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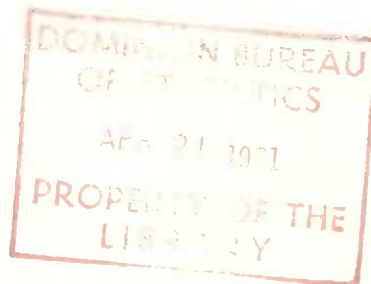


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**INDUSTRIAL RESEARCH-DEVELOPMENT
EXPENDITURES IN CANADA**

1959



DOMINION BUREAU OF STATISTICS

Business Finance Division

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PREFACE

This publication, prepared by the Dominion Bureau of Statistics in cooperation with the National Research Council, presents in tabular form an estimate of the magnitude and direction of the research-development program undertaken by Canadian industry in 1959 and provides an indication of the relative size of the 1960 program. A survey of industrial research and development is being conducted every second year. The next survey will be for the year 1961.

The current survey sought information on the cost of research-development conducted by the reporting companies, the source of these funds, and expenditures on purchases of research-development results from others. It also requested data on the principal fields of science and industrial product groups in which the work was being carried out, and the number of professionally-trained research personnel and technicians employed.

The concepts and definitions used parallel those followed in earlier surveys. They were formed as a result of consultations held with senior officials of the National Research Council, scientists and administrators of Canadian companies who were known to have a substantial interest in industrial research, and with several trade and professional associations.

The assistance of the many business firms who have cooperated with us by submitting reports is gratefully acknowledged.

WALTER E. DUFFETT,

Dominion Statistician.

April, 1961.

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SYMBOLS

The interpretation of the symbols used in the tables throughout this publication is as follows:

- .. figures not available.
- ... figures not appropriate or not applicable.
- nil or zero.

SECTION I

General Review

Industrial research-development expenditures in Canada are outlays for research performed within the reporting companies' Canadian facilities and payments to other research organizations operating in Canada. Statistics on expenditures for research-development outside Canada are collected but are subject to variation from accounting procedures and do not, in any case, reflect research-development activity in Canada. Industrial research-development activities range from pure research intent upon obtaining new knowledge in the life and physical sciences to conceiving and developing new products, new processes and major changes in products and processes and bringing them to the stage of production. Such activities as market and sales research and process and quality control are excluded.

The research-development expenditures of Canadian industry in Canada amounted to \$99.3 million in 1959, a decrease of 22.6% from the \$128.2 million spent in 1957. The decline in research-development expenditures was due to a substantial decline in research-development spending in the Transportation Equipment Industry, a reduction from \$64.6 million in 1957 to \$25.6 million in 1959. While outlays in the Transportation Equipment Industry declined, industrial research-development by all other industrial groups increased 20% from \$60.9 million in 1957 to \$72.9 million in 1959.

More than 97% of industrial research and development in Canada in 1959 as in 1957 was done within the reporting companies' own facilities (Intramural). In 1959, the Products of Petroleum and Coal Industry was the only industry to show a substantial increase in payment for research-development in Canada outside the reporting company.

In 1959, the reporting company financed a greater portion of research-development done within the company than in 1957, 65.7% as against 39.1% in 1957. Contribution of associated companies increased from 7.3% to 10.1%. In 1959 the reporting and associated companies financed 75.8 per cent or \$73.3 million of total research-development within reporting companies as against 46.4 per cent or \$57.7 million in 1957. Funds from the Federal Government for industrial research and development declined \$41.4 million from \$62.5 million in 1957 to \$21.1 million in 1959 or from 49.4 per cent of total funds for industrial research-development within reporting companies to 21.8 per cent. Federal funds for industrial research-development were concentrated in the Transportation Equipment Industry and the Electrical Apparatus and Supplies Industry. The amount going to Transportation Equipment Industry declined from \$58.0 million in 1957 to \$14.0 million in 1959, while funds to the Electrical Apparatus and Supplies Industry

increased from \$2.0 million to \$6.4 million. Funds from sources other than the Federal Government and associated companies declined between 1957 and 1959.

Research-development expenditures allocated by scientific field indicated that in 1959, more than half of these expenditures were for engineering research-development, \$51.6 million or 53.3 per cent; \$15.3 million or 15.9 per cent was for research-development in chemistry; and \$11.3 million or 11.7 per cent for metallurgy.

Research-development costs divided by Industrial groups indicated that in 1959 Aircraft and Parts accounted for 24.4 per cent or \$23.6 million; Chemicals (except drugs and medicines) \$16.1 million or 16.6 per cent; Primary Metals \$10.2 million or 10.6 per cent; Electrical Equipment other than Electronics \$8.5 million or 8.8 per cent. The remaining industrial groups accounted for \$27.9 million or 28.8 per cent.

Capital expenditures on new or extended facilities including special buildings and equipment for use in Industrial Research-development decreased by 15.4 per cent from \$12.6 million in 1957 to \$10.7 million in 1959. Capital expenditures decline was particularly large for the Transportation Equipment Industry falling from \$5.4 million in 1957 to \$1.4 million in 1959. Capital expenditures in industries other than Transportation Equipment increased from \$7.2 million in 1957 to \$9.3 million in 1959. Substantial increases in capital expenditures were incurred by the Non-ferrous Metal, Electrical Apparatus and Supplies, Petroleum and Coal, and Chemical Industries, and to a lesser extent the Textile, Non-metallic Minerals and Food and Beverage Industries. The remaining industries showed a decline in capital expenditures for 1959.

The number of persons doing industrial research and development in reporting companies declined from 11,479 in 1957 to 9,949 in 1959 or by 13.3 per cent. The largest decrease occurred in the Transportation Equipment Industry where research-development staff fell from 4,118 in 1957 to 1,460 in 1959, or by 64.5 per cent. In industries other than the Transportation Equipment Industry persons doing research-development increased in number during the same period from 7,593 to 8,479 or 10.5 per cent. The increase in the number of scientific engineers and other research scientists in other than the Transportation Equipment Industry was from 3,136 to 4,141 or 32.0 per cent.

Grants in aid of research showed a significant increase from \$559,036 in 1957 to \$708,485 in 1959 representing an increase of 21.1 per cent. The Chemical Products Industry, Non-ferrous Metal Industry, Food and Beverage Industry, and industries providing transportation, storage, communication and public utilities services provided grants totalling \$406,000 or 57 per cent of the total.

Expenditures on Industrial Research-development

Expenditures for industrial research-development in Canada amounted to \$99.3 million in 1959, having declined 22.6 per cent from \$128.2 million in 1957. Most of the industrial research and development in Canada is done within the reporting companies' research facilities, \$124.5 million or 97.2 per cent

in 1957, \$96.7 million or 97.4 per cent in 1959. The industrial research-development done in Canada but outside the reporting company, amounted to less than 3 per cent of the total in the two years, \$3.7 million in 1957 and \$2.6 million in 1959. These payments are made to commercial laboratories, educational institutions, research institutions, government research laboratories and others.

Year	Firms conducting research-development	Total research-development expenditures	Done within the reporting company		Done outside the reporting company	
	No.	\$'000	\$'000	%	\$'000	%
1955	377	53,277	51,386	96.4	1,891	3.6
1957	455	128,181	124,531	97.2	3,650	2.8
1959	471	99,272	96,690	97.4	2,582	2.6

The method of accounting for expenditures for research-development financed by the reporting companies, but done outside Canada, have been found to vary from firm to firm. Significantly higher figures would be obtained and much of the variation

from firm to firm removed if uniform accounting practice was applied in pro rating research done in other countries according to the activity of the Canadian company relative to the parent or affiliate in another country.

Research-development Expenditures

Year	Done within company	Done outside company			Total
		In Canada	In other countries	Total	
millions of dollars					
1957	124.5	3.7	19.8	23.5	148.2
1958	132.5	..	..	27.0	159.5
1959	97.7	2.6	21.7	24.3	121.0
1960	81.8	..	..	27.3	109.1

The decline in total research-development expenditures of 22.6 per cent or \$28.9 million results from a fall in research-development expenditures of the Transportation Equipment Industry from \$67.3 million in 1957 to \$26.4 million in 1959. This substantial decline in expenditures of the Transportation Equipment Industry more than offsets a rise of 20 per cent in expenditures by all other industries from \$60.9 million in 1957 to \$72.8 million in 1959.

The Chemical Products Industry showed the largest increase, \$2.5 million or 21 per cent, in expenditures on research-development or from \$11.7 million in 1957 to \$14.2 million in 1959. Three other industries increased their expenditures by about \$1.5 million, Electrical Apparatus and Supplies Industry \$1.6 million or 11 per cent; Iron

and Steel Products Industry \$1.5 million or 37 per cent; Products of Petroleum and Coal Industry \$1.5 million or 50 per cent. The Wood Products Industry showed the highest percentage increase, 88 per cent, but this was from only \$140.1 thousand to \$262.8 thousand.

The three major industries accounting for the largest portion of research-development cost were the Transportation Equipment Industry, the Electrical Apparatus and Supplies Industry and the Chemical Products Industry. However, because of the drop in research-development expenditures of the Transportation Equipment Industry in 1959, these three industries accounted for only 57.1 per cent of total research-development expenditures or \$56.7 million in 1959 as against 73.0 per cent or \$93.5 million in 1957.

Industry	1957		1959	
	Amount	Per cent of total	Amount	Per cent of total
	\$'000	%	\$'000	%
Transportation equipment	67,279	52.5	26,437	26.6
Electrical apparatus and supplies	14,457	11.3	16,021	16.1
Chemical products	11,748	9.2	14,244	14.4
Sub-totals	93,484	73.0	56,702	57.1
Other industries	34,697	27.0	42,570	42.9
Totals	128,181	100.0	99,272	100.0

The survey, conducted during 1960, indicated that for the year 1960, research-development done within the reporting companies would decline to \$81.8 million from \$96.7 million in 1959, as compared with \$132.5 million in 1958 and \$124.5 million in 1957. Total research-development expenditures including those made for research-development outside Canada would decline from \$121.0 million in 1959 to \$109.1 million in 1960, from highs of \$148.2 million in 1957 and \$159.5 million in 1958. Research-development performed within the reporting companies declined most markedly in the Transportation Equipment Industry from \$64.6 million in 1957 to \$25.6 million in 1959, to \$8.1 million in 1960. A decline of \$1.3 million was expected in research-development outlays in the Chemical Products Industry from 1959 to 1960. A rise of \$3.9 million was indicated for all other industry groups in 1960. The Electrical Apparatus and Supplies Industry with expenditures of \$17.6 million spent more than any other industry for research-development done within the company in 1960; Chemical Products Industry was second with expenditures of \$12.8 million and the Transportation Equipment Industry third with expenditures of \$8.1 million in 1960.

