7	7	2.2	(2/)	(2/)	(2/)
Primary metal industries	19	1.8	.5	.2	.9	13	1.0	.9	.7	1.5
Fabricated metal products	56	1.2	1.1	.5	2.1	13	1.1	1.0	.7	1.5
Machinery (except electrical)	78	1.4	1.1	.4	1.9	22	1.2	1.8	.5	2.1
Electrical machinery	86	1.5	1.3	.6	2.0	11	2.2	1.4	.8	1.8
Transportation equipment	41	1.9	1.2	.6	2.5	31	1.7	1.3	.5	3.0
Motor vehicles and equipment	10	3.2	2.8	1.3	3.7	9	5.6	5.0	.7	6.2
Aircraft and parts	24	1.8	1.0	.7	1.9	17	1.4	1.3	.5	2.4
Other transportation equipment	7	1.3	(2/)	(2/)	(2/)	5	.4	(2/)	(2/)	(2/)
Professional and scientific instruments.	31	1.1	.9	.5	1.5	6	1.6	(2/)	(2/)	(2/)
Photographic equipment and supplies	5	.5	(2/)	(2/)	(2/)	1	(2/)	(2/)	(2/)	(2/)
Other professional and scientific instruments	26	1.4	.9	.5	1.5	5	1.5	(2/)	(2/)	(2/)
Other manufacturing	29	1.4	.9	.3	1.5	8	1.6	1.0	.6	1.5
Nonmanufacturing	29	1.2	.7	.3	1.5	12	1.6	.7	.5	1.2
Commercial consulting firms	3	2.3	(2/)	(2/)	(2/)	--	--	--	--	--
Nonprofit research agencies	4	1.0	(2/)	(2/)	(2/)	--	--	--	--	--
Other nonmanufacturing	22	1.3	.6	.3	1.3	12	1.6	.7	.5	1.2

1/ Excludes 218 companies that failed to report number of research employees or number of research engineers and scientists. The numbers of reporting companies in the three size groups do not add to the totals shown in column 1, which include companies not reporting their total employment.

2/ Means are not shown for fewer than three companies; medians and quartiles are not shown for fewer than eight companies.

*/ Means were computed by dividing the aggregate number of supporting personnel by the number of research engineers and scientists for each specified group of companies. They thus reflect to a great extent the experience of the largest organizations in the group. This should be borne in mind in comparing the means with the median ratios, which were computed from rankings of ratios for individual companies.

C-15. Average number of supporting personnel per research engineer or scientist, by industry and size of professional research staff, January 1952

Industry	All reporting companies	Companies with professional research staff of--									
		0 to 4	5 to 14	15 to 29	30 to 49	50 to 74	75 to 124	125 to 249	250 to 499	500 to 999	1,000 or more
All industries	1.5	1.0	1.1	1.2	1.2	1.2	0.8	1.6	1.6	1.6	1.6
Manufacturing	1.5	1.1	1.2	1.3	1.3	1.3	.7	1.6	1.7	1.7	1.6
Food and kindred products	1.0	.8	.9	.5	1.4	(1/)	--	1.1	--	--	--
Textile mill products and apparel	1.6	1.2	.6	1.9	1.9	(1/)	(1/)	(1/)	--	--	--
Paper and allied products	.9	.9	.7	1.2	.9	(1/)	(1/)	--	--	--	--
Chemicals and allied products	.9	.6	.7	.7	1.0	.7	.9	1.0	1.1	(1/)	(1/)
Industrial organic and inorganic chemicals	1.1	.5	.6	.4	.8	1.1	1.0	(1/)	1.6	(1/)	(1/)
Drugs and medicines	.8	.7	.6	.6	1.2	.5	.8	.8	(1/)	--	--
Soap, cleaners, etc.	.8	.4	.2	(1/)	(1/)	(1/)	--	(1/)	(1/)	--	--
Paint, varnish, etc.	.8	.7	1.0	.9	(1/)	(1/)	(1/)	--	(1/)	--	--
Other chemical products	.7	.5	.8	1.1	.8	(1/)	(1/)	--	--	--	--
Petroleum refining	1.5	.8	1.2	.7	1.8	(1/)	.7	1.3	1.3	(1/)	--
Rubber products	.9	1.3	1.0	.7	(1/)	--	--	(1/)	--	(1/)	--
Stone, clay, and glass products	1.9	1.2	1.0	.8	--	(1/)	--	2.3	--	--	--
Primary metal industries	1.1	1.1	.6	1.0	.6	2.0	(1/)	(1/)	(1/)	--	--
Fabricated metal products	1.1	1.3	1.2	1.2	1.5	.4	(1/)	(1/)	(1/)	--	--
Machinery (except electrical)	1.3	.9	1.3	1.4	1.6	1.5	.6	2.2	--	--	(1/)
Electrical machinery	2.0	1.0	1.5	1.3	1.2	1.6	1.0	1.7	1.0	2.5	2.3
Transportation equipment	1.7	1.9	2.1	2.3	1.9	2.4	.2	2.6	3.4	1.6	1.4
Motor vehicles and equipment	5.2	2.4	2.5	5.6	1.7	(1/)	(1/)	(1/)	(1/)	--	--
Aircraft and parts	1.5	2.1	1.9	.9	(1/)	1.4	(1/)	2.9	1.3	1.6	1.4
Other transportation equipment	.7	.6	2.0	.7	(1/)	--	(1/)	--	--	--	--
Professional and scientific instruments	1.4	1.3	1.4	1.8	1.9	.8	.4	(1/)	(1/)	--	(1/)
Photographic equipment and supplies	1.2	.9	2.2	(1/)	--	(1/)	(1/)	--	(1/)	--	(1/)
Other professional and scientific instruments	1.4	1.4	1.2	1.9	1.9	.8	.6	(1/)	(1/)	--	(1/)
Other manufacturing	1.4	1.1	1.1	.6	1.3	--	.8	1.9	--	--	--
Nonmanufacturing	1.2	.8	1.1	1.0	.8	.6	1.0	1.2	1.1	(1/)	(1/)
Commercial consulting firms	1.0	.7	1.0	1.2	.9	.4	(1/)	1.4	--	--	--
Nonprofit research agencies	.9	1.0	1.1	.9	.8	.7	--	(1/)	.9	(1/)	--
Other nonmanufacturing	1.6	1.0	1.4	.6	.7	(1/)	1.2	(1/)	(1/)	--	(1/)

1/ Data are not shown for fewer than three companies.

C-16. Cost of research, by industry and size of company, 1951

(thousands of dollars)

Industry	All reporting companies	Companies with total employment of-- 0 to 24	25 to 99	100 to 199	200 to 499	500 to 999	1,000 to 4,999	5,000 to 24,999	25,000 to 49,999	50,000 to 99,999	100,000 or more	Not reported
All industries	1/ $1,804,529	$8,418	$34,523	$20,927	$69,461	$88,332	$236,866	$424,863	$317,686	$171,708	$397,168	$34,577
Manufacturing	1,624,687	2,080	10,319	12,509	49,818	62,157	218,765	420,093	316,329	171,570	(2/)	(2/)
Food and kindred products	23,889	27	(2/)	145	165	464	5,297	13,928	(2/)	--	--	(2/)
Textile mill products and apparel	15,817	--	(2/)	93	359	176	6,753	8,270	--	--	--	(2/)
Paper and allied products	11,116	(2/)	(2/)	--	377	278	4,952	5,453	--	--	--	--
Chemicals and allied products	204,230	815	2,659	2,024	8,190	10,741	31,618	89,452	(2/)	(2/)	--	2,731
Industrial organic and inorganic chemicals	131,340	362	553	898	3,604	1,717	11,548	(2/)	(2/)	(2/)	--	(2/)
Drugs and medicines	44,043	238	827	393	1,586	5,196	14,907	(2/)	--	--	--	(2/)
Soap, cleaners, etc.	12,342	--	275	259	(2/)	602	(2/)	10,406	--	--	--	--
Paint, varnish, etc.	6,486	22	468	(2/)	1,063	(2/)	1,519	2,855	--	--	--	--
Other chemical products	10,019	193	536	(2/)	(2/)	(2/)	(2/)	--	--	--	--	(2/)
Petroleum refining	92,942	(2/)	432	(2/)	1,694	540	7,570	25,146	28,272	--	(2/)	(2/)
Rubber products	22,890	(2/)	205	137	981	459	1,547	10,313	--	(2/)	--	(2/)
Stone, clay, and glass products	20,752	(2/)	(2/)	209	377	610	960	9,980	(2/)	--	--	(2/)
Primary metal industries	34,596	(2/)	(2/)	(2/)	542	753	3,846	6,030	8,501	--	(2/)	254
Fabricated metal products	38,404	48	906	2,154	3,267	3,122	12,206	11,432	(2/)	600	--	(2/)
Machinery (except electrical)	99,729	275	273	916	3,822	4,720	36,522	22,945	(2/)	(2/)	--	964
Electrical machinery	432,343	178	1,176	3,215	16,206	10,871	54,795	45,207	(2/)	--	(2/)	1,037
Transportation equipment	511,324	(2/)	963	234	2,454	14,568	33,756	132,145	189,657	93,174	43,501	(2/)
Motor vehicles and equipment	94,303	--	(2/)	--	(2/)	(2/)	4,344	11,236	--	(2/)	(2/)	(2/)
Aircraft and parts	410,804	(2/)	696	234	2,126	13,119	27,071	118,199	189,657	(2/)	--	(2/)
Other transportation equipment	6,217	--	(2/)	--	(2/)	(2/)	2,341	2,710	--	--	--	--
Professional and scientific instruments	91,813	453	2,689	1,940	9,403	8,860	9,360	34,676	(2/)	--	--	(2/)
Photographic equipment and supplies	30,794	68	(2/)	620	2,556	2,900	969	--	(2/)	--	--	--
Other professional and scientific instruments	61,019	385	(2/)	1,320	6,847	5,960	8,391	34,676	--	--	--	(2/)
Other manufacturing	24,842	139	523	1,226	1,981	5,995	9,583	5,116	145	--	--	134
Nonmanufacturing	179,842	6,338	24,204	8,418	19,643	26,175	18,101	4,770	1,357	138	(2/)	(2/)
Commercial consulting firms	44,193	5,210	17,343	6,113	10,637	4,260	--	--	--	--	--	630
Nonprofit research agencies	37,577	808	3,712	1,584	6,614	14,559	(2/)	--	--	--	--	(2/)
Other nonmanufacturing	98,072	320	3,149	721	2,392	7,356	(2/)	4,770	1,357	138	(2/)	(2/)

1/ This table is based on reports from 1,772 companies. In addition, the study includes 181 companies that failed to supply information on the cost of research in 1951.

2/ Data withheld to avoid disclosing figures for individual companies, but these data are included in totals.

C-17. Cost of research, by industry and size of professional research staff, 1951

(thousands of dollars)

Industry	All reporting companies	Companies with professional research staff of -- 0 to 4	5 to 14	15 to 29	30 to 49	50 to 74	75 to 124	125 to 249	250 to 499	500 to 999	1,000 or more	Not reported
All industries	1/$1,804,529	$19,466	$71,242	$80,021	$84,897	$67,469	$65,409	$199,884	$252,711	$194,122	$740,518	$28,790
Manufacturing	1,624,687	15,738	60,433	66,410	73,975	61,474	52,503	180,523	227,809	(2/)	(2/)	21,658
Food and kindred products	23,889	974	2,890	1,915	5,642	(2/)	--	8,351	--	--	--	(2/)
Textile mill products and apparel	15,817	1,059	1,793	3,044	(2/)	(2/)	(2/)	(2/)	--	--	--	2,141
Paper and allied products	11,116	393	1,490	1,625	4,224	(2/)	(2/)	--	--	--	--	(2/)
Chemicals and allied products	204,230	1,727	7,527	5,144	11,187	8,350	16,646	36,651	36,147	(2/)	(2/)	1,351
Industrial organic and inorganic chemicals	131,340	494	1,973	679	4,421	3,068	10,924	(2/)	22,433	(2/)	(2/)	681
Drugs and medicines	44,043	534	1,867	1,659	3,522	2,754	(2/)	23,078	(2/)	--	--	29
Soap, cleaners, etc.	12,342	196	190	(2/)	(2/)	(2/)	--	(2/)	(2/)	--	--	(2/)
Paint, varnish, etc.	6,486	178	927	680	(2/)	(2/)	(2/)	--	(2/)	--	--	257
Other chemical products	10,019	325	2,570	(2/)	2,269	(2/)	(2/)	--	--	--	--	(2/)
Petroleum refining	92,942	525	1,101	(2/)	2,278	(2/)	3,961	19,199	35,111	(2/)	--	(2/)
Rubber products	22,890	247	1,722	1,624	(2/)	--	--	(2/)	--	(2/)	--	(2/)
Stone, clay, and glass products	20,752	639	1,617	857	--	(2/)	--	16,849	--	--	--	(2/)
Primary metal industries	34,596	431	1,518	2,173	1,271	4,407	(2/)	(2/)	(2/)	--	--	1,593
Fabricated metal products	38,404	1,287	6,964	7,388	7,664	2,030	(2/)	(2/)	(2/)	--	--	1,280
Machinery (except electrical)	99,729	1,019	11,010	9,614	11,220	9,319	6,020	20,674	--	--	(2/)	(2/)
Electrical machinery	432,343	2,281	10,223	13,512	15,965	10,932	7,650	17,357	12,505	39,924	299,658	2,336
Transportation equipment	511,324	2,128	2,672	10,824	6,037	9,927	1,902	29,351	120,318	78,397	249,336	(2/)
Motor vehicles and equipment	94,303	572	769	5,689	2,982	(2/)	(2/)	(2/)	(2/)	--	--	(2/)
Aircraft and parts	410,804	926	1,312	2,491	(2/)	(2/)	(2/)	(2/)	(2/)	78,397	249,336	--
Other transportation equipment	6,217	630	591	2,644	(2/)	--	(2/)	--	--	--	--	(2/)
Professional and scientific instruments	91,813	1,591	5,746	6,973	3,662	7,547	5,683	(2/)	(2/)	--	(2/)	229
Photographic equipment and supplies	30,794	182	1,458	(2/)	(2/)	(2/)	(2/)	--	(2/)	--	(2/)	(2/)
Other professional and scientific instruments	61,019	1,409	4,288	(2/)	(2/)	(2/)	(2/)	(2/)	(2/)	--	(2/)	(2/)
Other manufacturing	24,842	1,437	4,160	1,302	4,030	--	3,847	9,143	--	--	--	923
Nonmanufacturing	179,842	3,728	10,809	13,611	10,922	5,995	12,906	19,361	24,902	(2/)	(2/)	7,132
Commercial consulting firms	44,193	2,434	7,491	8,053	5,647	2,976	(2/)	9,965	(2/)	--	--	3,970
Nonprofit research agencies	37,577	225	620	1,232	1,828	(2/)	--	(2/)	12,519	(2/)	--	2,627
Other nonmanufacturing	98,072	1,069	2,698	4,326	3,447	(2/)	(2/)	(2/)	(2/)	--	(2/)	535

1/ This total is based on reports from 1,772 companies. In addition, the study included 181 companies that failed to supply information on the cost of research in 1951.

