Royal Commission

on Canada's Economic Prospects

The Electronics Industry in Canada

by Canadian Business Service Limited

ROYAL COMMISSION ON CANADA'S ECONOMIC PROSPECTS

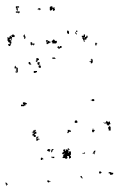
THE ELECTRONICS INDUSTRY IN CANADA

prepared by

CANADIAN BUSINESS SERVICE LIMITED

APRIL, 1956

While authorizing the publication of this study, which has been prepared at their request, the Commissioners do not necessarily accept responsibility for all the statements or opinions that may be found in it.



PREFACE

This study of the Canadian electronics industry has presented a number of problems for us. Due to the speed with which the industry has grown, its widespread ramifications, and the many recent technological changes, relatively few statistics were available. In determining the scope of this survey on electronics, therefore, it was decided that we should contact the major companies in the industry and that we should supplement the personal approach with a questionnaire. This was sent out and answers were received from all of the larger firms and a substantial number of the smaller firms; those responding represented more than 80% of the dollar value of sales in the electronics industry. The results secured were checked by a second questionnaire.

The industry was most co-operative. We are particularly appreciative of the efforts of Mr. Stuart Brownlee, until recently General Manager of Radio Electronics Television Manufacturers Association (R.E.T.M.A.). Mr. C. A. Pollock and Mr. J. D. Campbell, past and present presidents of R.E.T.M.A., gave us all the assistance that it was possible to furnish, as did Mr. F. W. Radcliffe, present general manager of R.E.T.M.A. Many others in the industry gave us a great deal of their time and were of material assistance in the formulation of our conclusions about the industry.

That the electronics industry in Canada is characterized by very keen competition is clearly in evidence. At the same time there is a prevailing spirit of optimism. This fact, and the calibre of the management that we have interviewed, suggests to us that the electronics industry in Canada has a very bright future

G. Armstrong

Canadian Business Service Ltd.

TABLE OF CONTENTS

TABLES

1

THE NATURE AND SCOPE OF ELECTRONICS

ELECTRONICS is that branch of electrical engineering that deals with the passage of electricity through a vacuum, through a gas under low pressure, or along and within the surfaces of solid electrical semi-conductors; by these means the flow of electrons is emitted, controlled and directed.

When conduction of the electron flow is through a vacuum the medium is commonly described as a vacuum tube; when through a gas the tubes are usually known by trade names such as *thyraton,* and when along or within the surfaces of a semi-conductor the device is referred to as a *transistor.*

The control exercisable over the flow of electrons in electronic tubes or transistors is greater, more varied, and more rapid than in any other medium, such as solid electrical conductors or electrolytes. Thus the controlled electron streams in electronic devices can be applied not only as a substitute for achieving the same results by mechanical, electrical or chemical means in a wide range of applications, but also for attaining ends impracticable by any other means.

Electrons have an exceedingly small mass and can move at almost infinite speed. Because of their minute mass, it is possible in electronic tubes and transistors to start and to stop, or to shift transversely, the direction and rate of flow of electron streams millions of times a second. Such rates and changes of motion are wholly unattainable by mechanical devices for reasons of inertia and other factors.

A vivid illustration is afforded by examining the development of the simple mechanical adding machine over the past few decades into the modern electronic computer. Initially the adding machine was wholly mechanical and hand operated. A series of levers, cranks, wheels, dials and such was actuated to produce the results. Then gradually electrical devices were added or substituted—some, such as motors, to produce the driving power, and others, such as electrical and magnetic circuits, to actuate start-stop, shift mechanisms, and such. The major improvements attained, at the cost of substantial

additions in price and complexity, were increases in operating speeds measurable in orders not greater than tens. It was not until electronic devices were developed and incorporated into adding machines that the modern electronic computer emerged, with speeds and capacities improved in the order of hundreds of thousands, together with a very sharp downward shift in cost and complexities relative to the magnitude of the improvements gained. A feature of the modern electronic computer is the almost complete absence of mechanical motion. The emancipation, in this field, from the limitations inherent in mechanical motion, is attained through control of the flow of electron streams. This control is, in turn, applied to direct the flow of electric currents in other media which, in turn, may be used to control mechanical, chemical or other actions.

The most significant aspect of electronics is the inherent and central position it holds in the function of exercising control. By controlling the flow of electron streams not only is it possible and distinctly economical to displace other competing means of control over mechanical motions and processes, but because of the extremely high speeds and displacement rates with which the flow of electron streams can be governed, electronic control devices can be applied over other electric and electronic devices having the same order of ultra high speed characteristics and which cannot be controlled in any other way.

It is from this characteristic of potential for exerting control, and from the almost infinite variety of uses which can be contemplated from what has already been achieved, that an immensely successful future for electronics and the electronic industry can assuredly be predicted.

In its more familiar uses, electronics is the basis of radio, television, radio detection (radar), automatic navigation, weather observation, etc. In the field of defence, electronic controls are the basis of the proximity fuses; and electronic mechanisms are the heart of the modern aircraft. Guided missiles today are controlled by electronic computers and are themeslves largely composed of electronic equipment. Nuclear fission is guided, controlled and recorded by electronics. The communications field is rapidly being converted to the use of electronics for transmitting messages. The recording of music, entertainment, statistics, inventories, business records, etc., is in almost all instances dependent on devices which utilize electronics. The field of calculation and mathematical forecasting is rapidly being revolutionized by electronic computers. Automatic machinery is dependent on the electron tube for guidance and control.

It may be said that within the last 30 years the following fields have been profoundly influenced or even revolutionized by the science of electronics: our entire home life, since the television set is today referred to as the modern hearth; defensive and offensive warfare; industrial production; office

methods; sea, air and land transportation; and an infinite number of related activities.

Few scientific developments of this century have had such an important effect on our way of life as has electronics. This single fact is so important that it overshadows all controversy as to whether electronics is an art, a science or an industry. The profitable pursuit of any art or science eventually is designated as an industry. For this reason we feel that the term *electronics industry* is appropriate and are referring to it as such.

By treating it as a single industry it is possible to focus attention on the rate of growth, to forecast future capital requirements and to study the problems with which it is confronted. Among these problems are the adequacy of research facilities, availability of trained technical personnel, interchange of technical information, maintenance of proper standards, etc.

By way of comparison, it is of interest to note that in the automobile industry, an infinite number of component parts are assembled to produce a single end product—the motor car. In the electronics industry, a single basic part, the vacuum tube (or transistor), is utilized with other electronic components to produce an infinite number of end products. Thus it would seem unlikely that the electronics industry will ever pass completely into the hands of a few giant companies. Undoubtedly the production of television, radio and other appliances or components, where the economies of large-scale production can be secured, will tend to be increasingly concentrated in a few manufacturers' hands. However, the multiplicity of end products will tend to leave a considerable field wherein the efficient small producer will be able to operate to advantage.

In the past, yardsticks which were frequently used to measure the relative industrial status of a country were its iron and steel output, its output of heavy chemicals, and so on. It may well be that in future the number of television sets used will furnish a measurement of the standard of living in a country; the quality of the television programmes will provide an index of its general cultural level; and the proportion of electronically controlled or automated machinery will supply an accurate barometer of the efficiency of its industry.

2

HISTORY AND GROWTH OF THE ELECTRONICS INDUSTRY IN CANADA

THE ELECTRONICS industry in Canada has developed almost entirely because of domestic demand. The opening of a radio station at Montreal in November, 1920, the first to broadcast regularly in Canada, provided the incentive to start the production of electronic equipment in Canada.

In 1921 two companies of electrical power line equipment began the production of vacuum tubes in Canada. Early in 1922 the first radio receiving tube was manufactured, but relatively little is known about the early years of tube production in Canada. In 1929, the first year for which figures on tube production were collected by the Dominion Bureau of Statistics (D.B.S.), the total value of production amounted to nearly $3.3 million. The greater part of output consisted of radio receiving tubes, of which 2.9 million units with a factory value of $3.1 million were manufactured in that year. The remainder was made up by X-ray, transmitting, and special purpose tubes. In 1930 the value of total tube production had risen to over $3.4 million (see Table III).

Some manufacturers of electrical power line equipment also commenced the production of radio receiving sets. Previously only self-built or imported radio sets had been in use. In 1925, the first year for which any figures on electronic equipment were collected by the D.B.S., approximately 49,000 radio receiving sets were manufactured, with a factory value of nearly $2.3 million (see Table II). Production expanded rapidly until 1931, when 292,000 sets were manufactured. The rapid development of domestic output of radio receivers made it possible, under the regulations of the Canadian Patent Act, to limit imports; since 1932, imports of radio receivers for sale in Canada have been almost negligible in relation to total sales.

	Radio sets imported	*Total sales in Canada*	*Imports as a percentage of total sales*
1927	45,000	74,000	61
1928	60,000	122,000	50
1929	64,000	180,000	36
1930	80,000	225,000	36
1931	30,000	274,000	11
1932	450	114,000	—
1939	10,000	358,000	3

As the science of electronics developed at a rapid rate its principles were applied to other fields, and some production of record players, broadcasting and communication equipment was undertaken in Canada. In 1929 about 11 companies were engaged in the production of electronic end products. In that year a group of radio manufacturers formed the Radio Manufacturers Association of Canada, which later developed into the Radio Electronics Television Manufacturers Association of Canada (R.E.T.M.A.). According to the D.B.S. the gross value of Canadian production of electronic equipment amounted to about $15.5 million in 1929, rising to $23 million in 1930.

The manufacture of electronic end products provided the incentive to produce parts and accessories, and by 1932 about 20 companies were manufacturing electronic components in Canada. The Report of the Tariff Board,[1] published in 1939, estimates that the Canadian content of radio receiving sets made in Canada in 1937 averaged 80.6% of total manufacturing costs and that the Canadian content of all material used amounted to 74%.

Along with most other industries, the Canadian electronics industry was adversely affected by the depression of the '30's. The production of radio receiving sets plummeted from 292,000 units in 1931 to 112,000 units in 1933. In the same period the production of receiving tubes dropped from 3.3 million units to 1.7 million units (see Table III). In 1933 the gross value of all electronic production had dropped to $6.2 million, less than one-third of the record of $23.0 million in 1930. During the depression the number of radio receiver manufacturers was reduced from over 30 to 12.

A strong recovery was made in 1934, and by 1937 the gross value of production amounted to $15.3 million. The main factor in this development was the production of radio sets, which rose from a depression low of 112,000 in 1933 to 289,000 in 1937 (see Table II). After another reversal in 1938 and 1939, production reached $16.3 million in 1940 (see Table I). These fluctuations in the output of the electronics industry in the prewar period were much sharper than those in total manufacturing (see Table IV).

[1]Ref. No. 104: The Radio Industry.

After the outbreak of the war the production of civilian products was rapidly reduced and the industry was converted to the large-scale manufacture of all kinds of electronic equipment for military use. Under the stimulus of government contracts, existing plants were greatly enlarged and new plants were built. In 1944 the gross value of Canadian production of electronic equipment reached a new high of about $115 million. Between 1940 and 1944 the gross value of electronic production rose by 600%, compared to a rise of 100% in the gross value of all Canadian manufacturing (see Table IV).

The manufacture of vacuum tubes was rapidly expanded, and by 1944 the value of production amounted to nearly $13.8 million. The most important factor in the swift growth of the Canadian tube production after the outbreak of the war was the rapid expansion in the output of transmitting, rectifier and special purpose tubes. Between 1940 and 1944 their value of production rose from $73,000 to over $10 million.

The manufacture of components was also greatly extended. Prior to World War II the greater part of the Canadian production of components consisted of standard components (such as resistors and condensers). By the end of the war, however, virtually all components needed in the manufacture of electronic equipment were available from Canadian sources.

In common with the production of most industries engaged in the manufacture of defence materials, the output of the electronics industry contracted sharply when the war ended. The value of production declined from $115 million in 1944 to $52 million in 1945 and to $35 million in 1946. The drop of 69% between 1944 and 1946 exceeded that for manufacturing generally, which amounted to 11% (see also Table IV).

The rapid development of electronic science during the war, however, resulted in a multitude of new and improved electronic products for peacetime use; in 1952 the gross value of electronic production in Canada, at $123.1 million, surpassed the previous record set in 1944. In 1954 the gross value of production amounted to nearly $243 million, twice the value produced in 1952 (see Table I), and in 1955 about $300 million was produced.