Source of Funds

In 1959, reporting and affiliated companies provided 75.8 per cent or \$73.3 million of funds for research-development within reporting companies, in contrast to \$57.7 million or 46.4 per cent in 1957, an increase of 27.0 per cent or \$15.6 million between 1957 and 1959.

In 1957 the Federal Government was the major source of funds for research-development within reporting companies, providing 49.4 per cent or \$61.5 million in contrast to 21.8 per cent or \$21.1 million in 1959. Federal Government support of industrial research-development declined to \$40.4 million in 1959 or to 34.3 per cent of the 1957 level.

The largest increase in research-development financing by reporting and affiliated companies was in the Transportation Equipment Industry which provided \$11.6 million for research-development in 1959 and \$4.0 million in 1957, an increase of \$7.6 million or 188.9 per cent. However, since research-development within companies of this industry fell to \$8.1 million in 1960 from \$25.6 million in 1957, a sharp decline in company support must have occurred in this industry in 1960. Reporting companies and affiliates in the Chemical Products Industry increased support of research-development by \$2.7 million or 23.4 per cent in 1959 more than in 1957. The affiliated companies in the Iron and Steel Industry increased support by \$1.5 million. A decline of reporting company and associated company support of \$2.7 million or 22 per cent occurred in the Electrical Apparatus and Supplies Industry.

Federal Government support was concentrated in two major industries, the Transportation Equipment Industry receiving \$58.0 million or 94.2 per cent in 1957 and \$14.0 million or 66.2 per cent in 1959, the Electrical Apparatus and Supplies Industry receiving \$2.0 million or 3.2 per cent in 1957 and \$6.4 million or 30.2 per cent in 1959. These two industries together received \$60.0 million or 97.5 per cent in 1957 and \$20.4 million or 96.4 per cent in 1959 of all Federal Government funds for research-development in industry.

Information on source of funds is not available for 1960. However, most of the decline in expenditures within reporting company research-development occurred in the Transportation Equipment Industry which fell from \$25.6 million to \$8.1 million indicating that Federal support as well as company support must have declined substantially.

Funds received from "other" sources for research-development projects carried by the reporting company decreased in 1959 from \$5.3 million (4.2 per cent of total) in 1957, to \$2.3 million (2.4 per cent of the total) for 1959.

Source of Funds for Research-development Done Within the Reporting Company, 1957 and 1959

Source	1957		1959	
	Amount	Per cent of total	Amount	Per cent of total
	\$'000	%	\$'000	%
Reporting company	48,680	39.1	63,542	65.7
Parent affiliate and/or subsidiary	9,047	7.3	9,750	10.1
Government funds received through:				
(a) Prime contracts	49,459	39.7	19,150	19.8
(b) Procurement contracts	12,081	9.7	1,958	2.0
Other	5,264	4.2	2,290	2.4
Totals	124,531	100.0	96,690	100.0

Funds received from the parent, affiliated and/or subsidiary companies increased by 7.7 per cent and accounted for 10.1 per cent of total funds for intramural¹ industrial research-development expenditures in 1959 as against 7.3 per cent for 1957.

Industrial Research-development by Size of Firm

The larger firms with annual sales over \$50 million performed 54.3% of the total industrial

¹ Refers to research-development activity done within the reporting company regardless of the source of funds.

research-development program in 1959, a decline from 72 per cent in 1957. The substantial decline in research-development expenditures in the larger firms of the Transportation Equipment Industry in 1959 resulted in a decline in the dominating position of larger firms in Canada's industrial research-development program. However, the larger firms, excluding the Transportation Equipment Industry, spent \$31.0 million in 1957 and accounted for 51 per cent of the research-development performed by these industries. In 1959, expenditures by these firms increased to \$40.9 million, accounting for 56 per cent of the research-development.

Industry	Research-development expenditures \$'000,000	Size groups ¹			
		\$50 million and over	\$10 to \$49 million	\$1 to \$9 million	Under \$1 million
		per cent			
Mining, quarrying and oil wells	5.1	—	82.9 ²	9.1	8.0
Paper products	6.6	73.5	22.4	4.1	—
Iron and steel products	5.7	39.5	37.7	21.0	1.8
Transportation equipment	26.4	49.2	48.2	2.6 ³	—
Non-ferrous metal products	5.9	90.9 ²	—	9.1	—
Electrical apparatus and supplies	16.0	50.1	33.3	16.5	0.1 ⁴
Chemical products	14.2	59.8	22.4	17.8 ³	—
Totals, all industries	99.3	54.3	30.9	12.4	2.4

¹ Size groups are based on annual sales value, 1959.

² Two largest size groups combined.

³ Two smallest size groups combined.

Firms with annual sales between \$10 million and \$49 million increased their research-development expenditures from \$19.5 million in 1957 to \$30.7 million in 1959. The increase in expenditures by firms in this size group was concentrated in the Transportation Equipment Industry, although this size of firm also increased their expenditures in the following industries; Paper Products, Iron and Steel Products and Chemical Products. The two largest size groups accounted for 85.2 per cent of research-development in Canada in 1959, a slight decrease from 87.3 per cent in 1957. Firms with annual sales under \$10 million reduced their research-development programs slightly from \$16.0 million in 1957 to \$14.7 million in 1959.

Expenditures on Industrial Research-development Outside the Reporting Company

Expenditures in 1959 on research and development done outside reporting organizations, less than 3 per cent of total expenditures, were largely for the Transportation Equipment Industry and Products of Petroleum and Coal Industry with expenditures of \$1.5 million out of \$2.6 million. In 1957, Transportation Equipment Industry paid \$2.7 million to others for research in Canada out of total payments to others in Canada of \$3.7 million.

Most of the funds paid for research-development outside the reporting company went to other

companies which did not report receipt of these funds. Funds to non-reporting companies represented 63.8 per cent of total funds for research-development outside reporting companies in Canada in 1959, as against 76.4 per cent of the total in 1957, a decline of \$1.1 million from \$2.8 to \$1.7 million.

The commercial laboratories and the educational institutions received larger proportions of funds available in 1959 than in 1957. In 1959 Educational

Institutions received \$181,402 as against \$76,800 in 1957, and the commercial laboratories received \$390,247 as against \$239,232. On the other hand, substantially less was given to research institutions for research-development projects. Payments made for research-development done by parent affiliated and/or subsidiary companies increased slightly. The following table shows the amount and change in the allocation of funds paid for research-development done outside the reporting company.

Payment Made for Research-development Done Outside Reporting Company 1957 and 1959

	1957		1959	
	Amount	Per cent of total	Amount	Per cent of total
	\$'000	%	\$'000	%
Parent, affiliated and/ or subsidiary companies	39	1.0	96	3.7
Commercial laboratories	239	6.6	388	15.1
Other companies	2,780	76.4	1,647	64.0
→ Educational institutions	76	2.1	181	7.0
↗ Research institutions	433	11.9	189	7.3
Governments	73	2.0	51	2.0
Others	—	—	23	0.9
Totals	3,640	100.0	2,576	100.0

Industrial Research-development Expenditures by Scientific Fields

Of the \$96.7 million industrial research-development program done within the reporting company, 81.0 per cent went for engineering, chemistry and metallurgical science. Engineering

accounted for 53.3 per cent of the total and of this mechanical engineering accounted for 18.3 per cent, electrical engineering 14.8 per cent, and other engineering fields 11.6 per cent. The largest expenditures in the non-engineering sciences were for chemistry, 15.9 per cent and metallurgy, 11.7 per cent.

Per Cent Distribution of Intramural Research-development Expenditures

Field of sciences	Amount	Per cent of total
	\$'000	%
All fields	96,690	100.0
1. Engineering	51,601	53.4
2. Chemistry	15,338	15.9
3. Physics	4,193	4.3
4. Geology	1,215	1.3
5. Metallurgy	11,268	11.7
6. Medicine	1,752	1.8
7. Agriculture	468	0.5
8. Other	10,855	11.2

As illustrated in the summary below, activity in many of the fields of research was concentrated in only a few industries:

Industry	Amount	Per cent of total
	\$'000	%
Chemical engineering, total	7,697	
Chemical products	2,660	22.6
Paper products	1,736	34.6
Mining, quarrying and oil wells	582	7.6
	4,977	64.8
Electrical engineering, total	14,343	
Electrical apparatus and supplies	9,728	67.8
Transportation equipment	1,528	10.7
Transportation, storage and communication services and public utilities ..	1,382	9.6
	12,638	88.1
Mechanical engineering, total	17,737	
Transportation equipment	8,549	48.2
Iron and steel products	4,032	47.2
	12,581	95.4
Chemistry, total	15,338	
Chemical products	7,352	47.3
Paper products	2,196	14.3
Petroleum and coal products	1,642	10.7
	11,190	72.9
Physics, total	4,193	
Transportation equipment	1,108	26.5
Paper products	940	22.4
Chemical products	760	18.1
	2,808	67.0
Geology, total	1,215	
Petroleum and coal products	381	31.3
Mining, quarrying and oil wells	173	14.2
Non-metallic mineral products	168	13.8
	721	59.3
Metallurgy, total	11,268	
Non-ferrous metal products	4,689	41.6
Mining, quarrying and oil wells	3,372	29.9
	8,061	71.5

Industrial Research-development Classified by Product Fields

An analysis of research-development in each of the product fields in which research-development was carried out for 1959, indicated that the aircraft and parts product field ranked first in dollar volume of research-development performed in 1959, account-

ing for \$23.6 million or 24.4 per cent of expenditures within reporting companies. Most of the expenditures in this field, \$23.0 million, were made by the Transportation Equipment Industry.