2/ Data withheld to avoid disclosing figures for individual companies, but these data are included in totals.

C-18. Cost of Government-financed research as percent of total research cost, by industry and size of company, 1951

Industry	All companies					Companies with fewer than 500 employees				
	Number of companies reporting	Mean */	Median	Lower quartile	Upper quartile	Number of companies reporting	Mean */	Median	Lower quartile	Upper quartile
All industries	1/ 1,630	46.8	10.0	0	71.4	888	57.6	22.0	0	90.0
Manufacturing	1,302	46.4	9.2	0	66.4	611	59.9	20.0	0	90.0
Food and kindred products	59	3.7	0	0	0	14	4.5	0	0	0
Textile mill products and apparel	41	14.4	.8	0	21.9	8	38.6	23.0	0	32.0
Paper and allied products	43	3.2	0	0	2.5	8	3.1	0	0	0
Chemicals and allied products	224	7.1	0	0	5.0	143	11.2	0	0	5.8
Industrial organic and inorganic chemicals	73	9.5	0	0	6.8	46	17.2	0	0	6.0
Drugs and medicines	62	.4	0	0	0	39	3.9	0	0	0
Soap, cleaners, etc.	15	2.9	0	0	4.4	9	5.2	0	0	5.4
Paint, varnish, etc.	23	9.8	7.9	0	13.4	16	11.8	8.1	0	13.3
Other chemical products	51	10.2	0	0	8.1	33	8.8	0	0	8.1
Petroleum refining	43	3.1	0	0	6.9	20	9.6	3.4	0	13.0
Rubber products	30	13.6	21.7	4.8	37.5	14	34.6	31.7	0	60.0
Stone, clay, and glass products	30	2.7	0	0	1.4	9	.1	0	0	0
Primary metal industries	37	9.5	.4	0	13.3	6	61.4	(2/)	(2/)	(2/)
Fabricated metal products	124	31.1	24.5	0	76.3	55	78.0	76.2	0	100.0
Machinery (except electrical)	151	23.8	2.9	0	33.3	59	53.5	0	0	66.4
Electrical machinery	208	57.0	67.4	22.7	100.0	111	80.8	86.7	33.3	100.0
Transportation equipment	96	70.8	91.7	24.2	100.0	24	73.3	94.5	40.0	100.0
Motor vehicles and equipment	23	9.4	16.1	1.9	28.7	3	31.8	(2/)	(2/)	(2/)
Aircraft and parts	59	85.1	100.0	82.9	100.0	18	77.7	100.0	42.9	100.0
Other transportation equipment	14	52.8	38.4	0	100.0	3	77.1	(2/)	(2/)	(2/)
Professional and scientific instruments	136	57.3	50.0	13.6	94.6	100	76.2	50.0	13.6	100.0
Photographic equipment and supplies	21	29.1	100.0	13.9	100.0	16	93.1	100.0	10.0	100.0
Other professional and scientific instruments	115	73.0	47.0	13.6	82.3	84	70.9	50.0	13.6	94.6
Other manufacturing	80	54.9	12.7	0	73.3	40	73.4	41.5	0	98.5
Nonmanufacturing	328	50.6	14.2	0	90.3	277	54.9	26.2	0	94.9
Commercial consulting firms	220	65.4	47.8	0	100.0	208	62.9	50.0	0	100.0
Nonprofit research agencies	33	53.2	10.3	0	50.0	29	48.4	7.3	0	48.6
Other nonmanufacturing	75	42.9	0	0	10.0	40	17.9	0	0	10.5

See footnotes at end of table.

C-18. Cost of Government-financed research as percent of total research cost, by industry and size of company, 1951--Continued

Industry	Companies with 500 to 4,999 employees					Companies with 5,000 or more employees				
	Number of companies reporting	Mean*/	Median	Lower quartile	Upper quartile	Number of companies reporting	Mean*/	Median	Lower quartile	Upper quartile
All industries	507	49.9	5.7	0	50.0	186	45.1	1.2	0	26.2
Manufacturing	480	48.0	6.2	0	50.0	175	45.7	1.7	0	26.3
Food and kindred products	28	.7	0	0	0	16	4.6	0	0	0
Textile mill products and apparel	23	25.1	0	0	6.6	9	2.6	.8	0	19.2
Paper and allied products	26	4.3	0	0	3.1	9	2.2	0	0	2.5
Chemicals and allied products	55	4.3	0	0	1.4	21	7.6	.3	0	4.8
Industrial organic and inorganic chemicals	17	5.1	0	0	1.3	9	9.7	2.7	0	6.8
Drugs and medicines	16	.4	0	0	0	6	(3/)	(2/)	(2/)	(2/)
Soap, cleaners, etc.	3	17.9	(2/)	(2/)	(2/)	3	.9	(2/)	(2/)	(2/)
Paint, varnish, etc.	4	6.7	(2/)	(2/)	(2/)	3	10.5	(2/)	(2/)	(2/)
Other chemical products	15	12.3	0	0	0	--	--	--	--	--
Petroleum refining	8	.8	0	0	0	14	2.1	.8	0	1.6
Rubber products	9	25.7	20.5	8.8	25.1	4	11.1	(2/)	(2/)	(2/)
Stone, clay, and glass products	13	6.9	0	0	9.9	7	.9	(2/)	(2/)	(2/)
Primary metal industries	17	27.8	1.3	0	33.3	11	4.2	.4	0	.9
Fabricated metal products	50	30.1	14.6	0	50.0	13	15.0	10.2	0	46.8
Machinery (except electrical)	71	38.7	4.0	0	19.3	20	8.6	2.9	0	9.3
Electrical machinery	82	65.6	55.3	11.2	87.8	10	54.0	54.4	31.4	68.8
Transportation equipment	41	91.2	97.1	24.2	100.0	29	68.7	85.9	2.5	97.6
Motor vehicles and equipment	10	28.6	23.4	6.2	28.7	9	8.2	2.5	.9	16.1
Aircraft and parts	23	98.7	100.0	90.1	100.0	17	83.6	95.1	85.9	99.1
Other transportation equipment	8	84.3	69.6	0	100.0	3	9.9	(2/)	(2/)	(2/)
Professional and scientific instruments.	28	50.4	32.6	8.6	66.4	5	54.4	(2/)	(2/)	(2/)
Photographic equipment and supplies	4	68.3	(2/)	(2/)	(2/)	1	(2/)	(2/)	(2/)	(2/)
Other professional and scientific instruments	24	46.6	(2/)	(2/)	(2/)	4	85.3	(2/)	(2/)	(2/)
Other manufacturing	29	63.4	3.0	0	32.0	7	18.3	(2/)	(2/)	(2/)
Nonmanufacturing	27	61.6	0	0	44.4	11	33.9	0	0	0
Commercial consulting firms	2	(2/)	(2/)	(2/)	(2/)	--	--	--	--	--
Nonprofit research agencies	4	55.5	(2/)	(2/)	(2/)	--	--	--	--	--
Other nonmanufacturing	21	61.7	0	0	0	11	33.9	0	0	0

1/ Excludes 323 companies that failed to report total research cost or Government-financed research cost. The number of companies in the three size groups do not add to the totals shown in column 1, which include companies not reporting total employment.

2/ Means are not shown for fewer than 3 companies; medians and quartiles are not shown for fewer than 8 companies.

3/ Less than 0.05 percent.

*/ Means were computed by dividing the aggregate cost of Government-financed research by the total research cost for each specified group of companies. They thus reflect to a great extent the experience of the largest organizations in the group. This should be borne in mind in comparing the means with the median percentages, which were computed from rankings of percentages for individual companies.

C-19 Cost of Government-financed research as percent of total research cost, by industry and size of professional research staff, 1951

Industry	All reporting companies	Companies with professional research staff of-- 0 to 4	5 to 14	15 to 29	30 to 49	50 to 74	75 to 124	125 to 249	250 to 499	500 to 999	1,000 or more
All industries	46.8	34.4	35.6	40.5	37.0	32.3	33.4	41.1	36.0	55.4	55.3
Manufacturing	46.4	33.7	33.0	40.0	34.6	30.8	27.2	37.8	32.3	55.6	56.7
Food and kindred products	3.7	2.2	1.0	0	14.0	(1/)	--	0	--	--	--
Textile mill products and apparel	14.4	15.9	31.2	34.6	(1/)	(1/)	(1/)	(1/)	--	--	--
Paper and allied products	3.2	6.6	1.7	9.0	3.0	(1/)	(1/)	--	--	--	--
Chemicals and allied products	7.1	5.3	10.8	8.1	9.1	6.5	6.5	1.0	19.1	(1/)	(1/)
Industrial organic and inorganic chemicals	9.5	7.5	8.8	1.1	12.6	8.8	8.2	(1/)	(1/)	(1/)	(1/)
Drugs and medicines	0.4	4.0	4.5	0	0	(1/)	(1/)	.3	(1/)	--	--
Soap, cleaners, etc.	2.9	1.6	0	(1/)	(1/)	(1/)	--	(1/)	(1/)	--	--
Paint, varnish, etc.	9.8	6.0	9.1	6.5	(1/)	(1/)	(1/)	--	(1/)	--	--
Other chemical products	10.2	6.2	18.5	7.5	13.8	(1/)	(1/)	--	--	--	--
Petroleum refining	3.1	13.0	5.3	(1/)	5.0	(1/)	0	2.5	5.2	(1/)	--
Rubber products	13.6	22.3	21.4	31.9	(1/)	--	--	(1/)	--	(1/)	--
Stone, clay, and glass products	2.7	2.1	2.7	32.1	--	(1/)	--	.9	--	--	--
Primary metal industries	9.5	26.4	43.6	6.0	(1/)	2.9	(1/)	(1/)	(1/)	--	--
Fabricated metal products	31.1	47.6	43.9	20.1	50.4	57.3	(1/)	(1/)	(1/)	--	--
Machinery (except electrical)	23.8	31.1	16.3	23.4	22.5	12.8	27.7	49.4	--	--	(1/)
Electrical machinery	57.0	49.9	58.1	69.3	65.1	53.3	65.0	92.6	69.8	70.8	51.9
Transportation equipment	70.8	64.9	48.8	49.3	28.4	60.3	76.3	93.0	40.4	88.4	79.7
Motor vehicles and equipment	9.4	33.6	11.7	18.1	11.4	(1/)	(1/)	(1/)	(1/)	--	--
Aircraft and parts	85.1	72.0	73.3	84.5	(1/)	99.2	(1/)	99.3	99.1	88.4	79.7
Other transportation equipment	52.8	83.3	39.9	83.2	(1/)	--	(1/)	--	--	--	--
Professional and scientific instruments	57.7	47.5	60.8	63.5	82.1	47.8	45.0	(1/)	(1/)	--	(1/)
Photographic equipment and supplies	29.1	36.2	85.3	(1/)	(1/)	(1/)	(1/)	--	(1/)	--	(1/)
Other professional and scientific instruments	73.0	49.1	52.2	63.6	79.5	35.3	46.3	(1/)	--	--	(1/)
Other manufacturing	54.9	27.0	40.8	47.2	31.3	--	45.7	79.7	--	--	--
Nonmanufacturing	50.6	38.0	49.2	43.0	51.4	48.4	57.3	70.8	67.0	(1/)	(1/)
Commercial consulting firms	65.4	45.9	58.9	63.0	88.9	79.7	(1/)	78.5	(1/)	--	--
Nonprofit research agencies	53.2	0	24.8	40.9	10.1	(1/)	--	(1/)	57.0	(1/)	--
Other nonmanufacturing	42.9	27.2	25.2	3.4	12.0	(1/)	57.9	(1/)	(1/)	--	(1/)

1/ Data are not shown for fewer than three companies.