It should be noted that these D.B.S. figures do not represent the total output of electronic equipment in Canada. In the first place some electronic equipment is produced by companies outside the electronics industry. In the second place electronic components are used in a variety of products customarily not looked upon as electronic. An automatic long-distance telephone dialing system, for example, not considered to be a product of the electronics industry, is built around a highly complicated electronic device which selects automatically the appropriate routing of the telephone call. We are told by one of the leading electrical companies in Canada that out of its production of about $210 million, some $140 million contains electronic components.

Nevertheless the greater part of this production is not considered by this company to be electronic and consequently is not included in figures of the total value of electronic production in Canada.

Companies that sent information for our study reported sales of close to $258 million for 1955, as against $244 million in 1954 (see Appendix A). The total number of employees of the reporting companies was about 15,427 in 1955 and sales per employee $16,700. R.E.T.M.A. estimates the total employment in the Canadian electronics industry in 1955 at about 25,000 people. Based on this number and on a figure of $16,700 for factory sales per employee in 1955, total factory sales of the Canadian electronics industry in 1955 may have been some $415 million. Nevertheless the D.B.S. figures—although they do not cover the whole industry—may be considered representative of the rate of development of the electronics industry in Canada.

In the postwar period the gross value of electronic production in Canada has risen faster than total Canadian manufacturing and than the Gross National Product (G.N.P.). Since 1950 its rate of growth has also exceeded that of its counterpart in the United States. As is illustrated in the Chart on page 9, the gross value of electronic production in Canada rose by 460% between 1947 and 1955, compared with a rise of 91% in the G.N.P. in Canada. In the period 1950-55 the output of the Canadian electronics industry rose by 385%, while the gross value of electronic production in the United States rose by 90%.

The most important factor in the development of the last few years has been the rapid growth in the production of television receiving sets. In 1949 the production of television sets was started in Canada. Awaiting the installation of Canadian television broadcasting stations, sales were confined to those areas within reach of U.S. border city stations. In September, 1952, the first Canadian stations at Toronto and Montreal started operations, and as a result the production of television sets rose from 142,000 sets with a factory value of $30 million in 1952 to 852,000 sets valued at $129 million in 1955.

Figures published by the D.B.S. show that in September, 1955 about 42% of the wired households in Canada had one or more television sets in use. According to a survey held recently this percentage had risen to 55% in the first half of 1956. The total number of television sets in use is estimated at over two million, and about 75% of the Canadian population is now within the range of television transmitters.

After the resumption of civilian production when the war ended, the production of radio receiving sets was rapidly expanded. A peak was reached in 1947, when 984,000 sets were manufactured. Under the impact of television the production and sales of home radio receivers have decreased, but the downtrend has been offset to some degree by rising sales of car radios and portable sets. In addition the trend towards small personal sets, replacing the

large console-type radio receiver, has had a favourable influence on the production and sales of radio sets. As a result of the trend towards smaller sets the average unit value of sets manufacturing in Canada decreased from $47.16 in 1951 to $33.03 in 1955.

In September, 1955, approximately 3,712,000 or 96% of the 3,872,000 Canadian households had one or more radio sets in use. The total number of home sets in use at that date was about five million. In addition about one million motor vehicles or 25% of the total number in use were radio equipped at that date.

As a result of new developments, the long-playing record, for example, and improved methods of recording such as high-fidelity sound equipment, the production of record players and amplifiers is becoming increasingly important.

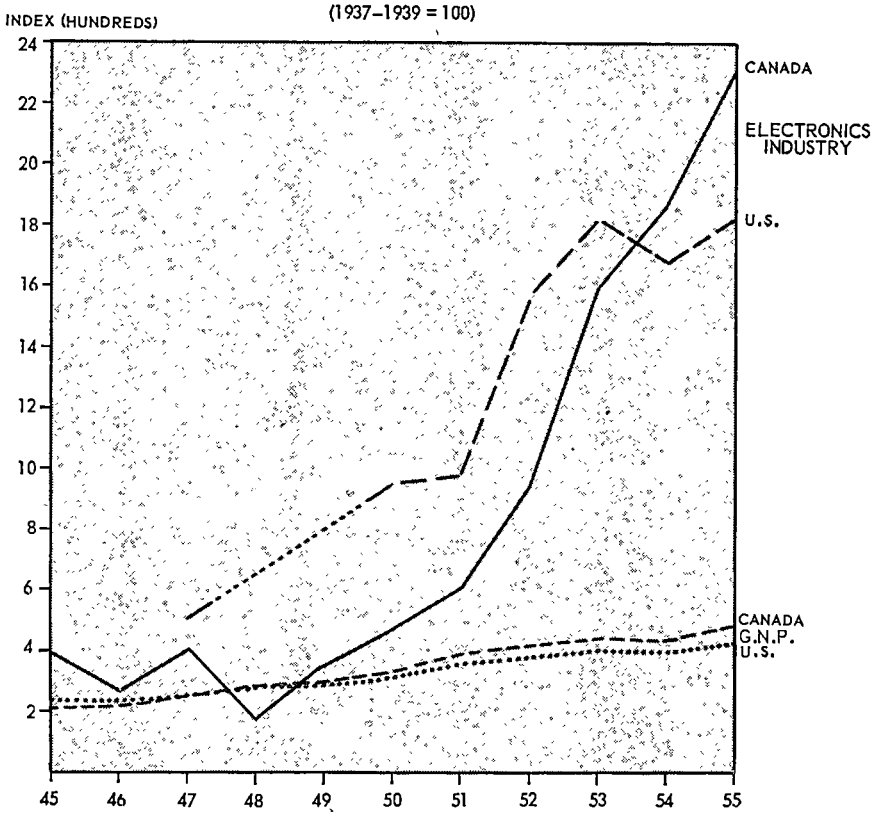
After the war the production of tubes other than radio receiving tubes was virtually abandoned again for reasons explained in the section on costs (section 3.4). The total value of production dropped to $1.9 million in 1948. The output of receiving tubes rose rapidly again upon the introduction of television in Canada. In 1949 the first television picture tubes were manufactured in Canada and in 1952, the only year for which figures are released by the D.B.S., 120,000 units, valued at $2.3 millions, were manufactured. Between 1952 and 1953 the value of total Canadian tube production nearly doubled, going from $7.1 million to $14.0 million, and by 1955 output amounted to some $22 million. It is estimated that between 600,000 and 700,000 television picture tubes were manufactured in 1955.

The development of the transistor some seven years ago has led to its replacing tubes in some applications. The transistor is basically a body of electronic semi-conductor material, at present usually germanium metal or silicon in crystalline form. Its features include small size, immunity to shock, no warm-up time, minute consumption of power (hence cool operation), long life, and high reliability. The transistor has made possible true miniaturization and portability, simplicity of design, and lower operating and capital costs. One of the first applications has been in hearing aids. Electronic hearing aids have now almost fully replaced the mechanical devices in use prior to World War II. The transistor enabled a reduction in the size of hearing aids, and its low power consumption cut down operating expenses.

Microwave relay transmission of telephone, television and radio signals is a modern development which circumvents geographic limitations. Microwave frequency radio signals are bounced from tower to tower, from horizon to horizon, thereby eliminating the high cost of poles and wires and reducing maintenance costs. In Canada a microwave network extending from Buffalo, N.Y. to Toronto, Ottawa, Montreal and Quebec City in the east and to Windsor in the west is used to transmit television programmes as well as telephone

GROWTH OF THE CANADIAN ELECTRONICS INDUSTRY
IN RELATION TO
THE GROWTH OF THE U.S. ELECTRONICS INDUSTRY
AND TO
THE G.N.P. OF CANADA AND OF THE U.S.

(1937–1939 = 100)



conversations. Extensions of this network now under construction will connect Canada from Halifax to Vancouver in a few years' time.

The electronics industry in Canada is mainly concentrated in greater Montreal and in the Toronto-Kitchener-Hamilton area. In addition there is some production at Ottawa, Belleville, St. Catharines, London, Vancouver and Halifax. The major companies are listed in Table XXII. The main reason for the concentration in the more densely populated and industrialized regions of Canada is the proximity of major markets and suppliers. As the largest plants are located in the greatest centres of population, the economies of the cities, towns and areas where the electronics industry is established are not to any important extent dependent upon the industry.

3

FACTORS AFFECTING THE COMPETITIVE POSITION OF THE ELECTRONICS INDUSTRY IN CANADA

FOR A VARIETY of reasons, costs of the Canadian electronics industry are higher than those of its counterparts elsewhere. In the following a number of the factors affecting the competitive position will be discussed.

3.1 *Machinery and Equipment*

Machinery and equipment used by the electronics industry can be classified in two broad categories.

Standard Machinery and Equipment

Machinery and equipment belonging to this category can be bought on the market and in most cases is used with or without minor alterations. Examples are metal-working machinery such as lamination presses and punch presses. Conveyors and belts used in assembling operations are in most cases built by the manufacturers themselves with standardized components bought on the market. Standard test equipment such as ampere and volt meters also belong to this category. Standard machinery and equipment is not subject to rapid obsolescense through technological innovations. The majority is written off in up to ten years but is often in service much longer.

Specialized Machinery and Equipment

The average length of life becomes shorter as machinery and equipment is more specialized. Examples of specialized machinery are winding machines for coils, wire-cutting machines, and machinery for the manufacture of vacuum tubes. Highly specialized machinery and equipment will be written off in a fairly short time, usually in three years, and will ordinarily be replaced by the end of this period. Some test equipment is especially designed and built for the testing of a certain model or type of product, and consequently will be obsolete as soon as the production of that particular type or model is stopped. As the average length of life of specialized electronic products is shortening, the average length of life of this kind of test equipment is shortening too.

An important part of the specialized machinery and equipment used is developed by the manufacturers in the electronics industry themselves. In some cases designs of foreign affiliates are used. In addition special machinery and equipment is bought from highly skilled machine-tool manufacturers, the majority of whom are located in the U.S. In many cases this machinery and equipment has to be modified to Canadian specifications or adapted to more flexible operation. American machinery for the manufacture of vacuum tubes, for example, is designed for the high-speed production of long runs of one particular type. In some cases over one million tubes may be produced in one run, while in Canada the average run amounts to only 100,000 units. Consequently alterations have to be made to make the machinery suitable for short runs. These modifications increase the cost of the machinery and equipment involved. Similarly the need to write off the cost of the equipment against relatively short runs increases tooling costs very substantially

A high degree of automation is being introduced in U.S. television assembly lines at the present time. The much smaller production in Canada, however, will mean that a different and more expensive technique must be followed in Canadian subsidiaries. The consequences of automation are more fully discussed in the section on effects of automation (section 4.2).

Although most of the machinery and equipment is of a class or kind made in Canada, the greater part is imported, mainly from the U.S. The customs tariffs on these items, shown in Table V, increase the cost to the Canadian manufacturers. Presumably the cost to Canadian manufacturers of equipment imported from the U.S. is between 7.5 and 22.5% higher than for their competitors in the U.S., but even so it is generally cheaper for the Canadian manufacturer to buy its machinery and equipment abroad rather than from Canadian suppliers. In certain cases, however, a premium is paid by buying from Canadian suppliers for reasons of continuing service and the possibility of close co-operation with the supplier.

According to our survey (see Appendix A), net investment in land, buildings, machinery and equipment per employee amounted to about $1,400 by the end of 1955. At the same date the total net investment (total assets less depreciation and actual liabilities other than funded or long-term indebtedness) amounted to $5,200 per employee. Based on a total employment of 15,427 people for the companies reporting for that year, the total net investment in land, buildings, machinery and equipment of the 14 companies that supplied information amounted to approximately $21.6 million, while the total net investment amounted to close to $81 million. The big difference between the two figures could be partly explained by the fact that several companies rent buildings while heavy depreciation charges reduced the book value of buildings and equipment owned.

Based on the R.E.T.M.A. employment estimate of 25,000 in 1955, the net investment in land, buildings and equipment could be estimated at $35 million in 1955, while on the same basis total net investment would have amounted to close to $130 million in that year.

In view of heavy capital expenditures in the postwar period, especially during the last five years, the greater part of the plant, machinery and equipment currently in use can be considered as of relatively recent vintage. Companies answering our questionnaire reported a net investment in land, buildings and equipment of $21.6 million by the end of 1955, while their capital expenditures amounted to $9 million in the period 1945-50 and to $29 million in the period 1951-55.

3.2 *Personnel and Productivity of Labour*

The labour force in the electronics industry includes a large number of female workers. The reason is that a substantial part of the work force is employed in the manufacture of consumer home products such as radio and television receivers. (In 1955 these two products accounted for about 50% of the total value of electronic production in Canada.) The assembling operations call for a high degree of finger dexterity, good eyesight and adaptability to close and repetitive work. Women are more suitable for this type of work than men and most can be fully trained to their jobs in about three months. The same holds true in the manufacture of tubes and components. For the production of industrial and military equipment, manufacturers employ relatively more male workers. Companies that answered our questionnaire reported that 44% of their hourly-paid employees in 1955 were female. R.E.T.M.A. estimates the average age of female workers in the electronics industry at 25 years.