The Federal Government provided the Transportation Equipment Industry with \$13 million and much of this was for aircraft and parts.

Product field	Amount	Per cent of total
	\$'000	%
Aircraft and parts	23,601	24.4
Chemicals (except drugs and medicines)	16,089	16.6
Electronics	10,369	10.7
Primary metals	10,250	10.6
Electrical equipment (excluding electronics)	8,489	8.8
Machinery (excluding electrical)	3,597	3.7
Fabricated metals	2,653	2.7
Petroleum and natural gas	2,271	2.4
Drugs and medicines	2,030	2.1
Motor vehicles and parts	1,536	1.6
Professional and scientific instruments	953	1.0
Other	14,853	15.4
Totals	96,690	100.0

The second largest product field of research-development separately was Chemicals, excluding Drugs and Medicines. Accounting for \$16.1 million or 16.6 per cent of the total. Product fields falling in the category "Other" include pulp and paper products which make up almost all the output of the Paper Product Industry. This industry accounted for \$5.6 million or 38.2 per cent of the \$14.9 million. The Food and Beverage Industry accounted for another 10.7 per cent or \$1.6 million.

Expenditures For Research-development Facilities

Capital expenditures on new or extended facilities, including special buildings and equip-

ment for use in industrial research-development fell by 15.4 per cent from \$12.6 million to \$10.7 million between 1957 and 1959. Capital expenditures for the Transportation Equipment Industry fell sharply, \$5.4 million in 1957 to \$1.4 million in 1959. Capital expenditures for research-development increased for the Non-ferrous Metal Industry, Electrical Apparatus and Supplies Industry, the Petroleum and Coal Industry and Chemical Industry. Capital expenditures in 1959, for industries other than the Transportation Equipment Industry increased from \$7.2 million in 1957 to \$9.3 million in 1959 or by 28 per cent.

Capital Expenditures on Research-development Facilities, 1957 and 1959

Industry	Amount	Per cent of total
	\$'000	%
1957		
Transportation equipment	5,423	42.9
Petroleum and coal and chemicals	2,566	20.3
Mining, quarrying and oil wells	942	7.4
Wood and paper products	852	6.7
Electrical apparatus and supplies	666	5.3
Sub-totals	10,449	82.6
Remaining industries	2,195	17.4
Grand totals	12,644	100.0
1959		
Petroleum and coal products	4,245	39.7
Transportation equipment	1,432	13.4
Non-ferrous metals	1,098	10.3
Electrical apparatus and supplies	1,063	9.9
Non-metallic minerals	564	5.3
Sub-totals	8,401	78.6
Remaining industries	2,291	21.4
Grand totals	10,692	100.0

Personnel Employed in Research-development Activity Done Within the Reporting Company

Industrial research-development done within reporting companies required 9,949 employees in 1959, or 83 per cent of the 11,479 required in 1956.

Supporting personnel accounted for 5,808 or 58.4 per cent of all employees in 1959 and 41.6 per cent or 4,141 were professional staff. A greater proportion of research-development personnel were professional in 1959 than in 1957, or 41.6 per cent to 37.9 per cent.

	1957		1959	
	Number	Per cent	Number	Per cent
Professional personnel:		%		%
Engineers	2,744	23.9	2,404	24.2
Other professions	1,610	14.0	1,737	17.4
Sub-totals	4,354	37.9	4,141	41.6
Supporting personnel:				
Technicians	3,661	31.9	3,186	32.0
Skilled craftsmen	792	6.9	862	8.7
Others	2,672	23.3	1,760	18.7
Sub-totals	7,125	62.1	5,808	58.4
Totals	11,479	100.0	9,949	100.0

Most of the decline in research-development personnel between 1957 and 1959 occurred in the Transportation Equipment Industry and a small decline occurred in the Non-ferrous Metal Industry and Rubber Industry. In 1959 the Transportation Equipment Industry had decreased its engineering staff by 42.5 per cent from 1,163 to 662; its professional staff other than engineering by 45.0 per cent from 149 to 82 and its supporting personnel by 74.5 per cent from 2,806 to 716. A slight decrease

in the number of research-development personnel employed occurred in the Rubber Industry and Non-ferrous Metal Industry although research-development expenditures were higher.

The most important decline in supporting personnel between 1957 and 1959, both relatively and in number, occurred in the Transportation Equipment Industry. The ratio of number of supporting personnel to professional employees is indicated in the following table:

Supporting Personnel Employed per Professional Employee 1957 and 1959

Industry	1957	1959
	number	
Mining quarrying and oil wells	1.8	1.1
Food and beverages	0.8	1.1
Rubber products	1.1	1.2
Textile products	1.6	2.1
Wood products	1.8	1.5
Paper products	1.5	1.6
Iron and steel products	2.9	2.7
Transportation equipment	2.1	1.0
Non-ferrous metal products	2.7	2.9
Electrical apparatus and supplies	1.1	1.4
Non-metallic mineral products	0.8	1.2
Products of petroleum and coal	1.1	1.3
Chemical products	1.1	1.1
Other manufacturing	2.2	1.7
Transportation, storage, communication and public utilities	1.0	0.9
Other non-manufacturing	1.4	2.1
Totals	1.6	1.4

**Distribution of Research-development Personnel
According to Training and Industry**

Of the total 4,141 professional personnel 3,111 or 75.1 per cent had Bachelor degrees, 480 or 11.6 per cent had Master degrees and 550 or 13.3 per cent had Doctorate degrees. The majority of those holding Bachelor and Master degrees were employed in the Transportation Equipment, Electrical Apparatus and Supplies and Chemical Products Industries. Those holding Doctorate degrees were

concentrated in the Chemical Product and Paper Product Industries.

Of the total 5,808 supporting personnel employed on research-development activity, 54.9 per cent or 3,186 were Technicians, 14.8 per cent or 862 were skilled craftsmen and 30.3 per cent or 1,760 were supporting personnel.

Again, the same major industries employed over 80.0 per cent of the total supporting personnel employed on research-development activity.

Professional Personnel, 1959

Industry	Number	Per cent of total
Bachelor level		
Transportation equipment	687	22.1
Electrical apparatus and supplies	684	22.0
Chemical products	407	13.1
Paper products	203	6.5
Mining, quarrying and oil wells	201	6.4
Sub-totals	2,182	70.1
Remaining industries	929	29.9
Totals	3,111	100.0
Master level		
Chemical products	107	22.3
Electrical apparatus and supplies	60	12.5
Transportation equipment	48	10.0
Paper products	38	7.9
Mining, quarrying and oil wells	37	7.7
Sub-totals	290	60.4
Remaining industries	190	39.6
Totals	480	100.0
Doctorate level		
Chemical products	222	40.4
Paper products	81	14.7
Non-ferrous metal products	38	6.9
Electrical apparatus and supplies	38	6.9
Sub-totals	379	68.9
Remaining industries	171	31.1
Totals	550	100.0

Supporting Personnel, 1959

Industry	Number	Per cent of total
Technician		
Electrical apparatus and supplies	596	18.7
Chemical products	563	17.7
Non-ferrous metal products	402	12.6
Transportation equipment	364	11.4
Paper products	226	7.1
Iron and steel products	206	6.5
Textile products	109	3.4
Petroleum and coal products	112	3.5
Sub-totals	2,578	80.9
Remaining industries	608	19.1
Totals	3,186	100.0
Skilled craftsmen		
Transportation equipment	181	21.0
Electrical apparatus and supplies	176	20.4
Iron and steel products	159	18.4
Other manufacturing	81	9.4
Paper products	49	5.7
Chemical products	48	5.6
Sub-totals	694	80.5
Remaining industries	168	19.5
Totals	862	100.0
Other supporting personnel		
Electrical apparatus and supplies	243	13.8
Paper products	242	13.7
Chemical products	238	13.5
Non-ferrous metal products	175	9.9
Transportation equipment	171	9.7
Other manufacturing	123	7.0
Other non-manufacturing	106	6.0
Mining, quarrying and oil wells	94	5.3
Sub-totals	1,392	78.9
Remaining industries	368	21.1
Totals	1,760	100.0

SECTION II

STATISTICAL TABLES

TABLE 1. Research-development Expenditures in Canada, by Industry, 1957 and 1959

Industry	1957			1959		
	Expenditures for research-development done within the reporting company	Payments to other organizations in Canada	Total	Expenditures for research-development done within the reporting company	Payments to other organizations in Canada	Total
	dollars					
Mining, quarrying and oil wells	4,835,332	151,129	4,986,461	4,907,029	171,429	5,078,458
Manufacturing:						
Foods and beverages	1,355,851	109,257	1,465,108	1,793,626	100,728	1,894,354
Rubber products	1,145,619	23,258	1,168,877	1,219,185	27,406	1,246,591
Textile products	1,292,876	17,380	1,310,256	1,395,789	13,621	1,409,390
Wood products	117,177	20,936	140,113	229,581	33,215	262,796
Paper products	5,700,747	201,048	5,901,795	6,571,953	77,915	6,649,868
Iron and steel products	4,045,061	88,699	4,133,760	5,569,828	106,311	5,680,039
Transportation equipment	64,566,901	2,711,800	67,278,701	25,570,722	866,000	26,436,722
Non-ferrous metal products	5,626,034	109,125	5,735,159	5,903,514	100	5,903,614
Electrical apparatus and supplies	14,444,799	12,000	14,456,799	15,903,065	117,972	18,021,037
Non-metallic mineral products	1,115,368	32,323	1,147,691	1,353,830	50,026	1,403,856
Products of petroleum and coal	2,934,400	11,000	2,945,400	3,761,700	661,500	4,423,200
Chemical products	11,717,093	31,197	11,748,290	14,133,296	111,157	14,244,453
Other manufacturing ¹	1,750,936	27,865	1,768,801	3,004,378	73,847	3,078,225
Transportation, storage, communication and public utility operations	2,377,100	7,400	2,384,500	2,779,440	45,482	2,824,922
Other non-manufacturing ²	1,505,533	93,840	1,599,373	2,593,485	118,960	2,712,445
Totals	124,530,847	3,650,257	128,181,104	96,690,381	2,575,669	99,266,050
Per cent distribution to total	97.2	2.8	100.0	97.4	2.8	100.0

¹ Includes tobacco and tobacco products, leather products, printing and miscellaneous manufacturing industries.
² Includes construction, scientific and engineering services and trade associations.

