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by

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FOREWORD

The dynamic character and continued growth of our economy, improvements in our standard of living, and the vigor of our competitive enterprise system depend to a considerable extent on the development of new products, improvements in quality of established products, and the successful search for more effective and economical methods of production. The research and development activities of American industry play a vital role in these dynamic aspects of our economy.

We have much to learn about the effectiveness of industrial research activities, the relationships among research, industrial growth, and industrial profitability, and the factors involved in management decisions as to appropriate magnitudes of expenditures for research. An earlier study of Professor Robert N. Anthony, assisted by John S. Day, *Management Controls in Industrial Research Organizations*, published by the Division of Research in 1952, dealt with the management control practices in research organizations. The present study represents a modest but a very important investigation of the magnitude of industrial research activities; it provides some of the basic quantitative information as to such activities, including the scale of expenditures for research and development by industrial firms and the variations of such expenditures among firms by industry and by size. Such information in itself will be of significant value to industrial firms and others concerned with the scope and character of research activities. The data also provide some of the necessary foundation for additional research in this area.

All three authors participated in the preparation of the final report. DeWitt C. Dearborn,

Research Associate, made the field investigations on which the surveys were based, prepared the questionnaire forms and instructions, planned the content and construction of the statistical tables, and analyzed the data for the 4,800-Company and 191-Company Surveys. He also planned the content and construction of the statistical tables and analyzed the data for the 1,456-Company Survey. Mrs. Rose W. Knezek, in addition to her responsibilities as Executive Secretary of the Bureau of Business Research which processed the statistical material, counseled in all stages of the statistical work and in the analysis of the data. Professor Anthony was the project supervisor and took an active part in the preparation of the final report.

The School is indebted to the many industrial firms who made this report possible by their cooperation in submitting data of their own activities. The School wishes to acknowledge especially the stimulation, support, and counsel of the Industrial Research Institute, Inc., the National Association of Manufacturers, the Office of Naval Research, and the Research and Development Board of the Department of Defense.

This bulletin constitutes the final report specified in Contract N5ori-07636 between the Office of Naval Research and the President and Fellows of Harvard College.

The costs of this research were defrayed by grants from the Office of Naval Research, the Research and Development Board of the Department of Defense, the National Association of Manufacturers, the Industrial Research Institute, Inc., and an allocation from the funds contributed by The Associates of the Harvard Business School.

BERTRAND FOX
Director of Research

Soldiers Field
Boston, Massachusetts
October 1953

PREFACE

This bulletin reports on the results of three coordinated surveys of spending for research and development by industrial companies in 1951 and 1952. The impetus for these studies came from the Research and Development Board of the Department of Defense (now the Office of the Assistant Secretary of Defense for Research and Development), the Office of Naval Research, the Industrial Research Institute, Inc., and the Committee on Research of the National Association of Manufacturers. These groups had long been interested in obtaining quantitative information on the amounts spent for industrial research, and in 1951 each of them was considering the possibility of conducting separate surveys to obtain such information.

The objective of each group was to some extent different from that of the others, but there was a sufficient degree of overlapping interest so that it seemed desirable to each of them to join their separate efforts. After several exploratory meetings, it became clear that the interests of the several groups could best be satisfied with three separate, but coordinated, surveys.

The Division of Research of the Harvard Business School was asked to undertake two of these surveys: one of a large cross-section of industrial companies, and the other of a selected group of companies known to have relatively large research organizations. The third survey was directed at *all* industrial companies believed to do research, and was conducted by the U. S. Bureau of Labor Statistics and the Research and Development Board. Many of the questions asked on the latter survey did not relate directly to the topic of industrial research spending, but some questions on this topic were included.

This bulletin reports on the two surveys conducted by the Harvard Business School, and on that part of the third survey relating to industrial research spending. A separate report on the third survey, to be titled "Scientific Research and Development in American Industry" is being prepared by the U. S. Bureau of Labor Statistics. Preliminary reports have been issued, both by the Harvard Business School and by the Bureau of Labor Statistics. This bulletin supersedes the

preliminary report of the Harvard Business School.

We were fortunate in being able to obtain the advice and counsel of a distinguished Advisory Committee. The Committee worked closely with us on all stages of the project from the preliminary investigation to the final draft of the manuscript. Their contribution of time and energy represents a real public service and had a significant impact on the conduct and results of the survey.

The cooperation of personnel of the U. S. Bureau of Labor Statistics was much appreciated. The task of coordinating the three surveys raised many problems, and that they were resolved is due largely to the skill and goodwill of Miss Helen Wood, Messrs. Joseph H. Schuster, and Robert W. Cain of the BLS group working on the survey, and Mr. Kenneth S. Colmen, the Research and Development Board representative.

The help of a large number of executives who made adjustments in their busy schedules to discuss important questions that arose during the process of developing a meaningful questionnaire is gratefully acknowledged. We wish also to express our appreciation to all persons in the respondent firms whose cooperation provided the data for this report, not only for their willingness to assume the burden of preparing the data, but also, in many cases, for their willingness to furnish information never before released to a group outside the company.

Dr. Melvin T. Copeland, former Director of Research; his successor, Professor Bertrand Fox; and Messrs. Arthur H. Tully, Jr., and Andrew R. Towl, Assistant Directors of Research of the Harvard Business School, gave encouragement and valuable advice. The statistical work was carried on by the Bureau of Business Research under the direction of Mrs. Kneznek and Miss Eleanor G. May, Assistant Executive Secretary, with Miss Caroline M. Timmerman handling the records, correspondence, and typing of tables, and Mrs. Bertha W. Daniels the IBM machine tabulations.

The authors assume sole responsibility for the conclusions expressed in this report.

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HIGHLIGHTS OF THE STUDY

Items	% of 4,800 Respondents Supporting Research	1952 Median Figures for 191 Leading Companies			
		% Research to Sales	Increase in Spending over 1951	Dollars Spent per Research Worker	% Professional to All Research Workers
ALL FIRMS	44%	1.3%	13%	\$8,400	46%
INDUSTRY					
Food and Kindred Products	31%	0.3%	8%	\$8,300	46%
Textile and Apparel	34	0.7	7	8,200	39
Furniture	27	0.5	9	6,500	19
Paper, Lumber, and Wood Products	28	0.7	15	7,100	49
Industrial Chemicals	74	2.9	15	9,400	45
Drugs	59	4.9	12	9,600	46
Paints	72	1.7	8	6,800	52
Miscellaneous Chemicals	69	2.4	9	7,700	39
Petroleum and Coal Products	40	0.7	14	9,000	43
Rubber	53	0.9	21	8,500	66
Stone, Clay, and Glass	42	1.3*	14	7,700	37
Primary Metal	43	0.9	11	8,500	40
Fabricated Metal	46	0.7	10	9,600	53
Machinery except Electrical	61	1.4	12	7,300	39
Electrical Machinery	71	2.7	17	8,200	44
Transportation Equipment	51	1.4	9	9,700	36
Laboratory Instruments	87	3.6	40	7,300	37
Mechanical Instruments	69	2.0	11	8,900	52
Other Professional, Scientific, and Controlling Instruments	79	2.0	14	10,000	50
SIZE					
Less than 500 Employees	32%	3.4%	10%	\$8,200	59%
500 - 2,000 Employees	80	2.0	16	8,100	49
2,000 - 5,000 Employees	94	1.4	12	8,000	45
5,000 - 7,000 Employees	96	1.2	12	8,200	50
7,000 - 10,000 Employees	97	1.5	13	8,500	46
10,000 Employees or More	99	0.8	14	8,700	41

* Estimated.

CHAPTER I

INTRODUCTION AND SUMMARY OF FINDINGS

Objectives

Managements of individual companies often find it useful to compare various aspects of their company's operations with those of similar companies. In many cases these comparisons begin with the use of statistical data describing the average, or typical, experience of a number of companies. Data on many areas or industries have been systematically accumulated over relatively long periods of time, thus permitting long-term trends, as well as short-term results, to be observed. The objective of the study reported on in this bulletin is to begin the collection of data in one such area, that of spending for research and development.

What Is Research?

One of the difficult parts of this study was to decide on a definition of research that would be meaningful to those supplying the data and useful to those studying the results. Although more precise definitions will be given in subsequent chapters, it is appropriate to state at this point that the term "research" as used herein includes basic research, applied research, and development, but that it is limited to technological research and development and therefore excludes such activities as market research, economic research, and similar functions.

Management Interest in Data on Research

No matter how large or how profitable it is, every company has a limited amount of resources to devote to any specific function, including research. Between this upper limit, whatever it may be, and the lower limit of zero lies a wide area of management discretion. The task of deciding how much should be spent on research is an especially difficult one since it is usually impossible to estimate the return that may be derived from a given investment in research. Nevertheless, decisions on how much to spend for research must be made, and in making them management must consider a variety of factors.

One of these factors may be the amount spent by competitors, and this bulletin provides quantitative data on this factor. More specifically, it is intended to help management answer such questions as:

1. What proportion of our competitors spend any money for research?
2. What proportion of our competitors maintain their own research organizations?
3. For those competitors who spend money for research, how much is so spent?
4. What proportion of this spending is for basic research? for research to find new products? for research to improve existing products?
5. How much, typically, is spent per professional person employed? for research plant and equipment?
6. What changes are taking place in the rate of spending?

Obviously, the decision on how much, if anything, to spend for research does not turn solely on the answers to the foregoing questions. The specific projects for which the money is spent and the ability of the people who actually carry out the research program are undoubtedly much more important considerations than information on the amount spent by competitors. Furthermore, the answers to these questions must necessarily be in terms of the *average* behavior of competitors, and there is no way of determining from the data how to be *better than average*. For example, the data presented in Chapter IV suggest that the typical manufacturer of industrial chemicals maintaining a research organization spent about 2% of sales for research in 1951. But is a chemical manufacturer who spends 3% doing better than average or is he doing worse than average? There is no way of answering this question since there is no way of specifying an amount of money that will produce optimum results in all companies.

Notwithstanding these limitations, many management men are interested in quantitative an-

swers to the questions given above. Such answers are helpful primarily because they suggest the further question: Why is our program different from that of our competitors? An attempt to answer this question may provide one useful way of appraising a company's research spending policy.

Plan of the Study

In exploring how the need for statistical data on the research activity of industrial firms might be met, it soon became apparent that the only feasible technique, from the point of view of coverage, cost, and time, was a mail questionnaire directed to individual companies. Previous experience has amply substantiated the fact, however, that many companies, especially small companies, will respond inaccurately, if at all, to a questionnaire containing lengthy or complicated instructions and definitions. Therefore it was decided to divide the study into three parts: the first was intended to find out what proportion of companies in various industry and size groups maintained research programs; the second was intended to develop *some* information on the cost of the research activity undertaken by *all* firms carrying on research; and the third was intended to develop more precise information, using full (and hence long and fairly complicated) definitions, from a small number of firms with relatively large research organizations.

To obtain the data required for the first part of the study, a short postal-card questionnaire (see Appendix A) was mailed to the membership list of the National Association of Manufacturers; this list consisted of approximately 20,000 firms. This questionnaire requested "yes" or "no" answers to only three questions about research: whether a company spent any money for research, whether it spent more than \$5,000 for research, and whether it maintained a research laboratory. In this questionnaire, terms were defined as briefly as possible. The key definition, that of "research and development," for example, was 44 words long, as contrasted with the corresponding definition in the most detailed questionnaire, which was approximately 750 words long. About 4,800 usable replies to this questionnaire were received. Chapter II of this bulletin reports on the findings of this survey (hereafter called the "4,800-Company Survey").

Since the special purpose of the 4,800-Company Survey was to determine what proportion of companies in various industry and size groups maintained research programs, it was important to secure a large response. It is noteworthy that a large number of small and medium-size companies submitted usable replies, with a sufficiently large number in most industries and size groups to permit reasonably valid conclusions. The number of respondent firms reporting annual expenditures of \$5,000 or more, classified by industry and size of company, is shown in Table I-1.

The collection of data from the thousands of firms known to maintain research organizations was undertaken by the Research and Development Board of the Department of Defense, with tabulation and analysis of returns being handled by the U. S. Bureau of Labor Statistics. Early in our investigation we learned that the RDB was planning to conduct a survey to determine industry's research potential, to collect data on the past and present effects of military call-ups upon this capacity, and to assist the military departments in locating possible contractors for research projects. The Research and Development Board personnel working on this project agreed to obtain, as part of their survey, data on the cost of research, sales volume, and company size (number of employees), and to compile statistical summaries of these data for use in this bulletin. Since the questionnaire circulated by the Research and Development Board aimed at broad coverage, and since the mailing list for this survey included more small than large companies, it was felt that a detailed set of definitions would tend to discourage responses. Therefore relatively short definitions were prepared for this survey (see Appendix B). Over 1,950 companies furnished usable data for this survey, but our analysis was limited to the approximately 1,450 manufacturing companies furnishing data to the questions in which we were especially interested.¹ The results of this larger survey (hereafter called the "1,450-Company Survey") are summarized in Chapter III.

The third survey was an intensive study of the research activity of a selected group of leading

¹ The companies *not* included in the present report include: (a) about 400 nonmanufacturing companies and (b) about 100 manufacturing companies that did not furnish usable data on spending.

Table I-1. DISTRIBUTION OF FIRMS REPORTING ANNUAL RESEARCH EXPENDITURES OF MORE THAN \$5,000, CLASSIFIED BY INDUSTRY AND SIZE OF COMPANY: 1952

Industry	All Firms	Number of Company Employees				
		Less than 100	100-500	500-2,000	2,000-5,000	5,000 or More
Ordnance and Accessories	35	2	17	11	1	4
Beverages	19	5	5	4	3	2
Food and Kindred Products except Beverages	101	13	31	30	10	17
Tobacco	7	0	1	0	2	4
Textile and Apparel	104	14	82	27	17	14
Lumber and Wood Products	52	6	26	14	5	1
Furniture	34	1	20	8	3	2
Paper and Allied Products	90	10	36	28	5	11
Printing and Publishing	33	5	11	12	4	1
Industrial Chemicals	87	20	28	16	11	12
Drugs	32	7	15	7	1	2
Soaps	11	4	5	2	0	0
Paints	42	19	19	4	0	0
Miscellaneous Chemicals	61	23	19	18	1	0
Petroleum Products	42	7	6	7	3	17
Coal Products	11	1	2	2	1	5
Rubber	57	10	21	18	2	6
Leather	16	0	10	3	2	1
Stone, Clay, and Glass	50	15	41	26	4	4
Primary Metal	54	6	11	10	12	15
Fabricated Metal	337	52	153	86	26	20
Machinery except Electrical	281	71	116	61	22	11
Communication Equipment	49	4	17	15	4	9
Other Electrical Machinery	88	7	35	23	14	9
Motor Vehicles and Parts	40	3	12	12	7	6
Aircraft and Parts	30	3	8	5	4	10
Other Transportation Equipment	25	5	7	3	4	6
Laboratory Instruments	13	6	4	1	1	1
Mechanical Instruments	29	12	10	4	2	0
Other Professional, Scientific, and Controlling Instruments	49	12	19	15	2	1
Other Manufacturing	165	30	66	48	13	8
All Firms	2,084	373	805	520	187	199

Source: 4,800-Company Survey.

firms in each industry. From these firms information was obtained on the distribution of the research budget among various kinds of research, the proportion of research capacity used to do research for others, the dollar cost of maintaining a research worker, and other data describing, in detail, the research activity of these selected firms. The questionnaire and detailed booklet of definitions (see Appendix C) for this survey were mailed to a selected group of firms, which included, in general, approximately the 15 believed to do the most research in each of 30 major manufacturing industries. Usable replies were received from 191 companies, and the findings of this part of the survey (hereafter called the "191-Company Survey") are reported in Chapter IV.

Before any of these questionnaires were mailed, one of the authors spent several months

asking research executives and controllers what information would be of greatest use to them and trying out various definitions to see which were the most easily understandable and most widely used. His findings were discussed with the Advisory Committee, whose members devoted much time to the problem both in formal meetings and in individual discussions. The definitions finally used therefore reflect the thinking of a great many informed and interested people.

Use of the Data

The focus of this study is upon the management of an industrial company, and the data have been presented so as to facilitate their use by company management. A previous study² has

² Robert N. Anthony and John S. Day, *Management Controls in Industrial Research Organizations* (Boston, Division of Research, Harvard Business School, 1952).

indicated that the most important variable explaining differences in the proportion of total resources devoted to research in various companies is the *industry* group in which the company falls, and the second most important variable is its size. For this reason, the data have been broken down, to the maximum extent feasible, into separate size and industry classifications.

The reader's first task therefore is to determine the *industry* and size categories in which his company falls. The industry categories used herein are adapted from the widely used definitions prepared by the U. S. Bureau of the Budget and published in the "Standard Industrial Classification Manual." Many will recognize their "SIC" classification from the industry titles given in the tables, but if the proper category cannot be determined from the title alone, a detailed definition of each industry group will be found in Appendix D, p. 101. In most tables, size categories are set up on the basis of total number of persons employed by the company: in a few, the size categories are based on the number of professional technical persons employed in the research organizations of the company.

Data from the 4,800-Company and the 1,450-Company Surveys have been classified by size groups within industry groups, but it was not feasible to analyze the data from the 191-Company Survey in such small classifications. Users of the latter data should give primary attention to the figures reported for their industry, and should adjust the industry figures to the extent that the figures for their size category indicate modification is desirable. In some cases, even in the 4,800-Company and 1,450-Company Surveys, data could not be reported for every industry-size category because in some instances there were not a sufficient number of responses to permit the construction of a usable average. In such cases, the reader will often find that he can obtain some information, even though it is only roughly comparable, by studying figures for an industry or size group similar to his own.

Although figures for all firms combined have been presented in some of the tables, these are not likely to be nearly so useful to individual company managements as the detailed industry-size data since the over-all figures hide the differences among the various industry groups, and these differences are substantial.

Differences between the 1,450-Company and 191-Company Surveys

Listed in the next section are some of the questions that may be put to the data, together with the location of the answers. It will be noted that in several cases relevant information can be found from either the 1,450-Company Survey (Chapter III) or the 191-Company Survey (Chapter IV). Some of the differences between the data in these two surveys are listed in Chapter III, pp. 27 to 29; these differences are such that no direct comparison between the two sets of data is advisable. In general, data from the 1,450-Company Survey will be more useful to small firms than data from the 191-Company Survey, since only a few small firms are included in the 191-Company Survey. Medium-size and large firms can use either survey. The difference in coverage of the two surveys is indicated by the following tabulation:

Distribution of Firms Reporting Cost of Research Done Within Company

Size of Company	1,450-Company Survey	191-Company Survey
Less than 500 Employees	47%	6%
500-5,000 Employees	37	39
5,000 Employees or More	14	55
Not Accounted for	2	..
Total	100%	100%

Also, as noted above, the data in the 191-Company Survey are presented only by industry groups and by size groups, and not by size groups *within* industry groups. In the 1,450-Company Survey, data are presented in the more detailed breakdown of size groups within industries.

Some Frequently Asked Questions

Consider an executive who is thinking about the possibility of starting a research program in his company. Among the many questions he will raise are some to which answers, or partial answers, may be obtained from the data reported herein. As a means of illustrating the scope of the data, several such questions, together with references to the table(s) showing the data pertaining to them, are given below. The tables include a great many additional items as described in the material relating to each table, but the following may serve as a useful introduction:

1. What proportion of companies spend money for research? Table II-1 presents the responses from 4,800 companies, classified by industry, with more detailed breakdowns by size groups within industries presented in Tables II-2 through II-6.
2. What percentage of sales does a company typically spend on research intended for its own benefit? See Table III-2 (for the 1,450-Company Survey) and Table IV-1, Item 2a (for the 191-Company Survey).
3. How much does it cost to support a professional technical person? See Table III-5 and Table IV-4, Item 3a, for annual operating cost. See Table IV-4, Item 5, for the total annual replacement cost of equipment and other fixed assets; Item 4a for annual expenditures for fixed assets.
4. What is the typical ratio of professional employees to all employees in a research organization? See Table IV-4, Item 6.
5. What proportion of the research financed by a company is done within the company? See Table IV-1, Item 2b.
6. What proportion of research effort is devoted to basic research? to the creation of new products? to the improvement of existing products? See Table IV-1, Item 3.

Cautions Regarding the Data

Readers associated with industrial research organizations undoubtedly will know the limitations inherent in data on research spending, but inasmuch as this report is also likely to be of interest to persons not familiar with the situation, certain cautions to be observed in using the data are mentioned here.

Definitions. By far the most serious limitation is that there is no generally agreed upon definition of any of the important terms used in the survey. Although a great deal of effort was expended in framing the definitions, it is unreasonable to expect that they cover all possible situations, that they were communicated precisely to the respondents, or that all respondents adhered to them. This limitation exists in any survey, but it is especially important in the present series of studies for two reasons. First, many of the questions dealt with information expressed in dollars.

There are considerable variations in the accounting practices of industrial companies, and these variations influence the comparability of any information drawn from a company's accounting records. Answers to the question "how many employees *worked on* function X?" are invariably better than answers to the question "how much did you *spend* for function X?", for example. Second, the word "research" and terms related to it are defined differently in different companies and industries, and these differences are almost certain to affect the figures reported on the survey, no matter how carefully the written definitions were framed. For these reasons, the reader should not expect that the figures reported in the tables correspond precisely to the terms as defined therein, and he should temper his interpretation of these figures accordingly.

Inadequacy of the Sample. Although the surveys reported herein have a much larger coverage than any previous survey of industrial research spending, they do not necessarily include a representative sample of companies with research organizations. With respect to the 4,800-Company and 1,450-Company Surveys, the coverage is so large that, with the exception of the bias mentioned below, a complete census of all companies might well show substantially the same ratios as those presented. With respect to the 191-Company Survey, however, the number of companies in most of the categories is so small that no claim of representativeness can be made; nevertheless, the amount of research done by these companies represents such a large fraction of the total amount of industrial research that a considerable amount of significance may be attached to the experience reported by these companies.

Bias. Completed questionnaires were accepted from all companies on our mailing lists that were willing to answer, and we have no way of knowing whether the companies that sent completed questionnaires differ significantly from the companies that did not choose to fill out the questionnaire. Experience with other surveys indicates that companies that respond to a questionnaire tend to be more interested in the topic being studied than companies that do not respond. In particular, the response to the 4,800-Company Survey is probably biased, in that the respondent group probably contained a higher percentage of

companies doing research than did the group not responding. Although there are techniques for measuring the influence of this "nonresponse" bias, it was not feasible to use them in the 4,800-Company Survey since the replies to it were anonymous.

Recency. The 191-Company Survey was the first attempt to collect detailed, clearly defined data on research spending. We have learned—particularly from our 33 years of experience with a survey of department store operating results—that the data become more reliable as the years pass. This results both from improvement of and better understanding of the definitions, and because many respondents change their accounting systems to conform to the definitions.

General Findings

Although the results of these surveys are intended primarily for use by individual company managements in comparing their own experience with that of similar companies, some general information obtained from them may be of interest. The bird's-eye picture of research spending that emerges from the three surveys is summed up in the following paragraphs.

Prevalence of Research. More than 40% of the firms responding to the 4,800-Company Survey stated that they spent more than \$5,000 for research in 1952. Virtually all large firms responding (5,000 employees or more) spent more than \$5,000 for research, as did over three quarters of the medium-size firms (500 to 5,000 employees). Even in small companies (less than 500 employees) nearly one out of three firms spent more than \$5,000 for research in 1952, a higher ratio than was generally believed to exist.

In several industries, generally described as "technologically based," considerably more than half the small firms responding reported that they spent more than \$5,000 for research. In this size group, about three-quarters of the respondents in the following industry groups spent more than \$5,000 each for research: all segments of the chemical industry; the ordnance and accessories industry; manufacturers of machinery (including electrical machinery) and communication equipment; and manufacturers of professional, scientific, and controlling instruments.

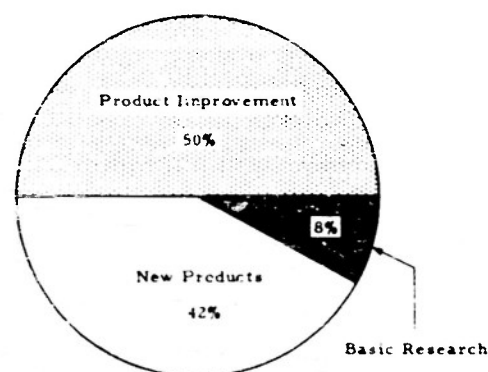
Total Spending for Research. Estimates based on data developed from the 191 Company

Survey indicate that the cost of *all* research which industrial firms financed or provided the facilities for amounted to approximately \$2.5 billion in 1951.³ Of the \$2.5 billion total estimated spending for research in 1951, more than \$836 million was spent by the firms participating in the 191-Company Survey (see Table I-2). Thus, these few firms accounted for over a third of the estimated total spending.

Distribution by Objective. For these 191 concerns, 92% of company funds (i.e., excluding government funds) committed to research was spent for research and development on specific products and processes, with the balance being allocated for research of a general or basic nature. While both large and medium-size firms typically spent some part of their research funds

Chart I-A

DISTRIBUTION OF COMPANY FINANCED RESEARCH WORK



Source: 191-Company Survey

to support basic research (i.e., programs not directed to the solution of a specific problem), small companies typically spent none of their research dollars for this purpose. Large companies typically reported that a larger share of their research funds was spent to improve present products or processes than to find new products or processes. In the largest firms (50,000 or more employees) research undertaken to improve existing products or processes absorbed more than twice as many dollars as did research on new products or processes.

³ See also estimate for national outlay for scientific research developed in *The Growth of Scientific Development* (Washington, Office of the Secretary of Defense (R & D), 1953).

**Table I-2. COST OF ALL RESEARCH FOR 191 MANUFACTURING COMPANIES,
CLASSIFIED BY INDUSTRY: 1961**

Industry	Number of Reporting Firms	Cost of All Research (in millions)
Food and Kindred Products	12	\$20
Textile and Apparel	5	9
Paper, Lumber, and Wood Products	14	8
Chemicals and Allied Products	41	178
Industrial Chemicals*	(13)	(127)
Drugs and Medicines*	(9)	(33)
Soaps*	(4)	(6)
Paints*	(5)	(1)
Miscellaneous Chemicals*	(10)	(11)
Petroleum and Coal Products	15	81
Rubber	7	22
Stone, Clay, and Glass	6	14
Primary Metal	11	18
Fabricated Metal	8	11
Machinery except Electrical	12	49†
All Electrical Machinery	9	190
Transportation Equipment	10	173
Aircraft and parts*	(5)	(124)
Professional, Scientific, and Controlling Instruments	19	52
Laboratory Instruments*	(6)	(38)
Mechanical Instruments*	(5)	(3)
Other Professional, Scientific, and Controlling Instruments*	(8)	(11)
All Other (not classified above)	18	13
All Firms	191	\$836*

* Detailed industry data. These data are also included in the totals shown for the pertinent industry group.

† Includes an estimated figure for one company.

Note: This table has been prepared to provide the reader with information on the magnitude of the research spending covered by the 191-Company Survey. It does not necessarily reflect the relative proportion of research done in the various industry groups.

Source: 191-Company Survey.

Where Research Is Done. By far the major part of industry's research work was carried on by persons employed directly by the company. In the 4,800-Company Survey, it was found that about 70% of all manufacturing firms spending more than \$5,000 for research maintained their own research organizations; that is, a distinct organization unit headed up by an executive who has primary responsibility for research. Even in the smallest firms (less than 100 employees) more than half the respondents that spent in excess of \$5,000 for research had established such an organization.

In a number of cases, companies participating in the 191-Company Survey reported that some company units other than the formal research organization carried on research work. On an aggregate basis, the costs incurred for research done in units other than the research organization amounted to less than 15% of the total cost of research done. Only a small part of total research funds was spent outside the company. Dollar-wise, about 3% of the more than \$600

million committed to research by these 191 firms was spent to support research carried on by persons not directly employed by the companies, with two-thirds of this relatively small amount being used to support scientific programs in non-profit organizations—mostly educational institutions—and the balance being spent for research in organizations such as independent commercial consulting laboratories and research programs maintained by trade associations.

Nonresearch Activities of Research Organizations. The 191-Company Survey also showed that the resources of research organizations were frequently drawn upon for the performance of activities other than research. Almost 20% of the aggregate cost of supporting the activities of formal company research organizations resulted from nonresearch work carried on by research organization personnel, with the most important nonresearch work being done in connection with the provision of technical service to operating units. Technical service includes such activities as quality and quantity control

**Table I-3. CHANGES IN TOTAL COMPANY FUNDS COMMITTED TO RESEARCH,
1952 COMPARED WITH 1951 (191-Company Survey)**

Industry Group	Number of Firms Showing:				1952 as a % of 1951	
	Increases	Decreases	No Change	Total	Median Figures	Middle Range Figures
Food and Kindred Products	9	3	—	12	103.2	102.2-115.9
Food except Beverages*	(7)	(2)	—	(9)	(110.0)	(106.1-120.5)
Textile and Apparel	6	5	—	9	107.1	96.3-112.7
Furniture	5	—	—	5	109.0	—
Paper, Lumber, and Wood Products	10	3	1	14	114.9	100.0-123.5
Paper and Allied Products*	(8)	(2)	—	(10)	(116.5)	(109.5-128.5)
Chemicals and Allied Products	32	6	—	39	111.9	105.3-117.5
Industrial Chemicals*	(9)	(2)	—	(11)	(115.1)	(111.6-122.1)
Drugs*	(8)	(1)	—	(9)	(111.9)	(108.4-121.5)
Paints*	(5)	—	—	(5)	(108.5)	—
Miscellaneous Chemicals*	(8)	(2)	—	(10)	(109.4)	(105.1-116.2)
Petroleum and Coal Products	14	1	—	15	113.6	107.8-119.3
Rubber	7	—	—	7	120.8	115.9-125.1
Stone, Clay, and Glass	5	—	—	5	112.4	—
Primary Metal	7	4	—	11	110.7	94.8-121.5
Fabricated Metal	7	1	—	8	110.3	105.4-126.2
Machinery except Electrical	9	2	—	11	112.0	106.0-118.1
Electrical Machinery	8	—	1	9	116.8	109.9-128.2
Transportation Equipment	5	3	2	10	108.9	93.5-132.8
Aircraft and Parts	(2)	(1)	(2)	(5)	(100.0)	—
Professional, Scientific, and Controlling Instruments	18	1	—	19	115.3	107.5-131.1
Laboratory Instruments*	(6)	—	—	(6)	(140.5)	(122.7-184.4)
Mechanical Instruments*	(5)	—	—	(5)	(110.7)	—
Other Professional, Scientific, and Controlling Instruments	(7)	(1)	—	(8)	(114.0)	(103.8-128.4)
All Firms	155	28	4	187†	113.0	105.5-122.9

* Detailed industry data. These data are also included in the totals shown for the pertinent industry group.

† Although 189 companies reported some data for 1952, the reports of only 187 companies are compared with 1951 since one of these companies did not report this item and a second company's data for the two years were not considered comparable.

work, plant sanitation, trouble shooting in connection with plant breakdowns, service to licensees, and like activities.

Cost per Person. Research is expensive both in terms of operating costs and of the investment required to provide facilities for research personnel. The typical (median) figure for the larger number of companies reporting for the 1,450-Company Survey for research cost per professional technical person was \$14,000 per year in 1951, with one-half the firms reporting amounts between \$9,000 and \$21,000. Cost per research worker for these firms showed a median figure of \$7,000, with a middle range of \$5,000 to \$10,000.

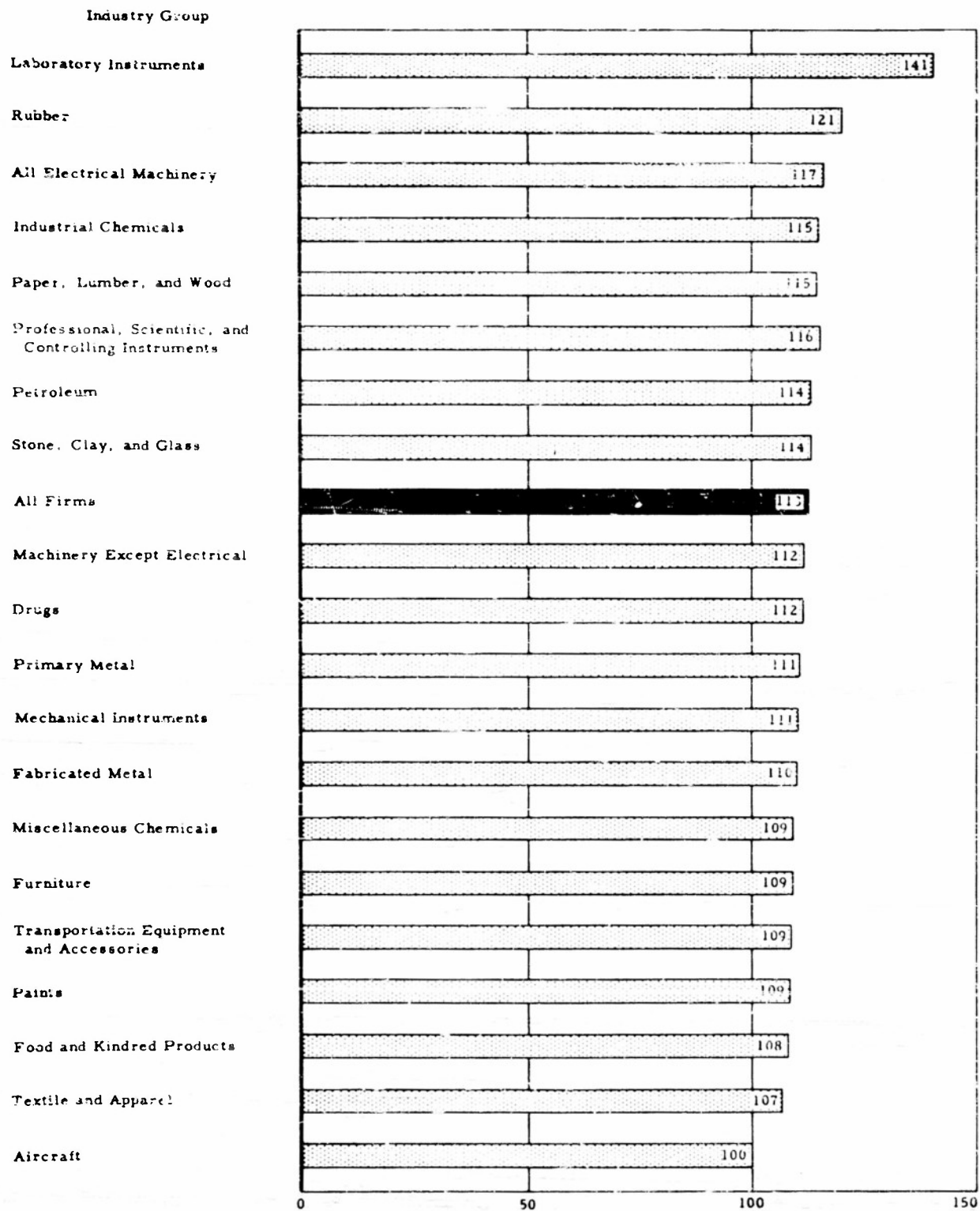
Similar figures developed in the 191-Company Survey showed typical cost per professional technical person to be \$18,000 for 1951 (middle-range figures fell between \$14,000 and \$25,000); for cost per research organization employee, the respective figures were \$3,000 and \$7,000-\$9,000. In addition to the outlay of approximately \$18,000 per professional techni-

cal person for current costs, an additional sum of \$600 typically was expended in 1951 for capital equipment for each such person on the staff of the research organization. The 1952 replacement cost of tangible facilities (land, buildings, and major items of equipment) was typically equal to about \$22,000 per professional technical person employed in the research organizations of these 191 firms.

1952 Compared with 1951. Industry expanded its research activity in 1952 over the 1951 level. Firms participating in the 191-Company Survey reported estimates made in the fall of 1952 of what they would spend for research for 1952, and these figures typically showed a 13% increase over actual expenditures for 1951 (see Table I-3). Nearly half the respondent companies expanded their research plant in this period, and general increases in research staffs, typically 7%, were also reported by the firms that participated in this survey.

Research as a Percentage of Sales. The median percentage for the portion of sales spent

Chart I-B
 COMPANY FINANCED RESEARCH
 1952 as a % of 1951



Source: 191-Company Survey.

Per Cent

by industrial firms for company research as reported by all firms in the 191-Company Survey was 1.1% in 1951 and 1.3% in 1952. There was a wide variation in this percentage, however, when companies were classified by industry and by size of company. The highest median figure for cost of company financed research (as a percentage of net sales) was reported by firms in the drug industry, 4.6% in 1951, and may be contrasted with the 0.3% reported for the food industry. When the companies in the 191-Company Survey were classified by size, the median figure for cost of company financed research as a percentage of net sales ranged from 3.2% for the smaller companies down to 0.5% and 0.9%,

respectively, for the two groups of largest companies.

We cannot emphasize too strongly that the general picture shown by the data on research spending is one of variation—variations among industries, among size groups, and among the individual companies within each industry and size group. Certain patterns do seem to be present: large companies tend to spend a smaller percentage of sales on research than do medium-size companies; companies in certain industries tend to spend more than companies in other industries. The important figures for most users of the report, however, are those for their industry and size groups, rather than the over-all averages.

CHAPTER II

THE 4,800-COMPANY SURVEY

Many persons in business, especially executives of firms not engaged in research, wish to know whether other companies spend money for research, and, if so, whether these firms maintain their own research organizations. The special purpose of this chapter is to provide this general information.

Description of the Survey

To accomplish this purpose, a short questionnaire was mailed in the spring of 1953 to the membership list of the National Association of Manufacturers. This list contained approximately 20,000 names. Of the several mailing lists that were considered, this one was chosen because it was the only large list known that could be surveyed with moderate cost and because the NAM agreed to cooperate in eliciting responses. This list is not a perfect cross-section of American industry; indeed, short of the extremely large list maintained by the Bureau of the Census and the confidential list of the Bureau of Internal Revenue, no adequate representative cross-section was known to us.