C-20. Cost of research as percent of sales, by industry and size of company, 1951

Industry	All companies					Companies with fewer than 500 employees				
	Number of companies reporting	Mean */	Median	Lower quartile	Upper quartile	Number of companies reporting	Mean */	Median	Lower quartile	Upper quartile
All industries	1/ 1,703	2.0	2.8	1.0	12.8	922	6.9	7.4	2.4	37.5
Manufacturing	1,377	2.0	2.0	.8	5.6	648	4.3	4.0	1.8	11.8
Food and kindred products	64	.3	.3	.1	.6	15	.5	1.3	.2	6.2
Textile mill products and apparel	45	.9	.6	.2	1.4	11	1.3	1.2	.5	2.0
Paper and allied products	46	.5	.4	.2	.7	9	.9	.6	.3	3.3
Chemicals and allied products	246	2.5	2.4	1.3	4.7	162	2.5	2.6	1.3	5.8
Industrial organic and inorganic chemicals	81	3.0	2.1	1.3	5.0	53	2.7	2.4	1.0	8.9
Drugs and medicines	65	3.3	3.5	1.7	5.8	42	3.2	3.6	1.4	6.6
Soap, cleaners, etc.	16	1.1	1.7	1.3	2.7	9	2.5	1.6	1.3	4.6
Paint, varnish, etc.	29	1.1	2.1	1.3	3.2	21	2.4	2.4	1.7	3.9
Other chemical products	55	1.6	1.8	1.0	3.3	37	1.8	2.4	1.2	4.2
Petroleum refining	41	.6	.6	.4	1.5	18	3.0	1.6	.6	3.0
Rubber products	31	.9	1.8	.8	3.5	14	3.9	3.3	1.9	6.8
Stone, clay, and glass products	33	1.3	1.1	.4	2.4	10	2.6	2.5	.4	4.0
Primary metal industries	39	.4	.6	.3	1.2	7	2.5	(2/)	(2/)	(2/)
Fabricated metal products	131	.9	1.4	.7	3.7	57	5.4	3.4	1.4	10.8
Machinery (except electrical)	164	1.5	1.5	.8	3.2	64	3.4	3.0	1.1	6.0
Electrical machinery	213	6.4	4.2	1.9	11.1	112	7.4	6.4	2.7	14.9
Transportation equipment	98	4.5	3.2	1.1	10.8	24	6.5	4.0	2.7	9.4
Motor vehicles and equipment	24	1.2	1.3	.4	1.9	3	1.9	(2/)	(2/)	(2/)
Aircraft and parts	60	12.7	7.7	3.2	18.8	19	9.1	4.1	3.3	12.5
Other transportation equipment	14	.9	.7	.2	3.0	2	(2/)	(2/)	(2/)	(2/)
Professional and scientific instruments	142	5.8	8.3	3.4	20.0	105	11.8	10.7	4.8	21.7
Photographic equipment and supplies	22	4.8	7.9	4.3	20.0	17	14.8	20.0	5.0	21.7
Other professional and scientific instruments	120	6.4	8.3	3.1	19.6	88	11.1	10.8	4.7	22.4
Other manufacturing	84	1.1	1.8	.4	5.0	40	4.1	4.3	1.8	25.0
Nonmanufacturing	326	1.8	66.7	11.1	92.3	274	27.5	73.4	25.0	94.3
Commercial consulting firms	222	47.4	77.4	38.7	93.8	207	51.3	77.8	40.0	93.9
Nonprofit research agencies	29	89.8	100.0	85.9	100.0	26	83.2	100.0	80.2	100.0
Other nonmanufacturing	75	1.0	2.6	.7	8.1	41	5.6	6.7	2.6	28.6

See footnotes at end of table.

C-20. Cost of research as percent of sales, by industry and size of company, 1951--Continued

Industry	Companies with 500 to 4,999 employees					Companies with 5,000 or more employees				
	Number of companies reporting	Mean*/	Median	Lower quartile	Upper quartile	Number of companies reporting	Mean*/	Median	Lower quartile	Upper quartile
All industries	536	2.0	1.3	0.5	2.9	200	1.9	0.7	0.3	2.0
Manufacturing	509	1.9	1.3	.5	2.8	188	2.0	.8	.3	2.3
Food and kindred products	32	.3	.2	.1	.6	17	.3	.2	.1	.4
Textile mill products and apparel	24	.9	.4	.2	1.0	9	.8	.3	.1	1.0
Paper and allied products	28	.5	.4	.2	.6	9	.4	.3	.1	.6
Chemicals and allied products	58	2.4	1.7	1.0	2.7	22	2.6	2.4	1.7	3.9
Industrial organic and inorganic chemicals	17	2.1	1.8	1.3	2.3	10	3.2	3.7	1.8	4.7
Drugs and medicines	16	3.9	3.2	1.3	4.7	6	3.0	(2/)	(2/)	(2/)
Soap, cleaners, etc.	4	1.8	(2/)	(2/)	(2/)	3	1.0	(2/)	(2/)	(2/)
Paint, varnish, etc.	5	1.5	(2/)	(2/)	(2/)	3	.7	(2/)	(2/)	(2/)
Other chemical products	16	1.3	1.0	.9	1.6	—	—	—	—	—
Petroleum refining	8	1.3	.4	.3	1.3	15	.5	.5	.3	.6
Rubber products	10	.7	.8	.3	1.3	4	.9	(2/)	(2/)	(2/)
Stone, clay, and glass products	13	.7	.6	.4	.8	8	1.3	1.2	.4	1.4
Primary metal industries	16	.8	.6	.2	1.2	13	.4	.4	.2	.8
Fabricated metal products	55	1.1	1.0	.5	1.8	13	.6	.4	.3	.6
Machinery (except electrical)	74	1.8	1.4	.7	2.2	24	1.3	1.0	.5	1.5
Electrical machinery	87	4.1	2.7	1.5	5.5	11	7.1	5.2	1.7	6.3
Transportation equipment	42	6.1	2.2	.8	7.9	30	4.4	4.8	.7	11.0
Motor vehicles and equipment	11	1.5	1.8	.4	2.1	9	1.2	.7	.4	1.3
Aircraft and parts	23	15.6	5.9	1.3	17.1	17	12.5	11.0	7.5	18.0
Other transportation equipment	8	1.6	.6	.1	3.0	4	.6	(2/)	(2/)	(2/)
Professional and scientific instruments	29	3.8	3.6	1.0	6.7	6	5.8	(2/)	(2/)	(2/)
Photographic equipment and supplies	4	4.8	(2/)	(2/)	(2/)	1	(2/)	(2/)	(2/)	(2/)
Other professional and scientific instruments	25	3.7	2.5	.8	5.4	5	7.6	(2/)	(2/)	(2/)
Other manufacturing	33	1.4	.8	.2	2.8	7	.5	(2/)	(2/)	(2/)
Nonmanufacturing	27	5.2	1.8	.4	4.5	12	.8	.2	(3/)	.6
Commercial consulting firms	3	29.0	(2/)	(2/)	(2/)	—	—	—	—	—
Nonprofit research agencies	3	94.2	(2/)	(2/)	(2/)	—	—	—	—	—
Other nonmanufacturing	21	1.9	1.5	.2	3.0	12	.8	.2	(3/)	.6

1/ Excludes 250 companies that failed to report total research cost or value of sales (or services). The numbers of reporting companies in the three size groups do not add to the totals shown in column 1, which include companies not reporting their total employment.

2/ Means are not shown for fewer than three companies; medians and quartiles not shown for fewer than eight companies.

3/ Less than 0.05 percent.

*/ Means were computed by dividing the aggregate cost of research by the total value of sales for each specified group of companies. They thus reflect to a great extent the experience of the largest organizations in the group. This should be borne in mind in comparing the means with the median percentages, which were computed from rankings of ratios for individual companies.

C-21. Cost of research as percent of sales, by industry and size of professional research staff, 1951

Industry	All reporting companies	Companies with professional research staff of--									
		0 to 4	5 to 14	15 to 29	30 to 49	50 to 74	75 to 124	125 to 249	250 to 499	500 to 999	1,000 or more
All industries	2.0	0.7	0.8	1.1	1.4	1.2	1.1	1.6	1.6	2.2	5.1
Manufacturing	2.0	.6	.8	1.0	1.3	1.2	1.0	1.5	1.5	2.1	7.0
Food and kindred products	.3	.2	.2	.1	.4	(1/)	--	.5	--	--	--
Textile mill products and apparel	.9	.2	.5	.7	(1/)	(1/)	(1/)	(1/)	--	--	--
Paper and allied products	.5	.3	.3	.6	.4	(1/)	(1/)	--	--	--	--
Chemicals and allied products	2.5	1.2	1.7	2.0	2.0	1.4	2.1	3.7	2.3	(1/)	(1/)
Industrial organic and inorganic chemicals	3.0	1.0	3.1	1.4	1.8	2.6	2.0	(1/)	4.6	(1/)	(1/)
Drugs and medicines	3.3	1.8	1.1	2.9	3.0	4.2	(1/)	4.1	(1/)	--	--
Soap, cleaners, etc.	1.1	.9	2.3	(1/)	(1/)	(1/)	--	(1/)	(1/)	--	--
Paints, varnish, etc.	1.1	1.9	1.9	2.0	(1/)	(1/)	(1/)	--	(1/)	--	--
Other chemical products	1.6	.9	1.6	1.6	1.9	(1/)	(1/)	--	--	--	--
Petroleum refining	.6	.9	.7	(1/)	(1/)	(1/)	.3	.5	.9	(1/)	--
Rubber products	.9	.9	1.0	.8	(1/)	--	--	(1/)	--	(1/)	--
Stone, clay, and glass products	1.3	1.4	.6	.8	--	(1/)	--	1.5	--	--	--
Primary metal industries	.4	.4	.3	.9	.8	.2	(1/)	(1/)	(1/)	--	--
Fabricated metal products	.9	.6	1.5	.6	.9	4.0	(1/)	(1/)	(1/)	--	--
Machinery (except electrical)	1.5	1.3	1.3	1.2	1.6	1.9	.9	2.5	--	--	(1/)
Electrical machinery	6.4	2.3	2.7	3.0	4.5	3.7	3.3	11.2	10.9	6.8	7.6
Transportation equipment	4.5	1.1	.8	1.3	1.6	1.3	.5	6.0	2.1	24.8	12.2
Motor vehicles and equipment	1.2	.6	.8	1.0	1.0	(1/)	(1/)	(1/)	(1/)	--	--
Aircraft and parts	12.7	2.9	1.7	5.2	(1/)	10.4	(1/)	10.0	11.8	24.8	12.2
Other transportation equipment	.9	1.0	.4	1.3	(1/)	--	(1/)	--	--	--	--
Professional and scientific instruments	5.8	3.5	3.9	3.6	18.7	3.9	5.5	(1/)	(1/)	--	(1/)
Photographic equipment and supplies	4.8	4.3	5.8	(1/)	(1/)	(1/)	(1/)	--	--	--	(1/)
Other professional and scientific instruments	6.4	3.4	3.5	3.5	18.1	3.0	5.6	(1/)	(1/)	--	(1/)
Other manufacturing	1.1	.5	.3	1.4	3.0	--	1.2	4.9	--	--	--
Nonmanufacturing	1.8	1.0	.6	3.3	4.1	2.3	2.0	6.0	91.0	(1/)	(1/)
Commercial consulting firms	47.4	30.3	30.0	37.4	83.5	94.0	(1/)	75.1	(1/)	--	--
Nonprofit research agencies	89.8	13.3	88.6	(1/)	97.2	(1/)	--	(1/)	(1/)	(1/)	--
Other nonmanufacturing	1.0	.3	.1	1.2	1.4	(1/)	1.6	(1/)	--	--	(1/)

1/ Data are not shown for fewer than three companies.

C-22. Average cost per research engineer or scientist, by industry and size of company, 1951 1/

Industry	All companies					Companies with fewer than 500 employees				
	Number of companies reporting	Mean*/	Median	Lower quartile	Upper quartile	Number of companies reporting	Mean */	Median	Lower quartile	Upper quartile
All industries	2/ 1,654	$21,900	$13,500	$ 8,900	$20,500	877	$14,800	$11,300	$7,500	$18,000
Manufacturing	1,346	22,500	14,200	9,200	21,000	621	15,600	11,100	7,500	18,000
Food and kindred products	61	17,000	14,900	10,000	20,000	14	10,600	9,400	6,700	10,900
Textile mill products and apparel	43	19,200	14,000	10,000	20,800	10	10,200	10,000	5,000	12,500
Paper and allied products	46	13,500	11,200	8,300	14,400	9	11,400	10,000	6,000	10,000
Chemicals and allied products	239	16,500	10,000	7,500	16,100	152	12,500	8,900	6,700	13,500
Industrial organic and inorganic chemicals	77	18,200	11,000	7,000	16,300	49	12,200	8,300	6,600	15,000
Drugs and medicines	67	16,400	10,000	7,100	16,600	42	10,200	8,500	5,000	12,300
Soap, cleaners, etc.	15	14,900	11,500	8,100	15,600	8	10,000	8,700	8,000	11,500
Paint, varnish, etc.	26	7,100	9,700	6,600	11,700	19	9,900	9,900	7,500	11,500
Other chemical products	54	13,500	10,000	7,800	16,500	34	12,500	9,800	6,700	14,300
Petroleum refining	44	20,900	17,100	12,500	19,700	19	20,500	12,500	7,700	17,500
Rubber products	30	13,600	12,500	8,500	16,300	14	12,800	10,600	8,500	12,500
Stone, clay, and glass products	34	18,600	14,300	9,200	20,000	12	13,300	10,400	4,600	18,800
Primary metal industries	37	21,500	16,700	11,200	23,900	6	14,500	(3/)	(3/)	(3/)
Fabricated metal products	128	16,500	15,000	9,100	22,000	55	16,000	12,500	7,700	20,900
Machinery (except electrical)	157	18,300	15,200	9,800	21,700	59	16,400	10,500	6,700	17,000
Electrical machinery	213	28,100	15,600	10,000	25,000	112	19,000	14,200	9,400	23,700
Transportation equipment	97	27,600	22,500	13,200	40,100	24	22,200	16,600	9,200	28,400
Motor vehicles and equipment	23	68,600	28,900	14,900	65,900	3	12,400	(3/)	(3/)	(3/)
Aircraft and parts	60	24,300	21,300	15,000	37,000	19	24,300	16,300	8,000	25,000
Other transportation equipment	14	30,800	15,400	11,500	25,000	2	(3/)	(3/)	(3/)	(3/)
Professional and scientific instruments	137	17,900	14,200	8,000	20,000	97	16,000	12,500	7,500	20,000
Photographic equipment and supplies	22	17,300	15,200	7,200	20,000	16	15,600	14,800	5,800	21,900
Other professional and scientific instruments	115	18,200	13,700	8,300	20,000	81	16,200	11,700	7,700	19,300
Other manufacturing	80	19,400	13,100	10,000	21,100	38	15,000	11,300	8,600	18,400
Nonmanufacturing	308	17,800	11,600	7,700	18,500	256	13,900	11,500	7,500	18,000
Commercial consulting firms	201	15,100	11,200	7,500	17,900	189	14,300	11,200	7,500	17,900
Nonprofit research agencies	32	12,400	10,800	7,100	15,000	28	11,400	10,800	6,500	15,000
Other nonmanufacturing	75	23,300	12,500	9,000	25,000	39	19,100	12,500	9,000	23,000

See footnotes at end of table.