TABLE 2. Research-development Expenditures Performed Within the Reporting Company 1957-1960

Industry	1957	1958 ¹	1959	1960 ¹
	dollars			
Mining, quarrying and oil wells	4,835,332	4,143,122	4,907,029	5,168,654
Manufacturing:				
Foods and beverages	1,355,651	1,480,150	1,793,626	1,971,900
Rubber products	1,145,619	1,121,000	1,219,185	1,199,140
Textile products	1,292,876	1,333,500	1,395,789	1,462,940
Wood products	117,177	124,400	229,581	242,252
Paper products	5,700,747	6,068,393	6,571,953	8,822,565
Iron and steel products	4,045,081	4,528,800	5,569,828	5,747,984
Transportation equipment	64,566,901	67,613,104	25,570,722	8,072,106
Non-ferrous metal products	5,626,034	6,837,880	5,903,514	6,709,421
Electrical apparatus and supplies	14,444,799	14,871,067	15,903,065	17,551,660
Non-metallic mineral products	1,115,368	1,204,781	1,353,830	1,444,771
Products of petroleum and coal	2,934,400	3,420,000	3,761,700	4,224,000
Chemical products	11,717,093	13,479,184	14,133,296	12,818,696
Other manufacturing ²	1,750,936	2,300,919	3,004,378	2,617,766
Transportation, storage, communication and public utility operations	2,377,100	2,553,000	2,779,440	3,126,460
Other non-manufacturing ³	1,505,533	1,405,500	2,593,485	2,600,840
Totals	124,530,847	132,480,800	96,690,381	81,781,155

¹ Estimates for the years 1958 and 1960 are based on the Company's intentions for these years.
² Includes tobacco and tobacco products, leather products, printing and miscellaneous manufacturing industries.
³ Includes construction, scientific and engineering services and trade associations.

TABLE 3. Source of Funds for Research-development Done Within Company, by Industry, 1957

Industry	Reporting company	Parent, affiliated and/or subsidiary companies	Government funds received through		Others	Total research done within company
			Research-development prime contracts	Research-development procurement contracts		
dollars						
Mining, quarrying and oil wells	3,480,372	883,420	-	-	471,530	4,835,332
Manufacturing:						
Foods and beverages	1,239,241	115,250	1,000	-	360	1,355,851
Rubber products	842,590	191,251	111,778	-	-	1,145,619
Textile products	1,290,376	1,500	-	-	1,000	1,292,876
Wood products	117,177	-	-	-	-	117,177
Paper products	3,603,578	797,169	-	-	1,300,000	5,700,747
Iron and steel products	3,995,953	11,311	15,850	-	21,967	4,045,081
Transportation equipment	3,983,041	35,000	47,354,112	10,676,493	2,518,255	64,566,901
Non-ferrous metal products	2,095,034	3,464,000	40,000	-	27,000	5,626,034
Electrical apparatus and supplies	11,215,183	993,706	848,218	1,137,794	249,896	14,444,799
Non-metallic mineral products	1,085,398	29,970	-	-	-	1,115,368
Products of petroleum and coal	1,780,323	1,154,077	-	-	-	2,934,400
Chemical products	10,905,636	479,492	188,215	-	143,750	11,717,093
Other manufacturing ¹	714,958	-	653,978	267,000	115,000	1,750,936
Transportation, storage, communication and public utility operations	2,267,100	110,000	-	-	-	2,377,100
Other non-manufacturing ²	64,068	780,148	245,854	-	415,463	1,505,533
Totals	48,680,028	9,046,296	49,459,005	12,081,287	5,264,221	124,530,847
Percent distribution to total	39.1	7.3	39.7	9.7	4.2	100.0

¹ Includes tobacco and tobacco products, leather products, printing and miscellaneous manufacturing industries.
² Includes construction, scientific and engineering services and trade associations.

TABLE 4. Source of Funds for Research-development Done Within Company, by Industry, 1959

Industry	Reporting company	Parent, affiliated and/or subsidiary companies	Government funds received through:		Others	Total research done within company
			Research-development prime contracts	Research-development procurement contracts		
dollars						
Mining, quarrying and oil wells	4,817,385	27,000	-	-	62,644	4,907,029
Manufacturing:						
Foods and beverages	1,588,587	205,039	-	-	-	1,793,626
Rubber products	956,388	262,777	-	-	-	1,219,165
Textile products	1,363,769	32,000	-	-	-	1,395,769
Wood products	229,581	-	-	-	-	229,581
Paper products	4,463,779	868,918	22,294	-	1,216,962	6,571,953
Iron and steel products	5,419,770	58,138	57,900	21,120	12,900	5,569,828
Transportation equipment	11,506,473	100,000	13,764,249	200,000	-	25,570,722
Non-ferrous metal products	2,471,446	3,428,640	-	2,400	1,028	5,903,514
Electrical apparatus and supplies	8,745,939	752,146	4,651,866	1,734,990	18,124	15,903,065
Non-metallic mineral products	676,060	677,770	-	-	-	1,353,830
Products of petroleum and coal	1,939,719	1,821,981	-	-	-	3,761,700
Chemical products	13,556,529	495,811	17,396	-	63,560	14,133,296
Other manufacturing ¹	2,127,528	286,307	342,135	-	248,408	3,004,378
Transportation, storage, communication and public utility operations	2,779,440	-	-	-	-	2,779,440
Other non-manufacturing ²	899,913	733,140	294,489	-	665,943	2,593,485
Totals	63,542,306	9,749,667	19,150,329	1,958,510	2,289,569	96,690,381
Percent distribution to total	65.7	10.1	19.8	2.0	2.4	100.0

¹ Includes tobacco and tobacco products, leather products, printing and miscellaneous manufacturing industries.
² Includes construction, scientific and engineering services and trade associations.

TABLE 5. Research-development Expenditures as Percentage of Sales, by Industry and Size Group, 1959

Industry and size group ¹	Firms	Total research-development expenditures done in Canada	Total value of sales ²	Total research-development expenditures as per cent of sales
	number	\$	\$'000	%
Mining, quarrying and oil wells:				
1. \$50 million and over	3	3	3	3
2. 10 to \$49 million	15	4,209,244	478,579	0.87
3. 1 " 9 "	13	465,136	36,807	1.26
4. Under \$1 million	4	404,078	4	4
Totals	32	5,078,458	515,386	0.99
Manufacturing:				
Foods and beverages:				
1. \$50 million and over	11	1,402,915	1,298,451	0.10
2. 10 to \$49 million	9	375,604	216,836	0.17
3. 1 " 9 "	11	115,835	61,108	0.19
4. Under \$1 million	—	—	—	—
Totals	31	1,894,354	1,576,395	0.12
Rubber products	8 ³	1,246,571 ³	233,605 ³	0.53 ³
Textile products:				
1. \$50 million and over	—	—	—	—
2. 10 to \$49 million	4	1,133,833	86,468	1.31
3. 1 " 9 "	6	275,557	29,049	0.95
4. Under \$1 million	—	—	—	—
Total	10	1,409,390	115,517	1.22
Wood products:				
1. \$50 million and over	—	—	—	—
2. 10 to \$49 million	3	197,046	80,802	0.24
3. 1 " 9 "	10	65,750	31,300	0.21
4. Under \$1 million	6	6	6	6
Totals	13	262,796	112,102	0.23
Paper products:				
1. \$50 million and over	10	4,888,776	1,064,722	0.46
2. 10 to \$49 million	16	1,489,936	405,729	0.36
3. 1 " 9 "	9	271,156	56,026	0.48
4. Under \$1 million	—	—	—	—
Totals	35	6,649,868	1,526,477	0.44
Iron and steel products:				
1. \$50 million and over	7	2,242,752	961,637	0.23
2. 10 to \$49 million	13	2,139,078	301,656	0.71
3. 1 " 9 "	38	1,191,135	149,954	0.79
4. Under \$1 million	6	103,174	3,393	3.04
Totals	64	5,676,139	1,416,640	0.40
Transportation equipment:				
1. \$50 million and over	5	13,018,771	1,138,497	1.14
2. 10 to \$49 million	8	12,733,662	256,380	4.96
3. 1 " 9 "	9	684,289	29,021	2.35
4. Under \$1 million	6	6	6	6
Totals	22	26,436,722	1,423,898	1.90

See footnotes at end of table.