The NAM list, however, turned out to be a much better cross-section than we had supposed when the possibility of using this list was first suggested. As to industry, there was an adequate number of responses in each industry group to permit data to be analyzed for each group. Although the representation from each industry did not match the structure of companies by industry in the whole economy, this was not important for the special purpose of this survey since, in the data reported, each industry was, with a few exceptions, considered by itself rather than as a percentage of the whole economy.

As to size, the widespread impression that the NAM membership is comprised primarily of large companies turned out to be incorrect. As shown by the following table, although the 4,800-company sample was not perfectly distributed by size, the percentage of small companies was high:

Distribution of Companies by Size

No. of Employees	Responses to 4,800- Company Survey		All U. S. Estab- lishments, 1950 ¹
	Number	Per Cent	Per Cent
Less than 500	3,765	77.8%	98.1%
500-2,000	654	13.7	1.6
2,000 and Over	403	8.5	0.3
Total	4,762	100.0%	100.0%

Essentially, we tried to find out in this survey the answers to two questions: (1) Do you spend money for research? and (2) Do you spend the money within your company, or do you hire an outside organization to do the research for you? Of the three questions actually asked on the survey, two pertained to the first topic. These were: "Did your company spend any money for research-development in 1952?" and "Did your company spend more than \$5,000 for research-development in 1952?" Although the answers to both these questions have been tabulated, we believe the second gives a better indication of the number of companies engaging in research programs, as the term is generally understood, since an annual expenditure of less than \$5,000 would buy very little research; for example, it probably would support the work of less than half a research man.

We got at the second topic by asking: "Did your company maintain a research-development laboratory in 1952?" and gave a brief definition of "laboratory," which will be found in Appendix A. The answers to this question indicate the proportion of companies which actually carry on research programs as contrasted with those which ask some outside organization to do all their research for them.

In order to elicit as many responses as possible, this questionnaire was printed on a postal

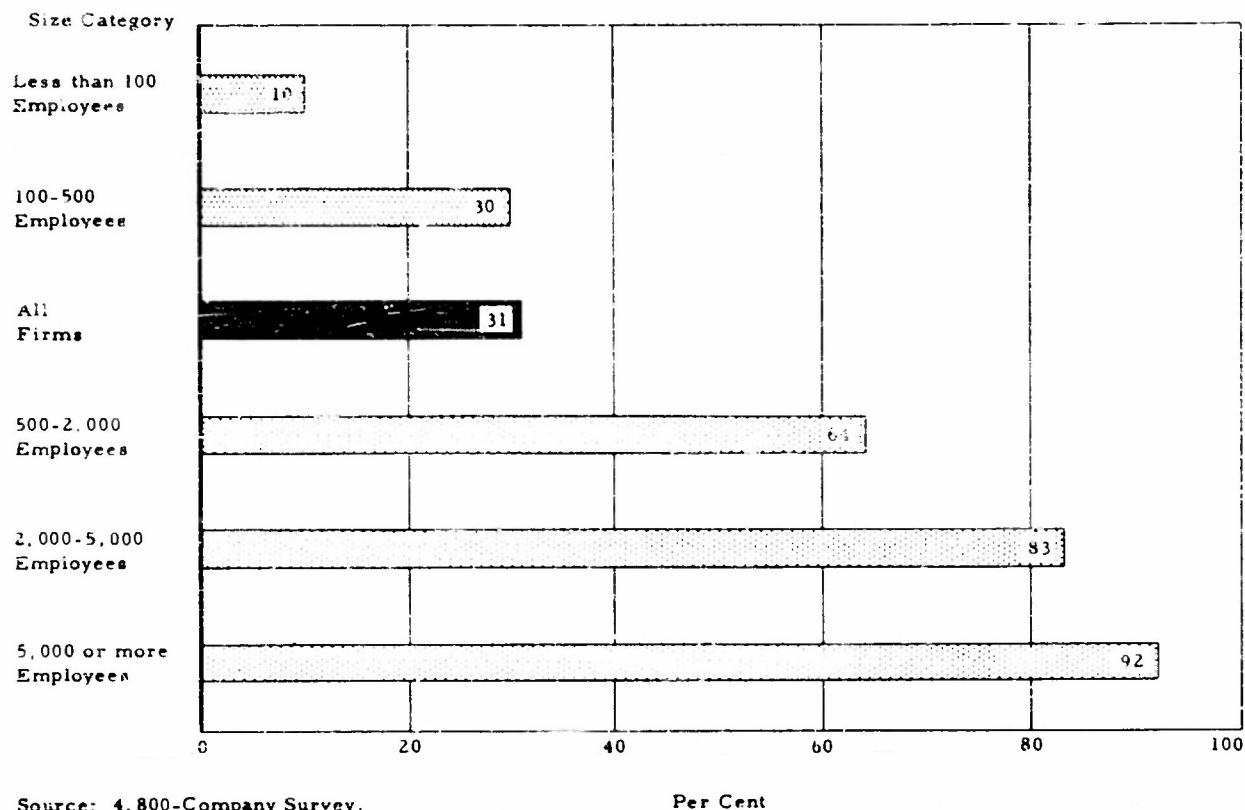
¹ Adapted from U. S. Bureau of the Census, *Annual Survey of Manufacturers: 1949 and 1950* (Washington, Government Printing Office, 1952), p. 116.

The actual percentage of small companies is lower than that shown here since these estimates are of establishments; that is, each separate plant of a multiplant company is counted as one unit. Multiplant companies thus appear as several smaller units rather than a single large unit.

Chart II-A

COMPANIES MAINTAINING RESEARCH ORGANIZATIONS BY SIZE OF COMPANY

% of Respondents Maintaining Research Organizations



card, and respondents were not asked to identify themselves. For this reason, no follow-up letters could be sent, and no check on nonrespondents could be made.

Summary of the Findings

Prevalence of Research

Total research activity of industry rests on a broad base. Of the 4,800 respondents to this survey, 64% indicated that they spent some money for research in 1952, and 44% further reported that these expenditures were in excess of \$5,000 annually. In addition, about 1,500 (or 31% of the total responding) indicated that they maintained their own research organizations.

Difference by Size of Company

Of these 1,500 research organizations, 48% were maintained by companies with less than 500 employees, 39% by companies with 500-

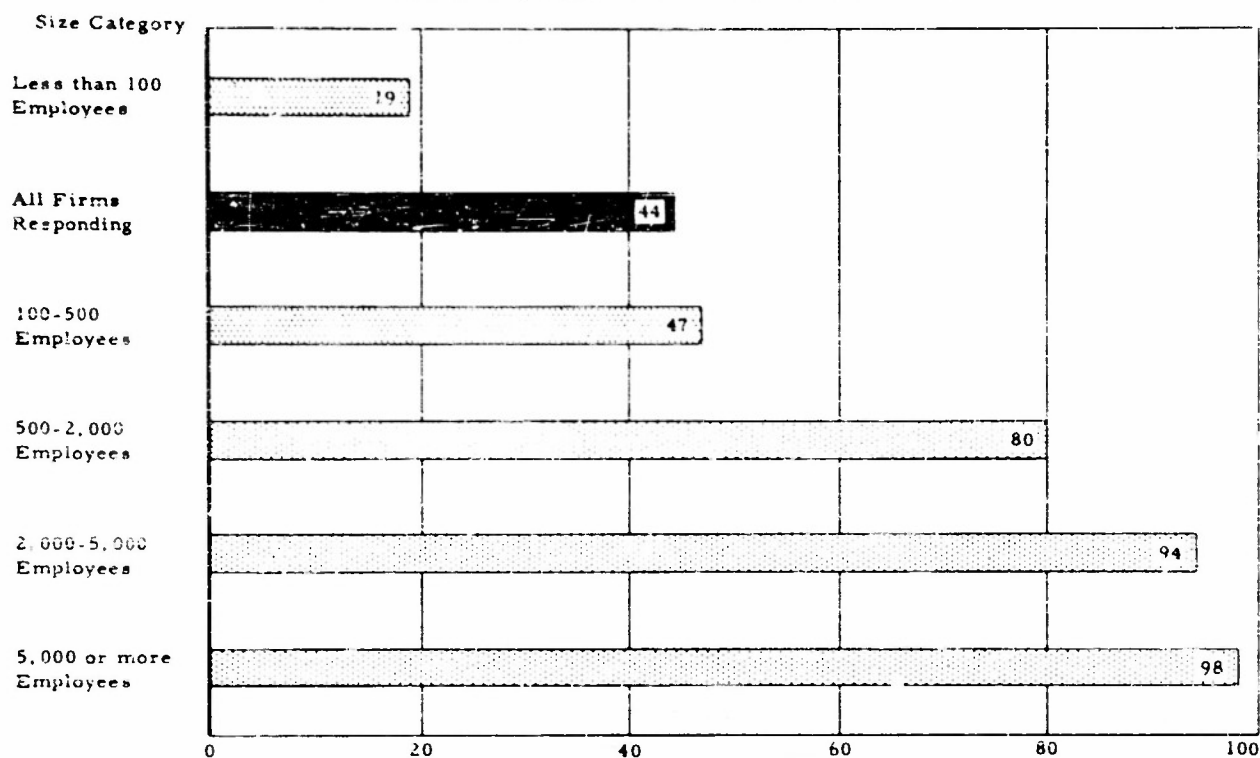
5,000 employees, and 13% by companies with 5,000 or more employees. These figures reflect primarily the fact that there are many more small firms than there are large firms, for the data also show that the percentage of companies maintaining research organizations is much higher in large companies than it is in small companies. Of the 203 respondents with 5,000 employees or more, 92% maintained research organizations, whereas only 10% of the 1,960 respondents with less than 100 employees and 30% of firms with 100-500 employees had their own research facilities (see Chart II-A). Thus, it can be seen that although research organizations are found in small as well as large companies, a large company is much more likely to have one than is a small company.

Similar differences associated with size of company are found when the number of respondent firms is related to the number spending

Chart II-B

PREVALENCE OF RESEARCH PROGRAMS BY SIZE OF COMPANY

% of Respondents Spending More Than \$5,000 for Research



Source: 4,800-Company Survey.

Per Cent

more than \$5,000 for research.² Of companies with fewer than 500 employees, 32% spent more than \$5,000 for research; but for firms with 5,000 or more employees, the figure was 98% (see Chart II-B).

Differences by Industry Group

Industry-wise, it is apparent that research activity rests on an equally broad base. Some respondents in every industry group reported that they both spent more than \$5,000 for research and supported their own research organization. With respect to research spending of \$5,000 or more, the percentages ranged from 17% for lumber and wood products companies to 87% for laboratory instrument companies.

² As mentioned above, many firms reporting that they spent less than \$5,000 annually for research probably were not engaging in research as this term is generally understood, and therefore all further analysis of these data will follow the more qualified definition: "companies spending more than \$5,000."

Similarly, with respect to the maintenance of research organizations, the percentages ranged from 8%, once again for the lumber and wood products industry, to 68% for the industrial chemicals companies, with laboratory instruments companies showing a slightly lower figure of 67%.

The distribution of research organizations (and research activity) among the various industry groups is further summarized in Table II-7. It is seen that of all companies reporting that they had a research organization, 13% were in the fabricated metal industry and 11% in the non-electrical machinery industry, with these same two industries reporting the largest number of firms spending more than \$5,000 for research. In this table an attempt was made to discover if the amount of research activity was related to the character of industry groups, but no such relationship could be established.

Differences by Size within Industry

When each industry group is further subdivided into size groups, the general pattern of the prevalence of research in different industries persists. For example, not only was the percentage of respondents reporting maintaining research organizations lowest in the lumber and wood products industry as a group, it was also among the lowest for each size group within the industry (see Table II-8).

The breakdown of industry categories into the five size groups also revealed that, excluding the few size-within-industry groups for which there were no respondents at all, research activity was reported in all industry groups in all size categories, with two minor exceptions: in the leather industry none of the reporting firms with less than 100 employees spent more than \$5,000 for research; and neither did the 500-2,000 employee group in the tobacco industry. With respect to the maintenance of a research organization, in five of the industry categories (ordnance and accessories, tobacco, furniture, leather, and coal products), there were size categories in which no respondent maintained a research laboratory.

The foregoing analyses indicate that the difference in the prevalence of research among the several industry groups reflects the characteristic of the industry and is not the accidental result of differences in the size of the companies in these industries.

Table II-9 gives further evidence on the extent of the dispersion of research organizations throughout companies of all sizes. The data in this table were derived in the following manner: Within each industry, respondent firms were ranked by size (as measured by number of employees) with the largest firm at the top and the smallest at the bottom. The number of respondents representing the largest 5%, the largest

10%, and the largest 20% of the total number of companies in each industry, respectively, were computed. Then the number of research organizations reported by the firms in each of these three groups was expressed as a percentage of the total number of firms maintaining research organizations in the industry. This table is another way of showing that research tends to be much more prevalent in large companies than in small companies. However, it also shows that in no industry category did firms representing the largest 20% of the respondents in that industry maintain more than 84% of the research organizations, and in only nine industries did firms representing the top 20% of the respondents maintain as many as 50% of the research organizations.

In summary, the data show that companies in all industries and in all size groups engage in research, and that the *percentage* of companies supporting research is higher for large companies. These data, it should be remembered, do not show *how much* research is done and therefore do not indicate the concentration of research personnel or research dollars in various industry and size groups.

Use of the Tables

Table II-1 reports the over-all figures on the prevalence of research in each industry.

Tables II-2 through II-6 are the tables that an individual company will use in considering the prevalence of research among companies in size and industry categories similar to its own. There is a separate table for each of the five size categories, with size measured by number of employees.

Tables II-7, II-8, and II-9 are rearrangements of the data for the purpose of the special analyses described in the preceding paragraphs.

Table II-1. PREVALENCE OF RESEARCH IN ALL FIRMS, 1952

Industry	Total Number of Respondent Firms	Percentages of Total Number of Respondent Firms for Each Industry			Respondents Spending More than \$5,000
		Those Spending Some Money for Research	Those Spending More than \$5,000 for Research	Those Maintaining Research Organizations	
Ordinance and Accessories	45	91.1%	77.8%	53.3%	65.5%
Beverages	79	35.4	24.1	15.2	63.2
Food and Kindred Products except Beverages	306	55.9	33.0	26.1	79.2
Tobacco	12	66.7	58.3	50.0	85.7
Textile and Apparel	307	49.8	33.9	23.1	68.3
Lumber and Wood Products	204	38.0	16.9	7.8	44.2
Furniture	127	52.8	26.8	11.0	41.2
Paper and Allied Products	192	64.1	46.9	39.1	83.3
Printing and Publishing	182	48.9	18.1	11.5	60.6
Industrial Chemicals	117	66.3	74.4	68.4	92.0
Drugs	54	81.5	59.3	55.6	93.8
Soaps	19	84.2	57.9	52.6	90.9
Paints	58	79.3	72.4	67.2	92.9
Miscellaneous Chemicals	85	86.2	71.7	63.5	88.5
Petroleum Products	90	63.3	45.7	40.0	35.7
Coal Products	24	70.8	45.8	20.8	45.5
Rubber	108	74.1	52.8	40.7	77.2
Leather	54	51.9	29.6	24.1	81.3
Stone, Clay, and Glass	215	68.4	41.9	32.1	76.7
Primary Metal	125	65.6	43.2	31.2	72.2
Fabricated Metal	843	63.0	40.0	23.1	57.9
Machinery except Electrical	462	77.7	60.8	34.4	56.6
Communication Equipment	65	90.8	75.4	67.7	99.8
Other Electrical Machinery	128	83.6	68.6	60.2	87.5
Motor Vehicles and Parts	81	61.7	49.4	34.6	70.0
Aircraft and Parts	58	63.8	51.7	34.5	66.7
Other Transportation Equipment	46	73.9	54.4	37.0	38.0
Laboratory Instruments	15	86.7	86.7	66.7	76.9
Mechanical Instruments	42	92.9	69.1	54.8	79.3
Other Professional, Scientific, and Controlling Instruments	62	91.9	79.0	61.3	77.6
Other Manufacturing	453	61.8	36.4	27.6	75.3
All Firms	4,762	64.2%	43.8%	31.1%	71.1%

Source: 4,800-Company Survey.

Table II-2. PREVALENCE OF RESEARCH IN FIRMS WITH LESS THAN 100 EMPLOYEES: 1952

Industry	Total Number of Respondent Firms	Percentages of Total Number of Respondent Firms for Each Industry			Number	% Maintaining a Research Organization
		Those Spending Some Money for Research	Those Spending More than \$5,000 for Research	Those Maintaining Research Organizations		
Ordnance and Accessories	9	68.7%	22.2%	0.0%	2	0.0%
Beverages	42	21.4	11.9	9.5	5	80.0
Food and Kindred Products except Beverages	121	42.2	10.7	8.3	13	76.9
Tobacco	0	—	—	—	0	—
Textile and Apparel	77	39.0	18.2	3.2	14	28.6
Lumber and Wood Products	158	20.9	3.8	0.6	6	16.7
Furniture	36	27.8	2.8	0.0	1	0.0
Paper and Allied Products	66	33.3	15.2	6.1	10	40.0
Printing and Publishing	102	32.4	4.9	2.9	5	40.0
Industrial Chemicals	45	68.9	44.4	35.6	20	80.0
Drugs	22	72.7	31.8	27.3	7	85.7
Soaps	11	72.7	36.4	16.4	4	100.0
Paints	34	67.7	35.9	12.9	19	84.7
Miscellaneous Chemicals	44	84.1	52.3	45.5	23	87.9
Petroleum Products	37	37.8	18.9	13.5	7	71.4
Coal Products	7	57.1	14.3	0.0	1	0.0
Rubber	40	60.0	25.0	17.5	10	70.0
Leather	18	33.9	0.0	0.0	0	—
Stone, Clay, and Glass	93	53.8	16.1	7.5	15	46.7
Primary Metal	43	44.2	14.0	2.3	6	16.7
Fabricated Metal	368	47.3	14.1	5.4	52	28.5
Machinery except Electrical	207	60.9	34.3	9.7	71	28.2
Communication Equipment	12	66.7	33.3	33.3	4	100.0
Other Electrical Machinery	35	60.0	20.0	17.1	7	85.7
Motor Vehicles and Parts	25	36.0	12.0	4.0	3	33.3
Aircraft and Parts	20	45.0	15.0	5.0	3	33.3
Other Transportation Equipment	15	60.0	33.3	26.7	4	80.0
Laboratory Instruments	8	75.0	75.0	50.0	6	66.7
Mechanical Instruments	21	85.7	57.1	47.6	12	83.3
Other Professional, Scientific, and Controlling Instruments	20	90.0	60.0	30.9	12	50.0
Other Manufacturing	244	46.7	12.3	6.6	30	53.3
All Firms with Less than 100 Employees	1,980	47.4%	18.8%	10.2%	373	53.9%

Source: 4,300-Company Survey.

Table 12-3. PREVALENCE OF RESEARCH IN FIRMS WITH 100-500 EMPLOYEES: 1952

Industry	Total Number of Respondent Firms	Percentages of Total Number of Respondent Firms for Each Industry			Number	Respondents Spending More than \$5,000
		Those Spending Some Money for Research	Those Spending More than \$5,000 for Research	Those Maintaining Research Organizations		
Ordnance and Accessories	20	95.0%	85.0%	55.0%	17	64.7%
Beverages	22	45.5	22.7	9.1	5	40.0
Food and Kindred Products except Beverages	111	50.5	27.9	18.0	31	64.5
Tobacco	3	32.3	33.3	0.0	1	0.0
Textile and Apparel	137	43.1	23.4	12.4	32	53.1
Lumber and Wood Products	119	49.6	21.9	7.6	28	34.6
Furniture	71	59.2	28.2	11.3	20	40.0
Paper and Allied Products	79	70.9	45.6	44.3	36	97.2
Printing and Publishing	56	64.3	18.6	8.9	11	45.5
Industrial Chemicals	33	93.9	84.9	75.9	28	89.3
Drugs	21	85.7	71.4	66.7	15	93.3
Soaps	6	100.0	83.3	66.7	5	80.0
Paints	20	95.0	95.0	85.0	19	95.5
Miscellaneous Chemicals	22	86.4	86.4	81.8	19	94.7
Petroleum Products	23	60.9	34.8	26.1	8	75.0
Coal Products	6	66.7	33.3	16.7	2	50.0
Rubber	40	75.0	52.5	35.0	21	63.7
Leather	26	53.9	38.5	26.9	10	70.0
Stone, Clay, and Glass	84	72.6	48.8	39.3	41	60.5
Primary Metal	42	57.1	26.2	19.1	11	72.7
Fabricated Metal	326	67.2	46.9	32.1	153	47.1
Machinery except Electrical	157	86.6	73.3	38.2	116	81.7
Communication Equipment	23	91.3	73.9	60.9	17	82.4
Other Electrical Machinery	46	87.0	76.1	63.0	35	82.9
Motor Vehicles and Parts	28	57.7	46.2	19.2	12	41.7
Aircraft and Parts	18	50.0	44.4	10.7	8	37.5
Other Transportation Equipment	14	64.3	50.0	2.4	7	42.9
Laboratory Instruments	4	100.0	100.0	75.0	4	75.0
Mechanical Instruments	14	100.0	71.4	42.9	10	60.0
Other Professional, Scientific, and Controlling Instruments	23	91.3	82.6	73.9	19	89.5
Other Manufacturing	133	72.2	49.6	33.8	66	63.2
All Firms with 100-500 Employees	1,725	67.4%	46.7%	29.6%	806	63.5%

Source: 4,800-Company Survey.

Table II-4. PREVALENCE OF RESEARCH IN FIRMS WITH 500-2,000 EMPLOYEES 1955

Industry	Total Number of Respondent Firms	Percentages of Total Number of Respondent Firms for Each Industry			Number	% Maintaining a Research Organization
		Those Spending Some Money for Research	Those Spending More than \$5,000 for Research	Those Maintaining Research Organizations		
Ordnance and Accessories	11	100.0%	100.0%	72.7%	11	72.7%
Beverages	10	40.0	40.0	20.0	4	50.0
Food and Kindred Products except Beverages	44	79.6	68.2	54.6	30	90.0
Tobacco	2	0.0	0.0	0.0	0	—
Textile and Apparel	59	55.9	45.8	35.6	27	77.8
Lumber and Wood Products	25	76.0	56.0	36.0	14	64.0
Furniture	15	66.7	53.3	25.7	8	50.0
Paper and Allied Products	31	93.6	90.3	64.5	28	71.4
Printing and Publishing	18	83.3	66.7	50.0	12	75.0
Industrial Chemicals	16	100.0	100.0	100.0	16	100.0
Drugs	8	87.5	87.5	87.5	7	100.0
Soaps	2	100.0	100.0	100.0	2	100.0
Paints	4	100.0	100.0	100.0	4	100.0
Miscellaneous Chemicals	18	100.0	100.0	83.3	18	83.3
Petroleum Products	10	90.0	70.0	60.0	7	85.7
Coal Products	4	75.0	50.0	25.0	2	50.0
Rubber	20	96.0	90.0	75.0	18	84.3
Leather	7	57.1	42.9	42.9	3	100.0
Stone, Clay, and Glass	30	93.3	86.7	70.0	28	80.8
Primary Metal	12	100.0	83.3	66.7	10	80.0
Fabricated Metal	103	89.3	83.5	60.2	86	72.1
Machinery except Electrical	63	98.4	96.8	76.2	61	78.7
Communication Equipment	17	100.0	88.2	88.2	15	100.0
Other Electrical Machinery	24	95.8	95.8	79.2	23	82.5
Motor Vehicles and Parts	15	96.7	80.0	66.7	12	83.3
Aircraft and Parts	6	83.3	83.3	83.3	5	100.0
Other Transportation Equipment	6	83.3	50.0	15.7	3	33.3
Laboratory Instruments	1	100.0	100.0	100.0	1	100.0
Mechanical Instruments	4	100.0	100.0	100.0	4	100.0
Other Professional, Scientific, and Controlling Instruments	15	100.0	100.0	80.0	13	80.0
Other Manufacturing	54	90.7	88.9	81.5	43	91.7
All Firms with 500-2,000 Employees	854	88.1%	79.5%	83.6%	520	80.0%

Source: 4,900-Company Survey.

Table II-5. PREVALENCE OF RESEARCH IN FIRMS WITH 2,000-5,000 EMPLOYEES: 1952

Industry	Total Number of Respondent Firms	Percentages of Total Number of Respondent Firms for Each Industry			Number	% Maintaining a Research Organization
		Those Spending Some Money for Research	Those Spending More than \$5,000 for Research	Those Maintaining Research Organizations		
Ordnance and Accessories	1	100.0%	100.0%	100.0%	1	100.0%
Beverages	3	100.0	100.0	66.7	3	66.7
Food and Kindred Products except Beverages	12	91.7	83.3	83.3	10	100.0
Tobacco	3	100.0	66.7	66.7	2	100.0
Textile and Apparel	20	85.0	85.0	75.0	17	85.2
Lumber and Wood Products	5	100.0	100.0	80.0	5	80.0
Furniture	3	100.0	100.0	0.0	3	0.0
Paper and Allied Products	5	100.0	100.0	100.0	5	100.0
Printing and Publishing	5	80.0	80.0	60.0	4	75.0
Industrial Chemicals	11	100.0	100.0	100.0	11	100.0
Drugs	1	100.0	100.0	100.0	1	100.0
Soaps	0	—	—	—	0	—
Paints	0	—	—	—	0	—
Miscellaneous Chemicals	1	100.0	100.0	100.0	1	100.0
Petroleum Products	3	100.0	100.0	100.0	3	100.0
Coal Products	2	50.0	50.0	50.0	1	100.0
Rubber	2	100.0	100.0	100.0	2	100.0
Leather	2	100.0	100.0	100.0	2	100.0
Stone, Clay, and Glass	4	100.0	100.0	100.0	4	100.0
Primary Metal	12	100.0	100.0	75.0	12	75.0
Fabricated Metal	26	100.0	100.0	84.6	26	84.6
Machinery except Electrical	22	100.0	100.0	95.5	22	95.5
Communication Equipment	4	100.0	100.0	50.0	4	50.0
Other Electrical Machinery	14	100.0	100.0	100.0	14	100.0
Motor Vehicles and Parts	9	77.8	77.8	66.7	7	85.7
Aircraft and Parts	4	100.0	100.0	75.0	4	75.0
Other Transportation Equipment	5	100.0	80.0	80.0	4	100.0
Laboratory Instruments	1	100.0	100.0	100.0	1	100.0
Mechanical Instruments	3	100.0	100.0	100.0	3	100.0
Other Professional, Scientific, and Controlling Instruments	3	66.7	66.7	66.7	2	100.0
Other Manufacturing	14	92.9	92.9	85.7	13	92.3
All Firms with 2,000-5,000 Employees	200	95.0%	93.5%	83.0%	187	88.8%

Source: 4,800-Company Survey

Table II-4. PREVALENCE OF RESEARCH IN FIRMS WITH 5,000 EMPLOYEES OR MORE: 1952

Industry	Total Number of Respondent Firms	Percentages of Total Number of Respondent Firms for Each Industry			Number	% Maintaining a Research Organization
		Those Spending Some Money for Research	Those Spending More than \$5,000 for Research	Those Maintaining Research Organizations		
Ordnance and Accessories	4	100.0%	100.0%	100.0%	4	100.0%
Beverages	2	100.0	100.0	100.0	2	100.0
Food and Kindred Products except Beverages	18	100.0	94.4	83.9	17	94.1
Tobacco	4	100.0	100.0	100.0	4	100.0
Textile and Apparel	14	100.0	100.0	100.0	14	100.0
Lumber and Wood Products	1	100.0	100.0	100.0	1	100.0
Furniture	2	100.0	100.0	100.0	2	100.0
Paper and Allied Products	11	100.0	100.0	100.0	11	100.0
Printing and Publishing	1	100.0	100.0	100.0	1	100.0
Industrial Chemicals	12	100.0	100.0	100.0	12	100.0
Drugs	2	100.0	100.0	100.0	2	100.0
Soaps	0	—	—	—	0	—
Paints	0	—	—	—	0	—
Miscellaneous Chemicals	0	—	—	—	0	—
Petroleum Products	17	100.0	100.0	94.1	17	94.1
Coal Products	5	100.0	100.0	40.0	5	40.0
Rubber	6	100.0	100.0	100.0	6	100.0
Leather	1	100.0	100.0	100.0	1	100.0
Stone, Clay, and Glass	4	100.0	100.0	100.0	4	100.0
Primary Metal	13	93.8	93.8	81.3	13	86.7
Fabricated Metal	20	100.0	100.0	95.0	20	95.0
Machinery except Electrical	13	100.0	84.6	76.9	11	90.9
Communication Equipment	9	100.0	100.0	100.0	9	100.0
Other Electrical Machinery	9	100.0	100.0	100.0	9	100.0
Motor Vehicles and Parts	6	100.0	100.0	100.0	6	100.0
Aircraft and Parts	10	100.0	100.0	80.0	10	80.0
Other Transportation Equipment	6	100.0	100.0	83.3	6	83.3
Laboratory Instruments	1	100.0	100.0	100.0	1	100.0
Mechanical Instruments	0	—	—	—	0	—
Other Professional, Scientific, and Controlling Instruments	1	100.0	100.0	100.0	1	100.0
Other Manufacturing	8	100.0	100.0	100.0	8	100.0
All Firms with 5,000 Employees or More	203	99.5%	98.0%	92.1%	199	94.0%

Source: 4,800-Company Survey.

Table II-7. DISTRIBUTION BY MAJOR INDUSTRY DIVISIONS OF RESPONDENTS SPENDING MORE THAN \$5,000 FOR RESEARCH AND/OR MAINTAINING RESEARCH ORGANIZATIONS: 1952

Industry	Firms Spending More than \$5,000		Firms Maintaining Research Organizations	
	Number	Percentage of Total	Number	Percentage of Total Research Organizations
Process Industries:	(876)	(42.0%)	(687)	(46.4%)
Coal Products	11	0.5	5	0.3
Primary Metal	54	2.6	39	2.6
Lumber and Wood Products	52	2.5	24	1.6
Paper and Allied Products	90	4.3	75	5.1
Leather	16	0.8	13	0.9
Tobacco	7	0.3	6	0.4
Food and Kindred Products except Beverages	101	4.9	80	5.4
Beverages	19	0.9	12	0.8
Textile and Apparel	104	5.0	71	4.8
Stone, Clay, and Glass	90	4.3	69	4.7
Industrial Chemicals	87	4.2	80	5.4
Drugs	32	1.5	30	2.0
Soaps	11	0.5	10	0.7
Paints	42	2.0	39	2.6
Miscellaneous Chemicals	61	2.8	54	3.7
Petroleum Products	42	2.0	35	2.4
Rubber	57	2.8	44	3.0
Fabricated Products:	(406)	(19.5)	(233)	(15.7)
Furniture	34	1.6	14	0.9
Fabricated Metal	337	16.2	195	13.2
Ordinance and Accessories	35	1.7	24	1.6
Machinery:	(418)	(20.1)	(280)	(18.9)
Machinery except Electrical	281	13.5	159	10.7
Communication Equipment	49	2.4	44	3.0
Other Electrical Machinery	88	4.2	77	5.2
Transportation Equipment:	(95)	(4.5)	(85)	(4.4)
Aircraft and Parts	30	1.4	20	1.4
Motor Vehicles and Parts	40	1.9	28	1.8
Other Transportation Equipment	25	1.2	17	1.1
Instruments:	(91)	(4.4)	(71)	(4.8)
Mechanical Instruments	29	1.4	23	1.5
Laboratory Instruments	13	0.6	10	0.7
Other Professional, Scientific, and Controlling Instruments	49	2.4	38	2.6
Other:	(198)	(2.5)	(145)	(9.8)
Printing and Publishing	33	1.6	20	1.4
Miscellaneous Manufacturing	165	7.9	125	3.4
All Firms	2,084	100.0%	1,481	100.0%

Source: 4,800-Company Survey.

Table II-3. INDUSTRIES RANKED BY PERCENTAGE OF RESPONDENTS MAINTAINING
RESEARCH ORGANIZATIONS: 1952

Industry	All Firms			Number of Company Employees		
	Total Number of Respondent Firms	Percentage of Respondents with Research Organizations	Rank*	Total Number of Respondent Firms	Percentage of Respondents with Research Organizations	Rank*
Industrial Chemicals	117	68.4%	1	45	35.6%	6
Communication Equipment	85	67.7	2	12	33.3	7
Paints	58	67.2	3	34	52.9	1
Laboratory Instruments	15	66.7	4	8	50.0	2
Miscellaneous Chemicals	85	63.5	5	44	45.5	4
Other Professional, Scientific, and Controlling Instruments	62	61.3	6	20	30.0	8
Other Electrical Machinery	128	60.2	7	35	17.1	12
Drugs	54	55.6	8	22	27.3	9
Mechanical Instruments	42	54.8	9	21	47.6	3
Ordnance and Accessories	45	53.3	10	9	0.0	27-30
Soaps	19	52.6	11	11	36.4	5
Tobacco	12	50.0	12	6		
Rubber	108	40.7	13	40	17.5	11
Petroleum Products	90	40.0	14	37	13.5	13
Paper and Allied Products	192	39.1	15	66	6.1	19
Other Transportation Equipment	46	37.0	16	15	26.7	10
Motor Vehicles and Parts	81	34.6	17	25	4.0	23
Aircraft and Parts	58	34.5	18	20	5.0	22
Machinery except Electrical	462	34.4	19	207	9.7	14
Stone, Clay, and Glass	215	32.1	20	93	7.5	17
Primary Metal	125	31.2	21	43	2.3	24
Other Manufacturing	453	27.6	22	244	6.6	18
Food and Kindred Products except Beverages	306	26.1	23	121	8.3	16
Leather	54	24.1	24	18	0.0	27-30
Textile and Apparel	307	23.1	25-26	77	6.2	21
Fabricated Metal	843	23.1	25-26	368	5.4	20
Coal Products	24	20.8	27	7	0.0	27-30
Beverages	79	15.2	28	42	9.5	15
Furniture	127	11.0	29-30	36	6.0	27-30
Printing and Publishing	182	11.0	29-30	102	2.0	25
Lumber and Wood Products	308	7.8	31	158	0.6	26
All Firms	4,762	31.1%	—	1,960	10.2%	—

* The industry with the highest percentage in each column is assigned the rank of 1; the next highest, the rank of 2; and so on. In those cases where more than one industry had the same percentage, the series of tied numbers is shown for each industry.

Source: 4800-Company Survey.

Table II-8. INDUSTRIES RANKED BY PERCENTAGE OF RESPONDENTS MAINTAINING
RESEARCH ORGANIZATIONS: 1952 (Continued)

Industry	Number of Company Employees			
	100 — 500		500 — 2,000	
	Total Number of Respondent Firms	Percentage of Respondents with Research Organizations	Total Number of Respondent Firms	Percentage of Respondents with Research Organizations
Industrial Chemicals	33	75.8%	16	100.0%
Communication Equipment	23	60.9	17	88.2
Paints	20	85.0	4	100.0
Laboratory Instruments	4	75.0	1	100.0
Miscellaneous Chemicals	22	81.8	18	83.3
Other Professional, Scientific, and Controlling Instruments	23	73.9	15	80.0
Other Electrical Machinery	46	63.0	24	79.2
Drugs	21	66.7	8	87.5
Mechanical Instruments	14	42.9	4	100.0
Ordnance and Accessories	20	55.0	11	72.7
Soaps	6	66.7	2	100.0
Tobacco	3	0.0	2	6.7
Rubber	40	35.0	20	75.0
Petroleum Products	23	26.1	10	60.0
Paper and Allied Products	79	44.3	31	64.5
Other Transportation Equipment	14	21.4	6	16.7
Motor Vehicles and Parts	26	19.2	15	66.7
Aircraft and Parts	18	16.7	6	33.3
Machinery except Electrical	157	38.2	63	16.2
Stone, Clay, and Glass	84	39.3	30	70.0
Primary Metal	42	19.1	12	66.7
Other Manufacturing	133	33.8	54	81.5
Food and Kindred Products except Beverages	111	18.0	44	54.6
Leather	26	26.9	7	42.9
Textile and Apparel	137	12.4	59	35.6
Fabricated Metal	326	22.1	103	60.2
Coal Products	6	16.7	4	25.0
Beverages	22	9.1	10	27.0
Furniture	71	11.3	15	26.7
Printing and Publishing	56	8.9	18	50.0
Lumber and Wood Products	119	7.6	25	36.0
All Firms	1,725	29.6%	654	63.6%

* The industry with the highest percentage in each column is assigned the rank of 1; the next highest, the rank of 2; and so on. In those cases where more than one industry had the same percentage, the series of tied numbers is shown for each industry.

Source: 4,800-Company Survey.

Table II-8. INDUSTRIES RANKED BY PERCENTAGE OF RESPONDENTS MAINTAINING
RESEARCH ORGANIZATIONS: 1952 (Concluded)

Industry	Number of Company Employees			
	Total Number of Respondent Firms	2,000—5,000 Percentage of Respondents with Research Organizations	Rank*	Total Number of Respondent Firms
Industrial Chemicals	11	100.0%	1-12	12
Communication Equipment	4	50.0	27-28	9
Paints	0			0
Laboratory Instruments	1	100.0	1-12	1
Miscellaneous Chemicals	1	100.0	1-12	0
Other Professional, Scientific, and Controlling Instruments	3	66.7	22-25	1
Other Electrical Machinery	14	100.0	1-12	9
Drugs	1	100.0	1-12	2
Mechanical Instruments	3	100.0	1-12	0
Ordinance and Accessories	1	100.0	1-12	4
Soaps	0			0
Tobacco	3	66.7	22-25	4
Rubber	2	100.0	1-12	6
Petroleum Products	3	100.0	1-12	17
Paper and Allied Products	5	100.0	1-12	11
Other Transportation Equipment	5	80.0	17-18	6
Motor Vehicles and Parts	9	66.7	22-25	6
Aircraft and Parts	4	75.0	19-21	10
Machinery except Electrical	22	95.5	13	13
Stone, Clay, and Glass	4	100.0	1-12	4
Primary Metal	12	75.0	19-21	16
Other Manufacturing	14	85.7	14	8
Food and Kindred Products except Beverages	12	83.3	16	18
Leather	2	100.0	1-12	7
Textile and Apparel	20	75.0	19-21	14
Fabricated Metal	28	84.6	15	29
Coal Products	2	50.0	27-28	5
Beverages	3	66.7	22-25	2
Furniture	3	0.0	29	2
Printing and Publishing	5	60.0	26	1
Lumber and Wood Products	5	80.0	17-18	1
All Firms	200	83.0%	—	203

* The industry with the highest percentage in each column is assigned the rank of 1; the next highest, the rank of 2; and so on. In those cases where more than one industry had the same percentage, the series of tied numbers is shown for each industry.