C-22. Average cost per research engineer or scientist, by industry and size of company, 1951 1/--Continued

Industry	Companies with 500 to 4,999 employees					Companies with 5,000 or more employees				
	Number of companies reporting	Mean */	Median	Lower quartile	Upper quartile	Number of companies reporting	Mean */	Median	Lower quartile	Upper quartile
All industries	535	$18,100	$15,400	$10,000	$23,200	194	$24,300	$18,000	$13,200	$23,700
Manufacturing	508	18,400	15,500	10,000	23,200	183	24,400	18,300	13,500	23,700
Food and kindred products	32	15,000	15,300	10,000	20,200	14	18,200	17,200	13,900	19,300
Textile mill products and apparel	22	19,600	13,900	10,000	16,700	10	20,000	19,400	10,000	22,700
Paper and allied products	28	12,100	12,100	8,300	14,300	9	15,400	12,700	9,400	18,100
Chemicals and allied products	60	14,700	13,000	9,300	16,800	22	17,900	15,200	12,000	19,100
Industrial organic and inorganic chemicals	17	12,900	11,100	7,500	14,400	10	19,600	18,300	13,300	24,300
Drugs and medicines	18	17,600	16,400	9,700	20,500	6	16,900	(3/)	(3/)	(3/)
Soap, cleaners, etc.	4	12,600	(3/)	(3/)	(3/)	3	15,700	(3/)	(3/)	(3/)
Paint, varnish, etc.	4	10,800	(3/)	(3/)	(3/)	3	5,100	(3/)	(3/)	(3/)
Other chemical products	17	13,600	13,100	7,800	29,300	--	--	--	--	--
Petroleum refining	8	17,900	15,100	13,300	17,500	16	21,000	19,000	16,600	20,000
Rubber products	10	18,100	15,800	7,700	27,000	4	13,400	(3/)	(3/)	(3/)
Stone, clay, and glass products	13	13,700	11,500	9,000	18,400	8	19,700	18,600	12,900	22,700
Primary metal industries	17	16,800	13,100	10,300	20,500	12	22,600	17,900	12,300	24,100
Fabricated metal products	54	15,900	15,500	10,100	22,800	13	17,800	18,000	12,000	20,000
Machinery (except electrical)	75	20,900	16,200	10,000	21,700	21	16,600	20,200	13,900	28,500
Electrical machinery	86	18,100	17,100	12,200	25,000	11	32,400	19,100	15,600	24,500
Transportation equipment	41	27,300	24,600	16,300	37,000	30	27,700	23,300	14,900	43,800
Motor vehicles and equipment	10	31,100	33,700	11,800	63,900	9	75,500	65,900	11,300	74,900
Aircraft and parts	23	26,000	24,500	17,300	27,500	17	24,100	24,100	15,800	42,300
Other transportation equipment	8	49,400	11,600	5,000	25,000	4	21,500	(3/)	(3/)	(3/)
Professional and scientific instruments	31	14,900	15,400	8,900	19,000	6	19,600	(3/)	(3/)	(3/)
Photographic equipment and supplies	5	10,300	(3/)	(3/)	(3/)	1	(3/)	(3/)	(3/)	(3/)
Other professional and scientific instruments	26	16,900	15,000	8,800	20,000	5	19,500	(3/)	(3/)	(3/)
Other manufacturing	31	21,700	15,700	11,300	22,700	7	17,100	(3/)	(3/)	(3/)
Nonmanufacturing	27	16,900	11,700	8,200	19,900	11	22,100	12,900	10,500	15,300
Commercial consulting firms	2	(3/)	(3/)	(3/)	(3/)	--	--	--	--	--
Nonprofit research agencies	4	3,000	(3/)	(3/)	(3/)	--	--	--	--	--
Other nonmanufacturing	21	25,500	10,000	7,500	25,000	11	22,100	12,900	10,500	15,300

1/ Cost figures rounded to the nearest $100.

2/ Excludes 299 companies that failed to report total research cost or number of research engineers and scientists. The number of reporting companies in the three size groups do not add to the totals shown in column 1, which include companies not reporting their total employment.

3/ Means are not shown for fewer than three companies; medians and quartiles are not shown for fewer than eight companies.

*/ Means were computed by dividing the total cost of research by the average number of research engineers and scientists for each specified group of companies. They thus reflect to a great extent the experience of the largest organizations in the group. This should be borne in mind in comparing the means with the median ratios, which were computed from rankings of ratios for individual companies.

C-23. Average cost per research engineer or scientist, by industry and size of professional research staff, 1951 1/

Industry	All reporting companies	Companies with professional research staff of--									
		0 to 4	5 to 14	15 to 29	30 to 49	50 to 74	75 to 124	125 to 249	250 to 499	500 to 999	1,000 or more
All industries	$21,900	$15,500	$17,700	$17,800	$17,800	$17,100	$14,500	$21,000	$24,900	$22,500	$25,000
Manufacturing	22,500	16,300	17,900	18,100	18,800	17,600	13,500	21,500	26,200	23,900	25,100
Food and kindred products	17,000	18,000	17,600	12,300	27,300	(2/)	--	14,800	--	--	--
Textile mill products and apparel	19,200	19,600	17,900	19,600	(2/)	(2/)	(2/)	(2/)	--	--	--
Paper and allied products	13,500	12,300	12,600	13,100	11,700	(2/)	(2/)	--	--	--	--
Chemicals and allied products	16,500	10,700	13,100	12,200	14,200	12,900	13,900	19,300	15,000	(2/)	(2/)
Industrial organic and inorganic chemicals	18,200	9,900	13,600	8,600	13,000	14,800	14,100	(2/)	20,900	(2/)	(2/)
Drugs and medicines	16,400	11,600	10,700	12,100	19,400	15,300	(2/)	19,300	(2/)	--	--
Soap, cleaners, etc.	14,900	16,300	8,600	(2/)	(2/)	(2/)	--	(2/)	(2/)	--	--
Paint, varnish, etc.	7,100	9,900	12,700	8,800	(2/)	(2/)	(2/)	--	(2/)	--	--
Other chemical products	13,500	9,000	15,900	19,500	13,600	(2/)	(2/)	--	(2/)	--	--
Petroleum refining	20,900	14,600	15,500	(2/)	23,200	(2/)	16,000	20,500	20,000	(2/)	--
Rubber products	13,600	13,000	17,900	12,300	(2/)	--	--	10,400	--	14,700	--
Stone, clay, and glass products	18,600	21,300	14,800	10,000	--	(2/)	--	30,300	--	--	--
Primary metal industries	21,500	22,700	16,700	23,600	11,900	19,200	(2/)	(2/)	(2/)	--	--
Fabricated metal products	16,500	14,100	20,700	16,500	15,900	12,000	(2/)	(2/)	(2/)	--	--
Machinery (except electrical)	18,300	12,600	22,200	16,800	24,500	17,800	13,000	26,600	--	--	(2/)
Electrical machinery	28,100	17,700	9,000	19,700	19,500	18,600	11,600	18,700	14,500	21,400	36,300
Transportation equipment	27,600	35,500	17,700	41,600	27,900	29,500	9,200	28,900	56,400	37,200	20,800
Motor vehicles and equipment	68,600	63,600	20,200	54,700	20,900	(2/)	(2/)	(2/)	(2/)	--	--
Aircraft and parts	24,300	25,000	16,200	25,200	(2/)	25,100	(2/)	31,000	31,600	37,200	20,800
Other transportation equipment	30,800	45,000	18,500	46,400	(2/)	--	(2/)	--	--	--	--
Professional and scientific instruments	17,900	15,000	18,100	17,000	18,700	15,400	13,900	(2/)	(2/)	--	(2/)
Photographic equipment and supplies	17,300	15,200	31,000	(2/)	(2/)	(2/)	(2/)	--	(2/)	--	(2/)
Other professional and scientific instruments	18,200	5,000	15,900	17,600	19,700	14,100	18,100	(2/)	(2/)	--	(2/)
Other manufacturing	19,400	15,500	19,100	13,600	29,000	--	(2/)	20,100	--	--	--
Nonmanufacturing	17,800	12,900	17,000	16,900	12,900	13,800	20,600	17,400	17,200	(2/)	(2/)
Commercial consulting firms	15,100	12,100	17,000	16,300	13,000	14,400	(2/)	18,500	(2/)	--	--
Nonprofit research agencies	12,400	12,500	12,400	13,200	10,100	(2/)	(2/)	(2/)	(2/)	(2/)	--
Other nonmanufacturing	23,300	15,500	17,900	19,700	5,000	(2/)	23,100	(2/)	(2/)	--	(2/)

1/ Cost figures rounded to the nearest $100.
2/ Data are not shown for fewer than three companies.

C-24. Average cost per research engineer or scientist on Government-financed research, by industry and size of company, 1951 1/

Industry	All companies					Companies with fewer than 500 employees				
	Number of companies reporting	Mean */	Median	Lower quartile	Upper quartile	Number of companies reporting	Mean */	Median	Lower quartile	Upper quartile
All industries	2/ 813	$23,900	$11,400	$ 6,800	$20,300	433	$15,800	$10,600	$6,000	$19,500
Manufacturing	657	24,500	11,700	7,000	20,900	292	17,700	10,500	6,000	20,000
Food and kindred products	7	4,200	(3/)	(3/)	(3/)	3	4,800	(3/)	(3/)	(3/)
Textile mill products and apparel	18	31,900	13,900	3,000	30,000	3	14,800	(3/)	(3/)	(3/)
Paper and allied products	10	12,000	8,500	4,000	16,200	--	--	--	--	--
Chemicals and allied products	61	22,400	8,300	5,000	15,500	30	11,600	6,300	5,000	12,000
Industrial organic and inorganic chemicals	27	30,700	9,500	5,300	17,500	14	13,800	6,300	5,000	12,000
Drugs and medicines	8	8,400	5,000	3,000	6,700	4	11,100	(3/)	(3/)	(3/)
Soap, cleaners, etc.	5	10,400	(3/)	(3/)	(3/)	2	(3/)	(3/)	(3/)	(3/)
Paint, varnish, etc.	10	7,300	6,700	3,800	10,000	5	9,100	(3/)	(3/)	(3/)
Other chemical products	11	13,900	10,100	5,000	13,300	5	9,300	(3/)	(3/)	(3/)
Petroleum refining	18	15,800	11,000	5,000	18,200	6	8,400	(3/)	(3/)	(3/)
Rubber products	18	9,300	9,400	6,000	12,500	8	9,100	9,400	5,000	10,600
Stone, clay, and glass products	10	9,300	9,200	2,000	11,000	--	--	--	--	--
Primary metal industries	18	20,300	12,100	4,000	20,000	3	18,500	(3/)	(3/)	(3/)
Fabricated metal products	71	14,900	12,200	7,500	18,800	32	16,700	13,800	6,700	25,000
Machinery (except electrical)	66	21,700	11,900	7,400	18,000	23	18,700	9,300	5,000	15,800
Electrical machinery	158	29,400	12,600	8,300	22,400	84	18,800	11,000	7,500	21,800
Transportation equipment	77	24,000	16,700	10,000	30,100	18	22,400	14,600	8,000	28,400
Motor vehicles and equipment	17	34,200	11,300	8,000	16,000	2	(3/)	(3/)	(3/)	(3/)
Aircraft and parts	51	23,700	20,300	12,500	30,100	14	22,300	14,600	8,000	16,300
Other transportation equipment	9	42,500	10,000	4,500	28,400	2	(3/)	(3/)	(3/)	(3/)
Professional and scientific instruments	89	19,800	12,400	7,500	23,200	64	18,400	10,600	6,000	21,300
Photographic equipment and supplies	16	13,300	13,500	7,200	21,900	12	21,000	14,300	4,500	21,900
Other professional and scientific instruments	73	21,100	11,900	7,000	24,500	52	17,600	10,300	6,000	21,100
Other manufacturing	36	17,200	10,300	5,700	19,100	18	14,700	12,900	7,100	19,100
Nonmanufacturing	156	20,100	11,200	6,200	20,300	141	13,700	10,900	5,900	16,700
Commercial consulting firms	121	15,700	11,200	6,700	17,100	117	14,500	11,200	6,700	17,100
Nonprofit research agencies	17	12,800	8,400	4,300	11,400	14	10,800	7,100	4,300	10,700
Other nonmanufacturing	18	32,300	29,000	6,000	33,500	10	17,000	10,200	5,000	29,900

See footnotes at end of table.