Approximately 60-75% of the total labour force is unskilled, while the remainder is in the semi-skilled to skilled category. The female employees predominantly belong to the unskilled category while the jobs taken by the male portion of the labour force vary from unskilled to highly skilled engineering technicians. Companies involved mainly in straight assembly work employ a slightly higher percentage of unskilled males than do manufacturers producing more complicated electronic equipment. In addition the larger companies employ a greater percentage of skilled male workers for machine shops, tool rooms and maintenance departments.

Sales of consumer home products are concentrated in the last three or four months of the year. As it is difficult to level off production throughout the year, the employment in this segment of the industry fluctuates seasonally. In the production of radio receiving sets the problem has been partially solved by the introduction of portable and car radios. Sales of these two types are not restricted as much to the last months of the year. No solution has been found to the problem as it relates to the production of television receiv-

ing sets. However in the other segments of the electronics industry there are no marked seasonal fluctuations of production and employment. As these segments are likely to show the strongest growth trend in future years, total employment in the electronics industry should tend to show less seasonal fluctuation as time goes on.

Our survey revealed that the average hourly wage rate in the Canadian electronics industry was about $1.48 in 1955 as against $1.40 in 1954. According to figures published by the D.B.S. the average hourly earnings in all Canadian manufacturing of durable goods amounted to $1.56 in 1955 and to $1.52 in 1954. In comparison the average hourly earnings for all non-supervisory employees in the U.S. radio, phonograph, television sets and equipment industry amounted to $1.74 in 1955 (not including employee benefits; figure published by the U.S. Dept. of Labor). In 1955 the average hourly wage rate for all manufacturing in Canada amounted to $1.45 as compared to $0.56 in the U.K.

The electronics industry employs large numbers of professional engineers in supervising positions and in research, development, and commercial departments. Engineers and other executive personnel are paid less in Canada than in the U.S.

There is a serious shortage of engineering technicians, engineers and research scientists, and this deficiency may inhibit the growth of the electronics industry in Canada. The shortage is not confined to the electronics industry but presents a general problem in Canada. Some 2,500 to 3,000 engineers are needed each year, but only 1,700 graduated from Canadian universities in 1956. The shortage is not limited to engineers but includes engineering technicians; the problem is aggravated by a continuing emigration of engineers and technicians to the U.S.

To compare the Canadian electronics industry with that in the U.S., we compiled information on 24 U.S. companies. (A list of these companies is included in Table XXIII.) As we were not able to get figures on the electronics divisions of Westinghouse and General Electric, we also excluded their Canadian subsidiaries from our compilation of Canadian companies. Sales and investment per employee compare as follows:

	1954		*1955*	
	Canada	*U.S.*	*Canada*	*U.S.*
Factory sales (sales & service)	$15,200	$14,800	$16,000	$14,700
Investment in land, buildings and equipment (depreciated value)	$ 1,400	$ 1,900	$ 1,300	$ 1,900
Total net investment	$ 4,500	$ 5,400	$ 5,200	$ 5,800
Capital turnover rate	3.38	2.74	3.08	2.52

The figures are not conclusive. Sales per employee in Canada are higher than those in the United States. Three factors could explain the difference:

(a) Far more people are engaged in development and research in the U.S. than in Canada.
(b) Canadian prices are generally speaking higher than those in the U.S.
(c) Canadian production of television sets was growing rapidly during 1954 and 1955, while that in the U.S. had levelled off.

It is expected that sales per employee in the U.S. will exceed those in Canada as soon as automated machinery and equipment comes into more widespread use. Already the capital turnover rate is lower in the U.S., indicating that more capital relative to sales is employed in the U.S. than in Canada.

3.3 *Materials*

Some of the more important basic materials used in the manufacture of electronic equipment are aluminum, copper, lead, zinc, tin, steel, and lumber, in addition to a wide variety of other materials such as plastics. Except for tin, the non-ferrous metals are readily available in Canada. If we compare the prices of the non-ferrous metals in Canada with those in the U.S. and the U.K. (as is done in Table VI), we find that the price of aluminum is lower in Canada than in the other two countries. The price of copper in Canada is usually higher than that in the U.S. but lower than that in the U.K. The Canadian price of lead is lower than that in the U.S. but somewhat higher than that in the U.K. The price of zinc in Canada is slightly higher than that in the U.K. but at about the same level as that in the U.S., if freight charges are taken into account. For tin no comparable prices were obtainable, but from the available information it would appear that Canadian prices are at the same level or slightly higher than those in the U.S.

Because of the many different kinds of steel used in the electronics industry, exact comparisons of steel prices are difficult to make. One kind fairly widely used is cold rolled sheets of steel used for chassis. Prices for this kind of steel are higher in Canada than they are in the U.S. However, as will be clear from Table VI, the difference is diminishing. In 1951 prices in Canada were about 19% higher than those in the U.S. In 1955 the difference in price had shrunk to 6%. In the U.K. prices of cold rolled steel have also been rising faster than those in Canada, and in 1955 the U.K. price exceeded that in Canada for the first time.

Price comparisons for lumber run into the same difficulties as those for steel. Birch, maple, walnut and mahogany, to name a few, are used in the manufacture of cabinets for radio and television receivers. Except for birch and maple, which are obtainable in Canada, they are imported, mainly from the U.S. Import duties depend on the stage of manufacture.

In summary, it may be said that the Canadian electronics industry is not seriously handicapped by its location in Canada so far as prices of basic materials are concerned. Nevertheless an important part of the requirements of components and accessories is imported, and reasons for this will be discussed in the section on costs (section 3.4).

3.4 *Costs*

As we have indicated, the costs of electronic products made in Canada compare unfavourably with those of similar products made in the U.S. and some other countries. In the following, some explanation will be offered. As little information was available on costs in the U.K., the comparisons are mainly made with manufacturers in the U.S. The electronics industry in that country is also the most important competitor for the Canadian electronics industry.

Products Manufactured on a Relatively Large Scale

The main reason why Canadian costs are higher than those elsewhere is the comparatively small production per type and model that can be achieved in Canada. Moreover, the Canadian market is divided between a relatively greater number of companies than in the U.S. The tables in the section on industry structure and competitive conditions (section 3.7) illustrate this point for some of the products that have the longest production runs in Canada.

As a result of these two factors, factory overheads (cost of supervision, foremen, housing, etc.), depreciation charges, and general, administrative, and distribution expenses per unit of product made in Canada are higher than those per unit of the same product made in the U.S. The more frequent changes to other models and types with the accompanying changes of the assembling lines require more supervision and foremen and increase the amount of idle time. Although wage rates in the U.S. are higher than those in Canada (section 3.2), the advantage to Canadian manufacturers is to a very large extent offset by the fact that U.S. manufacturers are able to install labour-saving equipment that Canadian manufacturers cannot economically use.

Apart from the higher relative costs, many cost elements are higher in themselves in Canada. Machinery and equipment is often more expensive in Canada for reasons discussed in the section on machinery and equipment (section 3.1). Distribution costs are higher for geographical reasons. A special factor tending to increase costs in Canada is the Canadian Standards Association code, the requirements of which are stricter than those of the Underwriters Laboratories in the U.S. and sometimes require special designs.

In the case of television sets, for example, it is estimated that the difference in costs between Canada and the United States generally varies from

10 to 15%. One Canadian manufacturer stated that, generally speaking, the difference in costs of electronic equipment varies from 5 to 15% and higher.

For reasons mentioned in the foregoing, the costs of most Canadian-made components and vacuum tubes are also higher than those of the same products made in the U.S., and this exercises an unfavourable influence on the cost of end products. Little information with regard to this differential in costs is available. Moreover, a great many different items are classified under components, from resistors and condensers to loudspeakers and television receiver tuners. Each has its own manufacturing method, and quantities produced in Canada are different in each case. The costs of fixed resistors, which are made in large quantities in Canada, for example, would appear to be around the same level as those of resistors made in the U.S. According to information received from some companies, the average difference in f.o.b. prices quoted by Canadian and U.S. component manufacturers is about 10 to 15%. As duties on imports of components from the U.S. are in most cases 20%, the majority of the Canadian companies buy the greater part of their component requirements in Canada. Prices of European-made components are also lower than prices of components made in Canada, but because of the long delivery times only a modest amount of standard components is imported from Europe.

In the case of tooled parts (such as metal sub-bases, plastic cabinets and aluminum moldings), the difference in price between U.S. and Canadian suppliers is often over 20%, and in those cases such parts are imported from the U.S. In the U.S. parts are made in such quantities that tooling costs may be spread over a much greater volume; consequently tooling charges per unit are considerably lower than they would have been in Canada, where smaller production runs mean that tools are usually discarded for obsolescence rather than wear. In some cases parts are made in Canada with used tools bought or borrowed from the U.S. If a special tool for a certain component has to be made both in Canada and the U.S., and the quantities of the component ordered are the same in both countries, then the purchase of the tooled part in the U.S. would not offer any advantage.

Highly specialized tools and dies are required for the manufacture of parts and sub-assemblies for vacuum tubes. Consequently practically all these parts and sub-assemblies are imported from the U.S. Parts utilized in the manufacture of vacuum tubes can be brought into Canada free of duty, but on most sub-assemblies a rate of 20% is levied. Very few parts and sub-assemblies are imported from Europe, as European tube types are of different design. Prices paid for parts and sub-assemblies by Canadian manufacturers are slightly higher than those paid by U.S. tube manufacturers, as most manufacturers of parts and sub-assemblies in the U.S. also have their own tube assembly plants.

The Canadian costs of some representative types of receiving tubes made or imported by one leading Canadian manufacturer compare as follows with those of the same types made in the U.S. (factory costs only, exclusive of profits, warranty or merchandising costs or allowances):

Type	*Canadian costs as a percentage of U.S. costs*
1	148.2
2	145.8
3	105.2
4	120.0
5	160.3
6	110.8
7	140.3
8	202.7

Sales per type range from about 300,000 to one million units annually. Total sales of these eight types by this manufacturer represents about one-fifth of the total unit sales of receiving tubes in Canada in 1955, which amounted to some 28 million units. The difference in costs between Canada and the U.S. ranges from 5% to more than 100%, as shown by the table, and consequently many types are imported. Another Canadian manufacturer of receiving tubes estimates the average difference in costs at 22.5%. The variance in costs between Canada and the U.S. can be explained by the difference in length of production runs. As pointed out in the section on machinery and equipment (section 3.1), over one million tubes may be produced in one run in the U.S., while the average run in Canada amounts to only 100,000 units. As set-up costs are very high in the production of vacuum tubes, the U.S. manufacturer is at an advantage.

The difference between the Canadian and U.S. costs of television picture tubes is smaller than the difference between the costs of receiving tubes in the two countries. In the first place, the material content of a television picture tube is higher than that of a receiving tube. The expensive glass envelope is bought from U.S. glass manufactures at the same price paid by U.S. manufacturers of picture tubes and is imported into Canada free of duty. In the second place, the production of picture tubes in Canada is not yet as competitive as is the production of receiving tubes relative to the U.S. In 1955 the average production of receiving tubes per manufacturer was 38.5 million units in the U.S. as compared to only four million in Canada. The average production of picture tubes, however, amounted to 250,000 units in the U.S. as against 220,000 in Canada. (See also the section on industry structure and competitive conditions, section 3.7.)

Products Manufactured in Small Quantities

From the foregoing, the position of Canadian manufacturers in these fields will be clear. The Canadian costs of military and commercial equipment come close to those in the U.S. These types of equipment are more frequently custom made. If the same quantities of a certain product should be ordered both in Canada and the U.S., if all necessary components were available from Canadian sources and if tools would have to be made in both cases, then the Canadian costs would probably be lower because of lower wage rates and salaries.

3.5 *Research and Development*

One of the basic factors in the development of the electronics industry to its present stage has been research. Most of the larger companies in the Canadian electronics industry have U.S. or European affiliates. The results of foreign research are available to the greater part of the electronics industry in Canada; hence little research has been done in this country. Moreover, the market in Canada is too small as compared to the U.S. for individual companies to bear the high cost of a large research programme.