Source: 4,800-Company Survey.

Table 11-9. DEGREE OF CONCENTRATION OF RESEARCH ORGANIZATIONS: 1952

Industry	Total Number of Respondent Firms	Number of Respondents Maintaining Research Organizations	Percentage of Research Organizations in:		
			the 5% Largest Firms	the 10% Largest Firms	the 20% Largest Firms
Industrial Chemicals	117	89	7.5%	15.9%	28.8%
Communication Equipment	65	44	6.8	15.9	25.0
Paints	58	39	7.7	15.4	30.8
Laboratory Instruments	15	10	10.0	20.0	30.0
Miscellaneous Chemicals	85	54	5.6	13.9	27.8
Other Professional, Scientific, and Controlling Instruments	62	38	7.9	13.2	26.3
Other Electrical Machinery	128	77	7.3	16.9	31.2
Drugs	54	30	10.0	16.7	33.3
Mechanical Instruments	42	23	8.7	17.4	30.4
Ordnance and Accessories	45	24	12.5	20.8	33.3
Soaps	19	10	10.0	20.0	30.0
Tobacco	12	6	18.7	16.7	33.3
Rubber	108	44	11.1	22.7	40.9
Petroleum Products	90	36	13.9	25.0	47.2
Paper and Allied Products	157	75	13.3	24.0	45.3
Other Transportation Equipment	46	17	11.8	23.5	47.1
Motor Vehicles and Parts	51	28	13.3	28.6	45.4
Aircraft and Parts	58	26	15.0	25.9	45.0
Machinery except Electrical	462	159	13.8	27.0	49.1
Stone, Clay, and Glass	255	69	15.9	27.5	46.4
Primary Metal	125	39	10.3	28.2	53.9
Other Manufacturing	453	125	15.2	30.1	58.1
Food and Kindred Products except Beverages	306	80	18.8	35.0	56.3
Leather	54	13	23.1	30.8	61.5
Textile and Apparel	307	71	21.1	36.5	62.0
Fabricated Metal	843	195	19.0	33.9	56.4
Coal Products	24	5	20.0	40.0	40.0
Beverages	79	12	25.0	41.7	41.7
Furniture	127	14	14.3	21.1	54.0
Printing and Publishing	182	20	25.0	55.0	70.0
Lumber and Wood Products	508	24	27.5	58.3	83.3
All Firms	4,762	1,481	14.7%	27.6%	54.9%

Note: Industries are listed here in the same order as in Table 11-8.

Within each industry, firms were ranked by size (number of employees) from largest to smallest. The number of respondents representing the largest 5%, largest 10%, and largest 20% of the respective industries were computed, and then the number of research organizations reported by the firms in each of these groups was expressed as a percentage of the total number of firms maintaining research organizations in the respective industry.

Source: 4,800-Company Survey.

CHAPTER III

THE 1,450-COMPANY SURVEY

This chapter presents part of the results of a survey conducted in the summer of 1952 by the U. S. Bureau of Labor Statistics and the Research and Development Board of the Department of Defense.¹ The data presented here are limited to an analysis of the responses of approximately 1,450 manufacturing companies to those questions that pertained directly to research spending in 1951. A full report, titled "Scientific Research and Development in American Industry," is being prepared by BLS and RDB.

Description of the Survey

The objective of this survey was to obtain responses from all companies with research organizations. The mailing list included the 2,845 companies listed in the National Research Council's "Industrial Research Laboratories of the United States" (ninth edition, 1950), and additional firms taken from lists of: 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.

Approximately 3,000 replies were received. Of these, 1,953 were usable, the remainder consisting of companies that either reported they did no research or were unwilling to disclose the information requested. Of the 1,953 usable responses, approximately 400 were from nonmanufacturing companies, principally consulting research organizations, and another 100 did not furnish data on the items in which we were interested. The data presented in this chapter are therefore based on the usable returns of approximately 1,450 manufacturing companies.

The tabulations on which the tables shown herein are based were prepared for us by the

U. S. Bureau of Labor Statistics. Since respondents were promised that individual replies would be kept in strict confidence by the Research and Development Board, we did not examine the actual returns.

Those pages of the questionnaire from which the data presented in this chapter were obtained are shown in Appendix B. The complete questionnaire contained, in addition, a two-page list of research "specialties," and companies were asked to check those in which they were qualified to do work. In order to increase the likelihood of response, definitions were kept brief enough so that they could be included on the schedule itself, usually as a part of the question being asked.

Differences between the 1,450-Company and 191-Company Surveys

The reader is again cautioned against attempting to make direct comparisons between the data presented in this chapter and data from the 191-Company Survey to be presented in Chapter IV. Although some of these data may superficially appear to report the same kind of information, there are important differences in the definitions used in, and the coverage of, the two surveys. The reader should therefore use the data from each survey in accordance with the definitions applicable to that survey. Some of the major differences are described briefly below.

Research Done for the Company by Others

Respondents in the 1,450-Company Survey were instructed to report only the cost of the research that was carried on *within the company*, whereas in the 191-Company Survey respondents were asked to report, in addition to the amount spent within the company, the money spent to support research in commercial research laboratories, universities, and other outside research organizations. Since many firms do support research carried on *outside* their company, the figures for company financed research

¹ Although the Research and Development Board has been abolished and its functions transferred to the Office of the Secretary of Defense (R & D), the work described herein occurred before the date of the change, July 1, 1953.

reported by many firms in the 1,450-Company Survey did not include *all* company funds committed to research.

Research vs. Nonresearch Activity

The definition used in the 1,450-Company Survey, while concise and embodying the major elements of the detailed definition of research included in the 191-Company Survey, necessarily left to the judgment of the individual respondent decisions as to whether certain kinds of borderline activity should be considered as being research. Examples of these borderline activities are pilot-plant operations, engineering and drafting work, geophysical and geological explorations, work in connection with patent litigation, and the development of manufacture of new tools and equipment. Both surveys intended that research done in departments outside the formal research organization be included, but in the 1,450-Company Survey this type of research was not specifically mentioned, whereas in the 191-Company Survey, space was provided for entering the amount of such research. Similarly, both surveys intended that nonresearch activities carried on by research organizations (such as technical services provided to sales and production organizations) be excluded from the definition of research, but in one case this topic was covered by a single sentence whereas in the other several paragraphs were devoted to it. It may well be, therefore, that a given respondent included certain activities as research in his answer to one survey and excluded them from the other.

Cost of Research

In the 1,450-Company Survey, the definition of "cost of research" was: "the cost of direct labor and materials plus the proportionate share of overhead costs—administration, maintenance, rent, depreciation, etc." Decisions as to the character and amount of specific expenditures that were to be included within this definition of cost were left to the judgment of the individual respondents. The instructions for the 191-Company Survey individually identified and defined the specific expense elements that were to be included in the cost of research, and respondents were requested to adjust the figures taken from their accounting records in accordance with detailed instructions given.

Based on our experience with accounting information generally, and on discussions about this specific matter with persons in industrial companies, we believe that companies tend not to include all the overhead elements that are part of the total cost of research unless each of the elements to be included is named and defined. For this reason, we believe that the cost of research in a given company would tend to be reported at a lower figure on the 1,450-Company Survey than on the 191-Company Survey, even if "research" were defined identically in both cases. We have not attempted to support this belief statistically nor to estimate the magnitude of this difference.

Research Done for the Government

In both surveys respondents were requested to indicate what portion of the cost of research done within the company was incurred to carry on government research. The question of how much of a firm's research is done "for the government" is subject to different interpretations. Many companies, for example, undertake research that, while not specifically contracted for and paid for by the government, does benefit the government. This kind of a situation arises especially in cases where firms contract to produce specific end items for the government and spend money for research as a prerequisite to the production of these items.

In the 1,450-Company Survey, companies were asked: "how much of this total operating cost [of research activity] was for research . . . performed on prime contracts from the federal government [and] subcontracts from other companies for work for the federal government?" Respondents in the 191-Company Survey, on the other hand, were asked to consider as government research *only* that part of the research done within the company undertaken as a result of (1) contracts to carry on specific research projects for government agencies, either as a prime or subcontractor, and (2) contracts with government agencies for the production of specific end items where the terms of the overall contract explicitly required a defined research project as part of the contract. Thus, in the 191-Company Survey all research expenditures which were recovered by the sale of the company's products, as opposed to recovery through direct reimbursement, were treated as company research and were

therefore not included in the cost of research done for the government.

It seems reasonable to assume that respondents to the 1,450-Company Survey would have included as government research, as a minimum, all the research so defined in the 191-Company Survey, and may have included, in addition, other research done in the company, especially research done at management's discretion on end products sold to the government. Thus, the data on government support of research in the 191-Company Survey probably understates the total amount of financial support received directly and indirectly from the government.

Difference between the "Consolidated" and the "Unconsolidated" Company

In the 1,450-Company Survey, the reporting unit was the corporation, and each corporation in a "family" of companies was requested to submit a separate report. The 191-Company Survey requested that data be furnished for the consolidated corporation, including all subsidiaries. We made tests of data supplied by a few companies to find out whether this difference in concept affected only the magnitudes of the data reported or whether it also affected the ratios in which we were primarily interested. In the few cases examined, there was a significant effect on the ratios. The reason for this is, we believe, that a multicompany firm often operates a central research laboratory that serves the several separate corporations making up the firm. In this situation, the ratio of research cost to sales would be higher in the company that operated the central laboratory and lower in the other companies in the firm, as compared with the ratio of research cost to sales for the consolidated corporation.

Coverage

The much broader coverage of the 1,450-Company Survey obviously means that each ratio or other figure reported therein is based on information obtained from many more companies than was the case with the corresponding figure in the 191-Company Survey. The figures reported in the 1,450-Company Survey are therefore less influenced by the report of any one company than figures reported in the 191-Company Survey. Further, data from the 1,450-Company Survey tend to reflect research in general, while data

from the 191-Company Survey tend to reflect the experience of the companies doing the most research in each industry.

In summary, the data from the two surveys are only superficially alike, and the reader should consider carefully the definitions, concepts, and coverage of the particular survey to which he chooses to refer.

Summary of the Findings of 1,450-Company Survey

Since the findings of the 1,450-Company Survey are being fully described in the BLS-RDB report, only brief mention of them will be made here. All figures are for 1951.

Cost of Research

The median² figure for the cost of research done within the company (including that done for the government, but excluding research done for the company by others) as a percentage of total sales was 2.0%, with half the companies reporting figures between 0.8% and 5.6% (see Table III-1). The variation among the medians of the different industry groups was considerable, from a low figure of 0.2% for the leather industry to a high of 10.0% for scientific instruments companies. The individual industry categories also indicated a wide range for the middle 50% of the respondents, thus pointing up the fact that within industries there were considerable differences in policy regarding the amount of sales revenue to be allocated to research spending.

There was a distinct tendency for the percentage of research spending to sales to be higher in small companies than it was in large companies. In companies with less than 500 employees, the median figure for research spending was 4.0% of sales; in those with 500-5,000 employees, the median figure was 1.3%, and for firms with 5,000 or more employees, it was 0.8%. This trend was generally observed for most industry categories, with the most striking exception occurring in the aircraft industry, where the figure was 4.1% of sales in the smallest size firms, 5.9% in the medium-size ones, and 11.0% in the largest companies.

²The median is the middle figure when the data are arrayed from lowest to highest.

Company Financed Research

The median firm reported that the amount of its own funds that it spent on research was 0.9% of net sales. The range for the middle 50% of the respondents was from 0.2% to 2.4%. Again, there was a considerable variation among the medians for the several industries.

The median aircraft company and the median manufacturer of other transportation equipment reported *no* company financed research, and 0.2% or less was reported for the food industry, the lumber and wood products industry, and the leather industry. At the other extreme was the drug industry, where the median was 3.1% of sales. The same pattern of spending in relation to size was present in these figures as that already noted in the figures for over-all research spending. The median company with less than 500 employees spent 1.4% of sales for company financed research done within the company; for the group with 500–5,000 employees, the median was 0.7%; and for 5,000 employees or more, it was 0.5%.

Government Financed Research

In the median company the cost of research financed by the federal government accounted for 9.2% of the total cost of research done within the company. This figure, being a median, does not indicate the over-all magnitude of government support for industrial research, however. The mean, or average, figure for all manufacturing companies was 46.4% of total research. A further indication of the unreliability of the median is the fact that the middle range (the range of figures reported by the middle 50% of the respondents) was extremely wide: from zero to 66.4%. There was a considerable difference among industries. In 11 of the 28 industry groups at least half the firms reported *no* research financed by the federal government; on the other hand, for three industry groups, at least half the firms reported that *all* research cost was financed by the federal government; and at least 25% of the firms in three additional industry groups reported that all their research was financed by the government.

Analysis of ratios of government financed research by size of company also showed considerable variation, with the median firm in the small-

est size group reporting that 20% of its research cost was so financed, the median medium-size firm reporting 6.2%, and the median large firm only 1.7%. Here again, however, the middle-range figures were so wide as to indicate that the medians have little significance.

Cost per Research Employee

In 1951 the median firm spent \$7,000 to support each research worker on its staff, or \$14,000 for each professional technical person. The cost per employee tended to be somewhat higher in the larger companies. For example, for firms employing less than 15 professional technical persons, and those employing 15 to 50 professional technical persons, the cost per research worker was \$7,000, whereas for the two groups with 50–125 and 125 or more professional technical persons, the median figure was \$8,000. Similarly, the median figure for cost per professional technical person was \$13,000 for the smallest organizations, \$14,000 for the two middle groups (15–50 and 50–125 professional technical persons), and it jumped to \$20,000 for the group with 125 or more professional technical persons.

Industry-wise, the variation was not large. For cost per research worker, the only industry with a median figure as low as \$5,000 was leather; for paints, the figure was \$6,000; and 14 of the 28 industry groups reported the median was \$7,000. The highest amount, \$10,000, was reported for the "other transportation and equipment" industry. The median industry figures for cost per professional technical person showed slightly larger variation; the lowest figure of \$8,000 was reported for lumber and wood products; for 6 of the 28 industry groups the median was \$14,000; and the highest figure of \$29,000 was reported for aircraft and parts.

In summary, therefore, it may be observed that although the variation from company to company and industry to industry was large, spending for research, including research for the government, typically amounted to 2.0% of sales; excluding government research, it was 0.9%. There was considerably less variation among companies and among industries in the amount required to support each research worker or each professional technical person on the staff,

with the medians for these items being \$7,000 and \$14,000, respectively.

Use of the Tables

Statistical Measures

The statistical measures used in these tables are median and middle range figures, based on ratios computed for each respondent in the group individually. Such measures give equal weight to each firm regardless of its size. The *median* is the middle figure in an array listed in order from lowest to highest. The *middle range* is the range of the middle 50% of the respondents reporting the item; therefore one-fourth of the respondents had lower figures than the lower limit of the middle range, and another one-fourth had higher figures than the upper limit. The median indicates the typical situation; the middle range is an indication of how far the respondents deviate from the median. In general, the smaller the middle range, the more the median represents the group as a whole.

Cost of Research

Tables III-1 and III-2 deal with different aspects of the cost of research as a percentage of net sales. Table III-1 presents the cost of *all* research done within the company, both company financed and government financed; and Table III-2 presents the cost of company financed research done within the company, excluding the amount of research supported in outside laboratories.

Government Research

Median figures for government research as a

percentage of total research are presented in Table III-3.

Since the figures in Tables III-1, III-2, and III-3 are medians, and each company is treated separately, figures in the three tables cannot be related to one another; that is, 100 minus the percentage for government research multiplied by the figures in Table III-1 will *not* produce the figures in Table III-2, or indeed any meaningful figure.

Cost per Research Worker

Table III-4 presents the median cost per research worker. The figure for each respondent was obtained by dividing the total amount spent for research by the total number of persons (professionals and all others) engaged in research, including both those working in the research laboratory and a proportionate share of the overhead personnel who provided service to the laboratory. The number of persons was an average of the number of employees as of January 1951 and of January 1952.

Cost per Professional Technical Person

The term used in the 1,450-Company Survey was "scientists and engineers," but the meaning intended was the same as that intended for the term "professional technical person" as used throughout this bulletin. Figures are shown in Table III-5. The total research cost used is the same as that used in computing the data for Table III-4, and this was divided by the number of scientists and engineers engaged in research and development. The number of persons was the average of the number as of January 1951 and January 1952.

Table III-1. TOTAL COST OF RESEARCH DONE WITHIN THE COMPANY AS A PERCENTAGE OF SALES, 1951

Industry	All Firms			Less than 500 Employees		
	Number of Firms	Median Figures	Middle Range Figures	Number of Firms	Median Figures	Middle Range Figures
Ordnance and Accessories	17	5.0%	2.3% - 33.2%	9	33.2%	3.0% - 35.4%
Food and Kindred Products	64	0.3	0.1 - 0.6	15	1.3	0.2 - 6.2
Tobacco	3	•	•	0	—	—
Textile and Apparel	45	0.6	0.2 - 1.4	11	1.2	0.5 - 2.0
Lumber and Wood Products	9	0.6	0.1 - 1.8	4	•	•
Furniture	3	•	•	1	•	•
Paper and Allied Products	46	0.4	0.2 - 0.7	9	0.6	0.3 - 2.7
Printing and Publishing	9	1.7	0.3 - 4.2	5	2.8	1.7 - 4.2
Industrial Chemicals	81	2.1	1.3 - 5.0	53	2.4	1.0 - 8.9
Drugs	65	3.5	1.7 - 5.8	42	3.6	1.4 - 6.6
Soaps	16	1.7	1.3 - 2.7	9	1.6	1.4 - 4.6
Paints	29	2.1	1.3 - 3.2	21	2.4	1.7 - 3.9
Miscellaneous Chemicals	55	1.8	1.0 - 3.3	37	2.4	1.2 - 4.2
Petroleum Products	41	0.6	0.4 - 1.5	18	1.5	0.6 - 3.9
Coal Products	2	•	•	1	•	•
Rubber	31	1.8	0.8 - 3.5	14	3.3	1.5 - 6.8
Leather	6	0.2	0.1 - 0.2	2	•	•
Stone, Clay, and Glass	33	1.1	0.4 - 2.4	10	2.5	0.4 - 4.0
Primary Metal	39	0.6	0.3 - 1.2	7	5.0	0.9 - 5.4
Fabricated Metal	131	1.4	0.7 - 3.7	57	3.4	1.4 - 10.8
Machinery except Electrical	164	1.5	0.8 - 3.2	64	3.0	1.1 - 6.0
Communication Equipment	95	5.4	2.5 - 13.3	52	7.6	3.1 - 15.9
Other Electrical Machinery	118	3.5	1.6 - 9.1	60	5.2	2.4 - 13.8
Motor Vehicles and Parts	24	1.3	0.4 - 1.9	3	•	•
Aircraft and Parts	60	7.7	3.2 - 18.8	19	4.1	3.2 - 12.5
Railroad Equipment	8	0.4	0.2 - 0.9	0	—	—
Other Transportation Equipment	6	4.0	0.2 - 5.2	2	•	•
Laboratory Instruments	47	10.0	5.5 - 19.2	38	10.4	5.6 - 20.0
Photographic Instruments	22	7.9	4.3 - 20.0	17	20.0	5.0 - 21.7
Other Professional, Scientific, and Controlling Instruments	73	5.2	2.2 - 10.6	50	11.6	3.3 - 22.7
Other Manufacturing	35	3.6	0.7 - 6.2	18	4.6	3.6 - 25.0
All Firms	1,377	2.0%	0.8% - 5.6%	648	4.0%	1.8% - 11.8%

* Insufficient data available to warrant setting figures.

Note: These figures include research done for the government.

Source: 1450-Company Survey.

Table III-1. TOTAL COST OF RESEARCH DONE WITHIN THE COMPANY AS A PERCENTAGE OF SALES: 1951 (Concluded)

Industry	500-5,000 Employees			5,000 Employees or More		
	Number of Firms	Median Figures	Middle Range Figures	Number of Firms	Median Figures	Middle Range Figures
Ordnance and Accessories	5	4.0%	3.7% - 10.2%	3	*	*
Food and Kindred Products	32	0.2	0.1 - 0.6	17	6.2%	0.1% - 0.4%
Tobacco	2	*	*	1	*	*
Textile and Apparel	24	0.4	0.2 - 1.0	9	6.3	0.1 - 1.0
Lumber and Wood Products	3	*	*	1	*	*
Furniture	2	*	*	0	*	*
Paper and Allied Products	28	0.4	0.2 - 0.6	9	6.2	0.1 - 0.6
Printing and Publishing	4	*	*	0	*	*
Industrial Chemicals	17	1.8	1.3 - 2.3	10	2.7	1.8 - 4.7
Drugs	16	3.2	1.3 - 4.7	6	3.1	2.0 - 3.8
Soaps	4	*	*	3	*	*
Paints	5	1.5	1.2 - 1.6	3	*	*
Miscellaneous Chemicals	16	1.0	0.9 - 1.6	0	*	*
Petroleum Products	8	0.4	0.3 - 1.3	15	6.5	0.3 - 0.6
Coal Products	0	—	—	1	*	*
Rubber	10	0.8	0.3 - 1.3	4	*	*
Leather	3	*	*	*	*	*
Stone, Clay, and Glass	13	0.6	0.4 - 0.8	8	1.2	0.4 - 1.4
Primary Metal	16	0.6	0.2 - 1.2	13	0.4	0.2 - 0.8
Fabricated Metal	55	1.0	0.5 - 1.8	13	0.4	0.2 - 0.6
Machinery except Electrical	74	1.4	0.7 - 2.2	24	1.0	0.5 - 1.5
Communication Equipment	35	4.1	2.3 - 7.7	7	5.9	2.1 - 5.3
Other Electrical Machinery	52	1.9	1.3 - 4.1	4	*	*
Motor Vehicles and Parts	11	1.3	0.4 - 2.1	9	0.7	0.4 - 1.3
Aircraft and Parts	23	5.9	1.3 - 17.1	17	11.0	7.5 - 18.0
Railroad Equipment	5	0.3	0.3 - 0.9	3	*	*
Other Transportation Equipment	3	*	*	1	*	*
Laboratory Instruments	5	7.9	6.8 - 9.7	2	*	*
Photographic Instruments	4	*	*	1	*	*
Other Professional, Scientific, and Controlling Instruments	20	2.2	1.0 - 4.3	3	*	*
Other Manufacturing	14	0.8	0.4 - 1.4	0	—	—
All Firms	509	1.3%	0.5% - 2.8%	188	0.8%	0.3% - 2.3%

* Insufficient data available to warrant setting figures.

Note: These figures include research done for the government.

Source: 1,459-Company Survey.

Table III-2. COST OF COMPANY FINANCED RESEARCH AS A PERCENTAGE OF SALES, 1951

Industry	All Firms			Less than 500 Employees		
	Number of Firms	Median Figures	Middle Range Figures	Number of Firms	Median Figures	Middle Range Figures
Ordinance and Accessories	17	0.8%	0.0%- 2.1%	9	0.8	0.0%- 2.5%
Food and Kindred Products	69	0.2	0.1 - 0.6	19	0.9	0.0 - 3.0
Tobacco	3	*	*	0		
Textile and Apparel	48	0.4	0.2 - 1.0	13	0.7	0.0 - 1.1
Lumber and Wood Products	10	0.2	0.1 - 1.6	5	0.4	0.3 - 8.7
Furniture	3	*	*	1	*	*
Paper and Allied Products	48	0.4	0.2 - 0.7	11	0.4	0.3 - 1.8
Printing and Publishing	10	0.7	0.0 - 2.2	5	1.4	0.0 - 1.7
Industrial Chemicals	55	2.0	1.0 - 4.5	53	2.1	1.0 - 5.0
Drugs	68	3.1	1.3 - 5.7	44	3.4	1.3 - 6.3
Scaps	16	1.7	0.9 - 2.6	9	1.6	1.3 - 4.4
Paints	31	1.9	1.0 - 2.6	23	2.2	1.3 - 3.5
Miscellaneous Chemicals	57	1.5	1.0 - 3.0	38	2.2	1.1 - 3.2
Petroleum Products	43	0.6	0.4 - 1.3	18	1.4	0.6 - 2.0
Coal Products	2	*	*	1	*	*
Rubber	32	0.8	0.5 - 2.4	14	2.2	0.8 - 2.7
Leather	6	0.1	0.1 - 0.1	2	*	*
Stone, Clay, and Glass	34	0.9	0.4 - 2.3	11	2.3	0.4 - 3.0
Primary Metal	45	0.4	0.0 - 0.9	9	0.9	0.0 - 4.4
Fabricated Metal	142	0.6	0.0 - 1.2	64	0.2	0.0 - 1.6
Machinery except Electrical	175	1.0	0.4 - 2.0	71	1.1	0.2 - 3.1
Communication Equipment	98	1.1	0.0 - 2.9	54	0.5	0.0 - 3.1
Other Electrical Machinery	124	1.1	0.0 - 2.4	64	0.6	0.0 - 3.3
Motor Vehicles and Parts	28	0.6	0.1 - 1.6	4	*	*
Aircraft and Parts	63	0.0	0.0 - 0.7	30	0.0	0.0 - 3.6
Railroad Equipment	8	0.3	0.2 - 0.9	0		
Other Transportation Equipment	7	0.0	0.0 - 0.0	2	*	*
Laboratory Instruments	48	2.7	0.0 - 5.6	39	2.9	0.0 - 5.6
Photographic Instruments	22	0.6	0.0 - 5.0	17	0.0	0.0 - 5.0
Other Professional, Scientific, and Controlling Instruments	75	2.4	0.8 - 5.2	52	2.8	1.4 - 8.0
Other Manufacturing	36	1.0	0.3 - 3.7	19	2.3	0.2 - 4.0
All Firms	1,451	0.9%	0.2%- 2.4%	694	1.4%	0.0%- 4.0%

* Insufficient data available to warrant setting figures.

Note: Companies participating in this survey were requested to limit their report to research done within the company; therefore the cost of research programs carried on for the company by others is not included here. Research done for the government and other outside organizations is also excluded from this table.

Source: 1,450-Company Survey.

Table III-2. COST OF COMPANY FINANCED RESEARCH AS A PERCENTAGE OF SALES: 1951 (Concluded)

Industry	500-5,000 Employees			5,000 Employees or More		
	Number of Firms	Median Figures	Middle Range Figures	Number of Firms	Median Figures	Middle Range Figures
Ordnance and Accessories	5	0.9%	0.0% - 2.1%	3	*	*
Food and Kindred Products	32	0.2	0.1 - 0.6	18	0.2%	0.1% - 0.4%
Tobacco	2	*	*	1	*	*
Textile and Apparel	24	0.2	0.2 - 0.8	9	0.2	0.1 - 1.0
Lumber and Wood Products	3	*	*	1	*	*
Furniture	2	*	*	0	—	—
Paper and Allied Products	28	0.4	0.2 - 0.6	9	0.3	0.1 - 0.6
Printing and Publishing	4	*	*	0	—	—
Industrial Chemicals	18	1.6	1.1 - 2.3	11	2.5	1.7 - 4.3
Drugs	16	3.2	1.3 - 4.6	7	2.4	0.2 - 3.8
Soaps	4	*	*	3	*	*
Paints	5	1.4	0.9 - 1.5	3	*	*
Miscellaneous Chemicals	17	1.0	0.6 - 1.5	0	—	—
Petroleum Products	9	0.4	0.2 - 1.3	16	0.4	0.5 - 0.5
Coal Products	0	—	—	1	*	*
Rubber	11	0.6	0.3 - 0.8	4	*	*
Leather	3	*	*	1	*	*
Stone, Clay, and Glass	13	0.5	0.2 - 0.7	8	1.2	0.4 - 1.4
Primary Metal	19	0.1	0.0 - 0.5	14	0.4	0.2 - 0.5
Fabricated Metal	58	0.8	0.3 - 1.2	13	0.3	0.2 - 0.6
Machinery except Electrical	77	1.0	0.5 - 1.7	25	0.8	0.3 - 1.4
Communication Equipment	36	1.1	0.5 - 2.5	7	1.5	1.2 - 2.6
Other Electrical Machinery	54	1.2	0.5 - 1.7	4	*	*
Motor Vehicles and Parts	11	0.4	0.2 - 1.9	10	0.6	0.0 - 1.1
Aircraft and Parts	25	0.0	0.0 - 0.2	17	0.4	0.0 - 0.7
Railroad Equipment	5	0.3	0.2 - 0.9	3	*	*
Other Transportation Equipment	3	*	*	2	*	*
Laboratory Instruments	5	0.8	0.8 - 6.9	2	*	*
Photographic Instruments	4	*	*	1	*	*
Other Professional, Scientific, and Controlling Instruments	20	1.2	0.5 - 3.5	3	*	*
Other Manufacturing	14	0.6	0.4 - 0.7	0	—	—
All Firms	527	0.7%	0.2% - 1.5%	196	0.5%	0.2% - 1.4%

* Insufficient data to warrant setting figures.

Note: Companies participating in this survey were requested to limit their report to research done within the company; therefore the cost of research programs carried on for the company by others is not included here. Research done for the government and other outside organizations is also excluded from this table.

Source: 1,450-Company Survey.

Table III-3. RESEARCH FINANCED BY FEDERAL GOVERNMENT AS A PERCENTAGE OF ALL RESEARCH
DONE WITHIN THE COMPANY: 1951

Industry	All Firms			Less than 500 Employees		
	Number of Firms	Median Figures	Middle Range Figures	Number of Firms	Median Figures	Middle Range Figures
Ordnance and Accessories	17	94.1%	26.2% - 100.0%	9	97.5%	50.0% - 100.0%
Food and Kindred Products	59	0.0	0.0 - 0.0	14	0.0	0.0 - 0.0
Tobacco	2	*	*	0		
Textile and Apparel	41	0.8	0.0 - 21.9	8	23.0	0.0 - 32.0
Lumber and Wood Products	8	0.0	0.0 - 34.2	4	*	*
Furniture	3	*	*	1	*	*
Paper and Allied Products	43	0.0	0.0 - 2.5	8	0.0	0.0 - 0.0
Printing and Publishing	9	0.0	0.0 - 21.1	5	0.0	0.0 - 21.1
Industrial Chemicals	73	0.0	0.0 - 6.8	46	0.0	0.0 - 6.0
Drugs	62	0.0	0.0 - 0.0	39	0.0	0.0 - 0.0
Soaps	15	0.0	0.0 - 4.4	9	0.0	0.0 - 5.4
Paints	23	7.9	0.0 - 13.4	16	8.1	0.0 - 13.3
Miscellaneous Chemicals	51	0.0	0.0 - 8.1	33	0.0	0.0 - 8.1
Petroleum Products	43	0.0	0.0 - 6.9	20	3.4	0.0 - 13.0
Coal Products	2	*	*	1	*	*
Rubber	30	21.7	4.8 - 37.5	14	31.7	0.0 - 60.0
Leather	7	0.0	0.0 - 0.0	2	*	*
Stone, Clay, and Glass	30	0.0	0.0 - 1.4	9	0.0	0.0 - 0.0
Primary Metal	37	0.4	0.0 - 13.3	6	9.3	0.0 - 18.6
Fabricated Metal	124	24.5	0.0 - 76.3	55	76.2	0.0 - 100.0
Machinery except Electrical	131	2.9	0.0 - 33.3	59	0.0	0.0 - 66.4
Communication Equipment	95	80.0	41.7 - 100.0	51	95.0	50.0 - 100.0
Other Electrical Machinery	113	55.6	2.0 - 100.0	60	70.7	8.3 - 100.0
Motor Vehicles and Parts	23	16.1	1.9 - 28.7	3	*	*
Aircraft and Parts	59	100.0	82.9 - 100.0	18	100.0	42.9 - 100.0
Railroad Equipment	9	24.5	0.0 - 39.1	1	*	*
Other Transportation Equipment	5	100.0	100.0 - 100.0	2	*	*
Laboratory Instruments	48	48.7	0.1 - 98.0	39	50.0	0.0 - 100.0
Photographic Instruments	21	100.0	13.9 - 100.0	16	100.0	100 - 100.0
Other Professional, Scientific, and Controlling Instruments	67	42.9	14.1 - 75.0	45	50.0	14.1 - 80.0
Other Manufacturing	22	9.2	0.0 - 73.3	18	30.0	0.0 - 98.5
All Firms	1,302	9.2%	0.0% - 66.4%	611	20.0%	0.0% - 90.9%

* Insufficient data available to warrant setting figures.

Source: 1,450-Company Survey.

Table III-3. RESEARCH FINANCED BY FEDERAL GOVERNMENT AS A PERCENTAGE OF ALL RESEARCH
DONE WITHIN THE COMPANY: 1951 (Concluded)

Industry	500-5,000 Employees				5,000 Employees or More			
	Number of Firms	Median Figures	Middle Range Figures	Number of Firms	Median Figures	Middle Range Figures	Number of Firms	Median Figures
Ordinance and accessories	5	94.1%	23.5% - 100.0%	3	*	*	3	*
Food and Kindred Products	28	0.0	0.0 - 0.0	16	0.0%	0.0%	16	0.0%
Tobacco	1	*	*	1	*	*	1	*
Textile and Apparel	23	0.0	0.0 - 6.6	9	0.8	0.0 - 19.2	9	0.8
Lumber and Wood Products	2	*	*	1	*	*	1	*
Furniture	2	*	*	0	*	*	0	*
Paper and Allied Products	26	0.0	0.0 - 3.1	9	0.0	0.0 - 2.5	9	0.0
Printing and Publishing	4	*	*	0	*	*	0	*
Industrial Chemicals	17	0.0	0.0 - 1.3	9	2.0	0.0 - 6.8	9	2.0
Drugs	16	0.0	0.0 - 0.0	6	0.0	0.0 - 0.0	6	0.0
Soaps	3	*	*	3	*	*	3	*
Paints	4	*	*	3	*	*	3	*
Miscellaneous Chemicals	15	0.0	0.0 - 0.0	0	*	*	0	*
Petroleum Products	8	0.0	0.0 - 0.0	14	0.8	0.0 - 1.6	14	0.8
Coal Products	0	*	*	1	*	*	1	*
Rubber	9	20.5	8.8 - 25.1	4	*	*	4	*
Leather	3	*	*	1	*	*	1	*
Stone, Clay, and Glass	13	0.0	0.0 - 9.9	7	0.0	0.0 - 0.4	7	0.0
Primary Metal	17	1.3	0.0 - 33.3	11	0.4	0.0 - 0.9	11	0.4
Fabricated Metal	50	14.6	0.0 - 50.0	13	10.2	0.0 - 46.8	13	10.2
Machinery except Electrical	71	4.0	0.0 - 19.3	20	2.9	0.0 - 9.3	20	2.9
Communication Equipment	34	61.7	14.4 - 95.0	7	58.7	38.2 - 58.8	7	58.7
Other Electrical Machinery	48	36.0	0.0 - 80.0	3	*	*	3	*
Motor Vehicles and Parts	10	23.4	8.2 - 28.7	9	2.5	0.9 - 16.1	9	2.5
Aircraft and Parts	23	100.0	90.1 - 100.0	17	95.1	85.9 - 99.1	17	95.1
Railroad Equipment	5	24.5	0.0 - 39.1	3	*	*	3	*
Other Transportation Equipment	3	*	*	0	*	*	0	*
Laboratory Instruments	5	12.5	0.0 - 21.2	2	*	*	2	*
Photographic Instruments	4	*	*	1	*	*	1	*
Other Professional, Scientific, and Controlling Instruments	19	34.0	8.6 - 54.4	2	*	*	2	*
Other Manufacturing	12	2.5	0.0 - 26.7	0	*	*	0	*
All Firms	480	6.2%	0.0% - 50.0%	175	1.7%	0.0% - 26.3%	175	1.7%

* Insufficient data available to warrant setting figures.

Source: 1,450-Company Survey.

Table III-4. COST OF RESEARCH PER EMPLOYEE IN THE RESEARCH ORGANIZATION: 1951

Industry	All Firms			Firms with Less than 15 Professional Technical Persons		
	Number of Firms	Median Figures	Middle Range Figures	Number of Firms	Median Figures	Middle Range Figures
Ordnance and Accessories	17	\$7,000	\$5,000-\$10,000	3	\$7,000	\$5,000-\$10,000
Food and Kindred Products	61	9,000	6,000-10,000	41	9,000	6,000-11,000
Tobacco	3	*	*	3	*	*
Textile and Apparel	45	7,000	5,000-10,000	30	8,000	5,000-10,000
Lumber and Wood Products	6	7,000	6,000-7,000	4	*	*
Furniture	3	*	*	3	*	*
Paper and Allied Products	47	7,000	6,000-9,000	27	7,000	8,000-8,000
Printing and Publishing	8	8,000	6,000-10,000	7	8,000	8,000-10,000
Industrial Chemicals	77	7,000	5,000-8,000	39	7,000	5,000-10,000
Drugs	64	7,000	5,000-9,000	38	6,000	4,000-8,000
Soaps	15	8,000	6,000-9,000	7	7,000	6,000-8,000
Paints	28	6,000	4,000-7,000	16	6,000	4,000-8,000
Miscellaneous Chemicals	54	7,000	5,000-8,000	38	7,000	5,000-8,000
Petroleum Products	43	8,000	6,000-9,000	20	7,000	5,000-10,000
Coal Products	1	*	*	0	—	—
Rubber	30	7,000	5,000-9,000	18	7,000	5,000-9,000
Leather	7	5,000	5,000-5,000	7	5,000	5,000-5,000
Stone, Clay, and Glass	33	7,000	5,000-9,000	23	7,000	5,000-9,000
Primary Metal	39	8,000	6,000-11,000	19	7,000	6,000-11,000
Fabricated Metal	127	7,000	5,000-10,000	80	7,000	5,000-11,000
Machinery except Electrical	160	7,000	5,000-10,000	92	8,000	5,000-12,000
Communication Equipment	93	8,000	5,000-11,000	45	8,000	5,000-11,000
Other Electrical Machinery	116	7,000	5,000-10,000	71	7,000	5,000-10,000
Motor Vehicles and Parts	23	9,000	7,000-11,000	8	10,000	6,000-13,000
Aircraft and Parts	58	9,000	5,000-14,000	24	7,000	5,000-13,000
Railroad Equipment	9	8,000	6,000-16,000	3	*	*
Other Transportation Equipment	6	10,000	7,000-10,000	5	10,000	7,000-10,000
Laboratory Instruments	46	7,000	4,000-8,000	29	7,000	4,000-8,000
Photographic Instruments	20	8,000	6,000-10,000	12	9,000	5,000-11,000
Other Professional, Scientific, and Controlling Instruments	70	7,000	5,000-9,000	42	6,000	4,000-11,000
Other Manufacturing	32	9,000	5,000-12,000	26	9,000	5,000-12,000
All Firms	1,341	\$7,000	\$5,000-\$10,000	783	\$7,000	\$5,000-\$10,000

* Insufficient data available to warrant setting figures.