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C-24. Average cost per research engineer or scientist on Government-financed research, by industry and size of company, 1951 1/—Continued

Industry	Companies with 500 to 4,999 employees					Companies with 5,000 or more employees				
	Number of companies reporting	Mean */	Median	Lower quartile	Upper quartile	Number of companies reporting	Mean */	Median	Lower quartile	Upper quartile
All industries	255	$21,000	$12,400	$ 8,000	$24,500	98	$26,500	$15,400	$ 8,800	$23,200
Manufacturing	245	20,800	12,200	7,900	22,400	97	26,500	14,800	8,800	20,800
Food and kindred products	3	3,700	(3/)	(3/)	(3/)	1	(3/)	(3/)	(3/)	(3/)
Textile mill products and apparel	9	40,100	11,000	1,000	31,300	5	16,700	(3/)	(3/)	(3/)
Paper and allied products	7	11,100	(3/)	(3/)	(3/)	3	13,600	(3/)	(3/)	(3/)
Chemicals and allied products	18	11,400	9,100	3,800	15,500	10	35,000	12,400	5,000	23,500
Industrial organic and inorganic chemicals	6	13,400	(3/)	(3/)	(3/)	6	41,100	(3/)	(3/)	(3/)
Drugs and medicines	3	6,700	(3/)	(3/)	(3/)	1	(3/)	(3/)	(3/)	(3/)
Soap, cleaners, etc.	2	(3/)	(3/)	(3/)	(3/)	1	(3/)	(3/)	(3/)	(3/)
Paint, varnish, etc.	3	4,600	(3/)	(3/)	(3/)	2	(3/)	(3/)	(3/)	(3/)
Other chemical products	4	17,500	(3/)	(3/)	(3/)	--	--	--	--	--
Petroleum refining	1	(3/)	(3/)	(3/)	(3/)	10	16,100	13,800	8,300	19,000
Rubber products	4	10,500	(3/)	(3/)	(3/)	4	9,300	(3/)	(3/)	(3/)
Stone, clay, and glass products	6	5,500	(3/)	(3/)	(3/)	2	(3/)	(3/)	(3/)	(3/)
Primary metal industries	8	14,900	14,600	6,400	19,000	6	26,000	(3/)	(3/)	(3/)
Fabricated metal products	29	12,900	11,700	7,600	15,000	6	19,600	(3/)	(3/)	(3/)
Machinery (except electrical)	31	27,900	12,700	8,200	18,800	11	9,700	16,000	9,800	17,300
Electrical machinery	62	18,500	16,200	8,900	25,000	9	36,200	18,200	6,000	24,300
Transportation equipment	34	27,100	19,900	9,600	29,900	23	23,600	17,400	9,500	41,900
Motor vehicles and equipment	8	24,000	13,200	8,100	36,000	6	38,700	(3/)	(3/)	(3/)
Aircraft and parts	20	26,100	21,900	16,300	26,700	16	23,400	28,200	16,200	43,800
Other transportation equipment	6	7,400	(3/)	(3/)	(3/)	1	(3/)	(3/)	(3/)	(3/)
Professional and scientific instruments	18	12,900	12,900	8,300	37,600	4	23,300	(3/)	(3/)	(3/)
Photographic equipment and supplies	4	8,900	(3/)	(3/)	(3/)	--	--	--	--	--
Other professional and scientific instruments	14	16,600	13,600	11,600	25,000	4	23,400	(3/)	(3/)	(3/)
Other manufacturing	15	19,500	10,000	5,000	17,900	3	9,800	(3/)	(3/)	(3/)
Nonmanufacturing	10	22,000	27,900	8,400	32,200	1	(3/)	(3/)	(3/)	(3/)
Commercial consulting firms	2	(3/)	(3/)	(3/)	(3/)	--	--	--	--	--
Nonprofit research agencies	3	14,400	(3/)	(3/)	(3/)	--	--	--	--	--
Other nonmanufacturing	5	34,500	(3/)	(3/)	(3/)	1	(3/)	(3/)	(3/)	(3/)

1/ Cost figures rounded to nearest $100.

2/ Excludes 727 companies that did not have any Government-financed research. Also excludes 413 companies that failed to report either cost of Government-financed research or number of research engineers and scientists working on Government-financed contracts. The number of reporting companies in the three size groups do not add to the totals shown in column 1, which include companies not reporting their total employment.

3/ Means are not shown for fewer than three companies; medians and quartiles are not shown for fewer than eight companies.

*/ Means were computed by dividing the aggregate cost of Government-financed research by the average number of research engineers and scientists working on Government contracts for each specified group of companies. They thus reflect to a great extent the experience of the largest organizations in the group. This should be borne in mind in comparing the means with the median ratios, which were computed from rankings of ratios for individual companies.

C-25. Average cost per research engineer or scientist on Government-financed research, by industry and size of professional research staff, 1951 1/

Industry	All reporting companies	Companies with professional research staff of --									
		0 to 4	5 to 14	15 to 29	30 to 49	50 to 74	75 to 124	125 to 249	250 to 499	500 to 999	1,000 or more
All industries	$23,900	$16,400	$17,500	$19,800	$16,600	$16,700	$17,300	$23,900	$25,800	$28,200	$25,700
Manufacturing	24,500	16,800	17,400	21,700	18,500	17,200	13,900	24,800	26,700	30,200	25,400
Food and kindred products	4,200	4,800	3,900	--	--	--	--	--	--	--	--
Textile mill products and apparel	31,900	14,600	21,300	50,200	--	(2/)	--	--	--	--	--
Paper and allied products	12,000	10,000	3,800	15,700	12,700	(2/)	--	--	--	--	--
Chemicals and allied products	22,400	8,100	15,700	10,500	10,800	13,500	17,000	8,700	57,900	(2/)	(2/)
Industrial organic and inorganic chemicals	30,700	10,800	14,200	6,000	15,500	26,700	17,400	(2/)	(2/)	(2/)	(2/)
Drugs and medicines	8,400	6,700	13,300	--	--	(2/)	--	7,500	--	--	--
Soap, cleaners, etc.	10,400	--	--	(2/)	--	(2/)	--	(2/)	--	--	--
Paint, varnish, etc.	7,300	2,500	7,600	7,500	(2/)	(2/)	--	--	(2/)	--	--
Other chemical products	13,900	4,000	20,300	33,300	9,500	--	(2/)	--	--	--	--
Petroleum refining	15,800	10,700	5,000	--	9,500	(2/)	--	17,700	15,900	(2/)	--
Rubber products	9,300	13,300	8,500	10,200	(2/)	--	--	(2/)	--	(2/)	--
Stone, clay, and glass products	9,300	9,000	8,600	9,800	--	(2/)	--	9,300	--	--	--
Primary metal industries	20,300	22,200	24,500	4,000	(2/)	18,300	(2/)	(2/)	(2/)	--	--
Fabricated metal products	14,900	18,000	19,500	12,100	18,300	9,800	(2/)	--	(2/)	--	--
Machinery (except electrical)	21,700	12,100	16,700	23,000	13,200	15,800	12,600	39,200	--	--	(2/)
Electrical machinery	29,400	14,300	18,100	20,400	19,900	15,900	17,700	18,000	14,100	(2/)	42,500
Transportation equipment	24,000	37,000	13,500	42,000	27,300	23,300	8,200	31,500	33,700	37,100	19,300
Motor vehicles and equipment	34,200	32,000	8,200	46,800	(2/)	(2/)	(2/)	(2/)	(2/)	--	--
Aircraft and parts	23,700	26,000	14,400	25,400	(2/)	24,900	(2/)	31,600	31,300	37,100	19,300
Other transportation equipment	42,500	65,600	13,800	100,000	--	--	(2/)	--	--	--	--
Professional and scientific instruments	19,800	14,700	19,600	21,700	22,300	17,100	18,600	(2/)	(2/)	--	(2/)
Photographic equipment and supplies	13,300	7,300	30,300	(2/)	(2/)	(2/)	(2/)	--	(2/)	--	--
Other professional and scientific instruments	21,100	15,800	15,700	22,500	25,000	13,900	20,000	(2/)	--	--	(2/)
Other manufacturing	17,200	8,600	16,000	11,000	17,000	--	11,300	21,600	--	--	--
Nonmanufacturing	20,100	14,800	17,900	14,800	11,600	14,200	29,500	20,300	22,400	(2/)	(2/)
Commercial consulting firms	15,700	13,100	17,300	15,200	12,500	14,700	(2/)	23,800	(2/)	--	--
Nonprofit research agencies	12,800	--	10,100	9,000	4,100	(2/)	--	(2/)	18,200	(2/)	--
Other nonmanufacturing	32,300	25,100	25,800	34,300	12,100	--	38,900	(2/)	(2/)	--	(2/)

1/ Cost figures rounded to the nearest $100.
2/ Data are not shown for fewer than three companies.

C-26. Average cost per research worker, by industry and size of company, 1951 1/

Industry	All companies					Companies with fewer than 500 employees				
	Number of companies reporting	Mean*/	Median	Lower quartile	Upper quartile	Number of companies reporting	Mean */	Median	Lower quartile	Upper quartile
All industries	2/ 1,666	$8,800	$7,300	$5,200	$10,000	885	$7,700	$6,700	$4,800	$10,000
Manufacturing	1,341	8,900	7,300	5,300	10,000	612	7,800	6,700	4,800	10,000
Food and kindred products	61	8,700	8,700	6,400	10,000	13	5,800	6,300	4,000	10,000
Textile mill products and apparel	45	8,500	7,100	5,000	9,500	10	7,100	5,000	4,600	8,300
Paper and allied products	47	7,100	7,000	6,000	8,500	9	5,600	6,000	3,600	6,700
Chemicals and allied products	238	7,900	7,000	5,000	8,500	155	6,900	6,100	5,000	8,000
Industrial organic and inorganic chemicals	77	7,800	7,000	5,000	8,300	50	7,700	6,800	5,000	9,800
Drugs and medicines	64	9,200	7,100	5,000	9,200	39	6,700	6,000	4,000	7,700
Soap, cleaners, etc.	15	8,600	8,000	5,800	9,500	9	7,800	7,100	5,600	10,000
Paint, varnish, etc.	28	4,000	5,700	4,000	7,000	21	5,300	5,800	3,600	7,100
Other chemical products	54	7,600	6,600	5,000	8,300	36	6,900	5,500	4,800	7,400
Petroleum refining	43	8,100	7,600	6,000	9,400	18	7,400	6,500	5,000	8,300
Rubber products	30	7,200	7,200	5,000	9,400	13	8,700	7,100	3,600	10,600
Stone, clay, and glass products	33	6,600	6,600	4,500	8,900	12	7,700	5,300	4,400	10,400
Primary metal industries	39	10,100	8,200	6,200	11,100	6	9,900	(3/)	(3/)	(3/)
Fabricated metal products	127	7,900	7,000	5,300	9,900	54	7,600	6,300	5,000	8,300
Machinery (except electrical)	160	8,000	7,300	5,000	10,400	58	8,300	6,300	4,000	10,000
Electrical machinery	209	9,400	7,700	5,100	10,300	109	8,400	7,900	5,000	10,800
Transportation equipment	96	10,000	8,700	6,100	12,400	24	7,800	7,300	5,000	10,000
Motor vehicles and equipment	23	10,900	8,800	7,000	11,300	3	8,000	(3/)	(3/)	(3/)
Aircraft and parts	58	9,700	8,500	5,500	13,700	18	7,800	7,000	4,000	10,000
Other transportation equipment	15	15,500	9,300	6,000	11,700	3	7,800	(3/)	(3/)	(3/)
Professional and scientific instruments	136	7,500	6,800	4,900	9,000	96	7,600	6,700	4,500	9,400
Photographic equipment and supplies	20	7,500	7,700	5,700	10,100	14	10,400	8,500	6,300	10,900
Other professional and scientific instruments	116	7,400	6,800	4,800	9,000	82	7,100	6,300	4,400	8,800
Other manufacturing	77	8,700	7,600	5,300	10,100	35	8,300	7,000	4,600	10,000
Nonmanufacturing	325	8,100	7,100	5,000	9,900	273	7,700	7,100	4,800	9,700
Commercial consulting firms	214	7,500	7,000	4,500	9,500	202	7,600	7,100	4,500	9,700
Nonprofit research agencies	35	6,600	6,300	5,000	8,000	31	7,100	6,300	4,800	8,000
Other nonmanufacturing	76	9,300	7,500	5,500	11,000	40	10,000	7,400	5,500	12,200

See footnotes at end of table.