There are two distinct types of scientific research: basic and applied. Basic research may be described as an inquiry into the laws of the universe; it is the search for an understanding of the phenomena of nature through studious inquiry that has as its aim the discovery and interpretation of facts and the formulation of physical laws. Basic research is of a long-term nature and may have to be carried on for years without any return on investment. Up to the present time little basic research has been conducted by the industry in Canada; it is, however, carried on by the National Research Council and the Defence Research Board in co-operation with the Canadian universities, and it is understood the results have been quite successful.

Applied research begins where fundamental research leaves off. Applied research is predominantly work directed for the industrial exploitation of the scientific truths discovered as a result of basic research. Before World War II practically no applied research was conducted in Canada. At the beginning of World War II, Research Enterprises Limited was founded as a crown company to conduct applied research in Canada. Since the war, more applied research has been done in Canada than ever before. However, because of the high cost, only a limited number of the larger companies in the electronics industry have facilities to carry out applied research programmes. Applied research work in Canada is mostly carried out in close co-operation with the foreign affiliates of these companies in order to avoid duplication of efforts. Companies without foreign affiliates or applied research laboratories sometimes have agreements with U.S. companies under which they may use the results of their research work. This course of action is cheaper for these companies than the conducting of research programmes.

Development and production engineering are carried out on a larger scale in Canada than is research. Development engineering means the taking of a design for a new or improved product from the applied research laboratory and adapting it to commercial production. Prototypes are produced and tested and manufacturing costs calculated. This process is usually followed by a decision whether or not to take the product into manufacture. Production engineering deals with adaptations of the product design to achieve lower cost or improved quality without changing the essential features of the design.

The reason that more development and production engineering than research is done in Canada is the necessity to adapt the products to the special requirements of the Canadian market. In the case of consumer home products such as radio and television receivers, the widespread population and the long distances from transmitting stations in Canada demand a higher standard of quality and performance than that which is adequate in more densely populated countries. In addition, some of the more heavily populated areas of Ontario are still using electric power of 25 cycles per second. In many cases receivers for use in these areas have to be specially designed. Finally, the safety requirements of the Canadian Standards Association are more strict than those of the Underwriters Laboratory in the U.S. and necessitate special designs, although often only modifications of foreign designs are necessary.

In the industrial and communications equipment sections of the electronics industry the same situation prevails. In addition, these types of equipment are often subject to frequency allocations and are custom built to a greater degree than are consumer durable products. Moreover, the severe Canadian winter and the nearness of the north magnetic pole require special designs, especially in the case of communication equipment.

It is estimated that most electronics firms in the U.S. spend from 6 to 9%[1] of their sales dollar on research and development. A large percentage of the research programmes undertaken in the U.S. is government sponsored. According to our survey, firms in the electronics industry in Canada spent from 0 to 12% of their sales dollar on research and development in 1955, averaging 4.14%. This compares with 4.13% in 1954, 3.4% in 1947, and 2.9% in 1937. Of the amount laid out in 1955, about 94% was spent in Canada and the remainder abroad.

One of the major firms in Canada is now setting up a basic research laboratory, but it is not clear just how large this will be. Two other firms already have such facilities. The attitude of the bulk of the industry is to favour research in theory but to leave the actual work to be carried out by foreign affiliates. It would seem that some specific policy should be formula-

[1]Standard & Poor's Industry Surveys.

ted, although the opinions of the various companies in the industry are not unanimous as to the form it should take.

In passing, it is worth while drawing attention to the co-operative research programmes that are being conducted by trade associations in Great Britain. These were described by Fraser Robertson, the financial editor of the Toronto *Telegram,* in an issue dated April 18th, 1956. He said:

> "Two big changes in the British tradition concerning scientific research are working now to give Britain a commanding position. One is that British firms within the same industry now are jointly paying for central research. Throughout Britain you will find scores of trade associations tying together the interests and activities of manufacturers in fairly small segments of industry. A vast number of these associations maintain research labs, which the individual members could not afford any more than could similar Canadian manufacturers. In addition, of course, there are independent labs maintained by some very large companies, and small testing labs operated by a great many medium-sized companies."

An example of co-operative research in Canada is the Pulp and Paper Research Institute of Canada, maintained by the Canadian Pulp and Paper Association.

We have discussed co-operative research with a number of the Canadian electronics companies and it has met with a very mixed reception. The bulk of the industry appears reluctant to follow it. The closer the ties with the foreign parent company, the greater is the degree of reluctance. However, it should be noted that the set-up of the R.E.T.M.A. would lend itself ideally to such an arrangement.

Correspondence which we have had with the National Union of Manufacturers of the U.K. indicates that the research associations in the U.K. are incorporated as non-profitmaking companies limited by guarantee. Their income comes in the main from subscriptions, which are based on the number of employees employed in a firm, the annual turnover, or, in some instances, the tonnage of output. It appears that the associations also carry out sponsored research, in which case the cost is based on the rate of remuneration of the scientists concerned plus a component to cover overhead. This co-operative research programme has been operating in Britain since 1916. It duplicates the National Research Board in some of its functions. However, the link is directly with the trade association, and the research laboratories are adjacent to the industry or to suitable technical facilities in universities and elsewhere. In this respect it differs from the National Research Council—for which organization, incidentally, a great deal of respect is felt, although a close working relationship does not appear to prevail. It would appear that the direct link with the trade association is particularly valuable, since the interest and guidance is direct and specific. One electronics

company which favours a co-operative research programme says that if the R.E.T.M.A. group were to sponsor something of this nature it would indicate that the various member companies intend to pay more than lip service to their slogan of more research in Canada. However, this opinion may not necessarily be shared by more than two or three leading electronics manufacturers in Canada. A number of Canadian electronics companies also suggest that the granting of tax concessions to companies in proportion to the amount of research work performed would encourage further Canadian research.

3.6 *Patents*

Electronic End Products

No company in the electronics field is able to keep abreast of the rapidly developing applications of electronic principles without utilizing the patents of others. This situation led to the incorporation of Canadian Radio Patents Limited (hereinafter referred to as the Patents Company) as a private company under the Dominion Companies Act in 1926. Without it any company desiring to acquire the necessary radio patents rights would be obliged to negotiate licence agreements with each company holding patent rights. To each of these companies royalties would have to be paid, often based on different royalty percentages and accounting procedures. The Patents Company facilitates licensing negotiations and royalty payment procedures.

The Patents Company has non-exclusive rights for the granting of sublicences for the manufacture of radio and television receivers and other electronic apparatus under Canadian Letters Patent owned or administered by Canadian General Electric Company, Canadian Westinghouse Company, Northern Electric Company, Canadian Marconi Company and Canadian Radio Manufacturing Corporation, and their affiliates. These five companies are the shareholders in the Patents Company.

At the present time the Patents Company also has licensing rights under the Canadian patents of Admiral for the radio, television receiver and phonograph field; and of Philco for all fields in which licences are granted by the Patents Company.

The Patents Company also has a non-exclusive agreement with the R.C.A. Victor Company Limited by which the Patents Company collects royalties from its licensees for the use of Canadian patents originating with R.C.A. Victor and its parent company. These royalty payments are collected on behalf of R.C.A. Victor, who pays a collection fee to the Patents Company for acting as its agent.

In addition, the Patents Company holds exclusive rights, including sublicensing rights, under Canadian patents on inventions originating with the Hazeltine Corporation of the U.S. The Hazeltine Corporation is an applied

research establishment and has no Canadian branch or affiliate; all technical innovations of this organization are made available to the Canadian electronics industry through the Patents Company.

The patent rights acquired from the Hazeltine Corporation also cover certain services which are available to the licensees of the Patents Company free of charge. These include testing of new pre-production electronic equipment by the Hazeltine laboratories in the U.S., together with full reports on these tests, and consultations of the licensees' engineering staffs with the Hazeltine experts. R.C.A. Victor and Hazeltine also provide technical reports on new developments, which circulate to the licensees of the Patents Company.

The Patents Company has no arrangements for the outright assignment to it of the title of newly issued Canadian patents, and the sub-licensing rights that the Company receives are only for the fields in which it is interested. Licensees are not required to assign to the Patents Company any patents or licensing rights that they own or may acquire in the future. The Patents Company is, however, always interested in considering the purchase of patent or licensing rights offered for sale in its field. There are many patents and licensing rights relating to electronics owned by parties other than the Patents Company. Several of the licensees of the Patents Company acquire licenses to use certain patented inventions owned by these other holders, and pay royalties to them. The Patents Company does not own a monopoly of patent rights.

Some of the types of patents under which the Patents Company has sub-licensing rights are as follows:

(a) Patents of primary importance, such as the Parker patent on an intercarrier sound system used in virtually all modern television receivers.

(b) Secondary patents generally involving valuable improvements whereby the more fundamental inventions of (a) may be utilized with improved performance, simplicity of production, and reduced cost.

(c) General patents applicable to specific methods, depending upon the type of electronic article concerned. Although not entirely necessary for the production of any particular product, they may be of use to the design engineer.

(d) Groups of patents not necessary for any particular type of electronic article, but where it may be more economical to have license rights instead of designing around the patented inventions or risking expensive patent litigation.

(e) Patents covering inventions not currently utilized in products on the market, but made available to designing engineers for use when the demands for receivers embodying such inventions will require their application.

Not all these patents are necessary to any one type of electronic product. The broad coverage, however, provides a great freedom of design and production.

Originally the Patents Company had patent licensing rights only in the radio receiver field. These were later expanded to include electric phonographs and television receivers. In 1951 arrangements were made with the shareholder companies and with the R.C.A. Victor Company to extend the Patents Company's non-exclusive rights to cover nearly the whole electronics field. These broader licences were offered to all interested Canadian companies. Shortly afterwards the Patents Company arranged a special licence for the Department of Defence Production. Under this licence the Patents Company receives yearly one single payment from the government as royalty to cover complete patent clearance for all the electronic defense products. This arrangement eliminated the necessity for the Department to deal with numerous royalty claims and infringement actions.

The royalty rate for radio receiving sets using vacuum tubes ranges from .45 of 1% to 1.75% of the manufacturer's net selling price, depending upon the patent coverage. For monochrome television receivers it is 2.5. For colour television receivers and transistorized radios the rates are 3.5%. However, various deductions for such items as sales and excise taxes and costs of tubes, batteries, clocks, record players, and cabinets (costs in excess of $30), reduce the actual royalty rate considerably. For other electronic equipment the rate is 3%. On exported equipment one-half of the normal royalty rate is levied because often royalties have to be paid in the countries to which exports are made.

No minimum annual royalty has to be paid. A deposit of $1,000, required as an advance security to be held against possible non-payments of the royalties, is returnable upon termination of the licensing agreement. No information on the income of the Patents Company is available.

A comparison of the rates charged by the Patents Company with those of the Radio Corporation of America is interesting. R.C.A. is an important source of patents in the U.S. It owns, controls or possesses licensing rights under approximately 10,000 U.S. patents. Over 400 U.S. manufacturers of electronic equipment are licensed under R.C.A.'s patents. Rights of licensees of R.C.A. would appear to be somewhat more extensive than those of licensees of the Patents Company.

In the following table the rates of the Patents Company and R.C.A. are stated. To make them comparable we added the rate of 0.9% charged by Hazeltine to U.S. manufacturers to the rates of R.C.A.

	Patents Company	*R.C.A. and Hazeltine* (percentages)
Radio receivers, using tubes	0.45-1.75	0.50 + 0.90 = 1.40
Radio receivers, using transistors	3.50	1.13 + 0.90 = 2.03
Television receivers, monochrome	2.50	1.25 + 0.90 = 2.15
Television receivers, colour	3.50	1.75 + 0.90 = 2.65
Commercial radio equipment	3.00	1.50 + 0.90 = 2.40

While the Patents Company allows deductions for sales and excise taxes (25%), tubes, batteries, cabinets (costs in excess of $30), record players and clocks, R.C.A. only allows deductions for excise taxes (10%), tubes and batteries. Taking these factors into consideration, it would appear that the rates of R.C.A. are little, if at all, lower than those of the Patents Company.

In order to avoid any implication of abuse of its patents, licences are granted only for production in Canada, except in special circumstances, such, as the case where the patented article is not made in Canada in ample quantities to meet the demand. The relative sections of the Patent Act are as follows:

> 67.2 The exclusive rights under a patent shall be deemed to have been abused in any of the following circumstances:
>
> (b) If the working of the invention within Canada on a commercial scale is being prevented or hindered by the importation from abroad of the patented article.
>
> (c) If the demand for the patented article in Canada is not being met to an adequate extent and on reasonable terms.
>
> 67.3 It is declared with relation to every paragraph of subsection (2) that, for the purpose of determining whether there has been any abuse of the exclusive rights under a patent, it shall be taken that patents for new inventions are granted not only to encourage invention but to secure that new inventions shall so far as possible be worked on a commercial scale in Canada without undue delay.