Note: Number of research workers is the average of those reported as of January 1951 and January 1952.

Source: 1,450-Company Survey.

Table III-4. COST OF RESEARCH PER EMPLOYEE IN THE RESEARCH ORGANIZATION: 1951 (Concluded)

Firms with 15-50 Professional Technical Persons			Firms with 50-125 Professional Technical Persons			Firms with 125 or More Professional Technical Persons		
Number of Firms	Median Figures	Middle Range Figures	Number of Firms	Median Figures	Middle Range Figures	Number of Firms	Median Figures	Middle Range Figures
6	\$8,000	\$5,000- \$10,000	1	*	*	2	*	*
13	9,000	6,000- 9,000	2	*	*	3	*	*
0	—	—	0	—	—	0	—	—
8	6,000	5,000- 9,000	3	*	*	1	*	*
1	*	*	0	—	—	0	—	—
0	—	—	0	—	—	0	—	—
16	7,000	6,000- 8,000	3	*	*	0	—	—
1	*	*	0	—	—	0	—	—
14	6,000	5,000- 7,000	12	\$7,000	\$7,000- \$8,000	8	\$2,000	\$7,000- \$8,000
11	8,000	7,000- 9,000	5	10,000	7,000- 10,000	8	10,000	7,000- 11,000
3	*	*	1	*	*	3	*	*
6	6,000	4,000- 6,000	3	*	*	1	*	*
13	7,000	5,000- 10,000	4	*	*	0	—	—
5	7,000	7,000- 9,000	5	8,000	8,000- 10,000	12	8,000	7,000- 9,000
0	—	—	1	*	*	0	—	—
8	8,000	4,000- 11,000	0	—	—	3	*	*
0	—	—	0	—	—	0	—	—
5	6,000	5,000- 6,000	1	*	*	4	*	*
8	8,000	5,000- 10,000	5	8,000	7,000- 10,000	3	*	*
37	7,000	5,000- 9,000	5	6,000	6,000- 10,000	3	*	*
41	7,000	5,000- 9,000	15	7,000	5,000- 9,000	6	8,000	5,000- 8,000
27	8,000	5,000- 11,000	9	7,000	6,000- 9,000	11	7,000	6,000- 9,000
31	8,000	6,000- 12,000	9	6,000	4,000- 8,000	4	*	*
9	7,000	7,000- 10,000	3	*	*	3	*	*
8	9,000	6,000- 21,000	4	*	*	22	9,000	7,000- 12,000
4	*	*	1	*	*	0	—	—
1	*	*	0	—	—	0	—	—
11	6,000	5,000- 8,000	1	*	*	2	*	*
2	*	*	4	*	*	2	*	*
17	7,000	4,000- 9,000	9	9,000	6,000- 9,000	2	*	*
2	*	*	1	*	*	1	*	*
306	\$7,000	\$5,000- \$9,000	108	\$8,000	\$6,000- \$9,000	104	\$8,000	\$7,000- \$10,000

* Insufficient data available to warrant setting figures.

Table III-5. COST OF RESEARCH PER PROFESSIONAL TECHNICAL PERSON: 1951

Industry	All Firms			Firms with Less than 15 Professional Technical Persons		
	Number of Firms	Median Figures	Middle Range Figures	Number of Firms	Median Figures	Middle Range Figures
Ordinance and Accessories	17	\$14,000	\$7,000- \$20,000	8	\$15,000	\$6,000- \$20,000
Food and Kindred Products	51	15,000	10,000- 20,000	42	15,000	9,000- 21,000
Tobacco	3	*	*	3	*	*
Textile and Apparel	43	14,000	10,000- 21,000	30	13,000	10,000- 20,000
Lumber and Wood Products	6	8,000	6,000- 10,000	5	7,000	6,000- 21,000
Furniture	3	*	*	3	*	*
Paper and Allied Products	46	11,000	8,000- 14,000	27	10,000	8,000- 13,000
Printing and Publishing	8	14,000	12,000- 19,000	7	16,000	13,000- 19,000
Industrial Chemicals	77	11,000	7,000- 16,000	42	9,000	6,000- 15,000
Drugs	67	10,000	7,000- 17,000	43	9,000	6,000- 12,000
Soaps	15	12,000	8,000- 16,000	5	10,000	8,000- 12,000
Paints	26	10,000	7,000- 12,000	16	10,000	8,000- 14,000
Miscellaneous Chemicals	54	10,000	8,000- 17,000	40	10,000	7,000- 15,000
Petroleum Products	44	17,000	13,000- 20,000	22	14,000	10,000- 18,000
Coal Products	2	*	*	1	*	*
Rubber	50	13,000	9,000- 15,000	19	13,000	9,000- 24,000
Leather	7	10,000	8,000- 10,000	7	10,000	8,000- 10,000
Stone, Clay, and Glass	34	14,000	9,000- 20,000	23	17,000	9,000- 19,000
Primary Metal	37	17,000	11,000- 24,000	20	13,000	10,000- 20,000
Fabricated Metal	128	15,000	9,000- 22,000	83	15,000	8,000- 25,000
Machinery except Electrical	157	15,000	10,000- 22,000	95	15,000	8,000- 21,000
Communication Equipment	98	15,000	10,000- 22,000	47	15,000	11,000- 21,000
Other Electrical Machinery	117	16,000	10,000- 23,000	72	15,000	10,000- 26,000
Motor Vehicles and Parts	23	29,000	15,000- 66,000	8	29,000	17,000- 42,000
Aircraft and Parts	60	21,000	15,000- 37,000	25	18,000	13,000- 25,000
Railroad Equipment	8	13,000	9,000- 22,000	3	*	*
Other Transportation Equipment	6	23,000	13,000- 28,000	5	18,000	13,000- 28,000
Laboratory Instruments	43	13,000	8,000- 20,000	29	13,000	8,000- 20,000
Photographic Instruments	22	15,000	7,000- 20,000	13	18,000	5,000- 34,000
Other Professional, Scientific, and Controlling Instruments	72	14,000	5,000- 25,000	44	12,000	7,000- 20,000
Other Manufacturing	34	14,000	10,000- 29,000	30	14,000	10,000- 23,000
All Firms	1,346	\$14,000	\$9,000- \$21,000	820	\$13,000	\$8,000- \$20,000

* Insufficient data available to warrant setting figures.

Note: Number of persons is the average of those reported as of January 1951 and January 1952.

Source: 1,450-Company Survey.

Table III-5. COST OF RESEARCH PER PROFESSIONAL TECHNICAL PERSON: 1951 (Concluded)

Firms with 15-50 Professional Technical Persons			Firms with 50-125 Professional Technical Persons			Firms with 125 or More Professional Technical Persons		
Number of Firms	Median Figures	Middle Range Figures	Number of Firms	Median Figures	Middle Range Figures	Number of Firms	Median Figures	Middle Range Figures
6	\$14,000	\$7,000-\$15,000	1	*	*	2	*	*
14	15,000	12,000-16,000	2	*	*	3	*	*
0	—	—	0	—	—	1	*	*
9	16,000	7,000-19,000	3	*	*	0	—	—
0	—	—	0	—	—	0	—	—
16	13,000	8,000-14,000	0	—	—	0	—	—
1	*	*	3	*	*	0	—	—
14	8,000	7,000-10,000	12	\$11,000	\$10,000-\$16,000	9	\$17,000	\$13,000-\$24,000
11	14,000	10,000-17,000	5	17,000	8,000-17,000	8	18,000	12,000-21,000
3	*	*	1	*	*	3	*	*
6	11,000	10,000-11,000	3	*	*	1	*	*
10	13,000	9,000-24,000	4	*	*	0	—	—
5	14,000	13,000-18,000	5	18,000	13,000-19,000	12	19,000	18,000-21,000
0	—	—	1	*	*	0	—	—
4	14,000	8,000-15,000	0	—	—	3	*	*
0	—	—	0	—	—	0	—	—
5	10,000	8,000-13,000	1	*	*	5	21,000	16,000-23,000
8	13,000	11,000-21,000	6	18,000	17,000-19,000	3	*	*
37	15,000	9,000-20,000	5	10,000	8,000-11,000	3	*	*
41	16,000	10,000-22,000	15	16,000	11,000-20,000	6	21,000	14,000-29,000
28	15,000	11,000-23,000	10	10,000	7,000-14,000	11	26,000	15,000-25,000
22	18,000	6,000-25,000	9	16,000	10,000-28,000	4	*	*
9	29,000	12,000-64,000	3	*	*	3	*	*
8	28,000	9,000-43,000	5	25,000	11,000-27,000	22	25,000	19,000-39,000
4	*	*	1	*	*	0	—	—
1	*	*	0	—	—	0	—	—
11	11,000	6,000-19,000	1	*	*	2	*	*
3	*	*	4	*	*	2	*	*
17	13,000	9,000-26,000	9	15,000	10,000-16,000	2	*	*
2	*	*	1	*	*	1	*	*
310	\$14,000	\$9,000-\$21,000	110	\$14,000	\$10,000-\$19,000	106	\$20,000	\$15,000-\$25,000

* Insufficient data available to warrant setting figures.

CHAPTER IV

THE 191-COMPANY SURVEY

The final chapter of this bulletin reports on the magnitude and nature of the research activity of 191 industrial firms whose research spending constitutes a large portion of all industrial research spending,¹ and which are, in their respective industries, among the leaders in research. The firms that cooperated in furnishing the information for this part of the study are firms that spend a large amount of money for research, and they also include firms which have had long experience in planning and administering industrial research. It is reasonable to suppose that this cumulative experience, as it affects decisions on how much to spend for research, how to allocate the total spending between various kinds of research, and other matters of research policy, are reflected in the data.

Description of the Survey

The mailing used in this survey consisted of the approximately 15 firms believed to do the most research in each of 30 major industries. In general, the companies selected within each industry were those employing the largest number of professional technical persons, as reported in the 1950 edition of *Industrial Research Laboratories of the United States*, a directory published by the National Research Council. Data were requested for both 1951 and 1952. Since the questionnaire was mailed in the fall of 1952, the 1951 data represent actual amounts, and it is reasonable to believe that the 1952 data were actuals for approximately the first eight or nine months and estimates for the balance of the year.

The information requested and the definitions used were selected as the result of several months of field investigation, discussion, and testing. The questionnaire schedule and definitions will be found in Appendix C. Some comments on the principal concepts that influenced the construction of the questionnaire are given below.

¹ The total cost of the research carried on in 1951 by these companies amounted to about \$936 million, or about 30% of the \$2.3-\$2.5 billion estimated to be the total amount of research undertaken by all manufacturing firms in 1951.

The Consolidated Company

Among consolidated corporations, or "families" of companies, the degree to which research activity is centralized varies considerably. In some multicompany firms the parent corporation maintains a central research organization which does research for the whole firm, including its subsidiaries. In others, while a central research organization is maintained by the parent corporation, some or all of the subsidiaries, or operating divisions, maintain their own research laboratories; in such firms, these separate laboratories plus the central research organization, constitute the research capacity of the firm. Thus, in order to avoid variations that were caused by differences in organization rather than by differences in the magnitude or the nature of the company research program, it was necessary that reports by respondent firms be prepared on a consolidated company basis. Otherwise, the ratio of research activity to sales would not have been comparable between the organizations that differed as to their practice with respect to central research laboratories.

Research

The process that leads to the full-scale production and sale of a new product consists of a sequence of steps that overlap and merge into one another. Any attempt to draw a line at one stage of this process, and to call activities on one side of the line "research" and activities on the other side of the line "not research," is necessarily arbitrary. Of the several possibilities that we discussed with research directors, we settled on the line between development and production as the one that would be the easiest to define in a manner that would be meaningful to respondents and to users of the data. Thus, our definition of "research" was broad and inclusive, and included all activities usually classified as basic research, applied research, and development.

More specifically, the definition was written to include laboratory-scale experimental activity

having as its purpose the planned search for new knowledge—whether or not the search had reference to a specific application—and the application of existing knowledge to problems involved in the creation of a new product or process, or an improvement of an existing product or process. This included pilot-plant work where the objective is to aid in the technical development of a product or process, but did *not* include pilot-plant work where the objective is to produce a finished product to be used in developing or testing the market, or to smooth out the production process.

The concept also included engineering activity required to advance the design of a product or a process to the point where it meets specific functional and economic requirements and can be turned over to manufacturing units as distinguished from the production of detailed construction drawings or manufacturing blueprints which were not to be considered as research activity.

Research activities as defined above were to be included regardless of where they were performed. Thus, in addition to research carried out in a formal research organization, companies were asked to include research done elsewhere in the company and research done for the company by consulting laboratories, universities, or other outside organizations. Research carried on by groups outside the formal research organization was reported separately so as to permit an analysis of the research organization itself.

Not all the work done by a research organization is research, however broadly the term may be defined, and companies were asked to exclude from the concept of research the nonresearch activities of research laboratories. Examples of these excluded activities are: minor adaptations of a product to meet the needs of a specific customer, quality and quantity control work, troubleshooting in connection with plant breakdowns, plant sanitation work, work done to develop advertising programs and to promote or demonstrate new products or processes, technical services furnished under licensing agreements, and experimental work performed to provide information needed during the prosecution of a patent litigation. The consensus was that while such activities might be appropriate activities for research personnel to undertake, they should be excluded from the definition of research.

Finally, the concept included only *technological* research. Activities such as market research and economic research are indeed research, but the majority of research directors with whom we talked considered these activities as being in a different category from technological research either because they were located at different places in the organization or because the skills and procedures required were different from those of technological research.

Cost of Research

To make the cost data comparable, companies were asked to report what was substantially the *full cost* of their research program, and a detailed definition of "cost" was provided. Included in this definition were all direct costs, depreciation, and overhead costs, including a proportionate share of the cost of such functions as personnel, accounting, procurement, legal, public relations, and so on. The method of allocating these overhead costs to research was left to the individual companies because no way could be found of prescribing a single method that would fit all situations.

Our definition differs from the usual concept of "full cost" in one respect; it does not include a share of top management and administration costs. None of the companies studied in the field investigation included this element as part of their research cost, and most said they would have no reliable basis for estimating it if we included it in the definition; therefore, we asked only that salaries and related costs of research executives not on the payroll of the research organization be included, and excluded other top management costs.

Government Research

As mentioned in Chapter III, the definition of government research included only that portion of government financed research that was carried on under a contract specifying that research be done. Some research work is done in connection with government contracts for the production of end items, even though this research is not specified in the contract. Since the value of these end items is included in the company's sales figure, the research done on them had to be included as nongovernment research so as not to distort the ratio of such research to sales. As a consequence

of this definition, the real amount of government financial support to industrial research organizations is probably understated in our tables.

Research by Objective Sought

It was clearly desirable to break down the total amount spent for research into some useful categories. Various possibilities were suggested, including (a) basic research, applied research, and development, (b) product research and process research, (c) the principal elements of cost, and (d) basic research, research on new products, and research on existing products. Of these, we concluded that the last was the best choice since it seemed to provide both a useful breakdown and one on which estimates could be made with reasonable accuracy. In framing the definitions, the governing concept was the *objective* or *purpose* for which the work was done, a concept first suggested to us by Dr. Eugene Scott, Secretary of the U. S. Interdepartmental Committee on Research and Development.

Yardsticks

The number of dollars spent for research by a company does not have much meaning, taken by itself, and becomes meaningful only when related to some measure of the company's size or ability to support research. The measure that we used as a measure of size or total resources available was, for most purposes, the net sales of the company, and we expressed the magnitude of research spending as a percentage of net sales. We also used one nondollar figure to indicate the magnitude of the research program; namely, the ratio of professional technical employees engaged in research and development to the total number of employees in the company.

The use of the "percentage of sales" ratio implies that there is some relationship between a company's sales revenue and the amount of money it appropriates for research. Taken roughly and over the long run, this implication seems to be warranted. Sales volume is a measure of size, and it is often the case that, within an industry, the larger the company the more it will spend for research. The relationship is rough because there are many factors other than size that affect research spending, and it is a long-run relationship because fluctuations in research spending in many companies do not correspond to monthly or

annual fluctuations in sales. In general, short-run variations in research spending are not so great as short-run variations in sales.

Organization of the Data

The data submitted for this survey were analyzed both on a company basis and on a research organization basis.

The analysis on a *company-wide* basis sought to develop data on the following major aspects of the company research program:

- (1) the magnitude of all research activity in which the company was engaged ("all research activity" included research carried on within the company—whether financed by the company or by others—and research activity carried on outside the company which was supported by company funds);

- (2) that portion of company resources expended for company financed research;

- (3) the distribution, by broad objectives, of company financed research; and

- (4) the magnitude of the total research activity carried on within the company and the proportion of such research that was carried on for the government and for other outside organizations.

The analysis on a *research-organization basis* sought to develop data describing:

- (1) the magnitude of the resources required to carry on all the activities of the research organization, including nonresearch activity;

- (2) the extent to which the facilities of the research organization were used to perform nonresearch functions; and

- (3) selected annual expenditure rates.

Companies and research organizations were classified both by size and by industry. Company-size classifications were made on the basis of the total number of company employees for data relating to companies, and on the basis of the number of professional technical persons in the research organization for data relating to research organizations.

Classification by industry was made according to the principal product of the company, and research organization classifications followed company classifications. Thus, it is possible that the classification of research organizations by industry does not exactly describe the kind of

research performed by these organizations. The industry classifications used are described in Appendix D.

Summary of Findings

The 191 firms whose research activities are described in this part of the report had net sales of about \$52,000,000,000 and employed more than 3,000,000 persons in 1951.

Cost of All Research,² 1951

The cost of all research performed within these 191 companies, and the additional research which these companies supported financially in

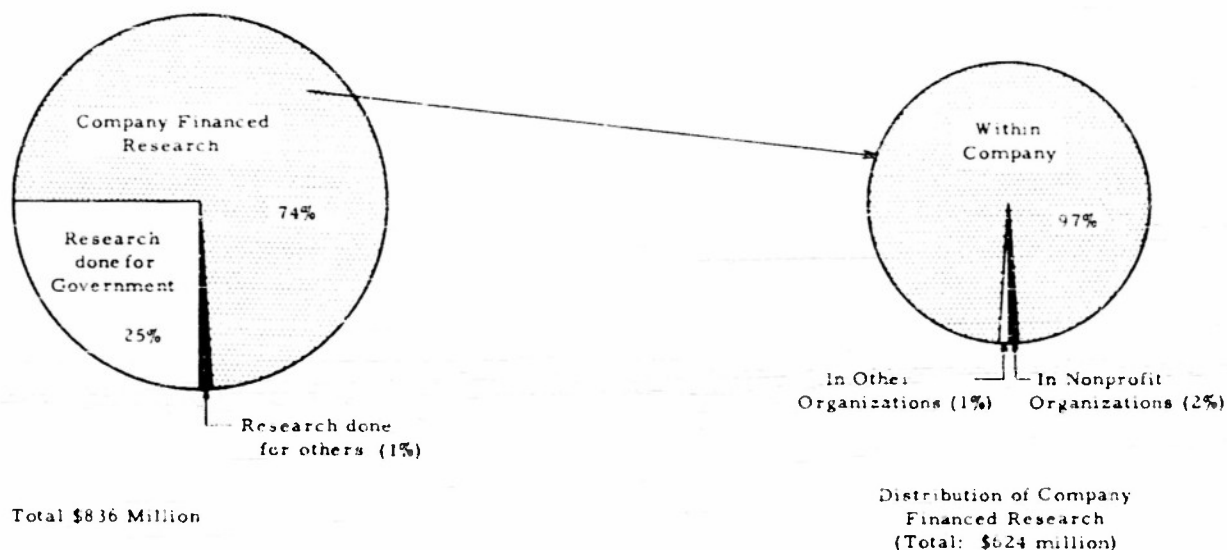
This breakdown of research activity reported by the respondents is summarized as follows:

<i>Cost of All Research Activities</i>			
	<i>Dollars</i>	<i>Percentages</i>	
	<i>(in millions)</i>		
Company Financed Research:			
Within Company	\$607	72%	97%
In Nonprofit Organizations	11	1	2
In Other Organizations	6	1	1
Total Company Financed Research	\$624	74%	100%
Research Done for Government	206	25	
Research Done for Others	6	1	
Total	\$836	100%	

For all firms, the median figure for the cost of research performed within the company, plus the

Chart IV-A

COST OF ALL RESEARCH



outside organizations, amounted to \$836,000,000 in 1951 (see Table I-2), and 98% of this amount was spent to support the research activity of persons directly employed by the reporting companies. Most companies did not limit their research activity to that performed within and for the company. Approximately one out of every two companies reported that some research was done for outside agencies, principally the government; and more than seven out of every ten companies reported that some company funds were spent to support research carried on in nonprofit and other outside research organizations.

² Cost of all research includes the cost of research financed by the company inside and outside the company, as well as the cost of research that was done by the company for others (principally the government).

cost of outside research financed by the company, was 1.3% of net sales in 1951 (see Table IV-1). Industry-wise this ratio varied considerably, ranging from a low of 0.3% (food and kindred products) to a high of 14.7% (aircraft).

Company Financed Research, 1951

As shown above, the aggregate funds spent by companies for their own programs accounted for about three-quarters of the cost of all the research in which the companies were engaged. This company financed research amounted in the median firm to 1.1% of sales revenue (see Table IV-1). The median figure for company financed research as a percentage of net sales varied widely by industries, from a low of 0.3% (food and kin-

dred products) to a high of 4.9% (drugs). The variation among the median ratios for the different industries, however, was not so great as the variation for the cost-of-all-research ratios since the exclusion of the cost of government research greatly affected median ratios for certain industries, especially those where the cost-of-all-research ratio was high. For example, in the aircraft industry the cost of all research (i.e., cost of company financed research plus cost of government research) was 14.7% of sales in the median company whereas the cost of company financed research was only 2.4% of sales.

Small companies, in general, spent a larger percentage of sales revenue on their own research than did larger companies (see Table IV-2). For companies with less than 500 employees, the median figure for the cost of company financed research was 3.2% of sales, whereas firms in the next-to-largest size group (25,000 to 50,000 employees) had the lowest median figure for this item, 0.5%.

Support of Outside Organizations

Although more than 70% of the companies reported that some of their company financed research was done outside the company, the aggregate of company funds spent in this manner accounted for less than 3% of the total. The respondents spent somewhat more to support programs in nonprofit³ organizations than they spent to support research programs in consulting laboratories and other outside research organizations. For all firms supporting outside research, the median amount spent to support programs in nonprofit organizations was 58.6% of the total spent outside the company. Generally speaking, larger companies spent a higher proportion of their outside research funds to support programs in nonprofit organizations than did smaller companies.

Distribution by Objectives

Companies were requested to show the distribution of the funds spent for their own research as between: (1) the improvement of existing products or processes; (2) the creation of new

products or processes; and (3) programs not committed to any specific problems. In the aggregate, 92% of the respondents' research funds were spent for the first two objectives (50% to improve present products or processes and 42% to create new products or processes); and 8% of total company research funds were spent to support programs uncommitted to specific problems.⁴

The median company spent 4.5% of company research funds for support of programs uncommitted to specific problems (see Table IV-1), and there was a wide variation among the several industry groups. For example, the median figure for primary metal companies was 0.3%, whereas for food (except beverages) companies the median figure was 20.9%. In several industries (aircraft, mechanical instruments, and other professional, scientific, and controlling instruments) the median figure was zero; in other words, at least half the companies in these industries did not report any expenditures for basic research. On the whole, large companies spent a somewhat greater share of company research funds to finance basic research programs than did the smaller companies (see Table IV-2). For companies with less than 500 employees, the median figure for programs uncommitted to specific problems was zero. For companies in all size groups beyond 7,000 employees, the median figure for this item was 5% or more of total spending for company financed research.

The median figure for spending on research aimed at creating new products or processes was about the same as the figure for spending to improve existing products or processes, for all firms in the survey; but larger companies tended to spend a smaller fraction of their research funds for new product research than did smaller companies. The median company with 50,000 or more employees spent more than twice as much to improve present products or processes as it spent to create new products or processes, while median companies in both size groups of fewer than 2,000 employees spent as much, or more, of their research dollars on projects undertaken to create new products or processes as they spent on projects aimed at improvement of existing products or processes.

³The funds spent in nonprofit organizations included the cost of fellowships, grants, and gifts, as well as the cost of specific research projects.

⁴This item included fundamental research, basic research, and all other research that could not be assigned to a specific product, product line, or process.

Research for Others

Approximately 25% of the aggregate costs of all research performed within the companies was incurred to carry on research for outside organizations, and more than 97% of this was for the government.⁵ Research for the government and other outside organizations was concentrated in relatively few firms, however. Less than half the reporting firms carried on any research for the government, and only 36 companies engaged in research for outside organizations other than the government.⁶

Activity of Research Organizations, 1951

The research organizations of the companies covered by this survey employed about 99,000 persons of whom approximately 39,000 were professional technical persons. Aggregate spending to support these activities amounted to about \$850,000,000 in 1951. The median company spent 1.4% of sales in 1951 to support all the activities, both research and nonresearch, of its research organization. For the middle half of the companies the range of the individual ratios was from 0.7% to 3.1%.

Proportion of Nonresearch Work

By no means all the work done in these organizations was research, even under the broad definition of research used in this survey. Reporting companies, as a group, utilized the aggregate capacity of their research organizations in 1951 in the following manner:

Type of Activity	% of Total
Research	82%
Nonresearch:	
Technical Service to Operating Units	13
Nontechnological Activity	5

The research organizations of at least 35 companies provided no technical service to operating

⁵ As explained above, the amount of government research done by these companies is understated by an amount that, while not feasible to estimate, is believed to be sizable. Research for government in this survey was limited, by definition, to that for which the company was reimbursed directly.

⁶ A study made by the National Association of Manufacturers in 1947 revealed that about 70% of the companies carrying on research without maintaining their own research facilities preferred to use facilities other than those of other industrial companies (*Trends in Industrial Research and Patent Practices*, National Association of Manufacturers, p. 5). This booklet, now out of print, is a report on the results of a survey of 983 manufacturing companies.

units, and those of about 75 companies did not report any nontechnological activity (market research, economic research, and legal work).

Spending per Person

Reflecting differing company policy in the ratio of professional technical persons to the total research organization staff, the amount spent per professional technical person showed greater variations among companies than did the amount spent per research organization employee.⁷ For all firms the median figure for the amount spent per professional technical person was \$18,200 (with half the individual ratios falling within a range of \$13,700 to \$24,600), and the median figure for amount spent per research organization employee was \$7,800 (middle range figures of \$6,700 to \$9,400). Industry-wise, the median figures for the amount spent per professional technical person varied from a high of \$34,600 (transportation equipment and accessories) to a low of \$9,900 (paints). The variation from industry to industry, however, for the typical amount spent per research organization employee was considerably less, the high industry figure being \$9,600 (transportation equipment and accessories) while the lowest industry figure was \$6,000 (laboratory instruments).

In the median research organization covered by this survey, 44 out of every 100 employees were professional technical persons. Research organizations with a high ratio of professional persons to total employees tended to spend less per professional technical person than did organizations with low ratios of professional persons. For example, in the transportation industry the median ratio of professional technical persons to total staff was 31.2%, and the median figure for dollars of spending per professional technical person was \$34,600; whereas in the rubber industry, where the median proportion of professional technical persons to total staff was 66.0%, the figure for dollars of spending per professional technical person was only \$11,800. This relationship results largely from the fact that in research organizations wage and salary costs are a large percentage of total costs; there-

⁷ Research organization employees are all persons on the payroll of the research organization, including both professional and non-professional persons.

fore laboratories with a smaller number of supporting personnel for each professional technical person tend to have lower costs per professional technical person. For example, if a laboratory employed 50 professionals and 50 nonprofessionals and had total costs of \$900,000, its cost per professional person would be \$18,000. Another laboratory, employing 60 professionals and only 40 nonprofessionals might have a higher total cost, say \$950,000, because of the higher salaries paid the professionals, but its cost per professional person would be only \$15,800 because of the higher divisor.

There was a marked tendency for cost per research organization employee to vary directly with the size of the organization. For organizations with less than 10 professionals, the cost was \$6,700 per research employee. For all other size groups the cost was over \$7,000, and for the two largest size groups, it was over \$8,000.

Replacement Cost of Facilities

The 191 companies cooperating in this survey estimated that the 1952 cost of replacing the tangible facilities (land, structures, and equipment) devoted exclusively to use of their research organizations would in the aggregate amount to approximately \$1,000,000,000. The median investment in research organization facilities, at 1952 replacement values, was \$21,700 per professional technical person, varying industry-wise from a low of \$7,000 (mechanical instruments) to a high of \$39,700 (textile and apparel).

Estimated 1952 Research Activity

In addition to actual data for 1951, companies were requested to provide estimated⁸ data on their 1952 research activities. The companies covered by this survey, as a group, reported an increase in their research efforts in 1952, as compared with 1951, as shown in the following tabulation:⁹

<i>Item</i>	<i>1951</i>	<i>1952</i>	<i>Percentage Increase</i>
Cost of All Research (in millions)	\$ 836	\$ 1,028	23%
Company Financed Research (in millions)	624	753	21
Cost of Research Done Within Company (in millions)	819	1,007	23
Total Employees of Research Organizations	99,000	110,000	11
Professional Technical Persons in Research Organizations	39,000	44,000	13

The stepped-up research activity was not confined to a few firms; over 80% of the firms spent more of their own funds to finance research in 1952 (see Table I-3), and more than 70% of the research organizations made net additions to their staffs in 1952.

The median increase in company financed research was 13%;¹⁰ this considerably exceeded the median increase in sales volume, which was less than 3%. Seven out of ten companies reported that they spent a higher percentage of their sales revenue for company financed research in 1952 than in 1951. In 1951, the cost of company financed research typically amounted to 1.1% of sales for all firms; in 1952 this figure rose to 1.3%. This increase in spending is also shown in Chart IV-B, where it will be noted that the majority of plotted points lie above the line of proportional change.

Increases in dollars spent for company financed research were reported even by firms that experienced decreases in sales volume for 1951 to 1952, as well as by firms whose sales volume increased. Of the 59 firms that reported a decrease in sales in this period, only 11 reported that the amount of company funds committed to research in 1952 was also decreased.

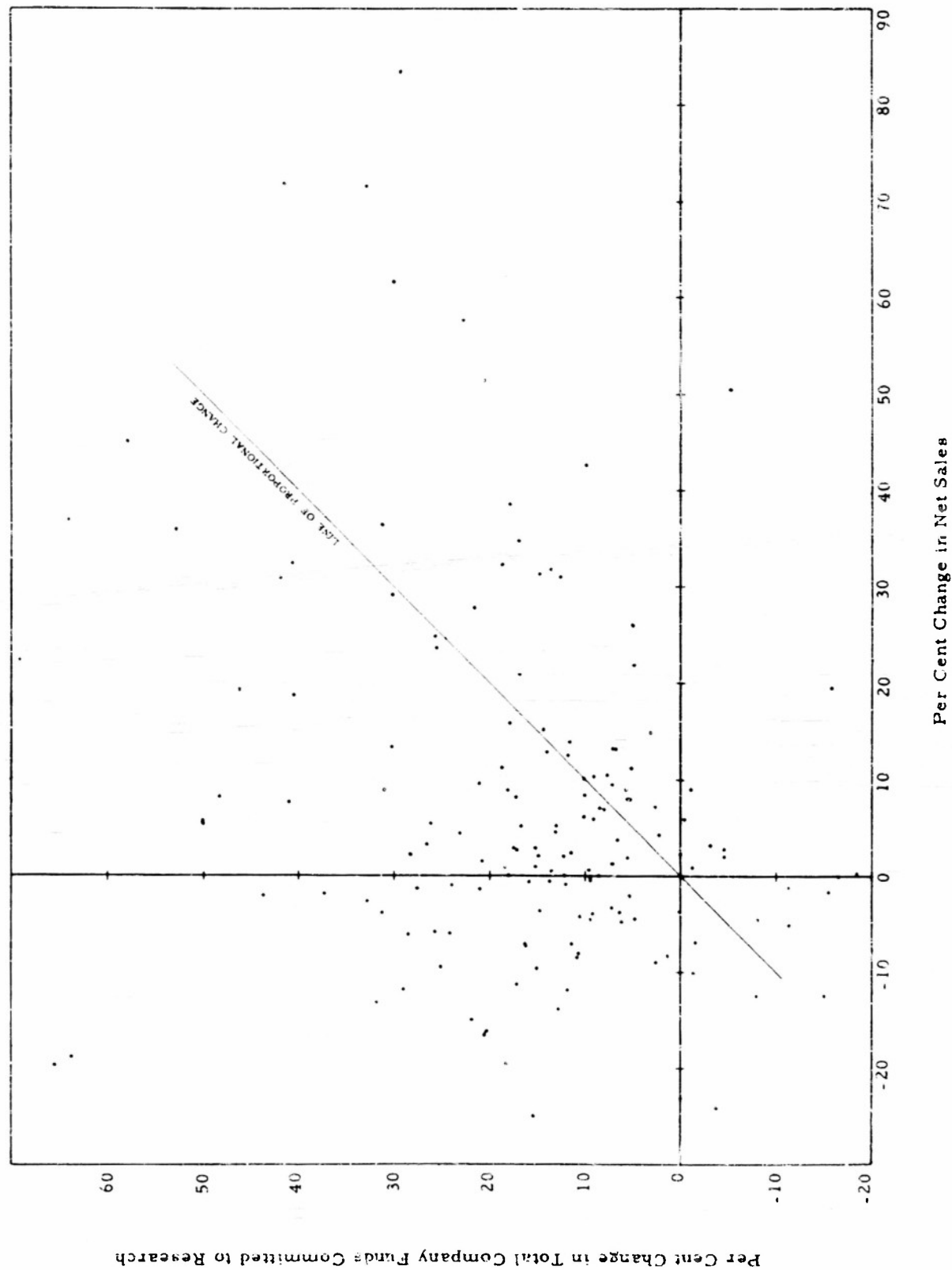
As shown in the summary above, the aggregate cost of all research done within the reporting companies was also considerably higher in 1952 than in 1951. This increase was due not only to an increase in company financed research (more than \$100,000,000) but also to a substantial increase in research undertaken for the government

⁸ Since the survey was made in the fall of 1952, these estimates were probably based on actual costs for the first eight or nine months of 1952.

⁹ A few reporting companies did not submit estimated data for 1952, and others did not furnish data on all items in both years; adjustments have been made for these situations.

¹⁰ The fact that the median increase (13%) was lower than the increase for the aggregate of all laboratories (21%) indicates that large companies increased their spending by considerably more than the median percentage.

Chart IV-B
CHANGES IN TOTAL COMPANY FUNDS SPENT FOR RESEARCH COMPARED WITH CHANGES IN
COMPANY SALES (1952/1951)



in 1952. The additional capacity required for this increased research was secured primarily by an expansion of company research organizations, with nearly nine out of ten companies reporting increased budgets for their research organizations in 1952.

Increases in spending for research organizations probably did not reflect a proportionate increase in research capacity since some of the dollar increase was undoubtedly due to rising costs of materials and services. More than 70% of the reporting companies, however, reported net additions (typically 7%) to the staffs of their research organizations in 1952; and approximately 50% of the reporting companies made expenditures for buildings and land for the exclusive use of their research organizations.

Typically, net additions to the research staff in 1952 tended to increase slightly the proportion of professional technical persons to total research staff in these firms (see Chart IV-C). For all research organizations as a group, net additions of professional technical persons represented a median increase of 8% in this personnel category, while net additions (including professional technical persons) in all categories represented a median increase of only 7% in total staff. Consequently, although the median proportion of professional persons to total staff in the research organizations of these firms was 43.7% in 1951, the median proportion was 45.5% in 1952. Also, as is shown in Chart IV-D, as total company employment increased, research organization staffs tended to increase in slightly greater proportion.

Thus, in summary, it may be noted that: (1) as a group, the reporting firms estimated a substantial increase in 1952 in the number of dollars to be spent for research and in the number of persons employed in their research organizations; (2) most firms estimated an increase in the portion of company resources that was to be allocated to research in 1952, compared with 1951; and (3) in most firms where a reduction in overall company activity (i.e., sales and employment) was experienced in this period, research activity was not, on balance, permitted to fall below its 1951 level.

Summary

The foregoing comments have focused primarily on the median figures. By way of summary, a brief description of the facts revealed by ratios computed from the aggregate figures reported by all firms will be given.

In 1951, the 191 firms participating in this survey spent 1.2% of their sales revenue for research intended for their own benefit. Of this amount, 97% was spent within the companies, and only 3% was spent to finance research done for the companies by outside organizations. Two-thirds of the amount spent outside the company was used to support research in nonprofit research organizations, and one-third was spent for research in commercial and consulting laboratories.

Over 90% of all the research financed in 1951 was undertaken to create new products and processes or to improve existing products and processes, and less than 10% of the firms' research funds was spent to support basic research.