TABLE 5. Research-development Expenditures as Percentage of Sales, by Industry and Size Group, 1959 - Concluded

Industry and size group ¹	Firms	Total research-development expenditures done in Canada	Total value of sales ²	Total research-development expenditures as per cent of sales
	number	\$	\$'000	%
Manufacturing—Concluded:				
Non-ferrous metal products:				
1. \$50 million and over	4	5,365,874	776,700	0.69
2. 10 to \$49 million	3	3	3	3
3. 1 " 9 "	10	537,740	48,992	1.10
4. Under \$1 million	—	—	—	—
Totals	14	5,903,614	825,692	0.71
Electrical apparatus and supplies:				
1. \$50 million and over	3	8,024,886	480,065	1.67
2. 10 to \$49 million	11	5,326,637	265,160	2.00
3. 1 " 9 "	34	2,646,514	138,726	1.90
4. Under \$1 million	3	23,000	1,321	1.74
Totals	51	16,021,037	885,272	1.81
Non-metallic mineral products:				
1. \$50 million and over	—	—	—	—
2. 10 to \$49 million	7	905,881	138,751	0.65
3. 1 " 9 "	11	497,975	40,474	1.21
4. Under \$1 million	—	—	—	—
Totals	18	1,403,856	179,225	0.78
Products of petroleum and coal	5 ³	4,423,200 ³	1,378,388 ³	0.3 ³
Chemical products:				
1. \$50 million and over	7	8,515,572	568,294	1.49
2. 10 to \$49 million	9	3,195,104	225,275	1.41
3. 1 " 9 "	32	2,533,777	126,172	2.00
4. Under \$1 million	6	6	6	6
Totals	48	14,244,453	919,741	1.54
Other manufacturing: ⁷				
1. \$50 million and over	3	3	3	3
2. 10 to \$49 million	8	1,017,339	410,072	0.25
3. 1 " 9 "	16	2,060,886	60,906	3.38
4. Under \$1 million	6	6	6	6
Totals	24	3,078,225	470,978	0.65
Transportation, storage, communication and public utility operations:				
1. \$50 million and over	6	2,806,456	1,759,105	0.16
2. 10 to \$49 million	10	10,000	204,474	0.005
3. 1 " 9 "	3	8,466	10,497	0.08
4. Under \$1 million	—	—	—	—
Totals	19	2,824,922	1,974,076	0.14
Other non-manufacturing ⁴	14	2,712,445	9	9
Grand totals for all industries:				
1. \$50 million and over	58	53,865,620	10,038,130	0.54
2. 10 to \$49 million	113	30,664,617	2,662,202	1.15
3. 1 " 9 "	211	12,348,037	873,461	1.41
4. Under \$1 million	26	2,387,776	13,557	17.61
Totals	408	99,266,050	13,587,350	0.73

¹ Size groups are based on annual sales value, 1959.

² Sales of firms reporting research-development expenditures.

³ Size groups 1 and 2 combined.

⁴ Includes firms in development stage for which no figure corresponding to sales value is obtainable.

⁵ All size groups combined.

⁶ Size groups 3 and 4 combined.

⁷ Includes tobacco and tobacco products, leather products, printing and miscellaneous manufacturing industries.

⁸ Includes construction industry, scientific and engineering services, and trade associations.

⁹ Trade associations, medical foundations and other firms for which no figure corresponding to sales value was obtainable are included in this group.

TABLE 6. Research-development Expenditures, by Industry, by Field of Research, 1959

Industry	Engineering					Chemistry	
	Chemical	Civil	Electrical	Mechanical	Other		
	dollars						
Mining, quarrying and oil wells.....	581,743	—	12,050	128,538	158,892	400,809	
Manufacturing:							
Foods and beverages	326,755	—	—	37,863	18,750	653,467	
Rubber products	234,161	—	25,000	380,558	110,834	429,196	
Textile products	213,753	—	50,200	82,799	—	641,417	
Wood products	10,500	4,250	—	12,000	129,124	6,000	
Paper products	1,735,804	3,240	6,835	313,510	95,567	2,196,373	
Iron and steel products	31,000	111,000	333,548	4,031,664	216,153	68,000	
Transportation equipment	174,935	—	1,528,368	8,549,230	8,787,620	172,425	
Non-ferrous metal products	153,684	35,400	102,600	89,931	108,000	532,333	
Electrical apparatus and supplies	43,274	—	9,727,818	1,444,823	930,297	171,387	
Non-metallic mineral products	231,548	4,000	13,550	21,670	72,800	332,605	
Products of petroleum and coal	801,090	68,754	—	171,885	481,278	1,642,261	
Chemical products	2,659,609	—	80,960	797,944	42,219	7,351,681	
Other manufacturing ¹	207,381	—	784,737	693,845	9,297	334,070	
Transportation, storage, communication and public utility operations	248,413	304,465	1,381,975	506,938	—	85,330	
Other non-manufacturing ²	43,141	32,235	295,455	474,221	100,000	320,187	
Totals	7,696,791	563,344	14,343,096	17,737,419	11,260,831	15,337,541	
Per cent distribution to total	8.0	0.6	14.8	18.3	11.6	15.9	
	Physics	Geology, geophysics and other earth sciences	Metallurgy	Medicine	Agriculture	Other	Total
	dollars						
Mining, quarrying and oil wells.....	44,334	173,226	3,371,584	—	—	35,853	4,907,029
Manufacturing:							
Foods and beverages	40,925	—	—	—	247,249	468,617	1,793,626
Rubber products	39,416	—	—	—	—	—	1,219,165
Textile products	185,600	—	—	—	—	222,000	1,395,769
Wood products	—	—	30,000	—	9,457	28,250	229,581
Paper products	939,723	4,514	—	—	—	1,276,387	6,571,953
Iron and steel products	50,367	2,500	559,494	—	49,000	117,102	5,569,828
Transportation equipment	1,108,475	150,000	738,492	—	—	4,361,177	25,570,722
Non-ferrous metal products	18,359	128,511	4,689,009	—	18,359	27,328	5,903,514
Electrical apparatus and supplies	466,490	—	119,500	175	—	2,999,301	15,903,065
Non-metallic mineral products	218,042	167,541	212,835	—	3,122	76,117	1,353,830
Products of petroleum and coal	137,508	380,670	34,377	—	34,377	9,500	3,761,700
Chemical products	759,719	27,478	145,351	1,723,451	33,196	511,688	14,133,296
Other manufacturing ¹	116,448	159,315	—	—	—	699,285	3,004,378
Transportation, storage, communication and public utility operations	24,380	—	215,749	—	12,190	—	2,779,440
Other non-manufacturing ²	43,140	21,570	1,151,302	28,760	61,093	22,381	2,593,485
Totals	4,192,926	1,215,325	11,267,693	1,752,386	468,043	10,854,986	96,690,381
Per cent distribution to total	4.3	1.3	11.7	1.6	0.5	11.2	100.0

¹ Includes tobacco and tobacco products, leather products, printing and miscellaneous manufacturing industries.
² Includes construction, scientific and engineering services and trade associations.

TABLE 7. Research-development Expenditures, by Industry, by Product Groups, 1959

Industry	Aircraft and parts	Chemicals (except drugs and medicines)	Drugs and medicines	Electric equipment (except electronics)	Electronics	Fabricated metals	
	dollars						
Mining, quarrying and oil wells	-	560,375	-	-	184,200	82,101	
Manufacturing:							
Foods and beverages	-	61,014	129,030	1,400	-	-	
Rubber products	7,389	533,744	-	25,000	-	-	
Textile products	-	836,202	11,981	-	-	-	
Wood products	15,000	-	-	-	-	90,331	
Paper products	-	705,357	-	-	-	-	
Iron and steel products	7,243	-	-	365,226	32,000	980,535	
Transportation equipment	22,991,071	-	-	4,597	1,072,078	392,738	
Non-ferrous metal products	2,865	-	-	-	15,053	764,023	
Electrical apparatus and supplies	-	91,795	175	7,108,062	8,467,483	93,990	
Non-metallic mineral products	-	265,000	-	-	85,185	-	
Products of petroleum and coal	-	1,547,240	-	-	-	-	
Chemical products	-	11,070,488	1,889,152	80,960	-	175,518	
Other manufacturing ¹	577,343	108,459	-	138,500	217,775	1,408	
Transportation, storage, communication and public utility operations	-	-	-	525,000	185,000	-	
Other non-manufacturing ²	-	309,173	-	240,000	150,331	71,901	
Totals	23,600,911	16,088,847	2,030,338	8,488,745	10,369,085	2,652,545	
Per cent distribution to total	24.4	16.6	2.1	8.8	10.7	2.7	
	Machinery (except electrical)	Motor vehicles and parts	Petroleum and natural gas	Primary metals	Professional and scientific instruments	Others	Total
	dollars						
Mining, quarrying and oil wells	2,000	-	43,480	3,351,472	40,000	883,401	4,907,029
Manufacturing:							
Foods and beverages	21,305	-	-	-	-	1,580,877	1,793,628
Rubber products	141,389	296,958	-	-	-	214,685	1,219,165
Textile products	-	12,800	-	-	-	534,786	1,395,769
Wood products	26,000	5,000	5,000	20,000	39,500	28,750	229,581
Paper products	37,020	-	-	-	-	5,829,578	6,571,953
Iron and steel products	3,015,038	290,080	10,000	490,278	20,000	359,430	5,569,828
Transportation equipment	64,048	852,191	8,000	1,820	150,000	34,179	25,570,722
Non-ferrous metal products	-	-	-	5,115,573	-	6,000	5,903,514
Electrical apparatus and supplies	20,012	23,000	-	6,500	-	92,068	15,903,065
Non-metallic mineral products	-	55,080	-	-	-	968,565	1,353,830
Products of petroleum and coal	-	-	2,204,980	-	-	9,500	3,761,700
Chemical products	230,373	-	-	91,080	-	595,725	14,133,296
Other manufacturing ¹	-	1,225	-	-	643,114	1,316,554	3,004,378
Transportation, storage, communication and public utility operations	-	-	-	-	-	2,069,440	2,779,440
Other non-manufacturing ²	40,000	-	-	1,172,872	60,000	549,208	2,593,485
Totals	3,597,185	1,536,334	2,271,440	10,249,593	952,614	14,852,744	96,690,381
Per cent distribution to total	3.7	1.6	2.4	10.6	1.0	15.4	100.0

¹ Includes tobacco and tobacco products, leather products, printing and miscellaneous manufacturing industries.

² Includes construction, scientific and engineering services and trade associations.

TABLE 8. Capital Expenditures on New Facilities for Use in Research-development Activities, 1957 and 1959

Industry	Capital expenditures for research facilities		Per cent distribution of total	
	1957	1959	1957	1959
	dollars		per cent	
Mining, quarrying and oil wells	924,415	388,955	7.4	3.6
Manufacturing:				
Foods and beverages	142,758	228,800	1.1	2.1
Rubber products	197,085	50,000	1.6	0.5
Textile products	69,300	116,100	0.5	1.1
Wood products	851,981	401,761	6.7	3.8
Paper products				
Iron and steel products	453,650	406,999	3.6	3.8
Transportation equipment	5,422,746	1,431,764	42.9	13.4
Non-ferrous metal products	163,500	1,098,173	1.3	10.3
Electrical apparatus and supplies	666,168	1,063,461	5.3	9.9
Non-metallic mineral products	111,286	562,800	0.9	5.3
Products of petroleum and coal	2,565,810	4,244,673	20.3	39.7
Chemical products				
Other manufacturing ¹	325,999	298,752	2.6	2.8
Transportation, storage, communication and public utility operations	150,900	69,350	1.2	0.6
Other non-manufacturing ²	580,129	330,297	4.6	3.1
Totals	12,643,727	10,691,885	100.0	100.0

¹ Includes tobacco and tobacco products, leather products, printing and miscellaneous manufacturing industries.