When unlicensed imports are reported to the Patents Company the procedure is as follows. First the Patents Company establishes that one or more of the patents for which it holds sub-licensing rights are used in the imported equipment. If there is no patent coverage, no action is possible. In case its patents have been infringed, the Patents Company warns the infringer and offers a licence to manufacture the equipment in Canada. If this proves to

be ineffective, the Patents Company then seeks an injunction order in the court. Usually this action is sufficient to terminate the imports. To settle the matter the importer is in most cases allowed to sell out his stock of the imported equipment after payment of royalties.

In 1953-54 the Patents Company took action against the import of television receiving sets. One of the brands imported into Canada in that period has been produced in Canada since. While there is a certain amount of criticism of the Patents Company, the simplicity of the procedure has been of great assistance to the development of the electronics industry in Canada.

Vacuum Tubes

In 1932, Thermionics Limited was incorporated to operate as a licensing agency for patent rights covering the manufacture, sale and use of vacuum tubes in Canada. Prior to its formation, tube manufacturers operated in virtue of numerous cross-licensing agreements between tube manufacturers. Thermionics ceased operations shortly before World War II and its charter was surrendered in 1947. At the present time licensing agreements are again negotiated between the individual tube manufacturers.

3.7 *Industry Structure and Competitive Conditions*

Generally speaking, no single company or group of companies dominates the manufacture of electronic equipment in Canada.

An indication of the competitive situation in the electronics industry can be derived from the results of our survey. They can be summarized as follows for 1955:

No. of companies	*Market share of each company (%)*
3	15-20
1	10-15
2	5-10
9	less than 5

The absence of domination by any company is even more apparent when the segments of the industry are analyzed.

Practically all receiver manufacturers in Canada are members of the R.E.T.M.A., which allocates dues in the receiver division in accordance with the dollar value of receiving set sales. R.E.T.M.A. figures also indicate that no single receiving set firm dominates the market:

No. of companies	*Each share of the market (%)*
6	over 7.5
6	2.5-7.5
4	1 -2.5
5	less than 1

In the following table a comparison is made with the U.S. for the production of radio and television receiving sets in 1955:

	Canada			*U.S.*		
	No. of Mftrs.	*Output*[1] *Total*	*Av. per Mftr.*	*No. of Mftrs.*	*Output*[2] *Total*	*Av. per Mftr.*
Television receivers	21	852	41	45-50	7,757	164
Radio receivers	28	579	21	65-70	14,344	214

[1]1,000 units.
[2]*Source:* R.E.T.M.A. of U.S.

From the table it is clear that there are relatively more manufacturers in Canada than in the U.S. This situation could be explained by the fact that foreign concerns are apt to establish Canadian subsidiaries for reasons of prestige and pride and to participate in the expected rapid growth of the Canadian economy. As a result competition is fiercer in Canada than it is in the U.S. and profits are consequently lower (see section on profits, section 3.9). Yet, in the U.S. competition in the television industry is also extremely keen. Between 1950 and 1955 the number of manufacturers of television receiving sets was reduced from about 100 to 45-50. Nevertheless the position was still not healthy last year, and so far in 1956 five more manufacturers have abandoned television set making or have been sold to other companies. In 1955 pre-tax profits of the U.S. electronics industry averaged only 7% of sales, which figure must be considered below normal (see also the section on profits, section 3.9). It compares with 13.8% for 18 major fabricating companies in the U.S. on which we compiled figures.

In 1955 the situation in receiving and T.V. picture tubes relative to the U.S. was as follows:

	Canada			*U.S.*		
	No. of Mftrs.	*Output*[1] *Total*	*Av. per Mftr.*	*No. of Mftrs.*	*Output*[2] *Total*	*Av. per Mftr.*
Radio & T.V. receiving tubes	4	16.0	4.00	10	479.8	48.0
T.V. picture tubes	3	0.65	0.22	40	10.9	0.27

[1]Million units.
[2]*Source:* R.E.T.M.A. of U.S.

The manufacture of receiving tubes is much more competitive in Canada than in the U.S. The average production per manufacturer of picture tubes, on the other hand, is comparable with that in the U.S., especially if the fact is taken into account that one of them started production only in the course of the year.

A wide variety of components is made in Canada. The majority of the component manufacturers are members of the R.E.T.M.A. Again taking the R.E.T.M.A. dues as a base, we arrive at the following tabulation:

No. of companies	*Yearly sales of each company (dollars)*
11	over 1 million
10	0.5-1.0 million
54	less than 0.5 million

In certain components, it could be said that a few companies dominate. Fixed resistors, for example, are made by only three manufacturers in Canada. The greater part of the volume controls sold in Canada originates with one company. In most cases, however, there are proportionately more companies engaged in the manufacture of any specific component in Canada than in the U.S.

That the expansion of the Canadian electronics industry in recent years has overreached itself is indicated by two recent developments. One is the decision of Motorola Inc. to liquidate Canadian manufacturing operations, as capital can be more profitably employed in the U.S. The other is the announcement of Crosley Radio and Television that it had suspended the production of television receivers in Canada indefinitely. In addition, several other companies have curtailed their production of radio and television receiving sets temporarily. In view of developments in the U.S., further consolidation may be expected in Canada.

3.8 *Taxation*

Rates of federal income and provincial taxes are the same for the electronics industry as they are for other manufacturing industries in Canada. A sales tax of 10% is levied on the sale price of electronic products in the same way as it is on other taxable goods. The excise tax, however, levied on consumer home products and receiving tubes at a rate of 15% is higher on these products than on all other durable consumer goods, which are taxed at 10% at the present time, unless tax-exempt. The yield from this tax on electronic products goes to the C.B.C.

The history of the sales and excise tax levied on consumer home products and receiving tubes has been as follows:

	Sales Tax	*Excise Tax*
	percent	
1933-36	6	—
1936-40	8	—
1940	8	10
1940-45	8	25
1945-47	8	10
1947-48	8	25
1948-50	8	10
1950-51	8	15
1951-52	10	25
1952-56	10	15

Corporation taxes are higher in the U.S. than in Canada. In Canada the federal income tax for corporations, inclusive of old age security tax, amounts to 47% on taxable income over $20,000, while in the U.S. the corporation profits tax is 52% at the present time.

In the U.S. no federal sales tax is levied and in addition the excise tax amounts to only 10%. This explains in part why radio and television receiving sets can be sold more cheaply across the border than in Canada and why so many radio sets are brought into Canada by tourists returning from the U.S.

3.9 *Profits*

No yearly statistics on profits made by the electronics industry in Canada are publicly available. Some information on profits in the prewar period, however, is contained in the Report of the Tariff Board.[1] The following figures for 1937 are derived from this report:

[1]Ref. No. 104: The Radio Industry.

	Investment[1]	*Sales*	*Net profit or loss*[2]	*Percentage of net profit*	
Mftrs.	*($1,000)*	*($1,000)*	*($1,000)*	*To investment*	*To sales*
Radio receiving sets	7,071	12,152	72d	1.3d	0.6d
Vacuum tubes	1,794	2,308	437	24.4	18.9
Components	404	1,130	48	11.9	4.2
Total	9,269	15,590	413	4.5	2.7

d = deficit

[1]Total of net fixed assets and working capital

[2]After including non-operating income and deducting non-operating expenses such as interest on borrowed capital, but before deducting income taxes.

The figure of net profit as a percentage of sales of 2.7% for 1937 compares with a deficit of 0.4% for 1936 and a deficit of 3.9% in 1935. According to our survey the comparable figures for 1947, 1954 and 1955 amounted to 2.80%, 5.50% and 4.69% respectively.

Our findings for 1955 can be summarized as follows:

	Canada	*U.S.*[1]
No. of companies	14	24
Total sales	$258 million	$3,167 million
Total net investment	$ 80 "	$1,262 "
Net profit before taxes	$ 12 "	$ 232 "
Net profit before taxes as a percentage of sales	4.69	7.32
Net profit before taxes as a percentage of total net investment	15.00	18.39

In comparison, net corporation profits (before deducting income taxes) for all manufacturing industries in Canada are stated by the D.B.S. at 8.22% of sales for the same year.

The main reasons for the lower profits of the Canadian electronics industry are the more competitive conditions in Canada and the higher costs of the industry. The higher costs can only be partly offset by higher selling prices. The difference in costs of receiving tubes between Canada and the U.S. for example, runs to over 100% (see section on costs, section 3.4). Prices of receiving tubes made in Canada are only about 16% higher, however. This percentage is due to the tariff protection of 20% on imports from the U.S. Consequently, profits on the production of receiving tubes in Canada are very low.

The electronics industry is characterized by rather large fluctuations in profit margins over the years. When a new product is brought out, profit margins tend to be rather large for a period of two to four years, but by the end of that time, when initial demand has been satisfied, profit margins tend to decrease. The most recent example is television. It is expected that profit margins will improve somewhat when colour television is introduced on a wide scale in Canada.

3.10 *Foreign Control*

Most manufacturers of electronic end products are affiliated in one way or another with companies in the U.S., the U.K., or the Netherlands. The degree of dependence varies from outright ownership to a considerable degree of control through holdings of voting stock.

[1] See Table XXIII.

Of the 21 manufacturers of television receiving sets in Canada, for example, 15 are foreign controlled or owned. Out of 27 companies producing radio receiving sets in Canada, 16 are foreign controlled. The manufacture of vacuum tubes in Canada is completely foreign controlled through foreign majority interests in the five companies producing tubes in Canada.

Most manufacturers of components in Canada, however, are either Canadian controlled or completely owned by Canadians. It should be noted, however, that the manufacture of components is largely concentrated in the smaller companies. Consequently it can be said that with a few exceptions all major companies in the electronics industry in Canada are either foreign controlled or foreign owned.

Foreign control of a company does not necessarily mean that all major decisions are made abroad. A number of companies submitted information regarding the relations with their foreign parent companies; from this it is clear that although the parent company may select the top management, it plays little or no part in the appointment of other senior technical and managerial personnel of the Canadian subsidiary. In a few cases assistance is given in the training of those personnel who are Canadians.

In financial matters the parent company plays more or less a controlling shareholders' role. Major decisions with reference to plant expansion and modernization, distribution of earnings, and new financing are subject to approval by the parent company.

The Canadian subsidiaries are, as far as can be ascertained, free to buy their components wherever they can get them most cheaply, and they can make their own marketing arrangements, including decisions to bring out new products. Although it was not stated officially, we have the impression that entering the export market is only allowed in special cases and with approval of the parent company. For reasons of policy, international concerns sometimes place export orders with their Canadian subsidiaries.

The tie-in with foreign companies is advantageous for the Canadian electronics industry in as far as Canadian companies are able to draw upon the findings of foreign research. As a result, however, little research is done in Canada.

3.11 *Tariffs*

The protective effects of the provisions of the Canadian Patent Act and the tariffs on imports have played an important role in the development of the Canadian electronics industry. The influence of the former is described in section 3.6. The following presents a description of the main tariff items applicable to the electronics industry.

Tariff item 445d—Electric wireless or radio apparatus and complete parts thereof n.o.p.

Year of insertion or change	British preferential	Most favoured nation	General
	(percentages)		
1930	15	25	27.5
1932	Free	25	30
1936	Free	25	30
1939	Free	25	30
1948	Free	20	30

Prior to 1930, products of the electronics industry were classified under tariff item 453 at the same rates as the new 445d. The reduction in 1948 was made under the General Agreement on Tariff and Trade.

As the electronics industry developed, new classifications were inserted in the Tariff Act for items formerly contained in 445d. Most electronic end products and components which are not specified elsewhere in the tariff are dutiable under this tariff item.

Tariff item 597a (2) Phonographs, graphophones, gramophones and finished parts thereof n.o.p.

1931	20	27.5	30
1939	15	25	30
1950	15	20	30

Tariff item 445o (i), (ii), (iii) specified materials and parts when imported for use in the manufacture or the repair of radio, television, phonographs, or other apparatus, which uses radio tubes

1939	Free	Free	30

The original Tariff item 445o, now 445o (i), was inserted in 1939, and in 1948 the items 445o (ii) and (iii) were added. Tariff items 445o (i) and (ii) cover specified parts and materials used in the manufacture or repair of apparatus using radio tubes, while 445o (iii) includes parts and materials for use by manufacturers of apparatus using radio tubes or of parts thereof, in the manufacture of the goods enumerated in tariff items 445o (i) and (ii). The usual clause "when of a class or kind not made in Canada" is only included in 445o (ii) and the omission from the other two items acts as a deterrent to the Canadian manufacture of goods covered by those items, as they do not automatically receive the tariff protection provided in other items, such as 445d.