C-26. Average cost per research worker, by industry and size of company, 1951 1/--Continued

Industry	Companies with 500 to 4,999 employees					Companies with 5,000 or more employees				
	Number of companies reporting	Mean */	Median	Lower quartile	Upper quartile	Number of companies reporting	Mean */	Median	Lower quartile	Upper quartile
All industries	533	$8,000	$7,500	$5,800	$10,100	197	$9,200	$8,200	$6,700	$10,000
Manufacturing	506	8,100	7,500	5,800	10,100	186	9,200	8,200	6,900	10,100
Food and kindred products	31	8,700	8,900	7,200	10,000	16	8,800	9,000	7,100	9,900
Textile mill products and apparel	24	11,200	8,300	5,600	11,000	10	7,200	7,300	4,800	8,200
Paper and allied products	29	6,500	7,000	6,000	8,700	9	8,000	8,400	7,300	8,600
Chemicals and allied products	58	8,200	6,900	6,000	9,600	21	7,900	8,200	6,400	8,700
Industrial organic and inorganic chemicals	17	7,100	6,600	6,000	7,900	9	8,000	8,100	7,500	8,200
Drugs and medicines	18	9,800	9,100	6,100	10,200	6	9,100	(3/)	(3/)	(3/)
Soap, cleaners, etc.	3	6,900	(3/)	(3/)	(3/)	3	8,900	(3/)	(3/)	(3/)
Paint, varnish, etc.	4	6,300	(3/)	(3/)	(3/)	3	3,000	(3/)	(3/)	(3/)
Other chemical products	16	7,600	6,600	5,500	9,600	--	--	--	--	--
Petroleum refining	8	6,900	7,900	6,500	9,700	16	8,100	8,600	7,200	9,400
Rubber products	10	8,400	8,000	4,900	9,400	4	7,100	(3/)	(3/)	(3/)
Stone, clay, and glass products	13	7,100	6,900	3,700	8,900	7	6,500	(3/)	(3/)	(3/)
Primary metal industries	17	5,600	7,000	5,200	8,400	13	11,500	8,400	7,200	12,900
Fabricated metal products	54	7,500	7,600	5,300	9,900	13	8,600	7,700	5,600	10,300
Machinery (except electrical)	76	8,800	7,200	5,400	10,000	23	7,400	8,400	6,500	10,500
Electrical machinery	85	7,600	7,500	5,700	10,000	11	10,000	8,700	6,700	9,600
Transportation equipment	40	9,500	8,700	6,700	15,800	30	10,000	8,900	7,000	11,900
Motor vehicles and equipment	10	7,500	7,900	6,100	10,400	9	11,200	8,800	5,900	11,300
Aircraft and parts	22	9,400	9,600	7,000	15,900	17	9,800	8,800	6,900	12,200
Other transportation equipment	8	18,200	9,500	5,000	16,300	4	14,200	(3/)	(3/)	(3/)
Professional and scientific instruments	31	6,900	6,900	5,700	8,600	6	7,600	(3/)	(3/)	(3/)
Photographic equipment and supplies	5	6,300	(3/)	(3/)	(3/)	1	(3/)	(3/)	(3/)	(3/)
Other professional and scientific instruments	26	7,100	7,100	5,000	8,900	5	7,700	(3/)	(3/)	(3/)
Other manufacturing	30	9,000	8,300	6,600	11,000	7	8,200	(3/)	(3/)	(3/)
Nonmanufacturing	27	7,500	7,500	5,900	10,000	11	8,700	8,500	5,800	8,900
Commercial consulting firms	2	(3/)	(3/)	(3/)	(3/)	--	--	--	--	--
Nonprofit research agencies	4	6,400	(3/)	(3/)	(3/)	--	--	--	--	--
Other nonmanufacturing	21	11,000	7,500	5,300	11,000	11	8,700	8,500	5,800	8,900

1/ Cost figures rounded to the nearest $100.

2/ Excludes 287 companies that failed to report total research cost or number of research employees. The number of reporting companies in the three size groups do not add to the total shown in column 1, which include companies not reporting their total employment.

3/ Means are not shown for fewer than three companies; medians and quartiles are not shown for fewer than eight companies.

*/ Means were computed by dividing the aggregate cost of research by the average number of research employees for each specified group of companies. They thus reflect to a great extent the experience of the largest organizations in the group. This should be borne in mind in comparing the means with median ratios, which were computed from rankings of ratios for individual companies.

C-27. Average cost per research worker, by industry and size of professional research staff, 1951 1/

Industry	All reporting companies	Companies with professional research staff of--									
		0 to 4	5 to 14	15 to 29	30 to 49	50 to 74	75 to 124	125 to 249	250 to 499	500 to 999	1,000 or more
All industries	$8,800	$7,900	$8,200	$7,900	$8,200	$8,000	$8,200	$8,300	$9,300	$8,600	$9,400
Manufacturing	8,900	8,000	8,200	7,800	8,400	7,900	7,900	8,400	9,400	8,900	9,500
Food and kindred products	8,700	8,500	9,100	8,400	12,100	(2/)	--	7,000	--	--	--
Textile mill products and apparel	8,500	9,000	11,100	7,200	(2/)	(2/)	(2/)	(2/)	--	--	--
Paper and allied products	7,100	6,100	7,500	6,000	6,300	(2/)	(2/)	--	--	--	--
Chemicals and allied products	7,900	7,100	7,300	7,400	7,300	7,700	7,400	9,800	7,200	(2/)	(2/)
Industrial organic and inorganic chemicals	7,800	7,200	8,400	6,400	7,300	7,300	6,900	(2/)	8,400	(2/)	(2/)
Drugs and medicines	9,200	7,300	6,500	7,700	7,900	11,700	(2/)	10,700	(2/)	--	--
Soap, cleaners, etc.	8,600	10,900	7,300	(2/)	(2/)	(2/)	--	(2/)	(2/)	--	--
Paint, varnish, etc.	4,000	5,900	6,100	6,100	(2/)	(2/)	(2/)	--	(2/)	--	--
Other chemical products	7,600	6,200	7,900	9,500	7,500	(2/)	(2/)	--	--	--	--
Petroleum refining	8,100	7,200	7,300	(2/)	8,400	(2/)	9,300	8,700	8,100	(2/)	--
Rubber products	7,200	6,300	9,200	7,400	(2/)	--	--	(2/)	--	(2/)	--
Stone, clay, and glass products	6,600	9,800	7,400	5,500	--	(2/)	--	6,500	--	--	--
Primary metal industries	10,100	8,500	6,100	10,700	7,100	6,800	(2/)	(2/)	(2/)	--	--
Fabricated metal products	7,900	6,300	9,800	7,700	6,600	8,900	(2/)	(2/)	(2/)	--	--
Machinery (except electrical)	8,000	6,600	10,000	7,000	9,400	7,300	8,300	8,500	--	--	(2/)
Electrical machinery	9,400	9,300	7,500	8,500	9,000	7,100	6,800	7,000	7,300	6,200	11,000
Transportation equipment	10,000	11,000	5,700	10,900	10,100	10,000	7,300	8,000	12,000	14,000	8,800
Motor vehicles and equipment	10,900	18,500	5,200	8,300	7,900	(2/)	(2/)	(2/)	(2/)	--	--
Aircraft and parts	9,700	9,000	5,700	12,500	(2/)	13,400	(2/)	7,900	12,300	14,000	8,800
Other transportation equipment	15,500	10,300	6,600	24,900	(2/)	--	(2/)	--	--	--	--
Professional and scientific instruments	7,500	6,900	7,700	5,900	6,500	8,100	9,600	(2/)	(2/)	--	(2/)
Photographic equipment and supplies	7,500	9,600	9,200	(2/)	--	(2/)	(2/)	--	(2/)	--	(2/)
Other professional and scientific instruments	7,400	6,600	7,200	5,900	6,500	7,700	11,100	(2/)	(2/)	--	(2/)
Other manufacturing	8,700	8,100	9,300	8,100	12,400	--	9,000	7,700	--	--	--
Nonmanufacturing	8,100	7,500	8,000	8,300	7,100	9,400	9,700	7,700	8,700	(2/)	(2/)
Commercial consulting firms	7,500	7,500	8,300	7,100	6,700	10,600	(2/)	7,200	(2/)	--	--
Nonprofit research agencies	6,600	6,900	6,000	7,000	5,800	(2/)	--	(2/)	7,400	(2/)	--
Other nonmanufacturing	9,300	7,800	8,000	12,900	8,800	(2/)	9,900	(2/)	(2/)	--	(2/)

1/ Cost figures rounded to the nearest $100.
2/ Data are not shown for fewer than three companies.

C-28. Annual separation rate of research engineers and scientists, by industry, July 1950 to June 1951 and July to December 1951

Industry	Number of separations per 100 research engineers and scientists							
	July 1950 to June 1951				July to December 1951 1/			
	Total	Reserve calls	Selective Service calls	Other separations	Total	Reserve calls	Selective Service calls	Other separations
All industries	13.9	1.8	0.8	11.3	16.4	1.8	1.2	13.4
Manufacturing	13.6	1.8	.9	10.9	16.2	1.8	1.2	13.2
Food and kindred products	10.2	1.4	.8	8.0	15.0	1.0	1.0	13.0
Textile mill products and apparel	8.9	1.0	.3	7.6	13.8	1.8	.8	11.2
Paper and allied products	10.7	3.3	.9	6.5	14.4	4.0	.8	9.6
Chemicals and allied products	8.8	1.2	.9	6.7	13.8	1.0	.8	12.0
Industrial organic and inorganic chemicals	8.0	1.0	.8	6.2	13.8	.8	.6	12.4
Drugs and medicines	9.9	1.0	.6	8.3	11.6	1.2	.6	9.8
Soap, cleaners, etc.	7.6	1.7	1.2	4.7	17.6	1.8	1.4	14.4
Paint, varnish, etc.	15.8	2.4	2.7	10.7	20.6	.4	3.2	17.0
Other chemical products	11.4	2.2	1.1	8.1	14.8	.6	.6	13.6
Petroleum refining	8.5	1.7	.2	6.6	8.8	1.2	(2/)	7.6
Rubber products	9.6	1.7	.6	7.3	11.8	1.4	.6	9.8
Stone, clay, and glass products	5.9	1.2	.4	4.3	10.8	.6	1.4	8.8
Primary metal industries	11.0	1.3	.5	9.2	11.4	1.4	.8	9.2
Fabricated metal products	13.4	1.8	.8	10.8	15.8	1.4	1.2	13.2
Machinery (except electrical)	12.9	1.9	1.8	9.2	17.6	1.8	5.4	10.4
Electrical machinery	15.2	3.1	1.3	10.8	15.8	3.2	1.4	11.2
Transportation equipment	19.3	1.9	.6	16.8	20.6	2.2	.6	17.8
Motor vehicles and equipment	13.6	2.4	.3	10.9	18.0	2.0	2.0	14.0
Aircraft and parts	19.9	1.8	.6	17.5	20.8	2.2	.6	18.0
Other transportation equipment	14.7	2.5	.7	11.5	16.4	2.8	4.0	9.6
Professional and scientific instruments	16.7	1.0	.8	14.9	18.6	1.2	.6	16.8
Photographic equipment and supplies	22.0	1.4	1.6	19.0	24.6	.6	.8	23.2
Other professional and scientific instruments	15.7	.9	.7	14.1	17.2	1.4	.6	15.2
Other manufacturing	14.1	1.6	.7	11.8	14.2	1.2	.4	12.6
Nonmanufacturing	15.5	1.3	.6	13.6	16.8	1.2	.8	14.8
Commercial consulting firms	16.3	1.3	1.0	14.0	19.8	1.6	1.2	17.0
Nonprofit research agencies	25.9	1.3	.5	24.1	24.8	.8	.4	23.6
Other nonmanufacturing	8.5	1.2	.4	6.9	9.0	1.0	.8	7.2

1/ Rates for the six-month period were converted to annual rates.

2/ Less than 0.05 percent.

C-29. Annual separation rate of research engineers and scientists, by industry and size of company, July to December 1951 1/

(Number of separations per 100 research engineers and scientists)

Industry	All reporting companies	Companies with total employment of --		
		Fewer than 500	500 to 4,999	5,000 or more
All industries	16.4	19.2	19.0	15.0
Manufacturing	16.2	18.2	17.8	15.8
Food and kindred products	15.0	24.4	14.2	14.8
Textile mill products and apparel	13.8	12.2	16.0	13.2
Paper and allied products	14.4	5.2	13.8	15.8
Chemicals and allied products	13.8	14.8	14.8	13.4
Industrial organic and inorganic chemicals	13.8	9.4	18.4	13.4
Drugs and medicines	11.6	10.4	12.0	11.2
Soap, cleaners, etc.	17.6	16.0	10.4	19.0
Paint, varnish, etc.	20.6	29.2	21.4	(2/)
Other chemical products	14.8	17.8	13.4	--
Petroleum refining	8.8	10.0	8.8	9.2
Rubber products	11.8	8.0	12.6	12.2
Stone, clay, and glass products	10.8	36.0	18.0	10.0
Primary metal industries	11.4	9.6	14.6	10.2
Fabricated metal products	15.8	19.2	18.6	14.8
Machinery (except electrical)	17.6	7.4	16.0	23.0
Electrical machinery	15.8	21.2	20.6	13.2
Transportation equipment	20.6	10.4	23.6	20.4
Motor vehicles and equipment	18.0	22.8	17.4	17.6
Aircraft and parts	20.8	8.0	23.6	20.6
Other transportation equipment	16.4	(2/)	35.6	8.8
Professional and scientific instruments	18.6	27.0	19.6	12.4
Photographic equipment and supplies	24.6	24.6	24.6	--
Other professional and scientific instruments	17.2	27.8	17.2	12.4
Other manufacturing	14.2	12.2	13.8	15.6
Nonmenufacturing	16.8	20.0	25.0	4.8
Commercial consulting firms	19.8	19.2	24.0	--
Nonprofit research agencies	24.8	23.0	25.8	--
Other nonmanufacturing	9.0	16.2	23.6	4.8

1/ Rates for the six-month period were converted to annual rates.
2/ Data are not shown for fewer than three companies.