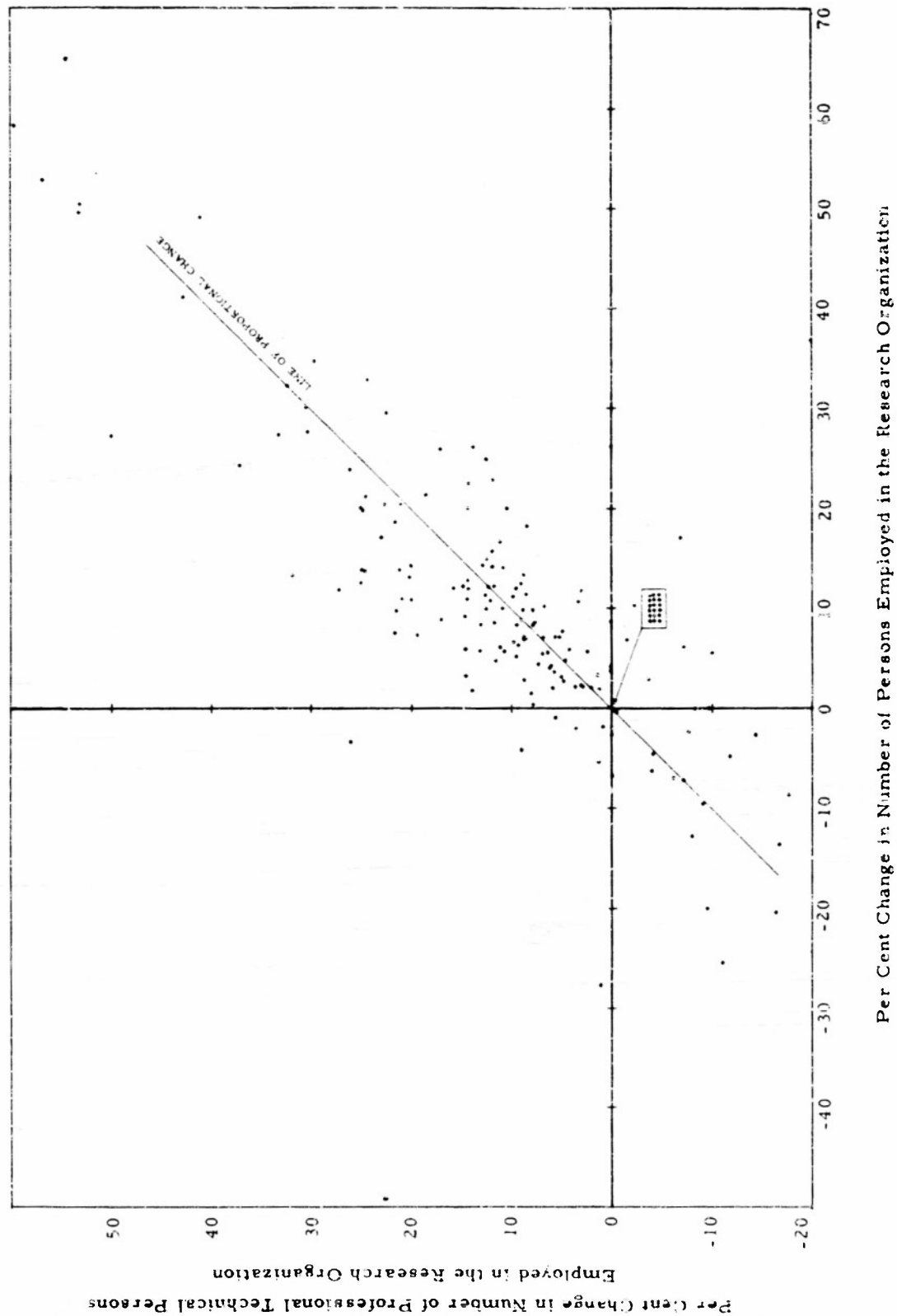
In 1952 these firms estimated an increase in their research effort as compared with 1951. The percentage of sales revenue spent for company financed research rose from 1.2% in 1951 to 1.4% in 1952.

Spending to support the activities of the research organization (including the nonresearch activities of the research organization) amounted to 1.6% of company sales revenue in 1951, or \$8,600 for each employee on the staff, or \$21,700 for each professional technical person in the research organization. This spending included all the operating costs of the laboratory. Supplementing these costs was an expenditure for equipment amounting to 4.7% of the operating budget, or \$1,100 per professional technical person.

In addition to providing the funds required to meet these recurring costs of their research organizations, the respondent companies had provided, for each professional technical person on the staff of the research organization, research facilities that would, at 1952 prices, cost approximately \$25,100 per person to replace.

In 1952 an increased number of dollars were to be spent to support the activities of research organizations, and these dollars were a higher

Chart IV-C
CHANGES IN NUMBER OF PROFESSIONAL TECHNICAL PERSONS EMPLOYED IN THE RESEARCH ORGANIZATION COMPARED WITH CHANGES IN THE TOTAL NUMBER OF PERSONS EMPLOYED IN THE RESEARCH ORGANIZATION (1952/1951)



percentage of sales (1.9% in 1952, compared with 1.6% in 1951). Although some of the increase in dollars to be spent to support activities of the research organization was probably due, in part, to rising costs, not all the additional spending can be attributed to this cause, inasmuch as these research organizations estimated additions of about 11% to their total staff in 1952. Net additions of professional technical persons were made at such a rate as to result in a slight increase in the proportion of professional technical persons to total staff. The fact that some of the increase in dollars spent to support activities of the typical research organization was probably due to rising costs is suggested by the changes in dollars spent per professional technical person and dollars spent per research organization employee. In 1952, spending per professional technical person in these companies averaged \$22,800 compared with \$21,700 in 1951. Spending per research organization employee also rose; in 1951 the average figure was \$8,600, whereas in 1952 it was expected to be \$9,200.

Use of the Tables

The data from the 191-Company Survey are presented in two groups of tables. One group (Tables IV-1, IV-2, and IV-3) is focused on the *company*, and the other (Tables IV-4, IV-5, and IV-6) is focused on the *research organization*. Within each group, there is a table of median and middle range figures by *industry* classifications (Tables IV-1 and IV-4), another of median and middle range figures by *size* classifications (Tables IV-2 and IV-5), and a third for *weighted averages* (computed from aggregate amounts) by industry classifications (Tables IV-3 and IV-6).

Statistical Measures. As explained in Chapter III, the *median* is the figure for the middle company in the group when the data are arrayed from low to high, and the *middle range* gives an indication of the extent to which other companies in the group vary from the median company.

The *weighted averages* are based on the aggregate amount reported for the item by all firms in the group. Large firms therefore influence these averages more than do small firms, and they are not a measure of the experience of the typical company. These weighted averages are useful for two main purposes: (1) as a means

of describing the group as a whole, rather than the typical company within the group—for example, as a means of comparing one industry with another; and (2) as a basis for extrapolation—for example, estimating the total dollar amounts spent by all research organizations for capital equipment. Extrapolations *should not* be made from the median figures.

Tables IV-1, IV-2, and IV-3

The items reported on these three tables are identical. A brief description of each item is given below. Full definitions of the data from which the ratios were calculated will be found in Appendix C. The formula used to calculate each item on these tables is given in the last column on page 63.

1. *Cost of all research* is a gross figure for all research spending done by and for the company. It includes research financed by the government and by other outside agencies. This item, and all the other items in this set of tables, does *not* include the cost of nonresearch activities carried on by the research organization.

2. *Company financed research* is the amount of research done for the benefit of the company. It includes research done in the company's research laboratories, research done outside the formal research organization, and research done outside the company. It does not include government financed research or other research done by the company for others.

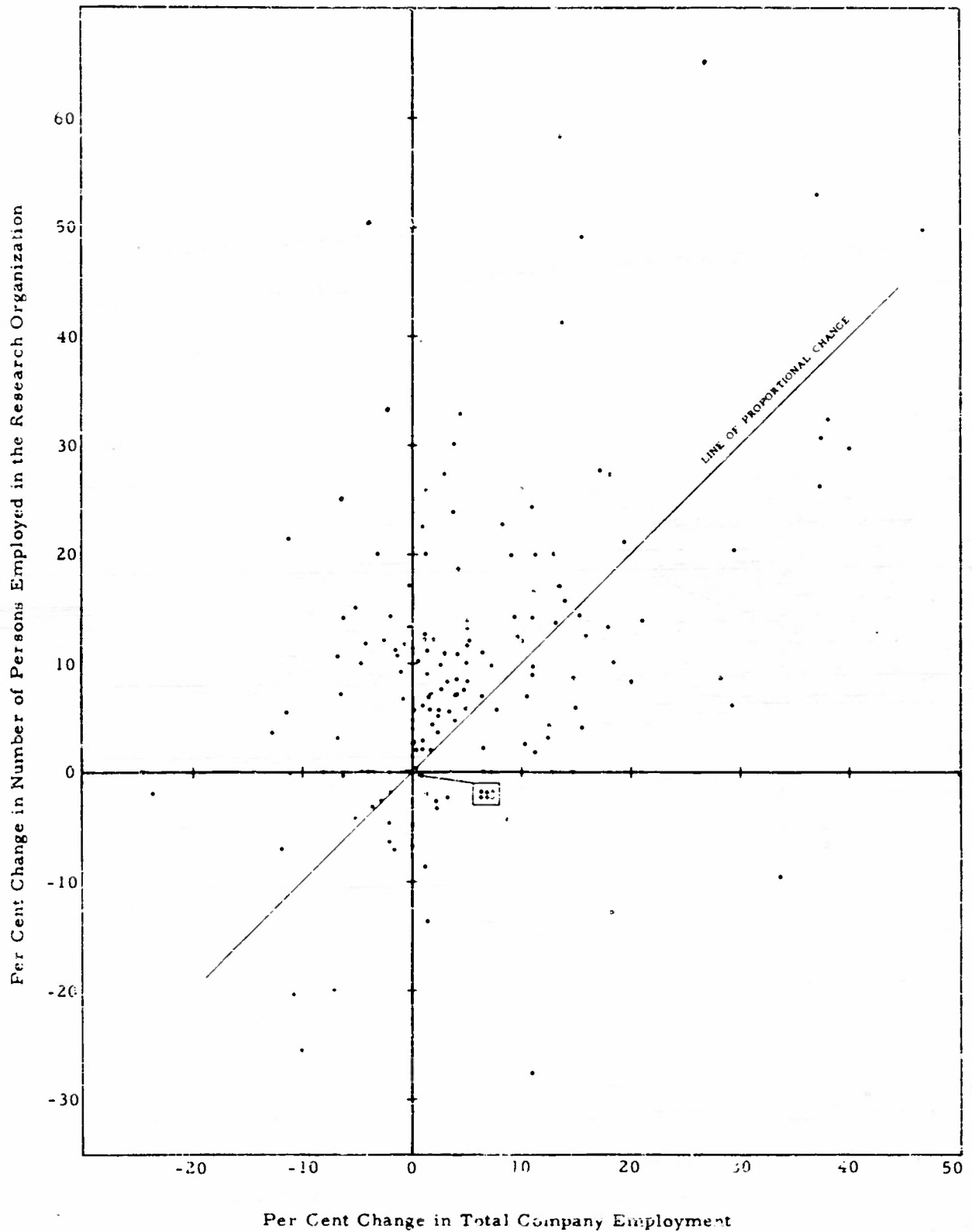
3. *Distribution by objective.* The three objectives listed are, essentially, product improvement, new product research, and basic research. Since in Tables IV-1 and IV-2 each figure is the median of all companies reporting the item, the three percentages will not necessarily add to 100%.

4. *Research done within the company* includes research done in the research laboratory and in other parts of the company, including research financed by the government and by other outside agencies, but excluding research supported in outside laboratories.

5. *Professional technical employees as a percentage of total employment.* This is another way of measuring the magnitude of the research effort, and has the advantage, as compared with any ratio based on dollar figures, of not being influenced by differences in accounting procedure.

Chart IV-D

CHANGES IN NUMBER OF PERSONS EMPLOYED IN THE RESEARCH ORGANIZATION
COMPARED WITH CHANGES IN TOTAL COMPANY EMPLOYMENT (1952/1951)



Tables IV-4, IV-5, and IV-6

This set of tables is focused on research organizations, including both the research and the non-research activities of these organizations, but excluding research done *by* the company outside the formal research organization and research done *for* the company by consulting or nonprofit laboratories. The items reported on all three tables are identical. The formula used to calculate each item on these tables is given in the last column on page 79.

1. *Spending to support all activities of the research organization* is the gross figure for the type of spending mentioned in the preceding paragraph.

2. *Distribution of spending to support all activities of the research organization.* The three activities listed are defined fully in Appendix C. Briefly, "research" means all technological research and development. "Technical services" means work of a technical nature done by the research organization for other divisions of the company (it does *not* refer to services supplied to the laboratory—these services are included as a part of the total cost of the laboratory). "Non-technological activities" are market research, economic research and legal work. In Tables IV-4 and IV-5 the figures are medians for each item, and they therefore will not necessarily add to 100%.

3. *Spending to support all activities of the research organization* is here given in terms of cost per person. In the term "professional technical person," the word "professional" is used in the same sense as it is used in the Wages and Hours Act, and "technical" refers to persons trained in science and engineering. "Research Organization Employees" include professional technical persons plus all other employees on the payroll of the research organization.

4. *Capital expenditures (excluding land and buildings)* are the expenditures for the current year for new equipment and other fixed assets, except real estate. The *depreciation* on these fixed assets is included in total cost. Real estate was excluded because spending for real estate is extremely erratic, and the typical figures for such spending would have little meaning.

5. *Replacement cost of research organization facilities* is an estimate, at 1952 prices, of the cost of replacing all land, structure, and equipment used by the research organization. Since this figure does not come directly from the accounting records, the estimate is probably rough.

6. *Total number of professional technical persons.* The percentages shown here is useful in estimating the balance between professional technical persons and supporting personnel in typical laboratories. The terms used are as defined under Item 3.

**Table IV-1. SELECTED DATA ON THE RESEARCH ACTIVITIES OF INDUSTRIAL COMPANIES,
CLASSIFIED BY INDUSTRY**

Items	All Firms		Food and Kindred Products		Food except Beverages	
	Median Figures	Middle Range Figures	Median Figures	Middle Range Figures	Median Figures	Middle Range Figures
1951						
Number of Reporting Firms ¹	191	—	12	—	9	—
1. Cost of All Research ² : % of Net Sales	1.3%	0.6% - 2.8%	0.3%	0.2% - 0.5%	0.4%	0.2% - 0.5%
2. Company Financed Research:						
a. Total Cost: % of Net Sales	1.1	0.6 - 2.3	0.3	0.2 - 0.4	0.4	0.2 - 0.4
b. Cost of This Research Done Within Company: % of Total Cost of Such Research	98.0	94.6 - 100.0	93.5	91.1 - 97.2	93.1	89.5 - 97.1
c. Cost of This Research Done by Nonprofit Organizations: % of Such Research Done Outside Company	58.6	21.7 - 96.8	56.5	41.8 - 100.0	66.3	46.9 - 100.0
3. Distribution by Objective of All Company Financed Research:						
a. To Improve Present Products or Processes	46.1	30.0 - 62.3	55.2	40.0 - 55.8	45.0	39.9 - 47.9
b. To Create New Products or Processes	43.7	29.0 - 60.2	31.7	25.0 - 50.1	28.4	26.0 - 53.7
c. To Support Programs Uncommitted to Specific Problems	4.5	0.0 - 12.2	15.1	7.6 - 24.6	20.9	9.8 - 27.8
4. Research Done Within Company:						
a. Total Cost: % of Net Sales	1.3	0.6 - 2.7	0.3	0.2 - 0.4	0.3	0.2 - 0.4
b. Cost of This Research for Others: % of Research Done Within Company	0.3	0.0 - 8.7	0.0	0.0 - 0.0	0.0	0.0 - 0.0
c. Cost of Research for Government: % of Research Done Within Company	0.0	0.0 - 7.3	0.0	0.0 - 0.0	0.0	0.0 - 0.0
5. Total Number of Professional Technical Persons: % of Total Number of Company Employees	1.5	0.7 - 3.1	0.6	0.4 - 1.0	0.6	0.3 - 1.1
1952						
1. Cost of All Research ² : % of Net Sales	1.4%	0.7% - 3.4%	0.3%	0.1% - 0.5%	0.3%	0.2% - 0.8%
2. Company Financed Research:						
a. Total Cost: % of Net Sales	1.3	0.7 - 2.6	0.3	0.1 - 0.5	0.3	0.2 - 0.5
b. Cost of This Research Done Within Company: % of Total Cost of Such Research	97.8	94.4 - 99.8	93.8	88.0 - 96.7	93.0	87.6 - 95.0
c. Cost of This Research Done by Nonprofit Organizations: % of Such Research Done Outside Company	61.5	18.0 - 100.0	45.8	32.5 - 82.6	56.5	41.0 - 96.5
3. NOT APPLICABLE						
4. Research Done Within Company:						
a. Total Cost: % of Net Sales	1.4	0.7 - 3.3	0.3	0.1 - 0.5	0.3	0.1 - 0.8
b. Cost of This Research for Others: % of Research Done Within Company	0.9	0.0 - 11.5	0.0	0.0 - 0.0	0.0	0.0 - 0.0
c. Cost of Research for Government: % of Research Done Within Company	0.0	0.0 - 9.0	0.0	0.0 - 0.0	0.0	0.0 - 0.0
5. Total Number of Professional Technical Persons: % of Total Number of Company Employees	1.5	0.8 - 3.5	0.7	0.5 - 0.9	0.7	0.5 - 1.0

¹ Not all firms submitted complete reports; therefore some of the ratios are based on a smaller sample.

² Cost of All Research includes: (1) the cost of research financed by the company (both inside and outside the company); and (2) the cost of research that was done for others by the company.

Note: See last column on p. 63 for formula used to compute each item.

Source: 191-Company Survey.

Table IV-1. SELECTED DATA ON THE RESEARCH ACTIVITIES OF INDUSTRIAL COMPANIES,
CLASSIFIED BY INDUSTRY (Continued)

Textile and Apparel		Furniture		Paper, Lumber, and Wood Products		Paper and Allied Products	
Median Figures	Middle Range Figures	Median Figures	Middle Range Figures	Median Figures	Middle Range Figures	Median Figures	Middle Range Figures
1951							
9	—	5	—	14	—	10	—
0.7%	0.4% - 1.0%	0.5%	*	0.7%	0.5% - 0.8%	0.7%	0.6% - 0.8%
0.7	0.4 - 1.0	0.5	*	0.7	0.5 - 0.8	0.7	0.5 - 0.8
98.5	98.0 - 100.0	89.9	*	98.8	97.3 - 100.0	97.6	96.3 - 98.4
98.8	0.0 - 100.0	*	*	43.2	0.0 - 100.0	71.6	8.3 - 100.0
54.8	33.7 - 66.4	*	*	54.9	28.6 - 75.4	62.3	43.1 - 78.4
41.4	27.6 - 56.6	*	*	37.6	24.6 - 66.8	33.5	21.5 - 40.7
3.2	0.5 - 6.7	*	*	0.3	0.0 - 0.0	3.8	0.0 - 9.2
0.7	0.4 - 1.0	0.4	*	0.7	0.5 - 0.8	0.7	0.5 - 0.8
0.0	0.0 - 0.0	0.0	*	0.0	0.0 - 0.0	0.0	0.0 - 0.0
0.0	0.0 - 0.0	0.0	*	0.0	0.0 - 0.0	0.0	0.0 - 0.0
0.4	0.3 - 1.2	0.2	*	0.8	0.4 - 0.9	0.7	0.4 - 1.0
1952							
0.8%	*	0.5%	*	0.7%	0.6% - 1.1%	0.8%	0.6% - 1.2%
0.7	*	0.5	*	0.7	0.6 - 1.1	0.8	0.6 - 1.1
98.3	97.4 - 99.3	91.3	*	98.5	95.9 - 100.0	96.9	93.6 - 98.8
100.0	48.8 - 100.0	*	*	88.9	40.0 - 100.0	94.5	41.2 - 100.0
0.8	*	0.5	*	0.7	0.6 - 1.1	0.8	0.6 - 1.1
0.0	0.0 - 0.5	0.0	*	0.0	0.0 - 0.0	0.0	0.0 - 0.0
0.0	0.0 - 0.0	0.0	*	0.0	0.0 - 0.0	0.0	0.0 - 0.0
0.4	0.3 - 1.1	0.2	*	0.6	0.4 - 0.9	0.7	0.4 - 0.9

* Insufficient data available to warrant setting figures.

**Table IV-1. SELECTED DATA ON THE RESEARCH ACTIVITIES OF INDUSTRIAL COMPANIES,
CLASSIFIED BY INDUSTRY (Continued)**

Items	Chemicals and Allied Products		Industrial Chemicals		Drugs	
	Median Figures	Middle Range Figures	Median Figures	Middle Range Figures	Median Figures	Middle Range Figures
1951						
Number of Reporting Firms ¹	41	—	13	—	9	—
1. Cost of All Research ² : % of Net Sales	2.4%	1.8% - 4.6%	2.8%	2.4% - 3.6%	5.1%	3.4% - 6.4%
2. Company Financed Research:						
a. Total Cost: % of Net Sales	2.3	1.6 - 4.4	2.3	2.2 - 3.5	4.9	3.4 - 6.4
b. Cost of This Research Done Within Company: % of Total Cost of Such Research	94.7	90.4 - 97.9	95.7	91.6 - 98.4	91.8	88.3 - 94.2
c. Cost of This Research Done by Nonprofit Organizations: % of Such Research Done Outside Company	75.2	34.7 - 100.0	67.7	39.0 - 84.6	100.0	88.0 - 100.0
3. Distribution by Objective of All Company Financed Research:						
a. To Improve Present Products or Processes	33.3	25.7 - 49.3	31.3	28.5 - 50.7	18.0	14.6 - 31.1
b. To Create New Products or Processes	53.3	40.5 - 60.5	53.4	40.9 - 56.8	56.0	50.5 - 78.9
c. To Support Programs Uncommitted to Specific Problems	10.1	5.5 - 15.2	13.4	8.4 - 18.1	12.1	7.7 - 13.8
4. Research Done Within Company:						
a. Total Cost: % of Net Sales	2.4	1.6 - 4.1	2.6	2.0 - 3.6	4.6	3.0 - 6.0
b. Cost of This Research for Others: % of Research Done Within Company	0.9	0.0 - 4.3	3.5	1.9 - 7.3	0.0	0.0 - 0.4
c. Cost of Research for Government: % of Research Done Within Company	0.4	0.0 - 3.2	3.5	1.9 - 7.2	0.0	0.0 - 0.4
5. Total Number of Professional Technical Persons: % of Total Number of Company Employees	3.4	2.4 - 5.4	3.2	2.0 - 4.1	4.0	2.7 - 5.6
1952						
1. Cost of All Research ² : % of Net Sales	3.1%	2.0% - 5.0%	3.4%	2.6% - 3.8%	5.1%	4.0% - 7.2%
2. Company Financed Research:						
a. Total Cost: % of Net Sales	2.7	1.9 - 4.5	2.9	2.3 - 3.7	4.9	3.9 - 7.2
b. Cost of This Research Done Within Company: % of Total Cost of Such Research	94.4	90.7 - 97.5	93.4	89.5 - 96.3	91.6	90.3 - 92.8
c. Cost of This Research Done by Nonprofit Organizations: % of Such Research Done Outside Company	81.5	37.0 - 100.0	67.2	48.4 - 92.2	93.4	87.1 - 100.0
3. NOT APPLICABLE						
4. Research Done Within Company:						
a. Total Cost: % of Net Sales	2.9	1.9 - 4.4	3.3	2.2 - 3.6	4.4	3.6 - 6.7
b. Cost of This Research for Others: % of Research Done Within Company	3.2	0.0 - 9.6	7.5	5.2 - 18.9	0.0	0.0 - 0.4
c. Cost of Research for Government: % of Research Done Within Company	1.1	0.0 - 7.3	7.5	2.9 - 18.9	0.0	0.0 - 0.4
5. Total Number of Professional Technical Persons: % of Total Number of Company Employees	3.8	2.4 - 5.6	3.4	2.1 - 4.7	3.9	2.9 - 5.4

¹ Not all firms submitted complete reports; therefore some of the ratios are based on a smaller sample.

² Cost of All Research includes: (1) the cost of research financed by the company (both inside and outside the company); and (2) the cost of research that was done for others by the company.

Note: See last column on p. 63 for formula used to compute each item.

Source: 191-Company Survey.

Table IV-1. SELECTED DATA ON THE RESEARCH ACTIVITIES OF INDUSTRIAL COMPANIES,
CLASSIFIED BY INDUSTRY (Continued)

Paints		Miscellaneous Chemicals		Petroleum and Coal Products		Petroleum Products	
Median Figures	Middle Range Figures	Median Figures	Middle Range Figures	Median Figures	Middle Range Figures	Median Figures	Middle Range Figures
1951							
5	—	10	—	15	—	13	—
1.3%	*	1.8%	1.4% - 3.5%	0.6%	0.5% - 0.7%	0.6%	0.5% - 0.7%
1.3	*	1.8	1.4 - 2.6	0.6	0.5 - 0.7	0.6	0.5 - 0.7
99.0	*	99.9	87.6 - 99.0	97.7	95.3 - 98.5	97.7	95.4 - 98.2
*	*	28.2	13.0 - 46.7	76.1	56.7 - 97.1	76.1	56.9 - 100.0
*	*	43.9	35.9 - 55.0	56.9	41.7 - 64.6	50.8	36.0 - 62.8
*	*	45.0	40.0 - 59.9	40.1	33.7 - 54.6	40.3	33.8 - 57.6
*	*	9.5	4.3 - 10.1	5.3	2.0 - 11.9	8.2	3.1 - 11.7
1.3	*	1.8	1.4 - 3.2	0.6	0.5 - 0.7	0.6	0.5 - 0.7
0.0	*	0.7	0.0 - 11.9	1.4	0.4 - 4.8	0.9	0.3 - 2.5
0.0	*	0.7	0.0 - 7.9	0.1	0.0 - 1.6	0.1	0.0 - 1.4
7.8	*	2.6	1.7 - 6.9	1.3	1.0 - 1.5	1.4	1.0 - 1.5
1952							
1.7%	*	2.5%	1.6% - 3.4%	0.7%	0.6% - 1.0%	0.7%	0.6% - 1.1%
1.7	*	2.4	1.5 - 2.6	0.7	0.6 - 1.0	0.7	0.6 - 1.1
99.1	*	95.4	90.6 - 98.1	97.8	95.5 - 98.9	97.8	96.1 - 98.8
*	*	32.5	9.1 - 96.3	80.4	63.4 - 100.0	80.0	61.7 - 100.0
1.7	*	2.4	1.5 - 3.0	0.7	0.6 - 0.9	0.7	0.6 - 1.1
0.0	*	5.2	0.0 - 13.4	1.9	1.0 - 3.9	1.7	0.9 - 2.3
0.0	*	3.0	0.0 - 11.4	0.4	0.0 - 1.8	0.4	0.0 - 1.7
8.0	*	2.9	1.7 - 8.5	1.3	0.9 - 1.9	1.5	1.1 - 2.0

* Insufficient data available to warrant setting figures.

**Table IV-1. SELECTED DATA ON THE RESEARCH ACTIVITIES OF INDUSTRIAL COMPANIES,
CLASSIFIED BY INDUSTRY (Continued)**

Items	Rubber		Stone, Clay, and Glass		Primary Metal	
	Median Figures	Middle Range Figures	Median Figures	Middle Range Figures	Median Figures	Middle Range Figures
1951						
Number of Reporting Firms ¹	7	—	6	—	11	—
1. Cost of All Research ² : % of Net Sales	0.9%	0.8% - 1.3%	1.3%	*	0.9%	0.4% - 1.2%
2. Company Financed Research:						
a. Total Cost: % of Net Sales	0.9	0.7 - 1.2	1.3	*	0.8	0.4 - 1.2
b. Cost of This Research Done Within Company: % of Total Cost of Such Research	99.2	98.6 - 99.7	98.1	96.2% - 100.0%	97.6	95.4 - 98.4
c. Cost of This Research Done by Nonprofit Organizations: % of Such Research Done Outside Company	47.7	*	*	*	94.6	64.8 - 100.0
3. Distribution by Objective of All Company Financed Research:						
a. To Improve Present Products or Processes	79.7	60.1 - 85.1	55.0	38.1 - 84.0	45.5	41.9 - 46.5
b. To Create New Products or Processes	20.3	12.4 - 31.7	18.5	11.7 - 55.0	53.9	52.1 - 58.1
c. To Support Programs Uncommitted to Specific Problems	4.9	0.6 - 5.7	7.0	0.0 - 15.4	0.3	0.0 - 3.7
4. Research Done Within Company:						
a. Total Cost: % of Net Sales	0.9	0.8 - 1.3	1.3	*	0.8	0.4 - 1.1
b. Cost of This Research for Others: % of Research Done Within Company	2.2	0.0 - 4.2	0.3	0.0 - 1.3	0.0	0.0 - 4.0
c. Cost of Research for Government: % of Research Done Within Company	2.2	0.0 - 4.2	0.1	0.0 - 1.3	0.0	0.0 - 0.6
5. Total Number of Professional Technical Persons: % of Total Number of Company Employees	1.7	1.5 - 3.6	1.1	0.9 - 2.0	0.7	0.3 - 1.4
1952						
1. Cost of All Research ² : % of Net Sales	1.0%	0.8% - 1.9%	*	*	0.9%	0.6% - 1.3%
2. Company Financed Research:						
a. Total Cost: % of Net Sales	0.9	0.8 - 1.9	*	*	0.9	0.6 - 1.3
b. Cost of This Research Done Within Company: % of Total Cost of Such Research	99.1	99.0 - 99.7	96.3	*	96.5	95.5 - 97.9
c. Cost of This Research Done by Nonprofit Organizations: % of Such Research Done Outside Company	2.1	*	*	*	87.0	50.9 - 100.0
3. NOT APPLICABLE						
4. Research Done Within Company:						
a. Total Cost: % of Net Sales	1.0	0.8 - 1.9	*	*	0.9	0.6 - 1.3
b. Cost of This Research for Others: % of Research Done Within Company	1.8	0.0 - 5.9	1.3	*	0.0	0.0 - 2.9
c. Cost of Research for Government: % of Research Done Within Company	1.8	0.0 - 5.9	0.8	*	0.0	0.0 - 0.6
5. Total Number of Professional Technical Persons: % of Total Number of Company Employees	2.4	1.9 - 4.2	1.2	*	0.8	0.4 - 1.9

* Insufficient data to warrant setting figures.

¹ Not all firms submitted complete reports; therefore some of the ratios are based on a smaller sample.

² Cost of All Research includes: (1) the cost of research financed by the company (both inside and outside the company); and (2) the cost of research that was done for others by the company.

Note: See last column on p. 63 for formula used to compute each item.

Source: 191-Company Survey.

Table IV-1. SELECTED DATA ON THE RESEARCH ACTIVITIES OF INDUSTRIAL COMPANIES,
CLASSIFIED BY INDUSTRY (Continued)

Fabricated Metal		Machinery except Electrical		Electrical Machinery		Transportation Equipment	
Median Figures	Middle Range Figures	Median Figures	Middle Range Figures	Median Figures	Middle Range Figures	Median Figures	Middle Range Figures
1951							
8	—	12	—	9	—	10	—
9.6%	0.4% - 15%	1.7%	1.4% - 2.6%	2.7%	1.6% - 4.1%	1.8%	0.6% - 14.7%
0.6	0.4 - 1.5	1.4	1.1 - 2.0	2.7	1.4 - 4.1	0.8	0.6 - 2.4
97.0	86.7 - 98.6	99.0	97.2 - 99.6	100.0	98.5 - 100.0	100.0	99.7 - 100.0
46.5	28.5 - 80.7	25.0	5.8 - 39.9	*	*	*	*
53.6	34.3 - 75.6	61.0	39.0 - 66.9	43.1	29.3 - 66.6	60.1	33.0 - 79.0
38.0	20.8 - 50.4	35.0	26.6 - 53.4	54.7	23.5 - 62.3	27.9	15.5 - 48.8
4.0	1.9 - 8.4	4.1	0.9 - 14.2	2.5	2.1 - 8.4	2.0	0.0 - 5.0
0.6	0.4 - 1.5	1.6	1.4 - 2.6	2.7	1.6 - 4.1	1.7	0.6 - 14.7
2.2	0.0 - 8.3	10.7	1.9 - 21.7	25.0	0.0 - 30.4	13.9	0.0 - 56.5
1.4	0.0 - 8.2	10.7	1.9 - 21.4	24.1	0.0 - 30.4	10.2	0.0 - 56.5
0.8	0.6 - 1.1	1.2	0.9 - 1.7	1.7	1.4 - 2.5	1.3	0.6 - 4.1
1962							
0.8%	0.6% - 1.5%	1.5%	1.3% - 3.4%	3.6%	2.3% - 8.0%	1.8%	0.9% - 8.3%
0.7	0.6 - 1.5	1.4	0.9 - 1.6	2.7	1.8 - 4.7	1.4	0.9 - 1.9
96.5	88.1 - 98.2	98.1	96.8 - 99.7	94.7	98.9 - 100.0	100.0	99.5 - 100.0
37.5	22.5 - 74.6	12.0	0.0 - 43.8	*	*	*	*
0.8	0.6 - 1.4	1.5	1.3 - 3.4	3.6	2.2 - 8.0	1.7	0.9 - 8.3
4.5	0.1 - 12.2	13.7	0.0 - 33.7	31.5	0.0 - 33.8	22.2	0.0 - 63.0
4.4	0.1 - 10.9	13.7	0.0 - 31.7	31.5	0.0 - 33.8	17.7	0.0 - 63.0
1.0	0.7 - 1.2	1.1	0.9 - 1.9	2.4	1.6 - 3.5	1.1	0.7 - 3.9

* Insufficient data available to warrant setting figures.

**Table IV-1. SELECTED DATA ON THE RESEARCH ACTIVITIES OF INDUSTRIAL COMPANIES,
CLASSIFIED BY INDUSTRY (Continued)**

Items	Aircraft		Professional Scientific, and Controlling Instruments		Laboratory Instruments	
	Median Figures	Middle Range Figures	Median Figures	Middle Range Figures	Median Figures	Middle Range Figures
1951						
Number of Reporting Firms ¹	5	—	19	—	6	—
1. Cost of All Research ² : % of Net Sales	14.7%	*	3.9%	1.7% - 10.3%	7.6%	3.2% - 10.5%
2. Company Financed Research:						
a. Total Cost: % of Net Sales	2.4	*	2.5	1.5 - 4.7	2.9	0.7 - 10.2
b. Cost of This Research Done Within Company: % of Total Cost of Such Research	100.0	*	100.0	97.9 - 100.0	100.0	99.6 - 100.0
c. Cost of This Research Done by Nonprofit Organizations: % of Such Research Done Outside Company	*	*	*	*	*	*
3. Distribution by Objective of All Company Financed Research:						
a. To Improve Present Products or Processes	69.0	*	38.0	16.7 - 53.2	25.0	13.8 - 46.5
b. To Create New Products or Processes	31.0	*	48.1	39.9 - 73.6	56.6	46.3 - 80.1
c. To Support Programs Uncommitted to Specific Problems	0.0	*	1.0	0.0 - 6.9	6.6	0.0 - 7.2
4. Research Done Within Company:						
a. Total Cost: % of Net Sales	14.7	*	3.9	1.7 - 10.3	7.6	3.2 - 10.4
b. Cost of This Research for Others: % of Research Done Within Company	56.5	*	15.4	0.5 - 44.6	1.5	0.0 - 81.9
c. Cost of Research for Government: % of Research Done Within Company	56.5	*	15.4	0.5 - 44.6	1.5	0.0 - 81.3
5. Total Number of Professional Technical Persons: % of Total Number of Company Employees	4.1	*	3.4	1.7 - 6.5	4.8	2.0 - 7.6
1952						
1. Cost of All Research ² : % of Net Sales	*	*	4.4%	1.9% - 9.7%	7.6%	3.8% - 11.4%
2. Company Financed Research:						
a. Total Cost: % of Net Sales	*	*	2.1	1.7 - 5.5	3.0	2.1 - 9.1
b. Cost of This Research Done Within Company: % of Total Cost of Such Research	100.0	*	100.0	98.8 - 100.0	100.0	99.5 - 100.0
c. Cost of This Research Done by Nonprofit Organizations: % of Such Research Done Outside Company	*	*	*	*	*	*
3. NOT APPLICABLE						
4. Research Done Within Company:						
a. Total Cost: % of Net Sales	*	*	4.4	1.8 - 9.6	7.6	3.8 - 11.4
b. Cost of This Research for Others: % of Research Done Within Company	63.0	*	12.5	0.5 - 46.3	3.0	0.0 - 60.5
c. Cost of Research for Government: % of Research Done Within Company	63.0	*	12.5	0.2 - 46.3	3.0	0.0 - 55.9
5. Total Number of Professional Technical Persons: % of Total Number of Company Employees	*	*	3.3	1.7 - 7.2	4.5	2.4 - 7.9

* Insufficient data to warrant setting figures.

¹ Not all firms submitted complete reports; therefore some of the ratios are based on a smaller sample.

² Cost of All Research includes: (1) the cost of research financed by the company (both inside and outside the company); and (2) the cost of research that was done for others by the company.

Note: See last column on p. 63 for formula used to compute each item.

Source: 191-Company Survey.