Tariff item 445p—Specified parts for vacuum tubes

1939	Free	Free	30

This item specifies tube materials and parts not available from Canadian sources. It was bound under the General Agreement on Tariffs and Trade in 1948, like item 445o (i) above.

Tariff item 445q—Specified parts for vacuum tubes

1942	Free	Free	30

This item covers additional tube materials not available from Canadian sources.

Tariff item 445s—Glass bulbs for the manufacture of cathode ray tubes for television receiving sets

1955	Free	Free	30

This item was inserted in January 1955 and is due to expire on December 31, 1956.

Tariff item 445k—Electrical apparatus and complete parts thereof n.o.p.

	15	22	30

This item was inserted into the Tariff Act long before World War II. Its rates are applicable to the imports of sound equipment which was largely developed in the postwar period.

Tariff item 440r—Radio for navigation and air traffic communication and parts of the foregoing, when of types or sizes not made in Canada

1955	Free	Free	27.5

This tariff item was inserted in the Tariff Act in 1955 as a consolidation of several aircraft items which had been in the Act previously.

Most electronic end products, parts and materials which are not specified elsewhere in the Tariff Act are dutiable under item 445d. It is contended by the industry, however, that the clause "when of types or sizes not made in Canada", which is found in item 440r almost completely eliminates protection for the Canadian electronics industry against imports of this type of electronic equipment. If the imported equipment varies slightly in dimension or in type from similar equipment made in Canada, it is eligible for free entry.

Generally speaking, tariffs on imports of electronic equipment are lower now than they were prior to World War II. At the present time almost all electronic imports from the British Preferential area can be brought into Canada dutyfree. Most notable exceptions are record players and parts and sound equipment, on which the tariff is 15%. In 1955, imports from the B.P.

area amounted to $5.7 million, and of this amount almost $5.6 million was imported free of duty.

Electronic equipment from the U.S. and most other countries is dutiable under the Most-Favoured-Nation Tariff. Specified parts and materials for the manufacture and/or repair of electronic equipment and vacuum tubes may be imported free of duty; the rate on record players and parts is 20%, while on sound equipment 22.5% is levied; on the remaining electronic end products, parts, and materials, 20% is levied, except for electronic equipment used for navigation and air traffic communication, which in nearly all cases can be imported free of duty.

Practically no electronic equipment is imported under the General Tariff, which is 30% except for radio for navigation and air traffic communication and parts thereof on which the tariff rate is 27.5%.

Ignoring the small amounts imported under the General Tariff, imports under Most-Favoured-Nation Tariff were as follows in 1955:

Tariff item	*Rate (percent)*	*Amount (millions of dollars)*
445d	20	70.6
597a (2)	20	1.6
445k	22.5	2.7
	dutiable imports	74.9
445o, p, q and s	free	14.5
		89.4

Imports under tariff item 445r are not recorded separately but are included in a general item of Parts of Aircraft, and separate figures for the various components are not available.

It is contended by the industry that the rapidity with which the electronics industry is growing makes necessary a frequent revision of the tariff situation. Otherwise new products or components may not get tariff protection as soon as needed. It is the view of the industry that an electronics specialist should be employed by the Tariff Board to ensure that proper classification is given to imports.

3.12 *Imports*

In the '20's a substantial number of radio receiving sets was imported into Canada each year. However, as the Canadian production of receiving sets expanded and the regulations of the Canadian Patents Act were enforced,

imports diminished rapidly and in the '30's the imports of radio receiver sets for resale were negligible in comparison with domestic production (see Chap. 2)

In the '30's total imports of electronic equipment into Canada averaged some $2.8 million per annum. As is shown in Table VII, they accounted on the average for about 18% of the domestic disappearance in this period, but between 1935 and 1939 this percentage rose from 14.1% to 22.7%. In comparison, imports constituted nearly 41% of domestic disappearance of electronic equipment in 1929. Little detailed information is available, but it would appear that communication equipment, vacuum tubes and parts, and materials for the manufacture of electronic end products and vacuum tubes made up the greater part of the imports (see also Tables VIII-XVII).

After the outbreak of World War II, the imports of electronic equipment into Canada rose rapidly and reached a peak of $33.5 million in 1944, constituting 35% of domestic disappearance. Military equipment, vacuum tubes and parts, and sub-assemblies for the manufacture of all kinds of electronic equipment made up the greater part of the imports during the war.

After a transition period in the years 1945 and 1946, imports averaged $14 million per annum in the period 1947-50 and accounted for about 23% of domestic disappearance. Imports have been steadily rising, from $9.7 million in 1948 to $95.1 million in 1955. As a result of this very rapid increase in imports, the share of imports in domestic disappearance rose to 30% in 1953. During the last two years the growth in domestic production exceeded that in imports, however, and consequently the share of imports in domestic disappearance declined to 28% in 1954 and to 24.5% in 1955.

The greater part of the imports in the postwar period has been made up of equipment for industrial and military applications such as testing equipment and instruments and aviation electronic gear. In addition, parts and sub-assemblies used in the manufacture of vacuum tubes and electronic end products have been imported.

Most of the imported industrial and military equipment consists of relatively new products representing the results of applied research. As little applied research has been done in Canada up to the present time, these products have to be imported until such time as demand warrants the setting up of production in Canada. As a result, imports constitute an important and even rising share of domestic disappearance. As new products are steadily being developed, the present pattern in imports is likely to prevail until such time as more research work is conducted in Canada.

Other factors that stimulated imports into Canada are the reduction in the Canadian tariff in 1948, the devaluation of the pound sterling in 1949 (in 1950 imports from the U.K. were over three times those in 1949), the relaxa-

tion of import controls in 1950, and the premium on the Canadian dollar since 1951.

Not shown in the statistics are the imports of radio receiving sets by Canadian tourists returning from the U.S. These sets can be brought into Canada duty and tax free by declaring that they are part of personal hand baggage. Imports are encouraged by differences in prices of radio sets between the two countries and R.E.T.M.A. estimates that they average 50,000 sets per annum, mainly portable sets.

Over 90% of all imports of electronic equipment originates in the U.S., a figure which has been fairly constant since the early '30's. However, the Canadian market has not been exposed to widespread dumping of electronic products from the U.S. in the past. The greater part of the remaining imports comes from the U.K., a potentially strong competitor because of its low wage rates, but from which up to the present time little is imported because of differences in style and designs. The greater part of the present imports from the U.K. consists of those kinds of equipment in which style does not play such an important role. The C.S.A. code has restricted imports from overseas more than from the U.S.

3.13 *Exports*

The costs of the Canadian electronics industry are higher than those of its U.S. counterpart. Consequently, exports of electronic products have always been small in relation to Canadian production, except under exceptional circumstances when prices are not all important.

During the '30's exports of the Canadian electronics industry amounted to some $200-300,000 per annum, constituting only about 2-3% of the gross value of Canadian production (see Table VII). The greater part of the exports in this period consisted of radio transmitting and communication equipment.

Exports of radio receiving sets were negligible. The Report of the Tariff Board of 1939-40 states:

> ". . . so far as is known, only one company has entered the export market. Most of the American subsidiaries (in Canada) cannot enter the export field for two reasons. In the first place, they cannot in some cases qualify under the Empire content qualifications which would give them an advantage over American manufacturers in other parts of the Empire; and in the second place, they are usually affiliated through their parent companies, with manufacturing concerns in the very countries that would offer export markets and, therefore, cannot be expected to enter into an export market in competition with such concerns."

According to the Report the Canadian content of sets made in Canada in 1937 varied between 92.2% and 66.1% of total manufacturing costs and averaged about 80.6%.

Exports of vacuum tubes were only small. According to the same report of the Tariff Board the patent situation in other countries militated against exports. In 1937, a top year for tube exports, they amounted to only some $30,000. Exports of phonographs, gramophones, and parts were also insignificant in the prewar period. Following the outbreak of World War II exports of electronic equipment rose rapidly, reaching a peak of $52.8 million in 1944. This constituted nearly half the gross value of the Canadian electronic production. Nearly all exports during World War II consisted of military equipment.

After a transition period in 1945-46, exports in the years 1947 through 1951 averaged some $3.5 million per annum, over 15 times the average of the '30's, and accounted for some 6% of the electronic output in these years against 2-3% prior to the War.

Exports of radio receivers in this period were more important than ever before and accounted for over one-third of the total exports of electronic products. Most of the orders were placed by international companies with their Canadian affiliates in order to fulfill the need for radio sets in those countries where production had been decreased or stopped during the War. In addition, in the period 1947-51 some exports of components and television picture tubes to the U.S. took place because of U.S. shortages when television production was expanding rapidly. In 1949 the exports of picture tubes amounted to nearly $300,000.

In the years 1952 and 1953 the exports of all electronic products accounted for 12% of the Canadian electronic output, and exports reached a postwar peak of nearly $25.4 million in 1953. The largest increase was in military equipment for N.A.T.O. countries. In 1954 exports again diminished to $9.7 million, constituting 4% of production, and in 1955 they declined further to $7.3 million, accounting for 2.4% of production.

In addition to patent regulations and inter-company agreements, exports in the postwar period have been hampered by import restrictions, monetary controls, and the inability to compete pricewise in foreign markets.

In the '30's the U.K. was the largest single customer for electronic products, taking about 30% of total exports; some 25% of the electronic exports went to the U.S., and the remainder was scattered among a great number of countries.

Since the war the U.S. has been the biggest customer, taking about one-third of total electronic exports in the period 1947-51. Exports to the U.K. accounted for only 4% of total exports. In 1952 and 1953 about half of all

exports went to the U.S. and 20% to the U.K. The higher share of the latter is attributable to exports of military equipment under N.A.T.O. In 1954 the pattern of the period 1947-51 was restored, the U.S. taking 68% and the U.K. slightly over 1% of the total exports of electronic products. In 1955, 53% of all exports went to the United States, while the United Kingdom accounted for slightly over 2%.

3.14 *The Role of Government Contracts in the Development of the Canadian Electronics Industry*

Prior to World War II, government contracts played little or no part in the development of the electronics industry in Canada. However, the rapid growth of the electronics industry after the outbreak of the war was largely the result of government contracts. Factories were built and equipped with funds obtained through capital assistance contracts.

As a result of the large-scale cancellations of government contracts upon the termination of hostilities, the output of the electronics industry was severely contracted in 1945 and 1946. In later years, however, especially since 1950, when the Korean War broke out, government contracts have helped materially in expanding the electronics industry in Canada.

The importance of having an electronics industry in Canada is stressed by the steadily increasing use of electronics in defence equipment. Mr. D. A. Golden, Deputy Minister of Defence Production, stated last year: "The one thing that can be said with absolute certainty about defence requirements of the future is that the need for a strong electronics industry will grow steadily."

In 1955, sales to government constituted 24.8% of the total sales of the companies that submitted information, as against 35.2% in 1954, 13.2% in 1947, and 2.8% in 1937. The greater part of the government contracts is for delivery of defence equipment. Most contracts are based on tenders. This results in keen competition not only between Canadian suppliers but also with imports from the U.S. and the U.K. Sometimes government contracts require production in Canada and as a result new U.S. companies set up assembling operations in Canada, intensifying the competitive situation; on the other hand, this regulation provides some protection to the Canadian industry.

Where the tender system is inappropriate, for example when there is a sole supplier or when a source of supply must be developed, delivery prices are negotiated or a form of cost reimbursements is employed. It is our understanding that if a cost reimbursement form of contract is used, the company is not allowed to include in its costs expenses incurred in any development work done prior to the letting of the contract.

A closer liaison is desirable between industry and the various departments of the government connected with defence production and research.

Limited and delayed disclosure on forward planning in regard to requirements of defence departments make it difficult for the industry to initiate the development of new products at a date early enough to be ready for production when requirements crystallize into orders. While security considerations cannot be neglected, more guidance to the industry on future needs would make easier the development of the right product at the right time by Canadian sources of supply and might reduce the number of orders placed with companies in the U.S.

A large percentage of the reseach and development conducted in the U.S. is government sponsored. If a similar policy of issuing development contracts to the Canadian electronics industry were undertaken by the Canadian government in those cases where domestic research might economically be carried out, it would, of course, be of considerable benefit to the industry.