² Includes construction, scientific and engineering services and trade associations.

TABLE 9. Number of Professional and Supporting Research-development Personnel, by Industry, 1959

Industry	Level of training			Total professional personnel	Level of training			Total Supporting personnel	Supporting personnel, per professional personnel
	Bachelor	Master	Doctorate		Research-development technicians	Skilled craftsmen	Other supporting personnel		
	number								
Mining, quarrying and oil wells	201	37	13	251	172	21	94	287	1.1
Manufacturing:									
Foods and beverages	57	19	28	104	71	9	36	116	1.1
Rubber products	43	5	12	60	39	8	27	74	1.2
Textile products	47	10	16	73	109	12	35	156	2.1
Wood products	14	3	1	18	4	14	9	27	1.5
Paper products	203	38	81	322	226	49	242	517	1.6
Iron and steel products	179	19	7	205	206	159	137	502	2.4
Transportation equipment	687	48	9	744	364	181	171	716	1.0
Non-ferrous metal products	145	24	38	207	402	15	175	592	2.9
Electrical apparatus and supplies	684	60	38	782	596	176	243	1,015	1.3
Non-metallic mineral products	65	6	2	73	67	18	21	106	1.5
Products of petroleum and coal	69	26	32	127	112	16	44	172	1.3
Chemical products	407	107	222	736	563	48	238	849	1.1
Other manufacturing ¹	133	27	9	169	88	81	123	292	1.7
Transportation, storage, communication and public utility operations	102	34	10	146	70	3	59	132	0.9
Other non-manufacturing ²	75	17	32	124	97	52	106	255	2.0
Totals	3,111	480	550	4,141	3,186	862	1,760	5,808	1.4

¹ Includes tobacco, tobacco products, leather products, printing and miscellaneous manufacturing industries.

² Includes construction, scientific and engineering services, and trade associations.

TABLE 10. Number of Professional and Supporting Research-development Personnel, by Field and Level of Training, 1957 and 1959

	1957					1959				
	Level of training			Total	Per cent	Level of training			Total	Per cent
	Bachelor	Master	Doctorate			Bachelor	Master	Doctorate		
	number				%	number				%
Professional personnel:										
Engineers, chemical	399	53	51	503	11.6	408	70	53	531	12.8
Engineers, civil	40	4	3	47	1.1	38	13	2	53	1.3
Engineers, electrical	771	72	13	856	19.7	654	64	17	735	17.8
Engineers, mechanical	886	25	15	926	21.3	623	46	9	678	16.4
Engineers, other	310	41	16	367	8.4	370	28	9	407	9.8
Totals, engineers	2,406	195	98	2,699	62.1	2,093	221	90	2,404	58.1
Chemists	498	121	255	874	20.1	491	126	272	889	21.5
Physicists	103	35	45	183	4.2	119	40	53	212	5.1
Geologists, geophysicists and other earth scientists	10	11	10	31	0.7	15	9	7	31	0.7
Metallurgists	177	17	22	216	4.9	206	26	20	252	6.1
Mathematicians	42	6	4	52	1.2	25	7	2	34	0.8
Medical scientists	22	17	14	53	1.2	19	13	44	76	1.8
Agricultural scientists	18	2	6	26	0.6	18	2	5	25	0.6
Administrators (of research-development)	67	16	34	117	2.7	92	27	47	166	4.0
Other ¹	86	8	9	103	2.3	33	9	10	52	1.3
Totals, professional personnel	3,429	428	497	4,354	100.0	3,111	480	550	4,141	100.0
Supporting personnel:										
Technicians .....	...	...	...	3,661	51.4	...	...	...	3,186	54.9
Skilled craftsmen .....	...	...	...	792	11.1	...	...	...	862	14.8
Other supporting personnel .....	...	...	...	2,672	37.5	...	...	...	1,760	30.3
Totals, supporting personnel .....	...	...	...	7,125	100.0	...	...	...	5,808	100.0
Totals, personnel employed on research-development activity .....	...	...	...	11,409	...	...	...	...	9,949	...

¹ Some firms were unable to give a detailed breakdown on the field and level of training of the research scientists employed. Their total employment of research scientists is included with "Other, bachelor level".

TABLE 11. Number of Professional Research-development Scientists, by Industry and by Field of Training, 1959

Industry	Engineering					Chemists	Physicists	
	Chemical	Civil	Electrical	Mechanical	Other			
	number							
Mining, quarrying and oil wells	66	—	3	13	40	28	28	
Manufacturing:								
Foods and beverages	21	—	—	3	—	43	1	
Rubber products	14	—	1	3	1	36	1	
Textile products	15	—	2	7	6	28	7	
Wood products	1	1	—	6	2	3	—	
Paper products	76	3	—	20	2	176	18	
Iron and steel products	6	8	15	106	11	1	—	
Transportation equipment	11	10	79	278	284	6	27	
Non-ferrous metal products	31	3	10	18	6	36	28	
Electrical apparatus and supplies	17	8	486	101	28	23	58	
Non-metallic mineral products	22	2	2	3	12	21	1	
Products of petroleum and coal	35	3	2	2	—	59	8	
Chemical products	177	—	2	16	7	380	17	
Other manufacturing ¹	13	3	50	54	2	17	15	
Transportation, storage, communication and public utility operations	14	9	70	21	5	2	1	
Other non-manufacturing ²	12	3	13	27	1	30	4	
Totals	531	53	735	678	407	889	212	
	Geologists geophysicists and other earth scientists	Metal-lurgists	Mathema-ticians	Medical scientists	Agri-cultural scientists	Adminis-trators	Other	Total
	number							
Mining, quarrying and oil wells	7	52	1	—	—	13	—	251
Manufacturing:								
Foods and beverages	—	—	—	4	19	5	8	104
Rubber products	—	—	—	—	2	—	2	60
Textile products	—	—	—	1	—	4	3	73
Wood products	—	4	—	—	—	1	—	18
Paper products	—	—	4	—	—	10	13	322
Iron and steel products	—	47	3	—	—	8	—	205
Transportation equipment	3	24	10	—	—	11	1	744
Non-ferrous metal products	—	71	—	—	—	8	—	207
Electrical apparatus and supplies	—	21	6	—	—	34	—	762
Non-metallic mineral products	4	1	2	—	—	1	2	73
Products of petroleum and coal	13	—	—	—	1	4	—	127
Chemical products	1	5	4	70	1	45	11	736
Other manufacturing ¹	—	3	2	1	—	6	3	169
Transportation, storage, communication and public utility operations	—	10	2	—	1	10	1	146
Other non-manufacturing ²	3	14	—	—	1	8	8	124
Totals	31	252	34	76	25	166	52	4,141

¹ includes tobacco and tobacco products, leather products, printing and miscellaneous manufacturing industries.

² includes construction, scientific and engineering services, and trade associations.

TABLE 12. Expenditures on Research Grants, by Industry, 1959

Industry	Firms making grants	Total expenditures on grants (in Canada)	Per cent distribution to total
	number	\$	%
Mining, quarrying and oil wells	6	37,300	5.2
Manufacturing:			
Foods and beverages	16	68,412	9.7
Rubber products	1	2,500	0.4
Textile products	1	9,300	1.3
Wood products	2	1,200	0.2
Paper products	7	27,800	3.9
Iron and steel products	6	17,089	2.4
Transportation equipment	4	27,675	3.9
Non-ferrous metal products	2	92,000	13.0
Electrical apparatus and supplies	2	6,200	0.9
Non-metallic mineral products	4	4,122	0.6
Products of petroleum and coal	3	22,500	3.2
Chemical products	17	185,692	26.2
Other manufacturing ¹	4	64,000	9.0
Transportation, storage, communication and public utility operations	10	59,570	8.4
Other non-manufacturing ²	7	83,125	11.7
Totals	92	708,485	100.0

¹ Includes tobacco and tobacco products, leather products, printing and miscellaneous manufacturing industries.

² Includes construction, scientific and engineering services and trade associations.

TABLE 13. Number of Firms Making Research-Development Expenditures in Canada, 1959

Industry	Firms surveyed conducting research-development within the reporting company ¹	Firms paying for research-development done outside the reporting company only ²	Total
	number		
Mining, quarrying and oil wells	30	5	35
Manufacturing:			
Foods and beverages	25	10	35
Rubber products	7	3	10
Textile products	8	2	10
Wood products	12	2	14
Paper products	26	5	31
Iron and steel products	64	7	71
Transportation equipment	24	—	24
Non-ferrous metal products	13	1	14
Electrical apparatus and supplies	51	2	53
Non-metallic mineral products	17	9	26
Products of petroleum and coal	5	3	8
Chemical products	47	4	51
Other manufacturing ³	21	3	24
Transportation, storage, communication and public utility operations	5	8	13
Other non-manufacturing ⁴	12	1	13
Totals	367	65	432

¹ These may also make payment for Research-development done outside the company.

² This column refers solely to companies paying for research-development done outside the company organization but located in Canada.

³ Includes tobacco and tobacco products, leather products, printing and miscellaneous manufacturing industries.

⁴ Includes construction, scientific and engineering services and trade associations.

SECTION III

DEFINITIONS

There is no generally accepted definition of the term "research-development". The concepts and definitions used in this survey parallel those used in previous studies which were developed in consultation with the National Research Council and others having an intimate knowledge of industrial research. They were also tested through visits to a number of companies active in the research field. The aim was to arrive at a definition which would describe the type of information required, and at the same time conform as far as possible with recognized accounting practices.