Table IV-1. SELECTED DATA ON THE RESEARCH ACTIVITIES OF INDUSTRIAL COMPANIES, CLASSIFIED BY INDUSTRY (Concluded)

Mechanical Instruments		Other Professional, Scientific, and Controlling Instruments		Method of Calculations
Median Figures	Middle Range Figures	Median Figures	Middle Range Figures	
1951				
5	—	8	—	
2.5%	*	2.9%	1.6% - 8.4%	Lines (4 + 8 + 9) ÷ Line 21
2.3	*	2.3	1.6 - 5.4	Line 10 ÷ Line 21
98.4	*	99.4	95.5 - 100.0	Line 7 ÷ Line 10
*	*	*	*	Line 8 ÷ Lines (8 + 9)
56.4	*	37.9	26.3 - 44.2	Line 11 ÷ Line 10
39.9	*	58.8	45.9 - 73.4	Line 12 ÷ Line 10
0.0	*	0.0	0.0 - 4.7	Line 13 ÷ Line 10
2.4	*	2.9	1.6 - 9.4	Line 4 ÷ Line 21
8.5	*	31.9	10.4 - 46.1	Lines (5 + 6) ÷ Line 4
8.5	*	31.9	9.9 - 46.1	Line 5 ÷ Line 4
3.4	*	2.3	1.1 - 10.4	Line 18 ÷ Line 24
1952				
2.1%	*	2.4%	1.7% - 9.9%	Lines (4 + 3 + 9) ÷ Line 21
2.0	*	2.0	1.7 - 5.2	Line 10 ÷ Line 21
98.9	*	99.4	96.8 - 100.0	Line 7 ÷ Line 10
*	*	*	*	Line 8 ÷ Lines (8 + 9)
2.1	*	2.4	1.7 - 9.9	Line 4 ÷ Line 21
6.2	*	34.8	11.7 - 55.5	Lines (5 + 6) ÷ Line 4
6.2	*	34.8	11.7 - 55.5	Line 5 ÷ Line 4
3.3	*	2.3	1.2 - 12.0	Line 18 ÷ Line 24

* Insufficient data available to warrant setting figures.

³ References are to line numbers on the questionnaire; see Appendix C. Columns (a) plus (b) of the questionnaire were used for 1951 data and columns (c) plus (d) were used for 1952 data.

**Table IV-2. SELECTED DATA ON THE RESEARCH ACTIVITIES OF INDUSTRIAL COMPANIES.
CLASSIFIED BY SIZE**

Items	All Firms		Less than 500 Employees		500-2,000 Employees	
	Median Figures	Middle Range Figures	Median Figures	Middle Range Figures	Median Figures	Middle Range Figures
1951						
Number of Reporting Firms ¹	191	—	12	—	28	—
1. Cost of All Research ² : % of Net Sales	1.3%	0.6% - 2.8%	3.2%	1.0% - 5.0%	1.9%	1.1% - 4.8%
2. Company Financed Research:						
a. Total Cost: % of Net Sales	1.1	0.6 - 2.3	3.2	1.0 - 4.7	1.8	0.9 - 4.2
b. Cost of This Research Done Within Company: % of Total Cost of Such Research	98.0	94.8 - 100.0	100.0	98.4 - 100.0	98.7	95.2 - 100.0
c. Cost of This Research Done by Nonprofit Organizations: % of Such Research Done Outside Company	58.5	21.7 - 98.8	*	*	46.7	17.0 - 87.6
3. Distribution by Objective of All Company Financed Research:						
a. To Improve Present Products or Processes	46.1	30.0 - 62.3	46.5	20.7 - 65.6	32.4	16.7 - 50.2
b. To Create New Products or Processes	43.7	29.0 - 60.2	46.5	27.8 - 56.5	54.7	34.6 - 73.9
c. To Support Programs Uncommitted to Specific Problems	4.5	0.0 - 12.2	0.0	0.0 - 10.0	4.2	0.0 - 12.1
4. Research Done Within Company:						
a. Total Cost: % of Net Sales	1.3	0.6 - 2.7	2.7	0.9 - 4.9	1.8	1.1 - 4.7
b. Cost of This Research for Others: % of Research Done Within Company	0.3	0.0 - 8.7	0.0	0.0 - 3.7	0.5	0.0 - 11.5
c. Cost of Research for Government: % of Research Done Within Company	0.0	0.0 - 7.3	0.0	0.0 - 1.5	0.0	0.0 - 6.0
5. Total Number of Professional Technical Persons: % of Total Number of Company Employees	1.5	0.7 - 3.1	6.7	1.8 - 13.5	4.3	1.6 - 6.3
1952						
1. Cost of All Research ² : % of Net Sales	1.4%	0.7% - 3.4%	3.8%	1.0% - 5.2%	2.3%	1.4% - 5.2%
2. Company Financed Research:						
a. Total Cost: % of Net Sales	1.3	0.7 - 2.6	3.4	1.0 - 4.7	2.0	1.3 - 4.7
b. Cost of This Research Done Within Company: % of Total Cost of Such Research	97.8	94.4 - 99.8	100.0	98.9 - 100.0	99.3	94.9 - 100.0
c. Cost of This Research Done by Nonprofit Organizations: % of Such Research Done Outside Company	61.5	18.0 - 100.0	*	*	*	*
3. NOT APPLICABLE						
4. Research Done Within Company:						
a. Total Cost: % of Net Sales	1.4	0.7 - 3.3	2.9	1.0 - 5.2	2.1	1.4 - 5.1
b. Cost of This Research for Others: % of Research Done Within Company	0.9	0.0 - 11.5	0.0	0.0 - 6.8	2.0	0.0 - 11.3
c. Cost of Research for Government: % of Research Done Within Company	0.0	0.0 - 9.0	0.0	0.0 - 6.8	0.0	0.0 - 8.1
5. Total Number of Professional Technical Persons: % of Total Number of Company Employees	1.5	0.8 - 3.3	6.8	2.1 - 13.9	4.3	1.7 - 7.9

* Insufficient data available to warrant setting figures.

¹ Not all firms submitted complete reports; therefore some of the ratios are based on a smaller sample.

² Cost of All Research includes: (1) the cost of research financed by the company (both inside and outside the company); and (2) the cost of research that was done for others by the company.

Source: 191-Company Survey.

**Table IV-2. SELECTED DATA ON THE RESEARCH ACTIVITIES OF INDUSTRIAL COMPANIES,
CLASSIFIED BY SIZE (Continued)**

Items	2,000-5,000 Employees		5,000-7,000 Employees		7,000-10,000 Employees	
	Median Figures	Middle Range Figures	Median Figures	Middle Range Figures	Median Figures	Middle Range Figures
1951						
Number of Reporting Firms ¹	47	—	24	—	17	—
1. Cost of All Research ² : % of Net Sales	1.4%	0.6% - 2.5%	1.3%	0.6% - 2.6%	1.7%	0.9% - 4.4%
2. Company Financed Research:						
a. Total Cost: % of Net Sales	1.3	0.6 - 2.2	1.2	0.6 - 1.9	1.5	0.8 - 3.0
b. Cost of This Research Done Within Company: % of Total Cost of Such Research	97.9	93.6 - 100.0	96.2	93.2 - 99.2	97.3	94.2 - 97.9
c. Cost of This Research Done by Nonprofit Organizations: % of Such Research Done Outside Company	17.4	0.0 - 86.3	39.5	15.4 - 78.8	87.2	27.0 - 100.0
3. Distribution by Objective of All Company Financed Research:						
a. To Improve Present Products or Processes	46.4	32.5 - 61.0	58.4	31.3 - 83.9	48.0	38.1 - 56.8
b. To Create New Products or Processes	43.4	32.6 - 59.4	36.0	24.7 - 62.8	42.3	31.2 - 56.9
c. To Support Programs Uncommitted to Specific Problems	3.6	0.0 - 10.0	2.8	0.0 - 8.0	6.0	1.8 - 13.2
4. Research Done Within Company:						
a. Total Cost: % of Net Sales	1.3	0.6 - 2.4	1.2	0.6 - 2.5	1.6	0.9 - 4.0
b. Cost of This Research for Others: % of Research Done Within Company	0.0	0.0 - 5.6	0.4	0.0 - 10.5	0.0	0.0 - 11.9
c. Cost of Research for Government: % of Research Done Within Company	0.0	0.0 - 5.6	0.3	0.0 - 5.8	0.0	0.0 - 3.3
5. Total Number of Professional Technical Persons: % of Total Number of Company Employees	1.0	0.6 - 2.4	1.2	0.7 - 1.8	1.8	0.7 - 2.4
1952						
1. Cost of All Research ² : % of Net Sales	1.5%	0.7% - 2.5%	1.4%	0.7% - 2.5%	2.1	1.1% - 4.9%
2. Company Financed Research:						
a. Total Cost: % of Net Sales	1.4	0.7 - 2.4	1.2	0.6 - 2.0	1.5	1.1 - 2.7
b. Cost of This Research Done Within Company: % of Total Cost of Such Research	98.1	91.9 - 100.0	95.9	92.5 - 99.4	96.0	93.6 - 98.3
c. Cost of This Research Done by Nonprofit Organizations: % of Such Research Done Outside Company	27.9	0.0 - 90.3	40.5	8.2 - 91.1	87.0	27.3 - 96.3
3. NOT APPLICABLE						
4. Research Done Within Company:						
a. Total Cost: % of Net Sales	1.5	0.7 - 2.5	1.3	0.7 - 2.1	2.0	1.1 - 4.5
b. Cost of This Research for Others: % of Research Done Within Company	0.0	0.0 - 10.1	0.4	0.0 - 11.3	0.4	0.0 - 11.9
c. Cost of Research for Government: % of Research Done Within Company	0.0	0.0 - 8.1	0.4	0.0 - 11.2	0.0	0.0 - 1.7
5. Total Number of Professional Technical Persons: % of Total Number of Company Employees	1.1	0.6 - 2.4	1.4	0.6 - 2.0	1.9	0.8 - 2.6

¹ Not all firms submitted complete reports; therefore some of the ratios are based on a smaller sample.

² Cost of All Research includes: (1) the cost of research financed by the company (both inside and outside the company); and (2) the cost of research that was done for others by the company.

Source: 191-Company Survey.

**Table IV-2. SELECTED DATA ON THE RESEARCH ACTIVITIES OF INDUSTRIAL COMPANIES,
CLASSIFIED BY SIZE (Concluded)**

Items	10,000-25,000 Employees		25,000-50,000 Employees		50,000 Employees and Over	
	Median Figures	Middle Range Figures	Median Figures	Middle Range Figures	Median Figures	Middle Range Figures
1951						
Number of Reporting Firms ¹	34	—	17	—	12	—
1. Cost of All Research ² : % of Net Sales	0.9%	0.5% - 2.4%	0.5%	0.3% - 1.0%	1.1%	0.4% - 2.0%
2. Company Financed Research:						
a. Total Cost: % of Net Sales	0.8	0.4 - 2.3	0.5	0.3 - 1.0	0.9	0.4 - 1.8
b. Cost of This Research Done Within Company: % of Total Cost of Such Research	97.7	95.2 - 98.9	97.7	96.8 - 99.5	99.3	96.5 - 99.7
c. Cost of This Research Done by Nonprofit Organizations: % of Such Research Done Outside Company	66.3	48.0 - 94.1	76.8	57.5 - 100.0	72.8	44.5 - 90.9
3. Distribution by Objective of All Company Financed Research:						
a. To Improve Present Products or Processes	47.0	33.4 - 55.8	46.5	31.6 - 68.1	69.0	29.1 - 79.8
b. To Create New Products or Processes	46.4	31.9 - 55.5	38.8	28.6 - 59.4	27.3	17.8 - 55.0
c. To Support Programs Uncommitted to Specific Problems	6.5	3.8 - 14.0	5.0	0.5 - 15.1	5.0	2.4 - 13.7
4. Research Done Within Company:						
a. Total Cost: % of Net Sales	0.9	0.4 - 2.4	0.5	0.3 - 1.0	1.1	0.4 - 2.0
b. Cost of This Research for Others: % of Research Done Within Company	3.6	0.0 - 10.3	0.1	0.0 - 2.5	4.1	0.7 - 12.5
c. Cost of Research for Government: % of Research Done Within Company	1.1	0.0 - 10.3	0.1	0.0 - 1.4	2.6	0.7 - 13.5
5. Total Number of Professional Technical Persons: % of Total Number of Company Employees	1.1	0.7 - 2.9	0.8	0.3 - 1.4	1.4	0.7 - 2.1
1952						
1. Cost of All Research ² : % of Net Sales	0.9%	0.7% - 1.9%	0.6%	0.3% - 1.2%	1.2%	0.2% - 2.9%
2. Company Financed Research:						
a. Total Cost: % of Net Sales	0.8	0.6 - 1.8	0.6	0.3 - 1.1	1.1	0.2 - 2.9
b. Cost of This Research Done Within Company: % of Total Cost of Such Research	97.0	94.9 - 98.7	97.0	96.2 - 99.2	99.3	94.7 - 99.8
c. Cost of This Research Done by Nonprofit Organizations: % of Such Research Done Outside Company	67.0	42.5 - 94.1	82.7	53.6 - 100.0	66.0	42.0 - 89.3
3. NOT APPLICABLE						
4. Research Done Within Company:						
a. Total Cost: % of Net Sales	0.8	0.7 - 1.8	0.6	0.3 - 1.2	1.2	0.2 - 2.9
b. Cost of This Research for Others: % of Research Done Within Company	3.8	0.0 - 20.1	0.1	0.0 - 2.3	3.8	0.6 - 11.7
c. Cost of Research for Government: % of Research Done Within Company	3.5	0.0 - 20.1	0.1	0.0 - 1.9	2.6	0.6 - 11.4
5. Total Number of Professional Technical Persons: % of Total Number of Company Employees	1.1	0.8 - 2.7	0.9	0.4 - 1.5	1.5	1.1 - 2.7

¹ Not all firms submitted complete reports; therefore some of the ratios are based on a smaller sample.

² Cost of All Research includes: (1) the cost of research financed by the company (both inside and outside the company); and (2) the cost of research that was done for others by the company.

Source: 191-Company Survey.

**Table IV-3. SELECTED DATA ON THE RESEARCH ACTIVITIES OF INDUSTRIAL COMPANIES,
CLASSIFIED BY INDUSTRY**

(Ratios Computed from Aggregate Amounts)

Items	All Firms	Food and Kindred Products	Food except Beverages	Textile and Apparel	Furniture
1951					
Number of Reporting Firms ¹	191	12	9	9	5
Net Sales of Reporting Firms ² (in millions)	\$51,925	\$8,396	\$7,648	\$664	\$169
1. Cost of All Research ³ : % of Net Sales	1.6%	0.2%	0.3%	1.0%	0.5%
2. Company Financed Research:					
a. Total Cost: % of Net Sales	1.2	0.2	0.2	1.0	0.5
b. Cost of This Research Done Within Company: % of Total Cost of Such Research	97.3	92.2	92.0	97.8	91.9
c. Cost of This Research Done by Nonprofit Organizations: % of Such Research Done Outside Company	65.7	63.5	65.3	85.2	0.0
3. Distribution by Objective of All Company Financed Research:					
a. To Improve Present Products or Processes	49.7	45.2	44.4	40.8	57.5
b. To Create New Products or Processes	42.3	32.8	32.6	49.1	39.9
c. To Support Programs Uncommitted to Specific Problems	8.0	22.0	23.0	10.1	2.6
4. Research Done Within Company:					
a. Total Cost: % of Net Sales	1.6	0.2	0.2	1.0	0.5
b. Cost of This Research for Others: % of Research Done Within Company	25.9	12.8	13.8	0.9	0.0
c. Cost of Research for Government: % of Research Done Within Company	25.2	12.8	13.8	0.1	0.0
5. Total Number of Professional Technical Persons: % of Total Number of Company Employees	1.4	0.5	0.5	0.8	0.3
1952					
Net Sales of Reporting Firms ² (in millions)	\$52,027	\$8,710	\$7,955	\$762	\$185
1. Cost of All Research ³ : % of Net Sales	2.0%	0.3%	0.3%	1.3%	0.6%
2. Company Financed Research:					
a. Total Cost: % of Net Sales	1.4	0.2	0.2	1.3	0.6
b. Cost of This Research Done Within Company: % of Total Cost of Such Research	97.2	93.2	93.1	97.5	90.9
c. Cost of This Research Done by Nonprofit Organizations: % of Such Research Done Outside Company	62.8	65.6	67.4	89.6	0.0
3. NOT APPLICABLE					
4. Research Done Within Company:					
a. Total Cost: % of Net Sales	1.0	0.2	0.3	1.3	0.5
b. Cost of This Research for Others: % of Research Done Within Company	27.7	14.2	15.1	2.1	0.0
c. Cost of Research for Government: % of Research Done Within Company	27.0	14.2	15.1	0.4	0.0
5. Total Number of Professional Technical Persons: % of Total Number of Company Employees	1.8	0.6	0.5	0.7	0.3

¹ Not all firms submitted complete reports; therefore some of the ratios are based on a smaller sample.

² Figures for some companies were estimated.

³ Cost of All Research includes: (1) the cost of research financed by the company (both inside and outside the company); and (2) the cost of research that was done for others by the company.

Source: 191-Company Survey.

**Table IV-3. SELECTED DATA ON THE RESEARCH ACTIVITIES OF INDUSTRIAL COMPANIES,
CLASSIFIED BY INDUSTRY (Continued)**
(Ratios Computed from Aggregate Amounts)

Paper, Lumber, and Wood Products	Paper and Allied Products	Chemicals and Allied Products	Industrial Chemicals	Drugs	Paints	Miscel- laneous Chemicals	Petroleum and Coal Products
1951							
14	10	41	13	9	5	10	15
\$940	\$685	\$5,607	\$3,902	\$727	\$50	\$480	\$13,042
0.6%	0.7%	3.2%	3.3%	4.5%	1.8%	2.3%	0.6%
0.6	0.7	3.1	3.1	4.4	1.8	2.0	0.6
97.2	96.7	95.5	97.2	90.7	83.8	93.5	95.9
64.8	65.6	75.2	76.1	90.1	35.6	32.4	70.1
56.5	60.2	31.8	29.7	32.7	40.5	40.8	53.6
38.8	34.1	55.5	56.3	55.4	44.9	52.0	38.8
4.7	5.7	12.7	14.0	11.9	14.6	7.2	7.6
0.6	0.7	3.0	3.2	4.1	1.5	2.2	0.6
1.3	1.6	4.1	4.1	1.8	1.3	12.6	2.3
0.6	0.8	3.3	3.6	0.2	0.0	10.7	2.0
0.6	0.7	3.1	3.0	3.6	5.3	2.6	1.3
1952							
\$916	\$659	\$5,748	\$3,989	\$722	\$48	\$499	\$13,860
0.7%	0.9%	3.6%	3.8%	5.1%	2.2%	2.4%	0.7%
0.7	0.9	3.4	3.6	5.0	2.1	2.1	0.7
96.8	96.3	95.1	96.9	89.9	84.0	92.5	94.6
74.4	75.1	77.3	76.3	90.1	38.5	51.6	50.0
0.7	0.8	3.4	3.7	4.6	1.9	2.3	0.7
1.1	1.3	5.2	5.4	1.9	3.2	15.6	2.5
0.3	0.4	4.5	5.2	0.4	1.8	11.4	2.1
0.7	0.8	3.7	3.6	3.9	5.1	2.8	1.3

**Table IV-3. SELECTED DATA ON THE RESEARCH ACTIVITIES OF INDUSTRIAL COMPANIES,
CLASSIFIED BY INDUSTRY (Continued)
(Ratios Computed from Aggregate Amounts)**

Items	Petroleum Products	Rubber	Stone, Clay, and Glass	Primary Metal	Fabricated Metal
1951					
Number of Reporting Firms ¹	13	7	6	11	8
Net Sales of Reporting Firms ² (in millions)	\$12,670	\$2,281	\$901	\$3,040	\$1,933
1. Cost of All Research ³ : % of Net Sales	0.6%	1.0%	1.6%	0.5%	0.6%
2. Company Financed Research:					
a. Total Cost: % of Net Sales	0.6	0.9	1.6	0.6	0.5
b. Cost of This Research Done Within Com- pany: % of Total Cost of Such Research	96.6	99.0	98.2	97.1	93.6
c. Cost of This Research Done by Nonprofit Organizations: % of Such Research Done Outside Company	64.4	60.2	51.2	87.2	56.8
3. Distribution by Objective of All Company Financed Research:					
a. To Improve Present Products or Processes	53.2	71.3	53.0	41.3	55.7
b. To Create New Products or Processes	39.0	25.1	32.7	57.0	37.2
c. To Support Programs Uncommitted to Specific Problems	7.8	3.6	14.3	1.7	7.1
4. Research Done Within Company:					
a. Total Cost: % of Net Sales	0.6	1.0	1.5	0.6	0.5
b. Cost of This Research for Others: % of Research Done Within Company	2.3	9.0	1.0	3.1	4.5
c. Cost of Research for Government: % of Research Done Within Company	2.0	9.0	1.0	0.8	4.3
5. Total Number of Professional Technical Persons: % of Total Number of Company Employees	1.3	2.1	1.1	0.6	0.8
1952					
Net Sales of Reporting Firms ² (in millions)	\$13,470	\$2,336	\$891	\$2,926	\$1,935
1. Cost of All Research ³ : % of Net Sales	0.7%	1.1%	1.6%	0.7%	0.6%
2. Company Financed Research:					
a. Total Cost: % of Net Sales	0.7	1.0	1.6	0.7	0.6
b. Cost of This Research Done Within Com- pany: % of Total Cost of Such Research	94.9	99.1	96.7	96.7	93.7
c. Cost of This Research Done by Nonprofit Organizations: % of Such Research Done Outside Company	46.5	48.7	41.7	77.9	51.9
3. NOT APPLICABLE					
4. Research Done Within Company:					
a. Total Cost: % of Net Sales	0.7	1.1	1.5	0.7	0.6
b. Cost of This Research for Others: % of Research Done Within Company	2.5	5.8	1.4	2.5	6.9
c. Cost of Research for Government: % of Research Done Within Company	2.1	5.9	1.3	1.0	6.4
5. Total Number of Professional Technical Persons: % of Total Number of Company Employees	1.4	2.7	1.3	0.7	0.9

¹ Not all firms submitted complete reports; therefore some of the ratios are based on a smaller sample.

² Figures for some companies were estimated.

³ Cost of All Research includes: (1) the cost of research financed by the company (both inside and outside the company); and (2) the cost of research that was done for others by the company.

Source: 191-Company Survey.

Table IV-3. SELECTED DATA ON THE RESEARCH ACTIVITIES OF INDUSTRIAL COMPANIES,
CLASSIFIED BY INDUSTRY (Concluded)

(Ratios Computed from Aggregate Amounts)

Machinery except Electrical	Electrical Machinery	Transportation Equipment	Aircraft	Professional, Scientific, and Controlling Instruments	Laboratory Instruments	Mechanical Instruments	Other Professional, Scientific & Controlling Instruments
1951							
12	9	10	5	12	6	5	8
\$2,675	\$6,097	\$4,269	\$1,012	\$824	\$285	\$196	\$343
1.9%	3.1%	4.0%	12.3%	6.4%	13.3%	1.9%	3.1%
1.4	2.0	2.2	4.9	2.3	2.9	1.6	2.2
99.2	99.3	99.7	100.0	97.6	99.6	95.8	96.2
24.4	34.8	8.8	0.0	45.1	59.5	66.2	33.7
62.0	53.0	63.3	44.3	52.1	58.6	59.3	41.4
33.9	41.1	33.5	54.1	38.7	31.0	39.4	47.3
4.1	5.9	3.2	1.6	9.2	10.4	1.3	11.3
1.9	3.1	4.0	12.3	6.3	13.3	1.8	3.1
28.4	36.7	48.1	60.3	64.3	78.6	14.3	29.4
28.3	36.7	44.1	59.9	62.1	77.9	14.3	29.1
1.2	1.0	2.3	4.4	3.1	4.9	1.8	2.2
1952							
\$2,766	\$7,045	\$4,329	\$1,618	\$992	\$432	\$189	\$371
2.2%	3.9%	4.6%	9.5%	6.4%	10.7%	2.1%	3.5%
1.4	2.5	2.4	3.8	2.3	2.4	1.8	2.4
98.0	99.6	99.5	99.5	98.1	99.6	96.3	97.0
22.2	47.5	40.7	73.5	44.1	58.7	79.1	21.3
2.2	3.9	4.6	9.5	6.3	10.7	2.0	3.4
34.2	35.3	49.1	60.1	64.4	77.5	12.1	32.7
33.0	35.3	47.2	60.0	64.1	77.0	12.1	32.5
1.4	2.7	2.4	4.3	3.3	4.8	1.9	2.5

**Table IV-4. SELECTED DATA ON INDUSTRIAL RESEARCH ORGANIZATIONS,
CLASSIFIED BY INDUSTRY**

Items	All Firms		Food and Kindred Products		Food except Beverages	
	Median Figures	Middle Range Figures	Median Figures	Middle Range Figures	Median Figures	Middle Range Figures
1951						
Number of Reporting Firms ¹	191	—	12	—	9	—
1. Spending to Support All Activities of the Research Organization: % of Net Sales	1.4%	0.1% - 3.1%	0.5%	0.3% - 0.4%	0.3%	0.2% - 0.5%
2. Distribution of Spending to Support All Activities of the Research Organization:						
a. To Carry on Research	83.9%	69.1% - 84.0%	83.4%	66.8% - 95.7%	82.1%	66.8% - 92.1%
b. To Provide Technical Service	11.5	3.0 - 22.4	6.7	0.0 - 22.1	9.6	2.6 - 22.1
c. To Carry on Nontechnological Activity	1.2	0.0 - 5.9	2.5	0.5 - 19.6	2.0	0.5 - 8.0
3. Spending to Support All Activities of the Research Organization:						
a. Dollars per Professional Technical Person	\$18,200	\$13,700 - \$24,600	\$16,100	\$12,500 - \$19,000	\$16,800	\$12,500 - \$21,400
b. Dollars per Research Organization Employee	\$7,800	\$6,700 - \$9,400	\$8,000	\$7,200 - \$8,500	\$7,900	\$7,200 - \$8,200
4. Capital Expenditures (excluding Land and Buildings):						
a. Dollars per Professional Technical Person	\$600	\$300 - \$1,400	\$700	\$400 - \$1,400	\$700	\$300 - \$1,400
b. % of Spending to Support All Activities of the Research Organization	3.3%	1.3% - 7.0%	3.8%	3.0% - 6.7%	3.8%	2.3% - 6.6%
5. NOT APPLICABLE						
6. Total Number of Professional Technical Persons: % of Total Number of Research Organization Employees	43.7%	34.4% - 55.0%	43.6%	36.3% - 58.5%	41.1%	33.3% - 57.5%
1952						
1. Spending to Support All Activities of the Research Organization: % of Net Sales	1.6%	0.8% - 3.5%	0.3%	0.2% - 0.5%	0.3%	0.2% - 0.5%
2. Distribution of Spending to Support All Activities of the Research Organization:						
a. To Carry on Research	84.8%	70.1% - 94.0%	83.3%	66.0% - 94.7%	81.9%	66.0% - 92.0%
b. To Provide Technical Service	9.7	3.1 - 21.0	7.2	0.0 - 22.1	9.9	1.7 - 22.1
c. To Carry on Nontechnological Activity	1.5	0.0 - 5.9	3.2	0.8 - 13.5	2.6	0.8 - 9.9
3. Spending to Support All Activities of the Research Organization:						
a. Dollars per Professional Technical Person	\$18,700	\$14,800 - \$24,900	\$16,300	\$12,700 - \$18,700	\$16,600	\$12,700 - \$22,500
b. Dollars per Research Organization Employee	\$8,400	\$7,100 - \$9,900	\$8,300	\$7,400 - \$8,900	\$8,500	\$7,400 - \$8,900
4. Capital Expenditures (excluding Land and Buildings):						
a. Dollars per Professional Technical Person	\$800	\$300 - \$1,500	\$600	\$400 - \$800	\$600	\$300 - \$1,300
b. % of Spending to Support All Activities of the Research Organization	3.6%	1.5% - 6.9%	3.7%	2.4% - 4.8%	3.7%	1.8% - 5.6%
5. Replacement Cost of Research Organization Facilities per Professional Technical Person	\$21,700	\$12,500 - \$34,100	\$33,300	\$18,200 - \$54,000	\$36,100	\$21,800 - \$65,300
6. Total Number of Professional Technical Persons: % of Total Number of Research Organization Employees	45.5%	34.7% - 55.8%	45.6%	36.5% - 63.1%	41.2%	34.8% - 60.0%

¹ Not all firms submitted complete reports; therefore some of the ratios are based on a smaller sample.

Note: See last column on p. 79 for formula used to compute each item.

Source: 191-Company Survey.

Table IV-4. SELECTED DATA ON INDUSTRIAL RESEARCH ORGANIZATIONS,
CLASSIFIED BY INDUSTRY (Continued)

Textile and Apparel		Furniture		Paper, Lumber, and Wood Products		Paper and Allied Products	
Median Figures	Middle Range Figures	Median Figures	Middle Range Figures	Median Figures	Middle Range Figures	Median Figures	Middle Range Figures
1951							
9	—	5	—	14	—	10	—
0.8%	0.7% - 1.0%	0.7%	*	0.6%	0.5% - 0.8%	0.7%	0.5% - 1.0%
74.5%	53.1% - 91.1%	52.1%	*	88.5%	66.5% - 94.6%	86.3%	66.5% - 94.6%
17.4	8.9 - 22.6%	12.8	*	9.8	1.0 - 24.1	9.8	1.0 - 24.1
3.4	0.0 - 5.9	5.4	*	1.7	0.0 - 5.2	2.9	0.0 - 8.3
\$21,700	\$16,400-\$25,600	\$29,400	*	\$14,900	\$13,000-\$19,800	\$15,400	\$12,100-\$19,800
\$7,600	\$6,200- \$7,800	\$6,300	*	\$7,000	\$6,500- \$7,500	\$7,300	\$6,800- \$8,900
\$1,400	\$100- \$6,400	*	*	\$300	\$100- \$3,500	\$300	\$100- \$3,500
5.3%	0.5% - 37.0%	*	*	2.0%	1.0% - 12.7%	1.9%	1.0% - 6.5%
29.4%	23.5% - 52.5%	19.1%	*	50.0%	39.7% - 59.2%	51.7%	43.1% - 60.0%
1952							
0.9%	*	0.8%	*	0.7%	0.5% - 1.2%	0.8%	0.6% - 1.2%
86.9%	53.7% - 94.2%	51.3%	*	88.7%	69.0% - 95.2%	85.4%	69.0% - 95.2%
9.3	5.8 - 23.2	11.3	*	8.7	2.6 - 22.0	8.7	2.6 - 22.0
3.5	0.0 - 6.3	5.8	*	1.9	0.0 - 7.8	3.5	0.0 - 7.8
\$21,900	\$16,700-\$24,300	\$32,200	*	\$15,100	\$14,400-\$21,000	\$15,400	\$14,400-\$22,000
\$8,200	\$7,400- \$9,400	\$6,500	*	\$7,100	\$6,600- \$7,600	\$7,200	\$6,500- \$8,400
\$1,000	\$200- \$1,900	*	*	\$300	\$100- \$1,500	\$300	\$200- \$1,600
4.3%	1.3% - 8.6%	*	*	2.2%	0.4% - 6.6%	2.7%	1.7% - 10.0%
\$39,700	\$28,600-\$75,200	*	*	\$16,400	\$10,700-\$41,200	\$16,400	\$8,900-\$37,500
38.9%	29.0% - 56.4%	19.1%	*	49.1%	40.7% - 60.0%	53.1%	43.8% - 60.2%

* Insufficient data available to warrant setting figures.

**Table IV-4. SELECTED DATA ON INDUSTRIAL RESEARCH ORGANIZATIONS,
CLASSIFIED BY INDUSTRY (Continued)**

Items	Chemical and Allied Products		Industrial Chemicals		Drugs	
	Median Figures	Middle Range Figures	Median Figures	Middle Range Figures	Median Figures	Middle Range Figures
1951						
Number of Reporting Firms ¹	41	—	13	—	9	—
1. Spending to Support All Activities of the Research Organization: % of Net Sales	2.8%	2.0% - 4.5%	3.3%	2.6% - 4.3%	4.2%	3.2% - 7.0%
2. Distribution of Spending to Support All Activities of the Research Organization:						
a. To Carry on Research	83.2%	74.4% - 94.9%	82.9%	77.6% - 91.0%	95.3%	87.7% - 100.0%
b. To Provide Technical Service	3.4	1.4 - 20.4	7.0	1.4 - 15.5	0.5	0.0 - 6.1
c. To Carry on Nontechnological Activity	1.6	0.0 - 6.3	3.9	0.4 - 8.5	0.0	0.0 - 3.7
3. Spending to Support All Activities of the Research Organization:						
a. Dollars per Professional Technical Person	\$18,300	\$13,700-\$23,400	\$20,100	\$15,100-\$23,400	\$21,800	\$19,600-\$24,400
b. Dollars per Research Organization Employee	\$7,900	\$6,700 - \$9,200	\$8,100	\$7,500 - \$9,500	\$9,200	\$8,300-\$10,900
4. Capital Expenditures (excluding Land and Buildings):						
a. Dollars per Professional Technical Person	\$500	\$400 - \$1,500	\$600	\$400 - \$1,600	\$500	\$400 - \$2,600
b. % of Spending to Support All Activities of the Research Organization	3.6%	1.6% - 8.3%	3.4%	1.5% - 7.6%	3.2%	2.0% - 9.3%
5. NOT APPLICABLE						
6. Total Number of Professional Technical Persons: % of Total Number of Research Organization Employees	46.0%	37.9% - 54.7%	45.1%	40.5% - 50.0%	45.8%	42.1% - 51.7%
1952						
1. Spending to Support All Activities of the Research Organization: % of Net Sales	3.1%	2.4% - 5.0%	3.7%	2.8% - 4.4%	4.9%	3.6% - 7.4%
2. Distribution of Spending to Support All Activities of the Research Organization:						
a. To Carry on Research	85.0%	75.7% - 93.5%	84.8%	78.0% - 90.7%	95.3%	87.9% - 100.0%
b. To Provide Technical Service	8.5	1.8 - 19.1	9.7	2.0 - 17.5	0.5	0.0 - 6.1
c. To Carry on Nontechnological Activity	2.0	0.0 - 6.0	4.2	0.9 - 9.1	0.0	0.0 - 3.3
3. Spending to Support All Activities of the Research Organization:						
a. Dollars per Professional Technical Person	\$17,600	\$14,400-\$24,900	\$19,200	\$17,000-\$25,200	\$22,600	\$18,800-\$26,100
b. Dollars per Research Organization Employee	\$8,500	\$7,500 - \$9,900	\$9,400	\$8,100 - \$9,900	\$9,600	\$8,600-\$11,100
4. Capital Expenditures (excluding Land and Buildings):						
a. Dollars per Professional Technical Person	\$1,100	\$500 - \$1,600	\$1,000	\$500 - \$1,300	\$1,600	\$1,000 - \$2,700
b. % of Spending to Support All Activities of the Research Organization	6.0%	2.9% - 9.8%	6.2%	3.8% - 6.7%	7.2%	5.0% - 11.1%
5. Replacement Cost of Research Organization Facilities per Professional Technical Person	\$21,800	\$16,200-\$30,400	\$20,000	\$17,000-\$36,100	\$27,000	\$24,400-\$31,200
6. Total Number of Professional Technical Persons: % of Total Number of Research Organization Employees	46.5%	38.8% - 55.1%	45.1%	38.8% - 50.8%	46.1%	40.7% - 57.4%

¹ Not all firms submitted complete reports; therefore some of the ratios are based on a smaller sample.

Note: See last column on p. 79 for formula used to compute each item.

Source: 1951-Company Survey.

Table IV-4. SELECTED DATA ON INDUSTRIAL RESEARCH ORGANIZATIONS,
CLASSIFIED BY INDUSTRY (Continued)

Paints		Miscellaneous Chemicals		Petroleum and Coal Products		Petroleum Products	
Median Figures	Middle Range Figures	Median Figures	Middle Range Figures	Median Figures	Middle Range Figures	Median Figures	Middle Range Figures
1951							
5	—	10	—	15	—	13	—
2.5%	*	2.1%	1.4% - 2.9%	0.7%	0.7% - 1.1%	0.8%	0.7% - 1.1%
50.0%	*	89.7%	74.4% - 95.9%	68.6%	61.2% - 79.0%	63.8%	61.8% - 78.4%
23.5	*	8.8	1.9 - 10.7	20.1	13.9 - 28.1	22.3	17.7 - 28.9
0.0	*	1.9	0.0 - 4.3	3.9	1.3 - 12.2	3.9	1.9 - 8.3
\$9,900	*	\$17,400	\$15,000 - \$31,300	\$19,700	\$17,500 - \$20,600	\$19,700	\$17,400 - \$20,500
\$6,300	*	\$6,600	\$4,600 - \$7,200	\$8,400	\$7,800 - \$9,300	\$8,300	\$7,800 - \$9,300
"	*	\$800	\$400 - \$900	\$800	\$400 - \$1,400	\$800	\$400 - \$1,300
"	*	5.6%	2.7% - 6.3%	3.4%	2.4% - 7.2%	3.2%	2.2% - 6.8%
55.0%	*	36.7%	29.4% - 53.2%	42.6%	38.1% - 49.9%	41.5%	37.9% - 49.1%
1952							
3.0%	*	2.7%	1.5% - 3.2%	0.9%	0.7% - 1.3%	1.1%	0.7% - 1.5%
48.1%	*	88.9%	75.2% - 94.3%	71.6%	63.6% - 80.0%	70.1%	61.9% - 79.0%
18.9	*	7.0	2.3 - 13.7	19.8	14.7 - 27.7	21.0	17.6 - 28.4
0.0	*	2.0	0.0 - 4.4	3.5	1.5 - 10.8	3.5	1.5 - 8.2
\$10,700	*	\$17,800	\$13,500 - \$34,000	\$20,300	\$18,000 - \$21,500	\$21,200	\$17,900 - \$21,700
\$6,800	*	\$7,700	\$7,100 - \$8,000	\$9,000	\$8,500 - \$9,700	\$8,800	\$8,100 - \$9,300
"	*	\$1,500	\$800 - \$1,800	\$700	\$300 - \$1,200	\$800	\$400 - \$1,200
"	*	5.5%	4.2% - 13.6%	3.6%	1.5% - 4.3%	3.9%	1.9% - 5.4%
\$8,200	*	\$27,300	\$14,800 - \$28,600	\$30,900	\$23,900 - \$39,400	\$30,200	\$21,200 - \$38,700
51.9%	*	39.1%	31.6% - 56.1%	42.8%	37.8% - 50.6%	40.9%	37.5% - 49.7%

* Insufficient data available to warrant setting figures.