3.15 *Other Factors*

At the present time 33 television broadcasting and over 200 radio broadcasting stations are in operation in Canada with a combined capital investment of close to $60 million. The number of people employed by these stations is well over 9,000. In its fiscal year 1955-56 the C.B.C. alone paid out approximately $31 million to employees, artists, musicians, singers, actors and script writers. According to figures released by the D.B.S., over $40 million was spent for advertising on radio and television in Canada in 1954. (None of these figures is included in our totals of electronic production.)

Under the Canadian Broadcasting Act, the C.B.C. is responsible for regulations to control the linking up of broadcasting stations that form networks and the proportion of time that may be devoted to advertising in broadcast programmes. Under the same Act, applications for licences to establish broadcasting stations, or for modifications of existing stations, are only granted by the government of Canada upon recommendations of the Board of Governors of the C.B.C. One of the considerations involved is that there must be non-interference with the present and proposed facilities of the C.B.C. In addition, the sale or transfer of any stock or shares held in any broadcasting station must be approved by the government of Canada after review by the C.B.C. Although it is generally conceded that the C.B.C. has an excellent staff and that its technical ability is excellent, this set-up gives rise to criticism which would not otherwise prevail.

The industry feels that this structure was responsible for the delay in the introduction of television broadcasting in Canada. No licences were granted for the erection of private stations until the C.B.C. was able to commence transmitting from its own stations in Montreal and Toronto in September, 1952. In comparison, already over 100 television stations were in operation in the U.S. in 1950. As a result the Canadian production of television receivers lagged some three years behind that in the U.S.

Colour television is now making definite progress in the U.S. and the number of hours of colour broadcasting is steadily being increased. Heavy expenditures are involved in the erection and running of colour stations, with the cost of construction and equipment of a station to produce and broadcast colour television estimated at $500,000, including the cost of a new studio. Taking into account this factor, however, the industry feels that colour television is not developing as rapidly as it might because the C.B.C. wants to be able to produce both English and French programmes when colour transmission begins in Canada.

This slow development may result in a serious falling-off in television sales commencing sometime in 1957, because the public by that time may tend to curtail purchases of the present type of set in anticipation of the coming of colour television. It is therefore contended by the industry that the larger existing stations in Canada should be converted to broadcast both colour and black-and-white programmes so that U.S. colour programmes now transmitted in Canada in black-and-white would be made available in colour. The cost of such a conversion is estimated at $40,000 per station. In this way a demand for colour television receivers would be created and the expected dip in production might be minimized.

No information is available on the number of distributors, dealers and service technicians that is engaged in the sale and service of electronic equipment in Canada. The industry estimates that these functions provided incomes of $150-200 million to Canadians in 1954. (This figure is not included in our total of electronic production.)

The sales pattern for consumer home products has been changing in the past few years. Manufacturers have in many instances been selling to retailers, via factory-owned and controlled distributors, eliminating the independent wholesaler. In centres such as Toronto, Montreal and Vancouver the independent wholesaler has largely disappeared. There is also a strong tendency on the part of the public to buy name brands at the neighbourhood shop rather than at the downtown department store. This is a characteristic of the entire durable goods industry in which the discount house with its lower overhead has reduced distribution costs.

This changing distribution pattern, in which volume operations are stressed, has made for intensely competitive conditions which have reduced the mark-ups taken by wholesalers and retailers. Many retailers are now working on a margin of 10-15%, and their operations can only be profitable if the volume of business is large. Consequently many of the smaller retailers who take a larger profit margin and give more service are at a serious disadvantage, and a number of them try to make up for their sub-normal profits by questionable practices in the service end of their business, particularly in regard to television sets. There have been many complaints that servicemen

and certain retailers are taking advantage of the situation to charge exorbitant and unjustified service fees, although the majority have endeavoured to maintain their standards. The situation in part reflects the fact that there are apparently too many manufacturers of television receivers in Canada—yet it is equally in evidence in the U.S. where competition at the manufacturers level is somewhat less intense.

There is a serious shortage of qualified servicemen. Service requirements for television sets are estimated to be $35 per set in use per year. With over two million sets in use at the present time, service requirements for television sets alone amount already to over $70 million per annum. The problems of servicing are expected to be greatly magnified when colour television comes into general usage. Colour television sets are much more complicated than black-and-white receivers, have more tubes and much more complex circuits.

4

OUTLOOK FOR THE FUTURE

4.1 *Sales and Markets*

In the postwar period the output of the electronics industry in Canada has risen faster than the Canadian Gross National Product. Since 1950 its rate of growth has also exceeded that of its counterpart in the U.S. As is illustrated in the chart, the gross value of electronic production in Canada rose by 460% between 1947 and 1955 compared with a rise of 91% in the G.N.P. of Canada and an increase of 260% in the gross value of electric production in the U.S. in the same period.

The rapidity of technological change, and the possibility that new products not presently known or still in the laboratory stage will become major products of the industry, make it difficult to predict the growth of the electronics industry in Canada in the years ahead.

The president of the Radio Corporation of America stated some time ago: "Today, for example, more than 80% of R.C.A.'s business is being done in products that did not even exist commercially ten years ago. And in another ten years, regardless of the size of the industry, I believe that a comparable percentage of the volume will be done in products that are not now on the market." This statement is equally true in Canada. The production of television receivers, for example, was only started in Canada in 1949, but in 1955 the output constituted already 43% of the gross value of electronic production in Canada.

Moreover products of other industries are becoming electronic to a various extent. Examples are several household appliances, business machines and aircraft. The "electronization" of other products does not necessarily mean expanded demand for the products of existing companies in the electronics field, as in many cases the outside companies start to manufacture the electronic part of their products themselves.

Estimates on the development of the U.S. electronics industry indicates a doubling of sales in the next decade. A similar trend is expected in Canada,

which would mean sales of about $800 million per annum by 1965. Predictions for the longer term are very difficult to arrive at for reasons mentioned above. Very roughly, sales could amount to some $1,600 million by 1980.

In view of the fact that already over 96% of Canadian households have one or more radio sets in use, the production and sales of radio receiving sets would appear to have only limited future growth possibilities. However, they should hold up well as a result of the increase in population, the trend towards personal sets, and the increasing use of radios in cars and trucks. The invention of the transistor and the development of very small long-life batteries will allow the eventual mass production of extremely small radio receivers, rendering obsolete the type of radio presently in use. It is expected that the production of radio receivers in Canada will rise to some $25-30 million by 1965, as compared to $19.1 million in 1955.

The demand for television sets in Canada is likely to grow, as saturation of the market is still a long way off. According to some forecasts, about 87% of Canadian households will have television by 1959 and some 3.4 million sets will probably then be in use, as against slightly over 2 million sets at the present time. The trend is to second and portable sets.

Colour television has made slow but steady progress since the N.T.A.C. compatible system was approved in 1953. Under this system monochrome sets can receive colour broadcasts in black-and-white and colour sets can receive black-and-white broadcasts as well as colour. Although the amount of colour programming in the United States is steadily increasing, the main deterrent to the mass production of colour sets has been the high cost of receivers. Recently, however, several sets have been brought on the U.S. market retailing below $500. It is expected that large-scale introduction of colour television sets in Canada will not take place before 1958. The adoption of colour television should spur the obsolescence of monochrome television sets in use. It is expected that the production of television receivers in Canada will decline for a period prior to the introduction of colour television and then rise to some $140-150 million by 1965.

A way to amplify light is presently being developed. This is a method of increasing the brightness of a projected image without altering the strength of its light source. By its use it will be possible for a household to have a centrally located television receiver and outlets in each room which will permit the television picture to be projected onto a wall.

High-fidelity sound equipment will likely grow into an important segment of the industry. And according to some forecasts the production of record players and hi-fi equipment should amount to some $10 million by 1965.

In the next decade electronic devices will likely replace conventional household appliances. Electronic ranges are already sold in the U.S. but their

widespread acceptance still appears to be a long way off. Electronic air-conditioners, refrigerators and washing machines are still in the experimental stage. The advantage of electronic air-conditioners and refrigerators will be their silent operation and the absence of moving parts. Electronic washing machines will probably employ ultrasonic sound waves rather than mechanical agitation to dislodge dirt and film.

A new development in the field of microwave is scatter propagation, whereby a high-power radio transmission is focussed in a narrow beam directed just above the horizon, scattering small amounts of this energy far over the horizon. By this means it is possible to locate relay stations 200 miles apart instead of the 30 miles presently possible. Scatter propagations may bring the era of intercontinental television much closer. Large-scale use of microwave equipment should develop among railroads, pipelines, and geographically dispersed industrial enterprises, in addition to the commercial broadcasting industry and telephone and telegraph companies.

Mobile radio equipment is finding a growing market in the transportation industries. Trucks are being equipped with mobile two-way radio systems, and telephones are making an appearance in private automobiles. Practically all airplanes are radio equipped. Radar is used for determining weather conditions up to 150 miles ahead of aircraft and it is likely that many more peaceful uses of radar for homes and factories will be devised in the future.

Industrial electronics is one of the most rapidly expanding segments of the electronics industry. Some of the products are apparatus for use with nuclear energy; equipment for radio broadcast and television telecast stations and studios, among which are sound tape and video tape recording equipment; computer and data processing systems; closed-circuit television to control industrial processes; and methods of production and control equipment used in connection with automated machinery and equipment.

Types of electronic equipment used in atomic energy include devices to measure radiation, sensitive gauges, and servo-mechanisms to handle radioactive materials. As nuclear energy is expected to become an important source of energy in the next two decades, sales of electronic gear for atomic energy should grow rapidly.

Apart from its application in radio broadcasting, phonograph record manufacture, and motion picture sound systems, sound tape recording equipment finds an expanding market in data analysis, input and storage of information in connection with computers, and the programming of work schedules for automated machinery.

Video tape recording is a new method of recording monochrome or colour television pictures on magnetic tape, similar in some respects to tape recording of sound. The present market for this type of equipment includes

television broadcasting stations and television film production companies. Television programmes are recorded on a reel of magnetic tape and shipped to network television stations, thereby doing away with costly cable transmission of live programmes and film developing.

Closed-circuit television makes it possible to inspect and control industrial processes at sites remote from the scene of operations. In medicine it is used as a teaching aid, allowing many students to follow surgical operations. In addition, closed-circuit television is employed for staff training programmes, sales conventions and similar meetings. Its greatest prospects for growth, however, appear likely to be in the field of manufacturing operations.

Electronic data processing machines may make it possible for a store proprietor to have all his accounts and books electronically processed. All transactions would be recorded on a magnetic tape connected with the cash register and the tape sent to the bank with the bank deposits. The tape would be fitted into an electronic data processing machine at the bank and the storekeeper would be provided with accurate figures on sales by departments, products, model numbers and colour ranges.

One of the fastest growing fields of industrial electronics will probably be that of electronic control equipment used in connection with automated machinery and equipment. Electronic computers are the heart of the automated processes. At the present time about 3.5% of the cost of automated machinery bought in the U.S. is constituted by electronic control equipment, but this percentage is rising rapidly. (See also the section on effects of automation, section 4.2.)

The backlog of computer demand in the U.S. has been calculated at $2,400,000,000, divided almost equally between small computers and the so-called Giant Brains. Purely on the basis of comparative gross national products Canadian demand would appear to approximate $175,000,000 (see also Appendix B).

The use of transistors is likely to expand rapidly. The first transistorized home and car radio receiving sets are now being introduced on the Canadian market. Further development will probably create new applications, some of which heretofore have been beyond the scope of vacuum tubes. It is doubtful, however, that vacuum tubes will be rendered obsolete. Most likely they will continue to be used in many applications.

A development which could have a tremendous impact on the electronics industry is the printed circuit. A printed circuit is a simplified way of connecting together electronic components without conventional wiring. Roughly analogous to the process of photoengraving, the various connections in an electronic circuit can be printed on a metal plate. Those portions which are exposed (not printed upon) can be eaten away by acid while the connecting lines that are protected by "printing" remain intact. There remains a thin,

flat latticing of complete circuits into which the appropriate components can be plugged by automatic machinery. In doing away with masses of delicate wiring, the printed circuit contributes further to design simplicity and miniaturization and, in addition, permits cheaper production methods.

As is discussed in the section on imports (section 3.12), the present pattern in imports is likely to be maintained in years to come until more applied research is conducted in Canada. As a result of low wage rates, imports from the U.K. could rise rapidly if that country adapted the style and designs of its products to North American standards. However, the Canadian Patent Act acts as a deterrent to the import of products that are manufactured in Canada in sufficient quantities to meet demand (see the section on Patents, section 3.11).

The prospects for exports of electronic equipment are not encouraging. The main deterrent to exports is costs, as explained in the section on exports (section 3.13). Canada will not likely be able to build up regular export markets unless and until its competitive position improves.