In general, research-development was defined as the activities directed to pure or basic research and to the conception and development of new products or processes or major changes in existing products. This concept would cover laboratory scale activity, the design and operation of pilot plants and the development of techniques or processes to the stage where the operation could be taken over by production departments. The design and operation of pilot plants and the development of techniques or processes may result in the inclusion of firms which do not conduct laboratory scale research. Included in research-development expenditures were supporting services, wages and salaries of all research personnel, materials and supplies

used, and an estimated portion of overhead costs. This latter item would include stenographic services, delivery services, storage facilities, light, heat, power, etc.

Such activities as market research to establish consumer preference or distribution studies and sales promotion were excluded. Similarly, routine quality or quantity control of a process or product as well as costs of patents were also excluded. Changes in process or improvements in a product to meet the requirements of a specific customer were not considered as research activity unless such changes were major in nature and resulted in the production of an improved product in volume on a continuing basis.

Although the records of some respondents did not follow the definitions as set out in the schedule, reporting companies were asked to follow the definitions as closely as possible for purposes of comparability. As a result of conversations with many officials in industry, and an examination of the individual returns received, it is felt that any variations in interpretation of the type of data to be included in the questionnaire were not significant enough to make any appreciable difference in the published data.

COVERAGE

Only those industries which were thought to be doing a significant amount of research were surveyed, and within the selected industries only those firms which were thought to be large enough to support some sort of research program on a continuing basis were contacted.

All industry groups as defined in the standard industrial classification were included except Clothing, Printing and Publishing, Retail and Wholesale Trade, Hospitals, Personal Services, and Fishing and Agriculture. This latter group was thought to contain few, if any, industrial firms which would carry out any appreciable amount of research-development as defined in this survey. Crown companies were included along with the private sector of Canadian business. The industries included in the survey were as follows:

Mining:

Companies primarily engaged in metal and non-metal mining, fuels, limestone quarrying and oil prospecting.

Foods and Beverages:

Companies primarily engaged in manufacturing food preparations.

Tobacco and Tobacco Products:

Companies primarily engaged in curing tobacco and manufacturing cigars and cigarettes.

Rubber Products:

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

Leather Products:

Companies primarily engaged in tanning, curing and finishing hides and skins, and manufacturing footwear (except rubber), leather belting, leather gloves, luggage, handbags and similar products.

Textiles:

Companies primarily engaged in manufacturing cotton, woollen or silk (including artificial silk) thread, yarn or woven fabrics, dyeing and finishing textiles, and in the manufacture of cordage, rope and twine, and coating, waterproofing, and otherwise treating fabrics. (Production of clothing, and related fabrication is excluded).

Wood Products:

Companies primarily engaged in producing lumber and wood basic materials, and manufacturing finished articles made entirely or mainly of wood. Companies engaged in manufacturing furniture and window and door screens and shades, regardless of materials used, are also included.

Paper Products:

Companies primarily engaged in the manufacture of pulp either from wood or other fibres, conversion of these pulps into any kind of paper or paper board, or the manufacture of paper and paper board into converted products.

Iron and Steel Products:

Companies primarily engaged in manufacturing primary iron and steel, fabricated and structural steel, sheet metal and iron products, industrial and household machinery and agricultural implements.

Transportation Equipment:

Companies primarily engaged in manufacturing or assembling motor vehicles and parts, aircraft and parts, railroad equipment, and other transportation equipment such as boats, motorcycles, bicycles, etc.

Non-Ferrous Metal Products:

Companies primarily engaged in the smelting and refining of non-ferrous metals, and in the manufacture of aluminum, brass, and copper products, including jewellery and silverware.

Electrical Apparatus and Supplies:

Companies primarily engaged in manufacturing heavy electrical machinery, batteries, radios, television, and electronic components and electrical appliances.

Non-Metallic Mineral Products:

Companies primarily engaged in manufacturing articles made entirely or mainly of non-metallic minerals such as cement, asbestos, clay, glass, stone and concrete.

Products of Petroleum and Coal:

Companies primarily engaged in refining crude petroleum, and in manufacturing products from petroleum as well as coke and coke-oven products, paving and roofing materials, and other products made from coal.

Chemical Products:

Companies primarily engaged in manufacturing industrial chemicals, medicinal and pharmaceutical preparations, soaps and washing compounds, paints, varnishes and allied paint products, and miscellaneous chemicals including fertilizers, sweeping compounds, adhesives, polishes and dressings, etc.

Miscellaneous Manufacturing:

Companies primarily engaged in manufacturing professional and scientific instruments, surgical, medical and dental instruments, and clockwork operated devices.

Construction:

Contractors engaged in the construction of buildings and highways, heavy construction and marine construction.

Transportation, Storage and Communication:

This group includes the following:

- (1) Transportation companies, primarily engaged in the operation of air or water transportation services, and railway transport.
- (2) Storage companies, primarily engaged in the operation of grain elevators and other storage facilities, including refrigeration.
- (3) Communication companies, primarily engaged in the operation of radio, television, broadcasting and telephone services.

Public Utility Operations:

Companies primarily engaged in the distribution of electric power, and the manufacture and distribution of gas.

Service:

This group includes the following:

- (1) **Engineering and Scientific:** Companies primarily engaged in providing engineering, chemical, metallurgical and architectural services. This includes research laboratories except medical and dental, which are classified as health services and excluded.
- (2) **Associations:** Trade or industrial organizations supported by members operating in Canadian industry, and conducting research on behalf of their paying members.

Only the larger firms were considered as being in a position to maintain full time research-development establishments. However, to ensure as complete coverage as possible, the survey was extended to include all firms in the industries noted above with 100 or more employees.

Research activity is generally conducted for the benefit of the entire firm rather than in the interests of an individual branch plant. Consolidated reports were therefore requested from "multiple" firms. In cases where all branches of a firm did not operate in the same industrial field, the firm was classified in the industry in which the major part of its operations were performed. This may lead to over or under statement of research in particular industries.

Respondents were requested to report the names of firms or associations from which they secured results of research activity, either with or without payment. Firms so reported and located in Canada, were checked against the mailing list, and, if they were not already included in the survey, they were

immediately sent a questionnaire for completion. This source resulted in comparatively few additions to the mailing list, but did insure more complete coverage. It also resulted in the inclusion in the survey of a few firms with less than 100 employees.

SURVEY METHODS

All firms in the survey were originally contacted by mail. Response was exceptionally good and the final result was a completed return received from over 98% of the firms contacted.

In order to ascertain the total cost of research-development, respondents were asked to report not only the cost of their own activities in this field, but also payments made to other companies or organizations both within Canada and outside the country. To avoid duplication, firms were also asked

to list the companies to which such payments were made as well as those from which payments were received for research results. Adjustments were then made on the reports received.

During the editing of the questionnaires some difficulties or differences in interpretation were encountered. These instances were clarified through correspondence or by telephone and on the advice of the respondents, adjustments were made in the reports.

Complete in duplicate. Keep one copy for your files and return one copy in the enclosed envelope to the Dominion Bureau of Statistics, Ottawa. Individual reports will be treated as CONFIDENTIAL and used only for the purpose of arriving at group totals.

FOR IMMEDIATE ATTENTION

CONFIDENTIAL

KEEP ONE COPY

Department of Trade and Commerce

Dominion Bureau of Statistics Business Finance Division OTTAWA, CANADA

INDUSTRIAL RESEARCH-DEVELOPMENT EXPENDITURES 1959

Please correct any mistakes in name or address

Taken in conformity with the requirements of the Statistics Act, Chap. 257 of the Revised Statute of Canada, 1952.

This survey is being conducted in cooperation with the National Research Council, in an effort to assess the magnitude of the industrial research program in Canada in terms of total expenditures incurred in the various scientific fields, numbers of trained personnel employed, and sources of funds.

Industrial research-development includes basic and applied research in the sciences, including medicines, and in engineering, and in the design and development of prototypes and processes. Do not include quality control, routine testing of products, testing of assembly line and production techniques, market research, sales promotion, sales service, geological and geophysical exploration or research in the social sciences or psychology. (SEE DEFINITIONS ON PAGES 3 AND 4).

Please complete the schedule as fully as possible. Your best estimate will be satisfactory if precise figures are not available.

NOTE: In the case of parent-subsidiary operations a consolidated return covering all companies which are within the organization will be satisfactory.

SECTION A

1. List of companies covered by this report. (Consolidated reports only).

Table with 2 columns: Name, Address. Dotted lines for entries.

2. Average number of persons employed by reporting company in all its activities in Canada during 1959. Include employees of subsidiaries and/or affiliates if consolidated reports. (Estimate only) No. _____

3. Total value of sales or services rendered by reporting company during 1959. (Estimate only) \$ _____

SECTION B

4. Was any industrial research-development conducted within reporting company during 1959? [] Yes [] No
(a) If "YES", was any industrial research-development done on behalf of other companies or organizations for which you were reimbursed? [] Yes [] No

Table with 2 columns: Name, Address. For question 4(b).

5. (a) Did reporting company spend any funds for industrial research-development done outside the company during 1959? [] Yes [] No
(b) If "YES" list names and addresses of outside organizations which undertook and/or supplied you with industrial research-development services:

Table with 2 columns: Name, Address. For question 5(b).

6. (a) Did reporting company grant funds to educational institutions, research institutes, foundations and hospitals for general research-development work during 1959? [] Yes [] No
(b) If "YES" list names and addresses of those to which these funds were granted:

Table with 2 columns: Name, Address. For question 6(b).

7. (a) Does reporting company have access to the results of industrial research-development done outside your company for which no payment is made? [] Yes [] No
(b) If "YES" list names and addresses of companies or organizations supplying this information:

Table with 2 columns: Name, Address. For question 7(b).

NOTE: IF THE ANSWERS TO QUESTIONS 4, 5 and 6 ARE "NO" PLEASE SIGN SCHEDULE AND RETURN AS SECTIONS C AND D DO NOT APPLY.