**Table IV-4. SELECTED DATA ON INDUSTRIAL RESEARCH ORGANIZATIONS,
CLASSIFIED BY INDUSTRY (Continued)**

Items	Rubber		Stone, Clay, and Glass		Primary Metal	
	Median Figures	Middle Range Figures	Median Figures	Middle Range Figures	Median Figures	Middle Range Figures
1951						
Number of Reporting Firms ¹	7	—	6	—	11	—
1. Spending to Support All Activities of the Research Organization: % of Net Sales	1.3%	0.8% - 1.9%	2.0%	•	0.9%	0.3% - 1.1%
2. Distribution of Spending to Support All Activities of the Research Organization:						
a. To Carry on Research	79.8%	65.3% - 84.7%	79.4%	74.8% - 83.6%	83.4%	74.2% - 91.9%
b. To Provide Technical Service	18.2	13.2 - 34.8	16.7	6.0 - 21.9	14.4	16.8 - 18.1
c. To Carry on Nontechnological Activity	0.0	0.0 - 3.6	1.1	0.0 - 6.3	0.0	0.0 - 1.9
3. Spending to Support All Activities of the Research Organization:						
a. Dollars per Professional Technical Person	\$11,800	\$9,800 - \$15,000	\$20,400	\$14,700 - \$25,800	\$18,300	\$15,300 - \$21,000
b. Dollars per Research Organization Employee	\$7,800	\$7,300 - \$8,700	\$7,100	\$6,400 - \$7,400	\$8,200	\$6,600 - \$10,400
4. Capital Expenditures (excluding Land and Buildings):						
a. Dollars per Professional Technical Person	\$400	•	\$1,100	\$600 - \$1,200	\$1,300	\$1,200 - \$3,900
b. % of Spending to Support All Activities of the Research Organization	3.1%	•	4.1%	4.0% - 5.9%	7.0%	5.2% - 11.2%
5. NOT APPLICABLE						
6. Total Number of Professional Technical Persons: % of Total Number of Research Organization Employees	66.0%	52.2% - 83.2%	32.9%	23.6% - 37.5%	40.0%	35.5% - 65.2%
1952						
1. Spending to Support All Activities of the Research Organization: % of Net Sales	1.5%	0.9% - 2.5%	•	•	0.9%	0.5% - 1.4%
2. Distribution of Spending to Support All Activities of the Research Organization:						
a. To Carry on Research	79.6%	64.5% - 85.3%	77.1%	•	85.1%	73.8% - 95.0%
b. To Provide Technical Service	19.3	11.3 - 35.5	14.8	•	12.0	2.4 - 18.7
c. To Carry on Nontechnological Activity	0.0	0.0 - 3.5	1.3	•	0.0	0.0 - 3.1
3. Spending to Support All Activities of the Research Organization:						
a. Dollars per Professional Technical Person	\$12,400	\$10,900 - \$16,100	\$20,700	•	\$16,800	\$15,600 - \$20,600
b. Dollars per Research Organization Employee	\$8,500	\$7,300 - \$9,000	\$7,700	•	\$8,500	\$6,900 - \$10,400
4. Capital Expenditures (excluding Land and Buildings):						
a. Dollars per Professional Technical Person	\$200	•	\$800	•	\$800	\$500 - \$1,500
b. % of Spending to Support All Activities of the Research Organization	2.5%	•	4.8%	•	4.1%	2.3% - 7.1%
5. Replacement Cost of Research Organization Facilities per Professional Technical Person	\$10,500	\$5,900 - \$13,100	\$22,800	•	\$25,300	\$16,100 - \$42,900
6. Total Number of Professional Technical Persons: % of Total Number of Research Organization Employees	65.9%	51.9% - 86.1%	36.5%	•	40.0%	36.1% - 67.4%

* Insufficient data available to warrant setting figures.

¹ Not all firms submitted complete reports; therefore some of the ratios are based on a smaller sample.

Note: See last column on p. 79 for formula used to compute each item.

Source: 191-Company Survey.

Table IV-4. SELECTED DATA ON INDUSTRIAL RESEARCH ORGANIZATIONS,
CLASSIFIED BY INDUSTRY (Continued)

Fabricated Metal		Machinery except Electrical		Electrical Machinery		Transportation Equipment	
Median Figures	Middle Range Figures	Median Figures	Middle Range Figures	Median Figures	Middle Range Figures	Median Figures	Middle Range Figures
1961							
8	—	12	—	9	—	10	—
1.1%	0.6% - 1.9%	1.8%	0.9% - 2.6%	2.5%	1.5% - 5.1%	2.2%	1.1% - 14.3%
62.2%	51.6% - 83.8%	85.6%	67.6% - 91.2%	92.7%	79.4% - 97.2%	90.9%	79.1% - 100.0%
34.0	11.5 - 43.5	9.9	5.6 - 24.5	6.0	1.5 - 18.4	4.7	0.0 - 15.6
3.3	0.5 - 6.9	1.9	0.0 - 8.8	1.6	0.0 - 2.6	0.0	0.0 - 11.1
\$17,600	\$14,100 - \$27,200	\$20,900	\$16,500 - \$29,000	\$21,300	\$13,900 - \$38,400	\$34,600	\$24,100 - \$41,100
\$9,300	\$7,700 - \$10,500	\$6,800	\$6,100 - \$8,200	\$7,700	\$6,900 - \$9,500	\$9,600	\$7,400 - \$12,500
\$400	\$300 - \$800	\$500	\$200 - \$800	\$700	\$200 - \$1,400	\$800	\$100 - \$8,300
2.0%	1.1% - 3.3%	1.3%	1.0% - 2.6%	2.5%	0.6% - 3.8%	1.4%	1.0% - 20.3%
51.4%	42.0% - 62.2%	38.2%	31.5% - 43.1%	41.1%	25.7% - 54.3%	31.2%	21.0% - 40.5%
1952							
1.2%	0.8% - 1.9%	1.8%	0.7% - 5.0%	3.2%	1.8% - 5.5%	2.1%	1.2% - 10.7%
63.6%	50.2% - 84.5%	86.6%	73.3% - 91.6%	92.7%	80.6% - 97.3%	93.9%	74.0% - 100.0%
33.1	12.4 - 44.5	8.8	4.5 - 14.0	5.5	2.0 - 16.5	2.9	0.0 - 16.0
3.0	0.4 - 7.0	1.4	0.0 - 8.3	1.5	0.0 - 2.5	0.0	0.0 - 7.6
\$17,600	\$15,400 - \$29,100	\$20,300	\$16,100 - \$29,000	\$25,200	\$14,400 - \$42,600	\$34,700	\$24,500 - \$43,400
\$9,600	\$8,400 - \$10,600	\$7,300	\$6,200 - \$10,400	\$8,200	\$7,500 - \$10,200	\$9,700	\$8,500 - \$13,100
\$900	\$500 - \$2,100	\$600	\$200 - \$800	\$900	\$200 - \$1,500	\$1,800	\$1,000 - \$5,000
4.1%	2.1% - 8.5%	1.7%	0.7% - 4.0%	3.3%	0.7% - 4.6%	3.1%	1.0% - 15.6%
\$23,500	\$22,500 - \$33,800	\$20,000	\$16,800 - \$28,300	\$21,800	\$8,600 - \$34,900	\$17,200	\$5,000 - \$36,300
52.6%	42.7% - 57.7%	39.2%	31.9% - 46.7%	43.7%	29.1% - 55.0%	35.8%	22.5% - 41.7%

**Table IV-4. SELECTED DATA ON INDUSTRIAL RESEARCH ORGANIZATIONS,
CLASSIFIED BY INDUSTRY (Continued)**

Items	Aircraft		Professional, Scientific, and Controlling Instruments		Laboratory Instruments	
	Median Figures	Middle Range Figures	Median Figures	Middle Range Figures	Median Figures	Middle Range Figures
1951						
Number of Reporting Firms ¹	5	—	19	—	6	—
1. Spending to Support All Activities of the Research Organization: % of Net Sales	14.3%	*	3.3%	1.9% - 9.9%	8.6%	3.2% - 11.9%
2. Distribution of Spending to Support All Activities of the Research Organization:						
a. To Carry on Research	97.1%	*	91.0%	84.7% - 96.6%	98.3%	87.2% - 100.0%
b. To Provide Technical Service	0.0	*	4.9	1.3 - 13.3	1.7	0.0 - 12.0
c. To Carry on Nontechnological Activity	0.0	*	0.2	0.0 - 1.2	0.0	0.0 - 0.8
3. Spending to Support All Activities of the Research Organization:						
a. Dollars per Professional Technical Person	\$25,100	*	\$17,100	\$11,000 - \$19,400	\$15,300	\$11,000 - \$33,300
b. Dollars per Research Organization Employee	\$3,200	*	\$8,200	\$6,100 - \$10,600	\$6,000	\$5,100 - \$10,600
4. Capital Expenditures (excluding Land and Buildings):						
a. Dollars per Professional Technical Person	*	*	\$600	\$300 - \$1,600	\$700	\$300 - \$1,000
b. % of Spending to Support All Activities of the Research Organization	*	*	2.8%	0.7% - 9.5%	2.6%	1.2% - 5.6%
5. NOT APPLICABLE						
6. Total Number of Professional Technical Persons: % of Total Number of Research Organization Employees	32.0%	*	51.0%	40.6% - 61.0%	37.1%	31.8% - 55.0%
1952						
1. Spending to Support All Activities of the Research Organization: % of Net Sales	*	*	3.3%	2.1% - 11.1%	10.4%	3.8% - 11.2%
2. Distribution of Spending to Support All Activities of the Research Organization:						
a. To Carry on Research	97.7%	*	91.3%	85.7% - 96.3%	98.2%	86.3% - 100.0%
b. To Provide Technical Service	0.0	*	5.5	1.0 - 12.9	1.8	0.0 - 12.6
c. To Carry on Nontechnological Activity	0.0	*	0.2	0.0 - 1.2	0.0	0.0 - 0.9
3. Spending to Support All Activities of the Research Organization:						
a. Dollars per Professional Technical Person	\$25,500	*	\$19,000	\$13,700 - \$20,800	\$17,000	\$13,700 - \$32,000
b. Dollars per Research Organization Employee	\$9,400	*	\$8,800	\$7,500 - \$11,000	\$7,300	\$6,300 - \$10,400
4. Capital Expenditures (excluding Land and Buildings):						
a. Dollars per Professional Technical Person	*	*	\$300	\$300 - \$1,200	\$600	\$400 - \$700
b. % of Spending to Support All Activities of the Research Organization	*	*	2.8%	1.0% - 5.9%	2.6%	1.6% - 3.2%
5. Replacement Cost of Research Organization Facilities per Professional Technical Person	*	*	\$10,000	\$6,400 - \$17,900	*	*
6. Total Number of Professional Technical Persons: % of Total Number of Research Organization Employees	33.3%	*	50.0%	39.4% - 56.5%	37.1%	32.4% - 51.5%

* Insufficient data to warrant setting figures

¹ Not all firms submitted complete reports; therefore some of the ratios are based on a smaller sample.

Note: See last column on p. 79 for formula used to compute each item.

Source: 1951-Company Survey.

**Table IV-4. SELECTED DATA ON INDUSTRIAL RESEARCH¹ ORGANIZATIONS,
CLASSIFIED BY INDUSTRY (Concluded)**

Mechanical Instruments		Other Professional, Scientific, and Controlling Instruments		Method of Calculation ²
Median Figures	Middle Range Figures	Median Figures	Middle Range Figures	
1951				
5	—	8	—	
3.2%	*	2.6%	1.6%- 3.5%	Line 1 ÷ Line 21
72.4%	*	83.3%	88.2%- 95.2%	Line 4 ÷ Line 1
21.0	*	4.5	2.5 - 10.8	Line 3 ÷ Line 1
0.4	*	0.6	0.0 - 2.1	Line 2 ÷ Line 1
\$18,200	*	\$15,900	\$12,300-\$19,300	Line 1 ÷ Line 18
\$8,600	*	\$8,200	\$7,700 - \$9,600	Line 1 ÷ Line 20
\$100	*	\$2,400	\$500- \$5,600	Line 15 ÷ Line 18
0.7%	*	3.7%	2.3%- 20.8%	Line 15 ÷ Line 1
52.4%	*	51.2%	45.1%- 63.7%	Line 18 ÷ Line 20
1952				
3.3%	*	2.4%	1.6%- 3.3%	Line 1 ÷ Line 21
70.7%	*	94.0%	88.8%- 94.5%	Line 4 ÷ Line 1
29.3	*	5.3	3.0 - 9.6	Line 3 ÷ Line 1
0.3	*	0.7	0.0 - 1.6	Line 2 ÷ Line 1
\$19,100	*	\$12,800	\$13,200-\$21,700	Line 1 ÷ Line 18
\$8,900	*	\$10,900	\$3,400 - \$10,700	Line 1 ÷ Line 20
\$300	*	\$1,200	\$400- \$6,200	Line 15 ÷ Line 18
3.0%	*	2.7%	1.2%- 19.6%	Line 15 ÷ Line 1
\$7,000	*	\$10,900	\$7,000-\$22,800	Line 25 ÷ Line 18
52.2%	*	50.4%	43.4%- 63.1%	Line 18 ÷ Line 20

¹ Insufficient data available to warrant setting figures.

² References are to line numbers on the questionnaire; see Appendix C. Column (a) of the questionnaire was used for 1951 data, and column (c) for 1952 data.

**Table IV-5. SELECTED DATA ON INDUSTRIAL RESEARCH ORGANIZATIONS,
CLASSIFIED BY SIZE**

Items	All Firms		Less than 10 Professional Technical Persons		10-30 Professional Technical Persons	
	Median Figures	Middle Range Figures	Median Figures	Middle Range Figures	Median Figures	Middle Range Figures
1951						
Number of Reporting Firms ¹	191†	—	15	—	40	—
1. Spending to Support All Activities of the Research Organization: % of Net Sales	1.4%	0.7%- 3.1%	0.5%	0.2%- 1.1%	0.8%	0.6%- 1.4%
2. Distribution of Spending to Support All Activities of the Research Organization:						
a. To Carry on Research	83.9%	69.1%- 94.0%	84.0%	52.1%-100.0%	87.2%	69.9%- 95.4%
b. To Provide Technical Service	11.5	3.6 - 22.4	9.5	0.0 - 17.7	8.3	1.9 - 15.9
c. To Carry on Nontechnological Activity	1.2	0.0 - 5.9	0.0	0.0 - 3.8	0.0	0.0 - 4.3
3. Spending to Support All Activities of the Research Organization:						
a. Dollars per Professional Technical Person	\$18,200	\$13,700-\$24,600	\$19,300	\$13,000-\$33,100	\$16,100	\$13,500-\$22,800
b. Dollars per Research Organization Employee	\$7,200	\$3,700- \$9,400	\$6,700	\$5,400- \$7,900	\$7,400	\$6,200- \$9,500
4. Capital Expenditures (excluding Land and Buildings):						
a. Dollars per Professional Technical Person	\$600	\$300- \$1,400	\$700	\$0- \$3,400	\$600	\$200- \$1,700
b. % of Spending to Support All Activities of the Research Organization	3.3%	1.3%- 7.0%	1.9%	0.0%- 5.6%	3.4%	1.1%- 7.5%
5. NOT APPLICABLE						
6. Total Number of Professional Technical Persons: % of Total Number of Research Organization Employees	43.7%	34.4%- 55.0%	40.0%	20.0%- 62.4%	43.0%	33.9%- 53.8%
1952						
1. Spending to Support All Activities of the Research Organization: % of Net Sales	1.6%	0.8%- 3.5%	0.2%	0.2%- 1.3%	0.9%	0.6%- 1.7%
2. Distribution of Spending to Support All Activities of the Research Organization:						
a. To Carry on Research	84.8%	70.1%- 94.0%	84.6%	51.3%-100.0%	86.9%	69.5%- 95.3%
b. To Provide Technical Service	9.7	3.1 - 21.0	9.4	0.0 - 16.1	7.2	2.3 - 15.4
c. To Carry on Nontechnological Activity	1.5	0.0 - 5.9	0.0	0.0 - 3.1	0.0	0.0 - 5.6
3. Spending to Support All Activities of the Research Organization:						
a. Dollars per Professional Technical Person	\$18,700	\$14,800-\$24,900	\$19,800	\$12,700-\$34,100	\$16,300	\$14,300-\$22,700
b. Dollars per Research Organization Employee	\$8,400	\$7,100- \$9,900	\$7,100	\$5,500- \$8,500	\$7,500	\$6,800-\$10,700
4. Capital Expenditures (excluding Land and Buildings):						
a. Dollars per Professional Technical Person	\$800	\$300- \$1,500	\$300	\$0- \$1,800	\$700	\$200- \$1,300
b. % of Spending to Support All Activities of the Research Organization	5.5%	1.5%- 6.9%	0.9%	0.0%- 1.9%	3.1%	1.3%- 7.2%
5. Replacement Cost of Research Organization Facilities per Professional Technical Person	\$21,700	\$12,500-\$34,100	\$9,200	\$5,000-\$30,600	\$17,800	\$12,500-\$32,300
6. Total Number of Professional Technical Persons: % of Total Number of Research Organization Employees	45.5%	34.7%- 55.8%	41.7%	19.8%- 68.8%	43.8%	35.3%- 56.7%

† Three firms did not report data on professional technical persons and one firm did not have a research organization; therefore the subsequent breakdown is based on 187 firms.

‡ Not all firms submitted complete reports; therefore some of the ratios are based on a smaller sample.

Source: 191-Company Survey.

**Table IV-5. SELECTED DATA ON INDUSTRIAL RESEARCH ORGANIZATIONS,
CLASSIFIED BY SIZE (Concluded)**

30-50 Professional Technical Persons			50-75 Professional Technical Persons			75-150 Professional Technical Persons			150-500 Professional Technical Persons			500 Professional Technical Persons and Over		
Median Figures	Middle Range Figures		Median Figures	Middle Range Figures		Median Figures	Middle Range Figures		Median Figures	Middle Range Figures		Median Figures	Middle Range Figures	
1961														
23	—		23	—		32	—		85	—		19	—	
1.8%	1.0%— 3.5%		2.6%	1.3%— 3.2%		1.8%	0.8%— 3.3%		1.9%	0.7%— 4.3%		1.9%	1.3%— 4.6%	
85.6%	56.3%— 93.3%		81.4%	72.4%— 93.7%		80.8%	73.2%— 88.4%		83.6%	67.3%— 98.5%		85.6%	65.4%— 96.8%	
13.3	0.0 — 24.1		14.6	3.1 — 25.7		14.8	6.4 — 22.7		12.1	6.8 — 24.5		6.4	1.5 — 29.4	
2.5	0.0 — 8.7		0.8	0.0 — 6.3		2.6	0.3 — 5.6		2.5	0.0 — 7.7		0.0	0.0 — 3.2	
\$17,800	\$13,000—\$28,800		\$17,900	\$14,000—\$21,400		\$17,400	\$15,800—\$22,500		\$17,400	\$14,200—\$23,100		\$21,150	\$17,350—\$27,500	
\$7,800	\$6,300— \$9,800		\$7,900	\$6,100— \$9,400		\$7,800	\$6,600— \$8,900		\$8,200	\$7,400— \$9,400		\$8,400	\$7,500—\$10,000	
\$500	\$100— \$1,400		\$500	\$300— \$900		\$700	\$450— \$1,800		\$800	\$400— \$1,300		\$500	\$200— \$1,000	
2.7%	1.0%— 8.3%		2.6%	1.4%— 4.8%		3.9%	2.2%— 7.3%		4.1%	2.2%— 7.7%		2.4%	1.0%— 3.4%	
53.9%	37.0%— 57.7%		47.7%	34.5%— 55.6%		42.3%	33.8%— 52.8%		47.9%	38.7%— 53.2%		40.5%	31.9%— 46.9%	
1962														
2.0%	1.2%— 3.8%		2.3%	1.5%— 4.1%		1.6%	0.9%— 3.4%		2.4%	0.7%— 5.1%		2.9%	2.1%— 10.7%	
86.7%	57.8%— 91.8%		84.8%	75.2%— 92.8%		82.3%	73.2%— 91.2%		81.8%	67.0%— 89.6%		82.4%	64.5%— 96.4%	
9.7	0.0 — 22.0		13.7	2.7 — 22.4		11.3	5.5 — 22.4		12.9	5.1 — 24.2		8.5	2.3 — 28.4	
7.2	0.0 — 10.7		1.2	0.0 — 4.9		3.1	0.4 — 5.8		2.5	0.0 — 7.4		0.8	0.0 — 3.5	
\$20,100	\$15,500—\$32,800		\$17,300	\$14,600—\$22,500		\$18,500	\$15,200—\$23,400		\$17,800	\$16,000—\$22,700		\$24,600	\$21,300—\$31,300	
\$8,600	\$7,200—\$10,400		\$8,600	\$7,000—\$10,500		\$8,500	\$6,900—\$9,300		\$8,700	\$8,000—\$10,000		\$9,200	200—\$10,400	
\$1,000	\$300— \$1,800		\$800	\$400— \$1,300		\$800	\$300— \$1,800		\$1,000	\$500— \$1,500		\$800	\$200— \$1,100	
3.9%	1.6%— 8.7%		2.9%	1.4%— 7.1%		4.2%	2.3%— 7.2%		4.4%	2.4%— 7.2%		2.4%	1.0%— 4.3%	
\$22,200	\$9,100—\$44,900		\$26,000	\$14,600—\$33,300		\$23,000	\$9,600—\$34,100		\$22,800	\$18,200—\$30,600		\$24,700	\$16,200—\$34,600	
56.0%	34.3%— 58.1%		48.9%	34.5%— 63.5%		45.5%	37.1%— 54.8%		49.5%	39.5%— 54.6%		38.8%	32.4%— 43.7%	

**Table IV-4. SELECTED DATA ON THE ACTIVITIES OF INDUSTRIAL RESEARCH ORGANIZATIONS,
CLASSIFIED BY INDUSTRY**
(Ratios Computed from Aggregate Amounts)

Items	All Firms	Food and Kindred Products	Food except Beverages	Textile and Apparel	Furniture
1951					
Number of Reporting Firms ¹	191	12	9	5	5
Net Sales of Reporting Firms ² (in millions)	\$51,928	\$8,396	\$7,548	\$364	\$169
Total Number of Professional Technical Persons ²	39,118	1,283	1,115	470	35
1. Spending to Support All Activities of the Research Organization: % of Net Sales	1.6%	0.2%	0.2%	1.2%	0.6%
2. Distribution of Spending to Support All Activities of the Research Organization:					
a. To Carry on Research	82.1%	79.1%	81.8%	80.5%	62.3%
b. To Provide Technical Service	13.0	15.0	14.5	15.2	19.4
c. To Carry on Nontechnological Activity	4.9	5.0	3.7	4.3	18.3
3. Spending to Support All Activities of the Research Organization:					
a. Dollars per Professional Technical Person	\$21,700	\$15,500	\$15,500	\$21,400	\$29,700
b. Dollars per Research Organization Employee	\$8,600	\$7,100	\$7,100	\$6,600	\$8,100
4. Capital Expenditures (excluding Land and Buildings):					
a. Dollars per Professional Technical Person	\$1,100	\$700	\$700	\$6,300	\$600
b. % of Spending to Support All Activities of the Research Organization	4.7%	4.4%	4.2%	29.4%	2.1%
5. NOT APPLICABLE					
6. Total Number of Professional Technical Persons: % of Total Number of Research Organization Employees	39.6%	46.0%	46.0%	2.8%	20.6%
1952					
Net Sales of Reporting Firms ² (in millions)	\$52,027	\$8,710	\$7,955	\$762	\$185
Total Number of Professional Technical Persons ²	44,224	1,367	1,217	534	40
1. Spending to Support All Activities of the Research Organization: % of Net Sales	1.9%	0.2%	0.2%	1.5%	0.6%
2. Distribution of Spending to Support All Activities of the Research Organization:					
a. To Carry on Research	82.2%	79.2%	81.0%	83.2%	63.9%
b. To Provide Technical Service	12.3	14.8	14.3	13.1	17.9
c. To Carry on Nontechnological Activity	5.5	6.0	4.7	3.7	18.2
3. Spending to Support All Activities of the Research Organization:					
a. Dollars per Professional Technical Person	\$22,800	\$15,900	\$16,200	\$21,000	\$29,600
b. Dollars per Research Organization Employee	\$9,200	\$7,800	\$7,800	\$7,600	\$8,500
4. Capital Expenditures (excluding Land and Buildings):					
a. Dollars per Professional Technical Person	\$1,100	\$800	\$600	\$4,800	\$200
b. % of Spending to Support All Activities of the Research Organization	4.5%	3.6%	3.6%	22.8%	0.8%
5. Replacement Cost of Research Organization Facilities per Professional Technical Person	\$25,100	\$33,700	\$34,900	\$50,700	*
6. Total Number of Professional Technical Persons: % of Total Number of Research Organization Employees	40.2%	48.3%	48.3%	36.3%	21.9%

* Insufficient data available to warrant setting figures.

¹ Not all firms submitted complete reports; therefore some of the ratios are based on a smaller sample.

² Figures for some companies were estimated.

Source: 191-Company Survey.

Table IV-6. SELECTED DATA ON THE ACTIVITIES OF INDUSTRIAL RESEARCH ORGANIZATIONS.
CLASSIFIED BY INDUSTRY (Continued)
(Ratios Computed from Aggregate Amounts)

Paper, Lumber, and Wood Products	Paper and Allied Products	Chemicals and Allied Products	Industrial Chemicals	Drugs	Paints	Miscel- laneous Chemicals	Petroleum and Coal Products
1951							
14	10	41	13	9	5	10	15
\$940	\$685	\$5,607	\$3,902	\$727	\$50	\$480	\$13,042
329	269	9,625	6,814	1,622	117	616	5,292
6.8%	0.9%	3.5%	3.6%	4.6%	2.6%	2.3%	0.8%
66.4%	61.1%	85.5%	85.6%	85.8%	54.6%	89.9%	67.3%
26.1	30.1	9.2	8.6	10.4	35.2	7.1	25.9
7.5	8.8	5.3	5.8	3.8	10.2	3.0	9.8
\$21,500	\$22,200	\$30,100	\$20,600	\$20,800	\$11,300	\$13,100	\$20,700
\$10,000	\$10,800	\$9,100	\$9,300	\$9,800	\$5,800	\$6,900	\$8,600
\$1,900	\$1,300	\$1,300	\$1,200	\$1,900	\$400	\$1,100	\$800
9.0%	5.7%	6.5%	5.8%	9.1%	3.9%	8.5%	4.0%
46.9%	48.5%	41.5%	45.3%	47.1%	51.8%	38.3%	41.5%
1952							
\$916	\$659	\$5,748	\$3,989	\$722	\$48	\$498	\$13,860
350	291	10,472	7,424	1,775	125	676	5,750
0.9%	1.0%	3.9%	4.1%	5.1%	3.2%	2.5%	0.9%
66.6%	61.9%	85.6%	85.3%	88.7%	54.1%	88.3%	68.5%
26.0	29.5	9.2	9.0	7.6	35.0	8.4	24.9
7.4	8.6	5.2	5.7	3.7	10.9	3.3	6.6
\$22,600	\$23,400	\$21,600	\$22,700	\$20,700	\$12,200	\$18,400	\$21,900
\$10,500	\$11,100	\$9,800	\$10,100	\$10,200	\$6,100	\$7,300	\$9,100
\$900	\$900	\$1,400	\$1,200	\$1,700	\$400	\$1,600	\$900
3.8%	3.9%	6.3%	5.3%	8.3%	3.6%	9.1%	3.8%
\$23,600	\$23,500	\$27,800	\$26,600	\$34,900	\$16,400	\$21,900	\$26,600
46.2%	47.4%	45.3%	44.4%	49.4%	50.4%	39.6%	41.6%

**Table IV-a. SELECTED DATA ON THE ACTIVITIES OF INDUSTRIAL RESEARCH ORGANIZATIONS,
CLASSIFIED BY INDUSTRY (Continued)
(Ratios Computed from Aggregate Amounts)**

Items	Petroleum Products	Rubber	Stone, Clay, and Glass	Primary Metal	Fabricated Metal
1951					
Number of Reporting Firms ¹	13	7	6	11	8
Net Sales of Reporting Firms ² (in millions)	\$12,870	\$2,281	\$901	\$3,040	\$1,933
Total Number of Professional Technical Persons ²	5,210	3,330	838	1,052	931
1. Spending to Support All Activities of the Research Organization: % of Net Sales	0.9%	1.5%	2.1%	0.6%	0.9%
2. Distribution of Spending to Support All Activities of the Research Organization:					
a. To Carry on Research	67.3%	63.3%	69.5%	78.7%	57.5%
b. To Provide Technical Service	26.1	35.3	27.2	18.4	37.3
c. To Carry on Nontechnological Activity	6.6	0.4	3.3	2.9	5.2
3. Spending to Support All Activities of the Research Organization:					
a. Dollars per Professional Technical Person	\$20,600	\$10,300	\$22,000	\$17,700	\$18,000
b. Dollars per Research Organization Employee	\$8,500	\$8,300	\$6,500	\$8,200	\$9,100
4. Capital Expenditures (excluding Land and Buildings):					
a. Dollars per Professional Technical Person	\$800	\$200	\$1,100	\$1,500	\$600
b. % of Spending to Support All Activities of the Research Organization	3.9%	2.6%	4.9%	8.4%	3.2%
5. NOT APPLICABLE					
6. Total Number of Professional Technical Persons: % of Total Number of Research Organization Employees	41.1%	90.4%	29.3%	46.2%	50.6%
1952					
Net Sales of Reporting Firms ² (in millions)	\$13,470	\$2,336	\$891	\$2,926	\$1,935
Total Number of Professional Technical Persons ²	5,618	3,709	868	1,183	1,035
1. Spending to Support All Activities of the Research Organization: % of Net Sales	0.9%	1.7%	2.1%	0.7%	1.0%
2. Distribution of Spending to Support All Activities of the Research Organization:					
a. To Carry on Research	68.2%	63.9%	68.7%	80.8%	58.0%
b. To Provide Technical Service	25.3	35.7	27.4	16.2	36.9
c. To Carry on Nontechnological Activity	6.5	0.4	3.9	3.0	5.1
3. Spending to Support All Activities of the Research Organization:					
a. Dollars per Professional Technical Person	\$22,000	\$10,500	\$21,900	\$17,000	\$18,100
b. Dollars per Research Organization Employee	\$9,100	\$8,300	\$7,500	\$8,000	\$9,300
4. Capital Expenditures (excluding Land and Buildings):					
a. Dollars per Professional Technical Person	\$900	\$300	\$1,200	\$1,000	\$900
b. % of Spending to Support All Activities of the Research Organization	3.9%	2.8%	5.3%	6.1%	4.9%
5. Replacement Cost of Research Organization Facilities per Professional Technical Person	\$31,000	\$6,100	\$36,200	\$26,900	\$28,400
6. Total Number of Professional Technical Persons: % of Total Number of Research Organization Employees	41.4%	79.2%	34.3%	47.1%	51.4%

¹ Not all firms submitted complete reports; therefore some of the ratios are based on a smaller sample.

² Figures for some companies were estimated.

Source: 191-Company Survey.

**Table IV-6. SELECTED DATA ON THE ACTIVITIES OF INDUSTRIAL RESEARCH ORGANIZATIONS,
CLASSIFIED BY INDUSTRY (Concluded)
(Ratios Computed from Aggregate Amounts)**

Machinery except Electrical	Electrical Machinery	Transportation Equipment	Aircraft	Professional, Scientific, and Controling Instruments	Laboratory Instruments	Mechanical Instruments	Other Professional, Scientific & Controling Instruments
1951							
12	9	10	5	19	6	5	8
\$2,675	\$6,097	\$4,265	\$1,012	\$824	\$285	\$196	\$343
2,349	4,937	5,574	4,661	2,095	1,232	244	619
3.0%	1.9%	4.4%	13.8%	6.2%	13.5%	2.0%	2.6%
84.5%	87.2%	88.6%	87.7%	93.4%	96.0%	71.6%	91.6%
12.1	11.1	3.5	2.1	6.3	3.9	27.4	7.4
3.4	1.7	7.9	10.2	0.3	0.1	1.0	1.0
\$21,500	\$23,500	\$33,200	\$30,000	\$25,000	\$31,200	\$15,800	\$15,500
\$7,800	\$8,600	\$8,800	\$8,400	\$9,800	\$10,300	\$3,300	\$8,900
\$800	\$600	\$900	\$400	\$1,800	\$900	\$300	\$4,300
2.8%	2.3%	2.5%	1.2%	7.0%	2.7%	1.6%	28.0%
36.5%	26.5%	26.4%	27.9%	39.3%	32.8%	52.3%	55.2%
1952							
\$2,766	\$7,045	\$4,329	\$1,618	\$992	\$432	\$189	\$271
2,798	5,808	6,785	5,525	2,524	1,540	258	726
2.3%	2.1%	5.2%	11.1%	6.2%	10.7%	2.3%	3.0%
86.2%	86.6%	85.6%	85.0%	92.8%	95.2%	69.3%	91.9%
10.5	11.8	2.4	1.5	6.9	4.7	29.7	7.0
3.3	1.6	11.0	13.5	0.3	0.1	1.0	1.1
\$22,400	\$25,700	\$33,100	\$32,400	\$24,800	\$30,000	\$16,800	\$16,200
\$8,300	\$9,400	\$9,300	\$9,400	\$9,900	\$10,100	\$8,900	\$9,500
\$500	\$600	\$1,200	\$600	\$1,300	\$700	\$400	\$2,800
1.9%	2.4%	3.6%	2.1%	5.0%	2.4%	2.6%	17.1%
\$18,700	\$18,900	\$29,900	\$25,100	\$13,000	\$11,800	\$16,000	\$13,800
37.8%	36.7%	28.0%	29.0%	39.6%	33.6%	52.7%	56.2%

APPENDIX A

QUESTIONNAIRE AND INSTRUCTIONS FOR 4,800-COMPANY SURVEY

Total Number of Employees	Industry Code Number (Use Attached List)
	Yes No
1. Did your company spend any money for research-development in 1952?	
2. Did your company spend more than \$5,000 for research-development in 1952?	
3. Did your company maintain a research-development laboratory in 1952?	

The following definitions and instructions are given as an aid to completing the questionnaire.

Total Number of Employees

The total number of persons employed by your company in all its activities as of December 31, 1952. This figure will be used to place your company's report in the proper size group.

Industry Code

A coded list of industries is given below. From this list select the *ONE* industry that accounted for the *major* portion of your company's activity in 1952. Ascertain the code number for this industry and record this number in the space provided on the card. This item will be used to place your company's report in the proper industry group.

Research-Development

Research-Development includes basic and applied research in the sciences (including medicine), and in engineering; and design and development of prototypes and processes. It does not include quality control, product testing, market research, sales promotion, sales service, and research in the social sciences and psychology.

Research-Development Laboratory

A research-development laboratory is a distinct organization unit, headed by a person often called a "director." It is responsible for the development of new or improved products and processes and for research that will ultimately lead to new products and processes. Organization units which are primarily engaged in quality control, customer service, and market research are *not*, according to this definition, research-development laboratories.

Industry Code

- 1 Ordnance and Accessories
- 2 Beverages
- 3 Food other than Beverages
- 4 Tobacco
- 5 Textile and Apparel
- 6 Lumber and Wood
- 7 Furniture
- 8 Paper
- 9 Printing
- 10 Organic and Inorganic Chemicals
- 11 Drugs
- 12 Soaps
- 13 Paints
- 14 Miscellaneous Chemicals
- 15 Petroleum Products
- 16 Rubber
- 17 Leather
- 18 Stone, Clay, and Glass
- 19 Primary Metal
- 20 Fabricated Metal
- 21 Machinery (except Electrical)
- 22 Communication Equipment
- 23 Other Electrical Machinery
- 24 Motor Vehicles
- 25 Aircraft
- 26 Other Transportation Equipment
- 27 Laboratory Instruments
- 28 Mechanical Instruments
- 29 Other Professional, Scientific, and Controlling Instruments
- 30 Miscellaneous Manufacturing
- 31 Coal

March 13, 1953

APPENDIX B

QUESTIONNAIRE SCHEDULE FOR 1,450-COMPANY SURVEY

SURVEY OF INDUSTRIAL RESEARCH AND DEVELOPMENT			
This questionnaire is concerned with all scientific research and development¹ conducted by your company and its divisions. In order to avoid duplication, please exclude all subsidiaries and affiliates.		INSTRUCTIONS 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, engineering, 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 year correct 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 1-2 (available for induction) OR 2-A (deferred because of civilian employment) Only males between the ages of 18 and 24 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.			

DD FORM 148
1 MAY 52

(Classified Only When Data Is Entered)

CONFIDENTIAL SECURITY INFORMATION

* Questions used in this Bulletin.