C-30. **Annual separation rate of research engineers and scientists, by size of company, July 1950 to June 1951 and July to December 1951**

Total company employment	Number of separations per 100 research engineers and scientists							
	July 1950 to June 1951				July to December 1951 1/			
	Total	Reserve calls	Selective Service calls	Other separations	Total	Reserve calls	Selective Service calls	Other separations
Total	13.9	1.8	0.8	11.3	16.4	1.8	1.2	13.4
Less than 500	17.3	1.5	1.2	14.6	19.2	1.4	1.2	16.6
500 - 4,999	16.4	1.5	.8	14.1	19.0	1.6	8	16.6
5,000 or more	12.6	1.9	.8	9.9	15.0	2.0	1.2	11.8

1/ Rates for the six-month period were converted to annual rates.

C-31. Annual separation rate of research engineers and scientists, by size of professional research staff, July 1950 to June 1951 and July to December 1951

Size of professional research staff	Number of separations per 100 research engineers and scientists							
	July 1950 to June 1951				July to December 1951 1/			
	Total	Reserve calls	Selective Service calls	Other separations	Total	Reserve calls	Selective Service calls	Other separations
Total.....	13.9	1.8	0.8	11.3	16.4	1.8	1.2	13.4
0 - 4	13.7	2.7	.9	10.1	18.8	1.2	2.4	15.2
5 - 14	14.4	2.0	1.3	11.1	19.0	1.8	1.2	16.0
15 - 29	14.6	1.6	1.2	11.8	19.2	2.0	2.0	15.2
30 - 49	14.0	2.0	1.1	10.9	17.0	1.2	1.2	14.6
50 - 74	15.5	1.5	1.1	12.9	17.8	2.6	1.4	13.8
75 - 124	14.7	1.6	.9	12.2	15.4	1.6	.8	13.0
125 - 249	12.0	1.2	.4	10.4	16.0	1.2	.2	14.6
250 - 499	15.0	1.8	.6	12.6	19.6	1.8	.8	17.0
500 - 999	14.0	1.3	.4	12.3	14.2	1.0	.2	13.0
1,000 or more	13.4	2.1	1.0	10.3	15.0	2.0	1.6	11.4

1/ Rates for the six-month period were converted to annual rates.

C-32. Research engineers and scientists liable for military duty per 100 employed, by industry and size of company, January 1952

Industry	All reporting companies		Companies with total employment of --					
			Less than 500		500 - 4,999		5,000 or more	
	Classified 1A or 2A	Members of Reserves or National Guard	Classified 1A or 2A	Members of Reserves or National Guard	Classified 1A or 2A	Members of Reserves or National Guard	Classified 1A or 2A	Members of Reserves or National Guard
All industries	6.3	18.9	4.1	10.5	3.9	14.8	7.5	21.8
Manufacturing	6.7	19.5	4.0	9.8	3.6	14.1	7.9	22.2
Food and kindred products	2.4	12.5	0	7.1	0	12.9	3.5	12.2
Textile mill products and apparel	2.5	13.6	2.9	5.9	1.3	17.1	3.0	12.3
Paper and allied products	2.8	17.9	0	7.5	1.8	14.4	4.1	23.3
Chemicals and allied products	4.9	17.1	4.6	10.1	3.4	13.8	5.8	19.4
Industrial organic and inorganic chemicals	6.3	19.3	6.6	11.7	4.6	14.7	6.8	20.8
Drugs and medicines	3.3	11.3	2.8	8.9	1.4	11.1	5.0	11.6
Soap, cleaners, etc.	2.9	22.2	2.2	5.6	8.7	13.0	2.1	26.1
Paint, varnish, etc.	6.4	12.9	3.9	7.8	10.1	22.6	(1/)	(1/)
Other chemical products	3.4	16.2	5.2	12.9	2.4	16.6	--	--
Petroleum refining	3.4	24.8	1.9	15.2	4.4	39.7	3.7	24.4
Rubber products	4.9	12.4	3.6	5.8	3.2	23.4	5.2	12.2
Stone, clay, and glass products	2.5	12.5	6.2	15.9	3.5	17.4	2.3	12.1
Primary metal industries	2.2	12.2	10.6	11.1	3.4	6.6	1.7	13.0
Fabricated metal products	2.7	11.9	3.0	10.3	3.7	12.3	1.8	13.1
Machinery (except electrical)	7.4	13.2	2.4	12.7	4.3	13.7	9.9	13.0
Electrical machinery	11.6	23.0	4.2	8.4	3.9	11.6	14.1	28.2
Transportation equipment	6.2	22.8	3.9	12.8	4.0	15.9	6.5	23.7
Motor vehicles and equipment	3.9	19.9	2.9	0	2.2	13.4	4.5	21.2
Aircraft and parts	6.3	23.0	4.4	16.1	3.9	16.3	6.6	23.9
Other transportation equipment	11.1	19.2	(1/)	(1/)	12.5	7.1	11.1	24.5
Professional and scientific instruments	7.2	17.3	4.5	9.9	2.6	11.2	13.1	25.9
Photographic equipment and supplies	1.5	6.8	1.5	7.9	1.5	3.7	--	--
Other professional and scientific instruments	8.5	18.7	5.7	10.7	3.2	13.4	13.1	25.9
Other manufacturing	4.4	13.6	2.9	7.6	4.2	13.9	5.8	15.9
Nonmanufacturing	3.7	14.4	4.3	11.4	5.4	18.4	1.1	14.2
Commercial consulting firms	4.4	11.3	4.9	10.2	.3	19.4	--	--
Nonprofit research agencies	5.3	14.3	3.1	13.6	6.4	14.7	--	--
Other nonmanufacturing	2.1	16.6	3.0	12.7	5.3	27.5	1.1	14.2

1/ Data are not shown for fewer than 3 companies.

C-33. Research engineers and scientists liable for military duty per 100 employed, by size of professional research staff, January 1952

Size of professional research staff	Classified 1A or 2A	Members of Reserves or National Guard
Total	6.3	18.9
0 - 4	3.7	12.4
5 - 14	3.3	12.0
15 - 29	2.9	11.6
30 - 49	3.0	13.1
50 - 74	3.4	10.7
75 - 124	4.4	15.2
125 - 249	4.4	16.4
250 - 499	5.0	23.6
500 - 999	6.4	14.9
1,000 or more	9.8	24.7

APPENDIX D

STATISTICAL DATA CLASSIFIED BY MAJOR RESEARCH SPECIALTY

In filling out the questionnaire, companies were asked to check the specialty in which they were most competent to perform research and development. Their choice was limited to a list of 16 fields oriented toward the research interests of the Department of Defense. 31/ In the tabulations, these 16 research categories have been consolidated into eight major research specialties as follows:

(a) Aeronautics
  Aircraft, piloted
  Guided missiles

(b) Basic and medical sciences
  Basic natural sciences
  Medical sciences

(c) Electronics

(d) Equipment and supplies
  Aircraft equipment
  Equipment and supplies

(e) Fuels and lubricants
  Fuels and lubricants
  Geophysics and geography

(f) Materials

(g) Ordnance

(h) Other major specialties
  Aircraft armament
  Atomic energy
  Biological warfare
  Chemical warfare
  Navigation

The classification of companies by major research specialty has some of the same limitations as the industry classification. Even if a company were competent to perform research in several major specialties, it was forced to select one of these as the field in which it was most competent to do research. To illustrate, some companies in the electrical machinery industry checked electronics as their primary specialty even though a part of their research activity was in aeronautics or materials.

In the statistics, the entire research staff and research cost of each company were, of necessity, classified under the specialty in which the company was most competent. Consequently, the figures presented in the following tables give only a rough indication of the distribution of scientific effort among different specialties.

The interrelationships between the specialty classification and the industry classification used elsewhere in the report are indicated in tables D-1 and D-2. Companies in the electrical machinery industry did most of the research work here classified under electronics. Aircraft manufacturers did most of that classified under aeronautics. In basic and medical sciences and materials, most of the work was done by companies in chemicals industries; in ordnance,

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31/ See questionnaire, reproduced in Appendix B.

most of it was done by motor vehicle manufacturers; in fuels and lubricants, by petroleum refining companies. The research classified under materials, equipment and supplies, and "other major specialties" was conducted in a variety of industries. These relationships explain the many similarities between the data given in the following tables and the statistics for different industries presented in the body of the report and in Appendix C.

Each company was asked to indicate on the questionnaire not only its primary research specialty but also all the specialties, out of a long and detailed list, in which it was qualified to undertake research. The numbers of companies which checked each specialty are given in table D-9. It should be noted that the figures in this table are not additive, since most companies checked more than one specialty; many checked 15 or more specialties.

D-1. Number of reporting companies, by industry and major research specialty

Industry	All reporting companies	Major research specialty of company							
		Aeronautics	Basic and medical sciences	Electronics	Equipment and supplies	Fuels and lubricants	Materials	Ordnance	Other specialties
All industries	1,953	79	324	277	647	112	321	119	74
Manufacturing	1,538	58	222	217	547	70	263	102	59
Food and kindred products	73	--	7	--	62	--	3	--	1
Textile mill products and apparel	49	--	2	--	39	1	6	1	--
Paper and allied products	49	--	1	--	24	1	21	1	1
Chemicals and allied products	276	--	155	2	16	7	80	2	14
Industrial organic and inorganic chemicals	85	--	36	--	3	4	32	2	8
Drugs and medicines	77	--	74	--	1	--	1	--	1
Soap, cleaners, etc.	19	--	12	--	2	1	3	--	1
Paint, varnish, etc.	32	--	10	1	7	--	13	--	1
Other chemical products	63	--	23	1	3	2	31	--	3
Petroleum refining	49	--	2	--	2	44	1	--	--
Rubber products	33	--	3	--	7	1	20	1	1
Stone, clay, and glass products	38	1	4	2	10	--	20	--	1
Primary metal industries	50	--	3	1	7	--	35	3	1
Fabricated metal products	150	7	3	4	76	2	26	26	6
Machinery (except electrical)	184	2	9	7	124	5	14	18	5
Electrical machinery	236	6	3	144	67	--	5	6	5
Transportation equipment	105	34	1	2	40	1	4	20	3
Motor vehicles and equipment	26	1	--	--	5	--	2	17	1
Aircraft and parts	63	31	1	2	27	--	1	--	1
Other transportation equipment	16	2	--	--	8	1	1	3	1
Professional and scientific instruments.	153	7	22	47	39	8	4	11	15
Photographic equipment and supplies...	24	--	1	5	16	1	--	1	--
Other professional and scientific instruments	129	7	21	42	23	7	4	10	15
Other manufacturing	93	1	7	8	34	--	24	13	6
Nonmanufacturing	415	21	102	60	100	42	58	17	15
Commercial consulting firms	286	14	74	46	74	18	35	13	12
Nonprofit research agencies	39	3	17	3	5	2	5	3	1
Other nonmanufacturing	90	4	11	11	21	22	18	1	2

D-2. Cost of research, by industry and major research specialty, 1951

(thousands of dollars)

Industry	All reporting companies	Major research specialty of company							
		Aeronautics	Basic and medical sciences	Electronics	Equipment and supplies	Fuels and lubricants	Materials	Ordnance	Other specialties
All industries	1/$1,804,529	$370,955	$146,706	$531,668	$291,906	$106,103	$187,698	$142,170	$27,323
Manufacturing	1,624,687	359,405	129,038	435,086	281,018	96,186	168,915	129,531	25,508
Food and kindred products	23,889	--	1,586	--	22,126	--	(2/)	--	(2/)
Textile mill products and apparel	15,817	--	(2/)	--	11,706	(2/)	2,976	(2/)	--
Paper and allied products	11,116	--	(2/)	--	4,202	(2/)	4,927	(2/)	(2/)
Chemicals and allied products	204,230	--	110,399	(2/)	10,084	1,417	77,545	(2/)	3,076
Industrial organic and inorganic chemicals	131,340	--	51,883	--	3,884	1,005	71,150	(2/)	(2/)
Drugs and medicines	44,043	--	43,403	--	(2/)	--	(2/)	--	(2/)
Soap, cleaners, etc.	12,342	--	11,020	--	(2/)	(2/)	(2/)	--	(2/)
Paint, varnish, etc.	6,486	--	1,322	(2/)	3,502	--	1,494	--	(2/)
Other chemical products	10,019	--	2,771	(2/)	1,805	(2/)	4,841	--	482
Petroleum refining	92,942	--	(2/)	--	(2/)	91,819	(2/)	--	--
Rubber products	22,890	--	450	--	996	(2/)	19,728	(2/)	(2/)
Stone, clay, and glass products	20,752	(2/)	2,686	(2/)	4,465	--	12,787	--	(2/)
Primary metal industries	34,596	--	642	(2/)	1,440	--	30,646	1,290	(2/)
Fabricated metal products	38,404	893	48	597	25,930	(2/)	3,217	6,216	(2/)
Machinery (except electrical)	99,729	(2/)	2,179	2,945	61,903	2,118	11,839	15,887	(2/)
Electrical machinery	432,343	6,261	956	397,381	19,371	--	240	2,658	5,476
Transportation equipment	511,324	347,662	(2/)	(2/)	51,996	(2/)	2,242	87,717	938
Motor vehicles and equipment	94,303	(2/)	--	--	3,722	--	(2/)	87,329	(2/)
Aircraft and parts	410,804	345,153	(2/)	(2/)	45,044	--	(2/)	--	(2/)
Other transportation equipment	6,217	(2/)	--	--	3,230	(2/)	(2/)	388	(2/)
Professional and scientific instruments	91,813	3,717	7,616	7,400	61,495	400	282	3,845	7,058
Photographic equipment and supplies	30,794	--	(2/)	1,006	29,552	(2/)	--	(2/)	--
Other professional and scientific instruments	61,019	3,717	(2/)	6,394	31,943	(2/)	282	(2/)	7,058
Other manufacturing	24,842	(2/)	476	5,662	4,696	--	2,286	7,196	(2/)
Nonmanufacturing	179,842	11,550	17,668	96,582	10,888	9,917	18,783	12,639	1,815
Commercial consulting firms	44,193	3,648	8,408	12,456	7,345	2,526	2,801	5,959	1,050
Nonprofit research agencies	37,577	5,328	8,584	5,492	960	(2/)	9,765	(2/)	(2/)
Other nonmanufacturing	98,072	2,574	676	78,634	2,583	(2/)	6,217	(2/)	(2/)

1/ This table is based on reports for 1,772 companies. In addition, the study includes 181 companies that failed to supply information on the cost of research in 1951.