SECTION C

8. Cost of industrial research-development performed or financed by reporting company during 1959. Report total cost for all industrial research-development. Include all professional and non-professional salaries, other direct costs and an estimated share of overhead expenses including depreciation. Exclude patent expense. Exclude also expenditures on construction or acquisition of buildings and durable equipment which should be reported under item 13 only.

(a) Done within your company organization (total 1959) \$ _____

Source of funds (approximate percentages):

(i) Reporting company %

(ii) Parent, affiliated and/or subsidiary companies %

(iii) Government funds received through:

(a) Industrial research-development prime contracts %

(b) Industrial research-development part of procurement contracts %

(iv) Others (Please specify) %

..... %

(b) Done outside your company organization (total 1959) \$ _____

	In Canada	Outside Canada
Payment made to:		
(i) Parent, affiliated and/or subsidiary companies \$ _____	\$ _____	\$ _____
(ii) Commercial laboratories and consultants \$ _____	\$ _____	\$ _____
(iii) Other companies \$ _____	\$ _____	\$ _____
(iv) Educational institutions - for industrial research-development only. (See item 12 below) \$ _____	\$ _____	\$ _____
(v) Research institutions, foundations, etc. \$ _____	\$ _____	\$ _____
(vi) Governments \$ _____	\$ _____	\$ _____
(vii) Others (Please specify) \$ _____	\$ _____	\$ _____
..... \$ _____	\$ _____	\$ _____

(c) Total cost of industrial research-development performed or financed by reporting company during 1959 \$ _____

9. Estimated cost of industrial research-development performed or financed by reporting company during 1960:.....

(a) Done within your company organization (total 1960) \$ _____

(b) Done outside your company organization (total 1960) \$ _____

10. Indicate approximate percentage of total 1959 industrial research-development expenditures made in each of the following scientific fields:

Engineering, Chemical %	Engineering, Other %	Metallurgy %
Engineering, Civil %	Chemistry %	Medicine %
Engineering, Electrical %	Physics %	Agriculture %
Engineering, Mechanical %	Geology, Geophysics and Other Earth Sciences %	Others (Specify) %

11. Indicate the approximate percentage of total 1959 industrial research-development costs, the results of which are to be used in the manufacture of products in the following industrial groups. SEE DEFINITION ON PAGES 3 AND 4.

Aircraft and Parts %	Electronics %	Petroleum and Natural Gas %
Chemicals (except Drugs and Medicines) %	Fabricated Metals %	Primary Metals %
Drugs and Medicines %	Machinery (except Electrical) %	Professional and Scientific Instruments %
Electric Equipment (except Electronics) %	Motor Vehicles and Parts %	Others (Please specify) %

12. Amount of funds granted to educational institutions, research institutions, foundations and hospitals during 1959 for general industrial research-development work. (This amount should not be included in Item 8 (b)) \$ _____

13. Estimated capital expenditures during 1959 on new or extended facilities, including special buildings and equipment, for use in industrial research-development activities \$ _____

SECTION D

14. Number of persons employed in industrial research-development done within your company organization during 1959 (full-time equivalent if part-time staff engaged). Include all persons whose pay is included in cost figures in question 8 (a).

(a) Industrial research-development scientists and engineers. All classes of supporting personnel are to be excluded from this sub-section.

Bachelor Level	Master Level	Doctorate Level		Bachelor Level	Master Level	Doctorate Level
			Engineers, Chemical	Geologists, geophysicists and other earth scientists		
			Engineers, Civil	Metallurgists		
			Engineers, Electrical	Mathematicians		
			Engineers, Mechanical	Medical Scientists		
			Engineers, Other	Agricultural Scientists		
			Chemists	Administrators (of Research-Development)		
			Physicists	Others (Please specify)		

(b) Supporting personnel - SEE DEFINITIONS.

- (i) Industrial research-development technicians
- (ii) Skilled craftsmen
- (iii) Other supporting personnel

Name and address of person making this report

.....

Date of this report 1960

DEFINITIONS

A. CONCEPT OF INDUSTRIAL RESEARCH-DEVELOPMENT:

Industrial research-development comprises activities ranging from pure research intent upon obtaining new knowledge in the life and physical sciences, to conceiving and developing new products, new processes and major changes in products or processes, and bringing them to the stage of production. Such activities as market and sales research and process and quality control are excluded, as well as other special cases outlined below. In case of doubt, please feel free to ask about special situations which you may encounter.

The following kinds of activity are to be included in the concept of industrial research-development:

1. Laboratory scale activity.
2. The design and operation of pilot plants or prototypes, provided the main purpose is one of the following:
 - (a) To test experimental conclusions reached at the laboratory level.
 - (b) To establish finished product formulas, specifications or standards.
 - (c) To design special equipment required by a new or improved process.
 - (d) To prepare operating instructions for use at the manufacturing level.
3. The engineering activity necessary to advance the design of a product or a process from the laboratory to the stage where it can be turned over to a production unit. The design, construction and testing of full scale models prior to production is included, along with the development of designs for special manufacturing equipment and tools required.
4. The preparation of drawings, formulas, specifications and manuals of instruction for the use of manufacturing units, all of which are based on the research activities. (See No. 9 in the following section).

The following activities are NOT to be included in the concept of industrial research-development:

1. Market research and development, including statistical surveys of consumer preferences, estimates of possible markets, distribution outlets, etc.
2. Development of advertising programs including sales promotion and demonstration of new products.
3. Economic research and other research in the social sciences.
4. Application for patents, including related legal work.
5. Experimental work performed to provide additional information as required for the completion of patent litigation.
6. Routine quality or quantity control of a process or products at the manufacturing level.
7. Investigation and/or analytical work in connection with mechanical interruptions in production (i.e. trouble shooting).
8. Work required for the minor modification of a specific product to meet the requirements of a specific customer.
9. Assistance furnished at the manufacturing level to facilitate production in accordance with established formulas, instructions or finished product specifications. This includes the cost of printing blueprints and instruction manuals. (See No. 4 in preceding section).
10. Geological or geophysical exploration.

B. COST OF INDUSTRIAL RESEARCH-DEVELOPMENT:

Include all costs incurred for industrial research-development work done.

If you maintain a separate industrial research-development organization, include all operating costs of this organization minus an estimated allowance of the cost of non-research technical services as outlined (Nos. 1 to 10) in the preceding section. Include also an estimate of the cost of industrial research-development work done by company divisions or technicians not part of the industrial research-development organization. Exclude capital expenditures as part of current industrial research-development costs, but include in this cost item 13. Costs incurred as a result of industrial research-development activity within your company organization may include but are not limited to the following:

1. Wages, salaries and related costs, including "fringe benefits", of all research personnel, including scientists and all classes of supporting staff.
2. Materials and supplies used (or purchased), including the cost of purchasing, receiving, inspection, storage and transportation.
3. Literature purchased to provide background information necessary for research operations.
4. Company overhead, which is an estimated share of the functions supporting industrial research-development activity.

If industrial research-development operations are being conducted for your company by outside organizations, enter the cost in Section 8(b). Your entries should include the total charges for the work including professional fees and administrative costs.

C. DEFINITION OF INDUSTRIAL GROUPS AS NOTED IN ITEM 11:

Aircraft and Parts:

Research and development related to piloted and unpiloted aircraft and parts of all types such as engines, landing gear, propellers, turrets and all auxiliary equipment specifically adapted for aircraft, including guided missiles. Radar and radar equipment and other electronic devices for aircraft should be included with electronics, and aeronautical instruments should be included with professional and scientific instruments.

Chemicals (except Drugs and Medicines):

Research and development related to organic and inorganic chemicals including petro-chemicals, primary plastics, synthetic fibres, explosives, soaps and glycerines, paints and varnishes and other products of a chemical nature.

Drugs and Medicines:

Research and development related to medical and pharmaceutical preparations. This includes patent and preparatory medicines, veterinary medicines, vitamin products and biological products, such as antitoxins, bacterins, serums, vaccines, etc.

Electrical Equipment (except Electronics):

Research and development related to systems, machinery, apparatus and supplies for generation, storage, transmission and transformation and utilisation of electrical energy, except those of an essentially electronic nature.

Electronics:

Research and development related to electronic systems and components, whether for wire and wireless telephone and telegraph of all kinds, radio and television transmitting and receiving, object detection, industrial controls and business machines.

Fabricated Metals:

Research and development related to fabricated metal products such as fabricated structural metal products, metal stamping, pressing and coating, hardware, tools and cutlery, fabricated wire products and non-electric heating apparatus. Exclude machinery and transportation equipment.

Machinery (except Electrical):

Research and development related to machinery and movers other than electrical equipment, including engines and turbines, agricultural, construction and mining machinery, metal working machinery and other special and general industrial machinery and equipment. Exclude motor vehicles and other transportation equipment.

Motor Vehicles and Parts:

Research and development related to motor vehicles including passenger automobiles, commercial cars and buses, trucks and truck trailers, universal carriers, and special purpose motor vehicles such as ambulances, fire engines, etc.

Petroleum and Natural Gas:

Research and development related to petroleum and natural gas. Petro-chemicals should be included under chemicals above. Geological and Geophysical activities are NOT to be reported.

Primary Metals:

Research and development related to smelting, refining, rolling, drawing, extruding and alloying of metals and the manufacture of castings, forgings and other basic metal products.

Professional and Scientific Instruments:

Research and development related to professional and scientific instruments and equipment, including surveyors, nautical, navigational and aeronautical instruments; instruments for laboratory work and scientific research; surgical, dental and medical instruments; electric and mechanical measuring instruments and surgical supplies; and photographic equipment and supplies.

D. SUPPORTING PERSONNEL: (Item 14(b) refers)

Technicians:

Technical personnel having high school graduation or equivalent and additional technical training, who assist scientists and engineers in industrial research-development work (i.e. laboratory technicians and assistants, draftsmen, etc.).

Skilled Craftsmen:

Workers in positions requiring specialized training and experience and who are engaged in industrial research-development work (i.e. glassblowers, machinists, modelmakers, etc.).

Other Supporting Personnel:

All other persons whose pay is included in Item 8(a).

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