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		MANUFACTURING (Cont'd)	
(101) ☐	COMMERCIAL CONSULTING FIRMS	(501) ☐	PRODUCTS OF PETROLEUM AND COAL:
(110) ☐	NONPROFIT RESEARCH AGENCIES	(51) ☐	PETROLEUM
(120) ☐	BUSINESS TRADE ASSOCIATIONS	(52) ☐	COAL
	Mining:	(53) ☐	RUBBER PRODUCTS
(20) ☐	COAL, METALLIC AND NON-METALLIC MINERALS	(54) ☐	LEATHER AND LEATHER PRODUCTS
(71) ☐	CRUDE PETROLEUM AND NATURAL GAS	(55) ☐	STONE, CLAY AND GLASS PRODUCTS
(22) ☐	RAILROADS	(56) ☐	PRIMARY METAL INDUSTRIES
(23) ☐	APPLIANCES	(57) ☐	FABRICATED METAL PRODUCTS (except ordnance, machinery, and transportation equipment)
(24) ☐	PUBLIC UTILITIES	(58) ☐	MACHINERY (except electrical)
(25) ☐	TELECOMMUNICATION, RADIO AND TELEVISION BROADCASTING	(59) ☐	ELECTRICAL MACHINERY, EQUIPMENT AND SUPPLIES:
(31) ☐	ALL OTHER NON-MANUFACTURING	(60) ☐	COMMUNICATION EQUIPMENT
	MANUFACTURING	(61) ☐	OTHER ELECTRICAL MACHINERY, EQUIPMENT AND SUPPLIES
(41) ☐	ORDNANCE AND ACCESSORIES		TRANSPORTATION EQUIPMENT:
(42) ☐	FOOD AND KINDRED PRODUCTS	(70) ☐	MOTOR VEHICLES AND MOTOR VEHICLE EQUIPMENT
(43) ☐	TOBACCO	(71) ☐	AIRCRAFT AND PARTS
(44) ☐	TEXTILE MILL PRODUCTS AND APPAREL	(72) ☐	RAILROAD EQUIPMENT
(45) ☐	LUMBER AND WOOD PRODUCTS (except furniture)	(73) ☐	OTHER TRANSPORTATION EQUIPMENT
(46) ☐	FURNITURE AND FIXTURES		PROFESSIONAL, SCIENTIFIC AND CONTROLLING INSTRUMENTS:
(47) ☐	PAPER AND ALLIED PRODUCTS	(80) ☐	SCIENTIFIC INSTRUMENTS
(48) ☐	PRINTING, PUBLISHING AND ALLIED INDUSTRIES	(81) ☐	PHOTOGRAPHIC EQUIPMENT AND SUPPLIES
	CHEMICALS AND ALLIED PRODUCTS:	(82) ☐	OTHER PROFESSIONAL, SCIENTIFIC AND CONTROLLING INSTRUMENTS
(40) ☐	INDUSTRIAL INORGANIC AND ORGANIC CHEMICALS	(90) ☐	ALL OTHER MANUFACTURING
(41) ☐	DRUGS AND MEDICINES		
(42) ☐	SOAP, CLEANERS, ETC.		
(43) ☐	PAINT, VARNISH, LACQUER AND INORGANIC PIGMENTS		
(44) ☐	OTHER CHEMICAL PRODUCTS		

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

APPENDIX C **QUESTIONNAIRE AND INSTRUCTIONS FOR 191-COMPANY SURVEY**

Strictly Confidential

DIVISION OF RESEARCH HARVARD GRADUATE SCHOOL OF BUSINESS ADMINISTRATION SURVEY OF INDUSTRIAL RESEARCH AND DEVELOPMENT SPENDING

	PARTICULARS	1951 Actual*		1952 Estimated*	
		By Research and Development Organization (a)	By Other Units (b)	By Research and Development Organization (c)	By Other Units (d)
Line 1	Spending to Support Activities of the Research-Development Organization				
Line 2	Less: Nontechnological Activity				
Line 3	Less: Technical Service				
Line 4	Spending for Research-Development Done within Company				
Line 5	Less: Research-Development for Government				
Line 6	Less: Research-Development for All Others				
Line 7	Spending for Company Oriented Research-Development Done within Company				
	Add: Company Support of Technical and Scientific Programs in:				
Line 8	(a) Nonprofit Research-Development Organizations				
Line 9	(b) Other Noncompany Research-Development Organizations				
Line 10	Total Company Funds Committed to Research-Development				

BREAKDOWN OF COMPANY FUNDS COMMITTED TO RESEARCH-DEVELOPMENT BY OBJECTIVE SOUGHT

Line 11	To Improve Present Products or Processes				
Line 12	To Create New Products or Processes				
Line 13	To Support Programs Uncommitted to Specific Problems				

SELECTED DATA

Line 14	Capital Expenditures for Land and Buildings				
Line 15	All Other Capital Expenditures				
Line 16	Operation of Pilot Plants or Semi-works Plants				
Line 17	Depreciation Charges Included in Line 4				
Line 18	Number of Professional Technical Persons				
Line 19	Number of Direct Research-Development Employees				
Line 20	Total Number of Employees of the Research-Development Organization				
		1951		1952	
Line 21	Net Sales of the Company				
Line 22	Net Profit of the Company				
Line 23	Net Profit plus Provision for Income Taxes				
Line 24	Total Employees of the Company				
Line 25	Estimated Cost to Replace Present Research-Development Facilities				

*Round dollar figures to the nearest thousands but do not round data on Lines 18, 19, 20, and 24.

DEFINITIONS AND INSTRUCTIONS

INTRODUCTION

The purposes of this study are as follows: to recommend a definition of research-development that can be used for statistical and accounting purposes; to collect, in accordance with this definition, data on research-development spending by industrial firms in 1951 and planned spending for 1952; and to present the information in a manner that permits each company to compare readily its spending with typical amounts spent by companies of similar size in the same industry.

Significant variations in company practices affect the figure reported as cost of research-development. Two of the most significant variables are (1) a determination of the activities of laboratory personnel and other technical groups that are considered by the company to be research-development, and (2) those specific expense elements which are either included or excluded when the cost of research-development is being accumulated. Unless all companies treat the important variables the same way, the data will not be comparable. Therefore, the instructions for filling out the questionnaire are given in considerable detail.

Of paramount importance are total company funds committed to support of research-development (Line 10 on the questionnaire). In many companies development, and sometimes research,

is carried on by laboratories and technical groups that are not a part of the *Company's* formal research-development organization. In order to include all the research-development of the company, we request that the data be reported in two categories: (1) spending by or on behalf of the **Research-Development Organization** (defined on page 3 and perhaps different from your formally designated research-development organization); and (2) spending by **Other Units** within the company that do some research-development. This spending is to be reported separately from that of the research-development organization.

Information is requested about the actual 1951 spending and estimated 1952 spending. If your records are kept on a fiscal-year basis, report in the 1951 column figures for that fiscal year which ends within the period, July 1, 1951 to June 30, 1952. Columns (a) and (c) are to be used in reporting 1951 and 1952 figures, respectively, for the research-development organization. Columns (b) and (d) are to be used for reporting 1951 and 1952 figures, respectively, for other units within the company. No data are requested in crosshatched boxes. Do not ignore a box. When the proper reply is "None," please enter the word "None," in the box.

GENERAL DEFINITIONS

I. The Company

Whenever the word "**Company**" appears in this survey, it refers to the sum of the organizations which are consolidated for the preparation of reports to stockholders, or which would be consolidated, were such reports prepared. Subsidiaries which are not consolidated are not company organizations for purposes of this survey. When a research-development organization is a separate corporation, the word "**Company**" does not include only that organization.

II. Research-Development Organization

This is the organization (or organizations) in your company that has research-development as its chief responsibility. This organization may be a department or departments, a division or divisions, or it may be a separate legal entity. It may operate more than one laboratory, some of which may be physically located in operating units. Laboratories and technical groups that are not part of your formally designated **Research-Development Organization** should be in-

cluded, even though they are located in a manufacturing facility and administratively responsible to an officer other than the person chiefly responsible for research-development, if such laboratories and technical groups have the following characteristics:

- (1) They are distinct *organization units*.
- (2) Over 50% of their effort is directed toward research-development rather than quality control, referee testing, technical inspection, and other nonresearch-development activity.

III. Other Units

These include plant laboratories and technical groups that do some research-development but have another function, such as technical service, for their primary responsibility. The cost of research-development activities of **Other Units** should be estimated for 1951 and forecast for 1952 and reported under Columns (b) and (d); these figures should include *only* research-development costs—and *not* all the costs of all the activities of these **Other Units**.

IV. Research-Development

For the purposes of this questionnaire, **Research-Development** includes activities carried on by persons trained, either formally or by experience, in the disciplines and techniques of the physical sciences including related engineering, and the biological sciences including medicine but excluding psychology, *if* the purpose of such activity is to do one or more of the following things:

- (1) Pursue a planned search for new knowledge, whether or not the search has reference to a specific application.
- (2) Apply existing knowledge to problems involved in the creation of a new product or process, including work required to evaluate possible uses.
- (3) Apply existing knowledge to problems involved in the improvement of a present product or process.

The following kinds of activity are included:

- (1) Laboratory scale activity.
- (2) The design and operation of pilot plants or semi-works plants so long as the *principal*

purposes are to obtain experience and to compile engineering and other data to be used as follows:

- (a) in evaluating hypotheses,
 - (b) in writing product formulas or in establishing finished product specifications,
 - (c) in designing special equipment and structures required by a process, and
 - (d) in preparing operating instructions or manuals.
- (3) The engineering activity required to advance the design of a product or a process to the point where it meets specific functional and economic requirements and can be turned over to manufacturing units. The design, construction, and testing of preproduction prototypes and models and "engineering follow-through" in the early production phase is included. The development of designs for special manufacturing equipment and tools is included but tool making and tool tryout are *not* included.
 - (4) The preparation of reports, drawings, formulas, specifications, standard practice instructions or operating manuals, and other media for transmitting to operating units information obtained from the above activities. However, the production of detailed construction drawings or manufacturing blueprints is *not* included.
 - (5) The development of designs for special scientific instruments for process control, exploration (for example, the airborne magnetometer) and for other similar purposes.

Do not include costs incurred to carry on geophysical and geological exploration activities.

The **Cost** of research-development includes, *in addition to* salaries of persons engaged in the activities above, *other direct costs* associated with their work, and the *costs of servicing and supporting them*, as defined more fully on pages 40 and 41.

V. Nonresearch-Development

The following activities are *nonresearch-development* activities, for purposes of this survey:

- (1) **Nontechnological Activities**, including the following:

- (a) Market Research, including surveys of product acceptance, estimates of market size, and studies of channels of distribution; and Market Development, including the sale of either old or new products to obtain acceptance of them in new outlets.
 - (b) Economic Research and other research in the social sciences.
 - (c) Legal work in connection with patent applications and litigation, and the sale or licensing of patents.
- (2) **Technical Service**, including the following:
- (a) Quality and quantity control tests and analyses.
 - (b) Trouble-shooting in connection with breakdowns in full-scale production, including related analytical work.
 - (c) Technical plant sanitation control.
 - (d) Work required for minor adaptations of a specific product to meet the requirements of a specific customer, including installation and servicing in a customer's plant.
 - (e) Engineering and other technical service furnished in accordance with agreements to licensees outside the Company.
 - (f) Aid furnished by the research-development organization to manufacturing divisions to enable them to operate in accordance with previously determined formulas, standard practice instructions, or finished product specifications.
 - (g) Aid furnished to develop advertising programs and to promote or demonstrate new products or processes, including the cost of material furnished for trial or demonstration.
 - (h) Assistance in preparation of speeches and publications for persons outside the research-development organization.
 - (i) Experimental work performed at the request of the patent division to provide information needed during the prosecution of a patent litigation.
 - (j) Geophysical or geological exploration activities.

The question, "When does development end and production begin?" is often asked. This question cannot be answered in terms of organizational responsibility, or the kinds of techniques employed or skills required. If the primary objective is to make further improvements on the product or process, then the work comes within the definition of research-development. If, on the other hand, the product or process is substantially "set," and the primary objective is to develop markets or to do preproduction planning, or to get the production process going smoothly, then the work is no longer research-development. For example, if a pilot plant is used to gather information leading toward improvements in products or processes, then the cost of this work is research-development. If the pilot plant is used to turn out initial quantities of the product for the purpose of creating or enlarging the market, the costs of this work should not be considered as part of the cost of research-development.

SPECIFIC DEFINITIONS AND INSTRUCTIONS

Line 1. Spending to Support Activities of the Research-Development Organization

Include here all the costs which were incurred in 1951 and estimated for 1952 to support the activities carried on by the research-development organization, including both research-development and nonresearch-development activities. *Do not* include capital expenditures. (See page 44.)

The relevant costs usually include, but are not limited to, the elements listed below. If in your accounting system, some of these cost elements are not charged to the research-development organization, we would greatly prefer that you estimate them in order to reflect what your costs would have been had all the elements been included.

- (1) **Wages, Salaries, and Related Costs** of everyone on the payroll of the research-development organization, including over-time, holiday pay, vacation pay, bonuses of all kinds, shift premiums, supper money, benefit plan payments, pensions and retirement funds, federal and state taxes related to payroll, cost-of-living adjustments, severance pay, moving allowances, cafeteria, recreation, and other employee service activities.
- (2) **Material and Supplies Consumed** (or purchased, if consumption figures are not available).
- (3) **Utilities**, such as telephone, telegraph, electricity, water, gas, and fuel.
- (4) **Books and Periodicals** purchased.
- (5) **Travel and Entertainment** costs.
- (6) **Professional Dues**.
- (7) **Property Taxes and Other Taxes** (except income taxes) incurred on account of the research-development organization or on the facilities which the research-development organization uses.
- (8) **Insurance Expense**.
- (9) **Maintenance and Repair**, including the maintenance of buildings and grounds.
- (10) **Depreciation** on buildings, equipment, and vehicles; or **Rentals**, if any facilities are leased.
- (11) **Company Overhead**. Estimate a fair share of the cost of any functions performed outside the research-development organization which support its activities. The basis of estimating the amount is left to the judgment of the individual respondents. These functions may include, but are not limited to, the following:
 - (a) **Personnel**, including personnel, medical and safety departments, and employee or industrial relations department.
 - (b) **Accounting, Control, and Fiscal** (Treasurer's office).
 - (c) **Procurement and Inventory**, including purchasing, receiving, inspection, storage, transportation, control, and issue of material and supplies.

(d) **Other Services**, including legal, public relations, shopwork, analytical work, plant protection, rearrangement of facilities, drafting, printing, duplicating, transportation of material and personnel, maintenance of motor vehicles, messenger service, stenographic service, and photography.

(e) **Salaries and Related Costs** of research executives not on the payroll of the research-development organization.

Do not include the following items in Line 1:

- (1) *Do not include the cost of research-development carried on for the Company by non-company research-development organizations of any kind; or fellowships, grants, and gifts to promote research-development or the study of the sciences and engineering. The costs of such programs are to be reported on Lines 8 and 9.*

We recognize that some companies include such expenditures as costs of the research-development organization. We wish, however, to develop, on Line 4, the cost of supporting all research-development activity carried on *within your company*. Therefore, it is necessary that none of the costs of supporting scientific activity in noncompany research-development organizations be included in Line 1.

- (2) *Do not include here, or anywhere on the questionnaire, that part of company held research-development contracts subcontracted to noncompany research-development organizations. For example, if your company entered into a contract to do research-development for a government agency and subcontracted a part or all of this research-development to a noncompany organization, the amount of costs involved should not be included anywhere on this questionnaire, since this activity neither absorbed company funds nor required utilization of company research-development capacity.*

Research-development is considered to have been subcontracted when, and to the extent that, a *noncompany research-development organization* is the subcontractor. All

work that was done for your laboratories and other technical units by *noncompany organizations which are not research-development organizations* (for example, model construction by a noncompany model shop) is to be considered as a purchase of equipment, material, or supplies for the company research-organization rather than as sub-contracted research-development.

- (3) Do not include royalties paid, income taxes, or interest.

Deduct the following items (if significant) in Line 1:

- (1) Net income (or add the net loss) from operation of cafeteria, concessions, or vending machines.
- (2) Income from sale of products manufactured in the research-development organization if these were sold to bona-fide customers.

Do not deduct from the costs included in Line 1 any of the following items:

- (1) Royalties received from either noncompany organizations or company units.
- (2) Credits for work charged or "sold" to other departments or to subsidiaries unless they were unconsolidated subsidiaries.

Note 1: Some research-development organizations carry on nontechnological activities, defined on page 38; others do not. Some companies utilize part of the capacity of their research-development organization to provide technical service and advice to operating units and customers; others do not.

We do not wish the costs of such activities to be eliminated when Spending to Support Activities of the Research-Development Organization is calculated. We do wish to know the approximate portion of such spending that was incurred to carry out these two kinds of activities, because it indicates how the company's scientific resources are being utilized. Therefore, we request that you report these costs on Lines 2 and 3. When the cost of these activities is subtracted from the gross spending for all activities of the research-development organization, the remainder will be the cost of all research-development activity carried

out by the research-development organization, including that for all noncompany organizations.

Some companies have company technical units, which are not a part of the research-development organization but which carry on development and, perhaps, research. If this is true in your case, we request that you estimate the approximate costs for the research-development work carried on by these Other Units, as defined on page 38, and enter the amounts on Line 4, Columns (b) and (d). The horizontal addition of the amounts on Line 4 in Columns (a) and (b) gives the total cost of Research-Development Done within Company in 1951 and a similar addition of the amounts on Line 4 in Columns (c) and (d) gives the forecast cost for 1952.

Line 2. Nontechnological Activity

Show here that portion of the amount reported on Line 1 which you estimate was incurred to support nontechnological activities. Include a prorated portion of the cost of the supporting activities.

Please note that in framing the definition of nontechnological activities, we did not intend to distinguish between direct costs and the cost of supporting activities. Many persons who work for the research-development organization do not work directly on research-development projects or on technical service to operating units, or engage directly in market research, economic research, patent work, and similar kinds of work.

Some of these persons perform functions which support all the activities of the research-development organization. Examples of such functions are the following: procurement, storekeeping, maintenance, building service, accounting, stenography, and operation of machine and model shops, test facilities, or instrument laboratories. These are supporting activities. The cost of such functions is part of the cost of all the activities of the research-development organization.

Line 3. Technical Service

Show here the portion of the amount reported on Line 1 which you estimate was incurred to provide technical service as defined on page 39. Include a prorated portion of the cost of supporting activities.

Line 4. Spending for Research-Development Done within Company

Columns (a) and (c)—Show here the amount remaining when the amounts shown on Lines 2 and 3 are subtracted from Line 1.

Columns (b) and (d)—Show here the approximate cost for research-development activity carried on by company laboratories and technical groups which were not included in the research-development organizations. If these Other Units carried on research-development for noncompany organizations, include the cost of such activity. Consider the same elements of expense as outlined on pages 39 and 40, if feasible, when estimating the cost of research-development activity carried on by Other Units.

We anticipate that only rough approximations for this item may be available in some cases. We have, therefore, provided separate columns for these data so that they will not be intermingled with the data about the research-development organization.

Note 2: Next we wish to ascertain in the utilization of each firm's research-development capacity what proportion was devoted to meeting the requirements of company programs and what proportion was devoted to helping meet the requirements of the programs of noncompany organizations. Research-development done by company personnel for the government and other noncompany organizations (that is, organizations which are not a part of the Company, as defined on page 37) represents a commitment of company research-development capacity to aid such organizations in carrying out their research-development programs.

The total cost of such activity is to be subtracted from the amount shown on Line 4, Spending for Research-Development Done within Company, to arrive at company oriented research-development. The latter represents the extent of the commitment of company funds. The cost of activities which are subtracted (Lines 5 and 6) does not represent a commitment of company funds.

Line 5. Research-Development for Government

Show here the costs of research-development programs carried out *within* the company that were the result of:

- (1) Contracts to carry on specific research-development projects for government agencies, either as a prime or subcontractor.
- (2) Contracts with government agencies for the production of specific end items where the terms of the over-all contract explicitly required a defined research-development project as part of the contract. Include only the research-development costs of such contracts.

Do not include in this item any research-development undertaken by the company in connection with a government contract which did not explicitly require it, even though the nature of the specific end items was such that development and perhaps research were a prerequisite to production. Any reimbursement for the costs of this activity is received as a part of the price of the end items. For purposes of this questionnaire treat such activity as company oriented research-development.

Line 6. Research-Development for All Others

Show here the approximate portion of the spending reported on Line 4 that was required to carry out, *within the company*, research-development for all other noncompany organizations.

Please note that subsidiary companies which are not consolidated in the company's annual report (or which would not be consolidated were such reports prepared) are noncompany organizations for the purposes of the survey. If research-development was carried out for such organizations, the approximate cost should be included in this item.

If research-development to meet customer requirements was done on a contract basis requiring payment of the costs of such work, include the amounts in this item. *Do not include* other research-development undertaken for customers.

Line 7. Spending for Company Oriented Research-Development Done within Company

Line 4 less Lines 5 and 6.

Note 3: Many companies support programs in nonprofit and commercial research-development organizations. Thus the amount shown on Line 7, Spending for Company Oriented Research-Development Done within Company, will not be, in many cases, the total company funds spent to support research-development.

We wish to find out and to report for your information to what extent companies in your industry, and in industry in general, supported research-development outside the company and what this support will be in 1952. For this purpose and for the purpose of arriving at a figure for the total funds committed to support research-development, we request the data on Lines 8 and 9. None of this spending should have been included in any figures previously recorded.

Line 8. Company Support of Technical and Scientific Programs in Nonprofit Research-Development Organizations

Show here the amount of company funds spent to support programs in educational or other nonprofit research-development organizations. Examples of disbursements to be included are as follows: fellowships, grants, and gifts, as well as the cost of specific research programs supported in whole or in part at educational or other nonprofit research-development organizations. Include the items above whether or not the objectives of the program were defined.

Do not include gifts to charitable organizations, community projects, and the like.

Line 9. Company Support of Technical and Scientific Programs in Other Noncompany Research-Development Organizations

Show here the amounts spent to support programs in all other noncompany research-development organizations, such as independent commercial laboratories, industry association research institutions, or research laboratories of other industrial companies. Include fees paid to consultants.

Do not include payments made to any non-company research-development organization because a research-development contract held by your company was subcontracted for performance. This activity did not require a commitment of company funds.

Line 10. Total Company Funds Committed to Research-Development

The sum of Lines 7, 8, and 9.

Note 4: The amounts reported on Line 10, Columns (a) and (b), give the total amount of company funds spent to support research-development in 1951, both inside and outside the company. The amounts reported under Columns (c) and (d) on the same line give the forecast spending for this purpose in 1952. This spending can be viewed as having been undertaken to achieve the following broad objectives:

- (1) To improve present products or processes.*
- (2) To create new products or processes.*
- (3) To support programs uncommitted to specific problems.*

We wish to ascertain and report for your information the typical distribution of spending, in terms of these objectives, in various industry groups in 1951. Please show on Lines 11, 12, and 13, the approximate portion of the total company research-development funds that was spent to achieve each of these objectives. The sum of the amounts shown on Lines 11, 12, and 13 should be equal to the amount shown on Line 10.

Some companies do not maintain records that distinguish research-development objectives in the amount of detail implied by (1) and (2) above. We greatly prefer an estimate, in such cases, to no answer. If you feel that even a reasonable estimate cannot be made, please show a lump sum figure for Lines 11 and 12 taken together, but do not combine Line 13 spending with Lines 11 and 12.

Line 11. To Improve Present Products or Processes

Show here the approximate portion of company funds committed to research-development (Line 10) that was spent to improve present products or processes. This estimate should in-

clude both the direct costs and supporting costs of this program.

Present Products are those products that have been accepted by operating units for manufacture in full-scale facilities and that are being, or are about to be, sold as a part of the company's regular product line. Do not include work on products being sold to selected customers on an experimental basis. **Present Processes** are processes which are being utilized in full-scale manufacturing facilities. The purpose of work included in this category has been described as the attempt to "keep up with the competition."

Some examples of the kinds of projects that should be included are those which seek the following objectives:

- (1) The reduction of the present amount of waste product produced by a process.
- (2) The improvement of the quality of a product manufactured by a present process.
- (3) The reduction of the danger of utilization of a present process.
- (4) The adaptation, without significant change in its technological characteristics, of a present process or product to new uses.
- (5) The development of a new annual model (for example, television receivers with increased picture area) where there is not a significant technological difference between the new model and its predecessor. The product generally will continue to perform the same function or provide the same service.

Line 12. To Create New Products or Processes

Show here the approximate portion of company funds committed to support research-development (Line 10) which was spent to *create* new products or processes. In general, the amount shown here should represent the costs of all projects or programs, other than those covered on Line 11, that were intended, at their inception, to solve specific problems. Include the costs of these research-development projects whether successful, in progress, or abandoned. Examples of these types of programs include the development of a product or process with the following characteristics:

- (1) It performs a function or service different from that performed by present products, in contrast to an increase in the capability of a present product to perform satisfactorily a function or service now being performed by the product or process.
- (2) It creates a new model or type of product with significantly different technological characteristics from its predecessor (for example, color television contrasted with black and white television), even though the product performs essentially the same function or service.
- (3) It permits utilization of different raw materials or discovers new uses for previously wasted products.
- (4) It requires utilization of new and *different* manufacturing facilities.

Line 13. To Support Programs Uncommitted to Specific Problems

Show here the approximate portion of company funds committed to support research-development (Line 10) which was spent in behalf of programs which could not be identified with specific product or process applications. This estimate should include both the direct cost and supporting costs of these programs. The primary objective of programs to be included here should have been to add to the over-all scientific knowledge of the firm. Although all the activity of the research program cannot help but meet this objective in varying measure, the activity to be included here is distinguished from that included on Lines 11 and 12 in that, *at its inception*, the primary purpose was to add to the over-all knowledge of the firm rather than to solve a specific problem. The fact that there was full expectation of future use of the information obtained from such programs does not exclude them from this item. In general, this item will include fundamental research, basic research, and all other research-development that cannot be assigned to a particular product, product line, or process.

Lines 14 and 15. Capital Expenditures

Up to this point the questionnaire has been concerned with *costs* of the research-development program. On Lines 14 and 15 we request infor-

mation on **Capital Expenditures**, defined here exactly as you define them for federal income tax purposes. None of the expenditures reported on Lines 14 and 15 should have been included in the amounts previously recorded on the questionnaire, although depreciation expense relating to them should have been included.

Do not include capital expenditures that were required to utilize the results of successful research. Confine the amounts to those expended in 1951, and anticipated in 1952, to house and equip research-development activities of the research-development organization only.

Do not include the capitalized portion of the cost of research projects. Such costs should have been included in the data already recorded.

Do not estimate these items for Other Units.

Line 16. Operation of Pilot Plants or Semi-works Plants

A factor which influences the validity of inter-company comparisons of the cost of research-development is the amount of pilot plant or semi-works plant operating cost that is included. For certain statistical treatment, we wish to have this cost isolated.

Show on Line 16 the estimated cost of operating pilot plants or semiworks plants to the extent that these costs were included in the amounts reported on Line 4.

Line 17. Depreciation Charges Included in Line 4

Since facilities used by different research-development organizations are not of uniform type or age, variations in reported spending may occur because depreciation rates are applied to noncomparable cost bases (when depreciation is estimated). For certain statistical treatment of the data, we wish to isolate this cost element.

Show on Line 17, Columns (a) and (c) the approximate charge for depreciation that was included in the amount reported on Line 4 under these columns; that is, as part of the spending of the research-development organization. Do not estimate this item for Other Units.

Note 5: We wish to calculate research-development expense per research-development organization employee, per research-development worker,

and per professional technical person. For these calculations we need the full-time equivalent number of persons, in these classifications, employed during the year. Please record this information on Lines 18, 19, and 20.

By full-time equivalent we mean the number of man-years of employment during the year, with part-time employees being converted to the equivalent number of full-time persons on the basis of a normal work-week, month, or other convenient basis of conversion. The figure should represent average employment during the year, rather than employment on any given date.

Line 18. Number of Professional Technical Persons

Use "professional" as the term is used in the Wages and Hours Act. A professional man must meet all the following requirements: (a) he must have a salary of not less than \$75 per week; (2) his work must be predominantly intellectual and varied in character, must require the exercise of judgment, and must be of such character that it cannot be standardized; (3) he must spend not more than 20% of his working hours in activities not essential or incidental to his professional work; and (4) his work must require knowledge normally obtained by advanced study, or must be predominantly creative or original in character. If a man engaged in professional type work is paid \$100 per week, or more, he can be considered professional, if he has the equivalent of a bachelor's degree in science or engineering, and meets requirements (2) and (3) above.

The word "technical" is used to designate persons trained in science and engineering, as distinguished from, for example, lawyers, who are professional but not technical.

For the Research-Development Organization [Columns (a) and (c)] report the full-time equivalent of *all* professional technical persons, whether their primary duties required them to engage directly in research-development or whether they were engaged primarily in supervision and administration.

For Other Units [Columns (b) and (d)] estimate the full-time equivalent professional technical persons whose services were required, either as active researchers, or as administrators, for

the research-development activities *only* of these Other Units.

Line 19. Number of Direct Research-Development Employees

Direct Research-Development Workers are *all* persons carrying on technical work on research-development problems (including persons who do some supervisory work but whose primary responsibility is to carry on technical work.) Include here those persons previously included on Line 18 whose work is primarily technical.

Line 20. Total Number of Employees of the Research-Development Organization

This designation includes *all* persons on the payroll of the research-development organization. It includes all persons directly engaged in carrying on technical work on research development problems and the persons who service the technical program. It includes all persons regardless of whether their primary responsibility was technical, service, or administrative.

This item does not apply to Other Units.

Line 21. Net Sales of the Company

Report the figure shown on your annual statement of consolidated corporate income as Net Sales of the Company (or, where more appropriate, revenue from services sold or property leased). Where consolidated corporate reports are not prepared, show the figure that would obtain were such reports prepared. When commodity excise taxes are a significant part of the sales figure, show sales net of such excise taxes. Show a forecast figure for net sales in 1952.

Line 22. Net Profit of the Company

Report the figure that represents income after taxes. Use the figure shown on your annual statement of consolidated corporate income. In case

such statements are not prepared, use the figure that would be shown were such statements prepared for your company. *Do not* show a forecast figure for 1952.

Line 23. Net Profit Plus Provision for Income Taxes

Add to Net Profit the provision for federal and state income taxes and excess profits taxes. Use the figure shown on your annual statement of consolidated corporate income or the figure which would be shown were such reports prepared. *Do not* show a forecast figure for 1952.

Line 24. Total Employees of the Company

Show the figure that reflects most accurately the average level of employment of persons, in all classifications, by your company during the year covered by your report.

Please estimate the average level of employment you expect to maintain in 1952. We anticipate that this latter figure may be a broad estimate.

Line 25. Estimated Cost to Replace Present Research-Development Facilities

Show here your estimate of the total amount of funds that would be required to replace at present costs the present tangible facilities now being used by your research-development organization, including land, structures, and equipment. Confine your estimate to those facilities devoted exclusively to research-development organization activities and do not include an estimate of replacement cost of facilities that are used only in part for this purpose; that is, facilities used by Other Units.

A report of the book value of these facilities will not be useful to us, but we do not expect or desire that an engineering estimate or a facilities inventory be accomplished to secure the estimate. A broad approximation covering the major facilities of the research organization will be sufficient.

APPENDIX D

INDUSTRY GROUPS USED IN THE SURVEYS

The manufacturing industry groups defined below, or a readily apparent combination of these groups, have been used throughout this report. These definitions were adapted from definitions prepared by the U. S. Bureau of the Budget and published in the *Standard Industrial Classification Manual* (Government Printing Office, 1945). Most of these groups are the major or "two-digit" groups found in this manual. These standard groups were adapted to our purposes by expanding certain groups where large amounts of research were done (for example, the chemicals group was expanded to four separate groups), and combining groups in which little research was done (for example, paper is combined with lumber and wood products in some tables). The Standard Industrial Classification numbers are shown in parentheses in the description of the groups that follows:

Ordnance and Accessories (19)

Companies primarily engaged in manufacturing arms, ammunition, tanks, and fire-control equipment. (In the 191-Company Survey no separate figures have been presented for this group since there were too few respondents; this and all other groups not tabulated separately, were included in the "All Firms" tabulations, however.)

Food and Kindred Products (20)

Companies primarily engaged in manufacturing food for human consumption and certain related products. In some tables, data are shown separately for the subgroup *Beverages (208)* which includes manufacturers of alcoholic and nonalcoholic beverages.

Tobacco (21)

Companies primarily engaged in manufacturing cigarettes, cigars, and other tobacco products. (In the 191-Company Survey no separate figures have been presented for this classification.)

Textile and Apparel (22 and 23)

Companies performing any of the following operations (regardless of the type of fiber used): (1) manufacturing yarn, thread, cordage, and twine; (2) manufacturing woven fabric, carpets and rugs, braids, laces, knit fabrics, knit garments, and other products from yarn; (3) dyeing and finishing fibers, yarn, and fabrics; (4) coating, waterproofing, and otherwise treating fabrics; and (5) producing clothing and related fabricated products by cutting and sewing the purchased woven or knit fabrics.

Lumber and Wood Products (24)

Companies primarily engaged in cutting timber and pulpwood, producing lumber and wood basic materials, and manufacturing finished articles made entirely or mainly of wood or wood substitutes (except furniture manufacturers).

Furniture (25)

Companies primarily engaged in manufacturing household, office, public-building, professional, and restaurant furniture, office and store fixtures, and window and door screens and shades, regardless of materials used.

Paper and Allied Products (26)

Companies primarily engaged in the manufacture of pulps either from wood or from rags and other fibers; the conversion of these pulps into any kind of paper or paperboard; and the manufacture of paper and paperboard into converted paper products such as coated paper, paper bags, paper boxes, cards, and envelopes.

Paper, Lumber, and Wood Products

This is a combination, used in some tables, of groups 24 and 26 above.

Printing and Publishing (27)

Companies primarily engaged in printing, publishing, and lithographing; and those performing services for the printing trades such as bookbinding, typesetting, engraving, photo-engraving, and electroplating. In the 191-Company Survey no separate figures have been presented for this group.

Chemicals and Allied Products (28)

This group includes the following subgroups which are shown separately in many of the tables:

(1) ***Industrial Chemicals (281 and 282)***. Companies primarily engaged in manufacturing basic industrial chemicals.

(2) ***Drugs (283)***. Companies primarily engaged in manufacturing biologicals, medicinal chemicals, and pharmaceutical preparations.

(3) ***Soaps (284)***. Companies primarily engaged in manufacturing soap and glycerin, cleaning and polishing preparations, and sulfonated oils and assistants. (In some tables, companies in this subgroup are not shown separately, but are included under Miscellaneous Chemicals.)

(4) ***Paints (285)***. Companies primarily engaged in manufacturing paints, varnishes, lacquers, japans, enamels, inorganic color pigments, wood fillers, whiting, and allied paint products.

(5) ***Miscellaneous Chemicals***. Companies primarily engaged in production of chemicals other than those included in the subgroups listed above, including: gum and wood chemicals (286); fertilizers (287); vegetable animal oils and fats (288); and other miscellaneous chemicals not elsewhere classified (289).

Petroleum and Coal Products (29)

This group includes the following subgroups which are shown separately in some of the tables:

(1) ***Petroleum Products***. Companies primarily engaged in refining crude petroleum and in manufacturing products from petroleum.

(2) ***Coal Products***. Companies primarily engaged in manufacturing coke and coke-oven products, paving and roofing materials, and other products made from coal.

Rubber (30)

Companies primarily engaged in manufacturing, from natural or synthetic rubber, all kinds of rubber products such as tires, rubber footwear, mechanical rubber goods, and rubber sundries.

Leather (31)

Companies primarily engaged in tanning, currying, and finishing hides and skins, and manufacturing footwear (except rubber), leather belting and packing, leather gloves, luggage, handbags, and similar products either from leather or from other materials. In the 191-Company Survey no separate figures have been presented for this group.

Stone, Clay, and Glass (32)

Companies engaged in manufacturing flat glass and other glass products, cement, pottery, abrasive and asbestos products, etc., from materials taken principally from the earth in the form of stone, clay, and sand.

Primary Metal (33)

Companies engaged in the smelting and refining of ferrous and nonferrous metals; in rolling, drawing, and alloying these metals; and in the manufacture of castings, forgings, and other basic products of ferrous and nonferrous metals.

Fabricated Metal (34)

Companies primarily engaged in fabricating ferrous and nonferrous metal products such as tin cans and other tinware, hand tools, cutlery, general hardware, nonelectric heating apparatus, fabricated structural metal products, metal stampings, and like products. Does not include manufacturers of ordnance, machinery, or transportation equipment.

Machinery except Electrical (35)

Companies primarily engaged in manufacturing engines and turbines, agricultural machinery and tractors, construction and mining machinery and equipment, industrial machinery, office and store machines, sewing machines, vacuum cleaners, refrigerators, etc., and parts for the above.

Electrical Machinery (36)

This group includes the following subgroups which are shown separately in some of the tables:

(1) **Communication Equipment (366).** Companies primarily engaged in manufacturing radio, television, radar, phonograph, telephone, telegraph, and other communication equipment and parts for the above.

(2) **Other Electrical Machinery.** Companies primarily engaged in manufacturing machinery, apparatus or supplies for the generation, storage, transmission, transformation, or utilization of electrical energy, except for communication equipment.

Transportation Equipment (37)

This group includes the following subgroups which are shown separately in some of the tables:

(1) **Motor Vehicles and Parts (371).** Companies primarily engaged in manufacturing or assembling automobiles, trucks, busses, and special-purpose motor vehicles and parts for the above.

(2) **Aircraft and Parts (372).** Companies primarily engaged in manufacturing or assembling airplanes, gliders, dirigibles, and balloons and parts for the above.

(3) **Railroad Equipment (374).** Companies primarily engaged in manufacturing locomotives, railroad cars, street cars, and parts for the above.

(4) **Other Transportation Equipment.** Companies primarily engaged in manufacturing ships, barges, boats, motorcycles, bicycles, and other transportation equipment not included elsewhere, and parts for the above.

Professional, Scientific, and Controlling Instruments (38)

This group includes the following subgroups which are shown separately in several of the tables:

(1) **Laboratory Instruments (381).** Companies primarily engaged in manufacturing laboratory, scientific, and engineering instruments (except surgical, medical, and dental instruments).

(2) **Mechanical Instruments (382).** Companies primarily engaged in manufacturing instruments for indicating, measuring, recording and controlling purposes.

(3) **Photographic Instruments (386).** Companies primarily engaged in manufacturing photographic equipment and supplies.

(4) **Other Professional, Scientific, and Controlling Instruments.** Companies primarily engaged in manufacturing optical instruments and lenses; surgical, medical, and dental instruments and supplies; ophthalmic goods; and watches, clocks, clockwork-operated devices, and parts.

Other Manufacturing (39)

Companies primarily engaged in the manufacture of jewelry, silverware, and plated ware; musical instruments and parts; toys and sporting and athletic goods; pens, pencils, and other office and artists' materials; and other products not elsewhere classified. No companies in this category were included in the 191-Company Survey.