2/ Data withheld to avoid disclosing figures for individual companies, but these data are included in totals.

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D-3. Distribution of research employment and research cost, by major research specialty 1/

Major research specialty of company	Number of companies	Percent distribution			
		Employment, January 1952			Cost of research, 1951
		All research workers	Engineers and scientists	Supporting personnel	
Aeronautics	79	18.7	19.3	18.3	18.8
Basic and medical sciences	324	8.6	11.6	6.6	7.7
Electronics	277	27.1	22.8	30.0	27.0
Equipment and supplies	647	16.8	18.9	15.3	15.2
Fuel and lubricants	112	6.0	6.3	5.9	5.7
Materials	321	10.8	12.3	9.8	10.4
Ordnance	119	10.3	6.9	12.6	13.8
Other research specialties	74	1.7	1.9	1.5	1.4
Total	—	100.0	100.0	100.0	100.0
Total number reported 2/	1,953	238,266	95,694	142,572	$1,980 (millions)

1/ The figures in this table are estimates covering all 1,953 companies in the survey. They include companies that failed to report one or more of the items shown in the table.

2/ Although the manpower estimates are given in exact numbers, not all digits of the numbers are statistically significant.

D-4. Number of research engineers and scientists, by major research specialty and size of professional research staff, January 1952

Major research specialty of company	All reporting companies	Companies with professional research staff of --									
		0 to 4	5 to 14	15 to 29	30 to 49	50 to 74	75 to 124	125 to 249	250 to 499	500 to 999	1,000 or more
All specialties	1/ 91,585	1,440	4,590	5,053	5,334	4,629	5,386	10,787	11,223	9,689	33,454
Aeronautics	18,475	23	146	173	352	189	466	1,282	1,883	2,632	11,329
Basic and medical sciences	10,833	309	665	550	585	880	636	2,394	2,354	(2/)	(2/)
Electronics	21,781	166	726	1,015	842	597	659	1,400	1,564	2,094	12,718
Equipment and supplies	17,567	527	1,604	1,760	1,627	1,463	1,344	2,013	1,008	--	6,221
Fuels and lubricants	5,928	102	203	257	183	(2/)	604	1,122	2,178	(2/)	--
Materials	10,502	(2/)	747	713	890	854	926	1,022	1,203	2,002	(2/)
Ordnance	4,665	(2/)	290	444	445	355	396	1,036	1,033	(2/)	--
Other research specialties	1,834	(2/)	209	141	410	(2/)	355	518	--	--	--

1/ This table is based on reports from 1,815 companies. In addition, the study included 138 companies that failed to supply information on the number of research engineers and scientists employed in January 1952.

2/ Data withheld to avoid disclosing figures for individual companies, but these data are included in totals.

D-5. Average number of supporting personnel per research engineer or scientist, by major research specialty and size of professional research staff, January 1952

Major research specialty of company	All reporting companies	Companies with professional research staff of --									
		0 to 4	5 to 14	15 to 29	30 to 49	50 to 74	75 to 124	125 to 249	250 to 499	500 to 999	1,000 or more
All specialties	1.5	1.0	1.1	1.2	1.2	1.2	0.8	1.6	1.6	1.6	1.6
Aeronautics	1.4	2.5	2.6	2.0	1.2	.4	.7	2.7	1.4	1.6	1.2
Basic and medical sciences	.8	.6	.8	.9	.9	.8	.7	.8	1.0	(1/)	(1/)
Electronics	2.0	1.2	1.3	1.2	1.1	1.5	1.1	1.7	1.2	2.5	2.2
Equipment and supplies	1.2	1.1	1.2	1.1	1.3	1.1	.8	1.4	.6	--	1.4
Fuels and lubricants	1.4	.8	1.0	1.4	1.4	(1/)	.5	1.3	1.3	(1/)	--
Materials	1.2	.9	.9	.7	.9	1.4	.9	1.9	1.5	1.1	--
Ordnance	2.6	1.7	1.7	2.9	1.4	2.1	.9	2.0	5.7	(1/)	--
Other research specialties	1.1	1.1	1.0	1.0	1.6	.8	.4	1.5	--	--	--

1/ Data are not shown for fewer than three companies.

D-6. Cost of Government-financed research as percent of total research cost, by major research specialty and size of professional research staff, 1951

Major research specialty of company	All reporting companies	Companies with professional research staff of—									
		0 to 4	5 to 14	15 to 29	30 to 49	50 to 74	75 to 124	125 to 249	250 to 499	500 to 999	1,000 or more
All specialties	46.8	34.4	35.6	40.5	37.0	32.3	33.4	41.1	36.0	55.4	55.3
Aeronautics	87.0	38.4	61.9	77.4	52.2	96.2	81.3	97.7	98.8	88.4	83.3
Basic and medical sciences	6.2	11.1	16.7	9.1	12.3	5.4	1.4	8.7	1.3	(1/)	(1/)
Electronics	58.5	53.4	63.7	71.3	75.4	59.9	66.3	95.8	74.7	70.8	52.3
Equipment and supplies	36.0	39.2	31.8	31.7	27.3	47.9	29.5	24.4	18.0	--	45.1
Fuels and lubricants	5.2	21.6	27.2	15.5	13.3	(1/)	11.0	2.2	5.2	(1/)	--
Materials	13.9	14.9	15.6	27.7	17.4	7.8	8.7	2.1	35.0	22.1	(1/)
Ordnance	23.5	61.6	43.1	36.6	41.8	12.1	60.7	44.9	7.9	(1/)	--
Other research specialties	49.0	32.2	44.8	26.7	41.0	19.3	33.9	80.4	--	--	--

1/ Data are not shown for fewer than three companies.

D-7. Average cost per research engineer or scientist, by major research specialty and size of professional research staff, 1951 1/

Major research specialty of company	All reporting companies	Companies with professional research staff of-- 0 to 4	5 to 14	15 to 29	30 to 49	50 to 74	75 to 124	125 to 249	250 to 499	500 to 999	1,000 or more
All specialties	$21,900	$15,500	$17,700	$17,800	$17,800	$17,100	$14,500	$21,000	$24,900	$22,500	$25,000
Aeronautics	24,100	32,900	17,600	34,300	17,600	18,400	11,900	30,800	29,700	37,200	20,200
Basic and medical sciences	14,500	11,000	13,300	12,900	13,800	13,200	13,500	17,300	13,800	(2/)	(2/)
Electronics	27,500	16,700	19,000	20,200	19,600	17,800	18,200	20,500	18,800	21,400	32,800
Equipment and supplies	17,900	18,100	19,800	16,100	19,100	18,200	14,300	18,700	9,700	--	19,300
Fuels and lubricants	20,300	14,000	16,600	20,700	17,600	(2/)	14,300	20,200	20,000	(2/)	--
Materials	18,600	11,800	14,800	13,900	15,400	16,400	15,300	26,900	20,100	14,100	(2/)
Ordnance	33,900	16,600	22,900	27,400	17,600	22,900	11,500	21,700	79,900	(2/)	--
Other research specialties	16,300	19,500	15,400	13,900	19,800	14,600	14,700	15,700	--	--	--

1/ Cost figures rounded to nearest $100.
2/ Data are not shown for fewer than three companies.

D-8. Average cost per research worker, by major research specialty and size of professional research staff, 1951 1/

Major research specialty of company	All reporting companies	Companies with professional research staff of-- 0 to 4	5 to 14	15 to 29	30 to 49	50 to 74	75 to 124	125 to 249	250 to 499	500 to 999	1,000 or more
All specialties	$8,800	$7,900	$8,200	$7,900	$8,200	$8,000	$8,200	$8,300	$9,300	$8,600	$9,400
Aeronautics	9,900	9,300	5,000	11,000	8,200	13,300	8,200	8,100	11,500	14,000	8,900
Basic and medical sciences	7,900	7,200	7,300	6,800	7,000	7,700	8,200	9,600	7,000	(2/)	(2/)
Electronics	9,400	8,500	8,100	8,800	9,500	7,200	8,700	7,800	8,700	6,200	10,300
Equipment and supplies	8,100	8,500	9,200	7,700	8,300	9,100	8,000	7,500	5,700	--	8,000
Fuels and lubricants	8,200	7,600	8,900	9,000	7,500	(2/)	9,300	8,700	8,100	(2/)	--
Materials	7,800	6,400	7,200	7,900	8,100	7,200	8,100	9,200	8,300	6,600	--
Ordnance	9,200	6,500	8,600	6,700	7,000	7,100	6,100	8,000	11,700	(2/)	--
Other research specialties	7,600	8,800	8,100	6,900	8,700	8,100	9,900	6,200	--	--	--

1/ Cost figures rounded to nearest $100.
2/ Data are not shown for fewer than three companies.

D-9.--Number of companies reporting that they were qualified to do research in selected research specialties 1/

Research specialty	Number of companies 2/
Aircraft armament	289
Bombing systems and equipment	124
Fire control systems	169
Guns	54
Munitions	44
Testing and evaluation	88
Aircraft equipment	497
Automatic control systems	201
Electrical systems	185
Instrumentation	204
Mechanical systems	215
Parachutes	29
Testing and evaluation	147
Aircraft, piloted	185
Aerodynamics and structures	89
Catapults and arresting gear	50
Hydrodynamics	48
Propulsion	79
Testing, aircraft flight	56
Testing, propulsion systems	62
Basic natural sciences	674
Biology	146
Chemistry	539
Mathematics	168
Physics	272
Electronics	639
Acoustics	136
Antennas and propagation	160
Communication	275
Components	302
Electron tubes	73
Electronic countermeasures	140
Infrared	102
Interference reduction	96
Radar and related fields	258
Test equipment	328
Equipment and supplies	1,034
Clothing and personal	94
Electrical	214
Food	160
Heavy equipment and engineering construction	178
Maintenance equipment and utilities	162
Marine crafts and associated hydrodynamics	92
Mechanical	64
Photography and optics	102
Packing, packaging and preservation	62
Power units	356
Shelter	107
Storage	238
Tools, general purpose	165
Fuels and lubricants	248
Petroleum	96
Synthetic lubricants and hydraulic fluids	100
Liquid propellants	76
Equipment for storage, protection, and distribution	97
Geophysics and geography	207
Atmosphere	19
Atmospheric physics	22
Cartography	15
Geodesy	6
Geology	62
Geomagnetism and electricity	26
Geophysics and geography--Continued	
Hydrology	26
Ionosphere	52
Meteorological equipment	47
Oceanography	16
Photogrammetric equipment	31
Photo interpretation	8
Seismology	12
Soil mechanics	45
Weather forecasting	16
Guided missiles	437
Aerodynamics and structures	90
Countermeasures	73
Guidance and control	209
Launching and handling	92
Propulsion and fuels	84
Target drones	56
Test range procedures and instrumentation	130
Test and training equipment	149
Warheads and fuzes	95
Medical sciences	319
Antibiotics	85
Atomic medicine	22
Aviation medicine	28
Bacteriology	137
Dentistry	13
Disease	53
Immunology	107
Medical aspects of biological and chemical warfare	29
Medical equipment and prosthetic devices	11
Neuropsychiatry	70
Physiology and pathology	41
Sanitation	39
Shock and transfusion	61
Surgery	65
Toxicology	4
Materials	717
Inorganic and mineral	230
Metallurgy, extractive	101
Metallurgy, physical	208
Organic and fibrous	278
Physics of metals	147
Plastics	253
Navigation	174
Celestial	24
Dead reckoning	28
Electronic, common user	105
Electronic, self sufficient	104
Gyro and inertial	59
Pilotage and beacons	44
Ordnance	537
Degaussing nets and booms	20
Explosives and propellants, molecular	50
Fire control	175
Fuzes, firing, and exploding mechanisms	165
Guns and mounts, large caliber	78
Land mines and grenades	57
Projectiles and ammunition details	93
Rockets and rocket launchers	94
Sea mines and depth charges	52
Small arms and automatic weapons	70
Torpedoes and tubes	114
Vehicles, combat	154
Vehicles, noncombat	39
Warheads and bombs	83

1/ The numbers of companies qualified to do research in atomic energy, biological warfare, and chemical warfare are not shown.
2/ Totals shown do not add, since many companies indicated that they were qualified to do research in more than one research specialty within an area of specialization. Similarly, most companies indicated that they were qualified in more than one area of specialization.

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ERRATUM

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"Mean" cost per research engineer or scientist for "Nonprofit research agencies" with 500 to 4,999 employees should be $13,000 instead of $3,000.