4.2 *Effects of Automation*

Essentially, automation is only a new step in the ever continuing process of mechanization. Equipment for the automatic control of machinery has been in use for many years. It has been applied in food processing, cigarette making and automobile assembling, to state a few examples. The control equipment used has not been capable of correcting its own mistakes, however. The human operator is vital to the production process, for only he can make logical decisions and take corrective action if anything goes wrong.

The concept of *feedback,* the ability of control equipment to correct mistakes, is probably the essence of automation, adding a new dimension to mechanization. It is the capability of control equipment to check automatically the dimensions or composition of the products being manufactured and to adjust the machinery if an error is evident. This provides automatic quality control, or inspection, of the products being produced. Machines for rolling paper capacitors, for example, are fully mechanized; once started, they continue to produce capacitors sections, wound with a uniform, predetermined number of turns. However, the machines are not capable of correcting for capacity changes resulting from fluctuations in such things as paper thickness and paper density. Through the introduction of feedback controls, and thus automation, it is possible to adjust automatically and correct the number of turns needed to produce units that are uniform within a very small tolerance.

Through combination of electronically controlled machinery and equipment, fully automated production processes are made feasible. Through the use of computers with their ability both to memorize instruction for future use and to make a choice between several possible courses of action in accordance with instructions supplied to them, a flexibility of the production

process is made possible, allowing variety in the types of goods being manufactured.

Industries largely dealing with continuous flow processes, are readily subject to automation. In industries with more diversified products, automation involves numerical control, and this has proved to be more costly to achieve without sacrificing the versatility so necessary in short-run production. Except for industries such as petroleum refining, flour milling, etc., automation will be more difficult in Canada's industry and will likely lag some years behind the U.S., because of smaller production runs.

A considerable amount of research and development is necessary in order to be able to produce the largely custom-made control equipment required for automated machinery. Developments in this relatively new field are likely to be made at a rapid rate. Unless more research and development is conducted in Canada in the future, it is clear that a major part of the control equipment sold in Canada will be imported. However, the Canadian electronics industry should benefit to some degree from the rising demand for control equipment which is largely electronic.

On the other hand the introduction of automation in the U.S. electronics industry will likely have an adverse effect on the competitive position of the Canadian electronics industry. Few Canadian operations are large enough to permit an expenditure on automated equipment comparable to what U.S. companies can afford, more particularly, where frequent style changes and technical developments tend to require frequent modifications in a production line. One leading U.S. television manufacturer has completely redesigned its assembly line to obtain the fullest advantage from automated machinery. It appears that the direct labour content of a television receiving set, which in this instance is some 15% of the total factory cost in the U.S. at the present time, will be cut in half. This would mean that the difference in costs of 12.5-15% between Canada and the U.S. might widen to 20-25% in the next two to three years.

It is obvious that Canadian manufacturers, whose average television production is only one-fourth of that in the U.S., will be forced to follow a different technique of assembly, which implies the development of a different line of television sets suitable for this technique. In order to automate Canadian assembly lines as much as possible and to cut tooling costs, a lengthening of production runs in Canada is necessary. This could be achieved by freezing designs for two or three years instead of changing them every year as has been done in Canada and the U.S. up to the present time and will likely continue to be done in the U.S. in future. In the intervening years the emphasis could be on styling rather than on design.

A widening of the differential in production costs will likely occur in all lines where automation is introduced. It is expected too that upon the automation of the U.S. vacuum tube industry the difference in production costs

between Canada and the U.S. will increase by about 50%. In a number of instances where the differential is already wide, the industry states that it may be necessary to terminate the production of certain types of vacuum tubes in Canada.

4.3 *Technology, Productivity and Personnel Requirements*

The history of the electronics industry shows that technological innovations are made at a rapid rate. One of the latest is the printed circuit which makes possible the automated assembly of electronic equipment.

The introduction of automation principles in the assembling operations of electronic equipment will likely reduce the unskilled female portion of the labour force and increase the demand for higher skilled male workers. In view of the expected rapid growth of the electronics industry, however, a future decline in the number of people employed by the industry does not appear likely. An indication can be derived from the fact that in that portion of the electronics industry in the U.S. producing television receivers, only some 15% of the costs of a receiver is accounted for by direct labour costs.

Assuming a quadrupling of sales in the next 25 years, from $400 million in 1955 to $1,600 million by 1980 and an increase in the productivity of labour of 2.5-3% per annum, the number of employees in the electronics industry could grow from 25,000 in 1955 to 43,000 by 1980.

Reference to the section on personnel and productivity of labour (section 3.2) indicates the disparity in the numbers of engineers who are graduated annually from Canadian universities, as compared to the need for them. It is evident that something specific and immediate must be done to remedy this situation. A joint effort of government and industry appears to be necessary to solve the problem.

More and better research and technical facilities are required both in the universities and in the industry. Many research men are more concerned about adequate and proper research facilities than they are about the actual remuneration. Similarly, greater recognition must be given to the engineering profession if it is to attract increased personnel to handle the technical problems of an industry which is growing both in size and in complexity. It is apparent too that greater stress must be given to the teaching of science in high schools and that the opportunities that may be open to students from the study of science must be emphasized.

4.4 *Expansion and Capital Requirements*

From a technical point of view, the electronics industry in Canada should be capable of ready expansion to meet the expected demand for its products. This applies also in the case of an emergency, except for the manufacture of components. Assembling operations could be quite rapidly expanded, but

additional specialized machinery would be needed for extension of the production of most components. Stepping up of imports of components from the U.S. would likely be difficult, as the U.S. electronics industry would naturally be served first. Hence the view of certain leaders in the Canadian electronics industry that a greater reserve capacity for the manufacture of components in Canada is necessary. One of the major U.S. manufacturers of components has three shadow factories which it maintains in readiness for possible wartime requirements or in case any of the other factories would be destroyed in an aerial attack.

As calculated in the section on plant and equipment (section 3.1), the net investment in fixed assets and working capital of the Canadian electronics industry in 1955 amounted to some $130 million. To finance the expected doubling of factory sales to about $800 million in the next decade, another $130 million would be needed if the present capital turnover ratio is maintained.

Based on a net profit before taxes figure of 5% (in 1955 it was 4.69% and in 1954 5.50%), accumulated net profits in the next decade would amount to $300 million. Roughly half of it would have to be paid in income taxes. Under the assumption that one half of the net profits after taxes will be paid out in dividends, about $75 million would be available to finance the projected expansion. According to our survey, depreciation charges accounted for about 1.3% of the sales dollar in 1955. Under the assumption that this percentage will remain the same in the next ten years, funds created in this way would amount to some $78 million. However, it would not appear likely that the funds generated out of depreciation charges will be available for expansion purposes to any great extent. Since the rate of obsolescence in the electronics industry is high in comparison to most other industries, replacement of machinery and equipment will likely absorb all the funds created out of depreciation charges. As a result some $55 million will have to be provided by outside financing.

However, this figure may be on the conservative side. In the first place, it is likely that more capital relative to sales will be employed in future than there is at the present time. Secondly, in the light of past experience, a profit figure of 5% of sales appears to be too high to be maintained throughout the next decade.

The greater part of the future expansion is likely to take place in the geographical regions in which the electronics industry is presently located. There has been some tendency towards de-centralization within the over-all area during the last few years. Future trends in location will largely depend on the centres of population.

RESULTS OF A SURVEY UNDERTAKEN IN CONNECTION WITH THE STUDY ON THE ELECTRONICS INDUSTRY IN CANADA

Appendix A

(A) Breakdown of sales dollar for fiscal years

	1937		1947		1954		1955
No. of reporting companies	6		12		14		14
Net sales (sales & service)	$8,769,000		$51,606,000		$244,289,000		$257,866,000
Wages & salaries	$2,009,000	$12,864,000		$50,100,000		$57,260,000	
Employee benefits	47,000	519,000		3,190,000		3,426,000	
Materials	3,228,000	23,780,000		118,615,000		119,235,000	
Other expenses	2,076,000	7,327,000		29,883,000		33,699,000	
End products purchased	1,247,000	5,234,000[a]		28,209,000[a]		29,884,000[a]	
Depreciation	116,000	624,000		2,685,000		3,357,000	
	8,723,000		50,348,000		232,682,000		246,861,000
Net profit from operations (before deducting income taxes)	46,000		1,258,000		11,607,000		11,005,000
Other income	37,000		189,000		1,819,000		1,097,000
Total net profit (before deducting income taxes)	$ 83,000		$ 1,447,000		$ 13,426,000		$ 12,102,000
Total as a percentage of net sales	0.96		2.80		5.50		4.69
Net profit from operations as a percentage of net sales	0.52		2.44		4.75		4.27

(a) One company reported that its purchases of end products are included in the amount of materials purchased. In 1955 these purchases amounted to $4,758,000. Figures for prior years not disclosed.

(B) General Information

I. *Sales to government*

No. of reporting companies	7	12	18	14
Net sales (sales & service)	$11,029,000	$48,789,000	$249,263,000	$257,866,000
of which to government	311,000	6,425,000	87,649,000	64,035,000
Sales to government as a percentage of net sales	2.8	13.2	35.2	24.8
Percentage range	0–8	0–68	0–83	0–88

II. *Amount paid in sales and excise taxes*

No. of reporting companies	7	13	17	14
Net sales (sales and service)	$11,029,000	$52,837,000	$249,168,000	$257,866,000
Sales & excise taxes paid	490,000	4,602,000	24,900,000	26,773,000

III. *Cost of product engineering, development and research*

No. of reporting companies	6	11	17	14
Net sales (sales and service)	$8,769,000	$43,393,000	$245,766,000	$257,866,000
Cost of product engineering, etc.	253,000	1,492,000	10,151,000	10,686,000
These costs as a percentage of net sales	2.89	3.44	4.13	4.14
Percentage range	1–8.0	0–12.5	0–15.5	0–11.8

Of the the amount spent in 1955, 94% was spent in Canada and the remainder abroad.

IV. *Capital expenditures in each of the years 1945-55*:

No. of reporting companies	18	14		18	14
1945	$ 849,000	807,000	1950	$ 2,406,000	$ 2,364,000
1946	1,678,000	1,642,000	1951	3,600,000	3,572,000
1947	1,791,000	1,773,000	1952	5,625,000	5,548,000
1948	1,426,000	1,403,000	1953	6,282,000	6,085,000
1949	1,023,000	966,000	1954	7,765,000	7,680,000
			1955	n.a.	6,380,000

V. *No. of employees and sales per employee*

(a) *1954* (14 companies reporting)
Total no. of employees: 15,204
Net sales (sales & service) $245,012,000
Sales per employee $ 16,115

(b) *1955* (14 companies reporting)
hourly paid male 4,743
female 3,739
8,482

salaried	male	5,382	
	female	1,583	
			6,945
Total no. of employees			15,427
Net sales (sales service)			$257,866,000
Sales per employee			$ 16,715

Remark: The growth in the sales of the 14 companies reporting for 1955 has been as follows (in dollars):

1937	11,571,000	(7 of these companies in business)
1947	50,537,000	(12 of these companies in business)
1954	241,086,000	(14 of these companies in business)
1955	257,866,000	(14 of these companies in business)

VI. *Average hourly wage rate* (inclusive of employee benefits)

(a) 1954 (13 companies reporting) $1.395

(b) 1955 (14 companies reporting with 8.482 hourly-paid employees) $1.480

VII. *Investment in land, buildings and equipment* (after deduction of depreciation)

(a) 1954 (8 reporting companies)
No. of employees (hourly-paid and salaried): 10,490
Net investment $15.1 million, close to $1,440 per employee

(b) 1955 (14 reporting companies)
No. of employees (hourly-paid and salaried): 15,427
Net investment $21.6 million, close to $1,400 per employee

VIII. *Total net investment* (total assets less depreciation and actual liabilities other than funded or long-term indebtedness).

(a) 1954 (11 reporting companies)
No. of employees (hourly-paid and salaried): 13,984
Net investment: $67.8 million or about $4,850 per employee

(b) 1955 (12 reporting companies)
No. of employees (hourly-paid and salaried): 15, 322
Net investment $80.1 million or about $5,230 per employee

Remark: Included in the $80.1 million are $21.5 million of investment in land, buildings and equipment (at depreciated value).

REPORTING COMPANIES

Acme Electric Corporation[1]	Toronto, Ont.
Aerovox Canada Limited	Hamilton, Ont.
Canadian Admiral Corporation Limited	Port Credit, Ont.
Canadian Aviation Electronics Limited	Montreal, Que.
Canadian General Electric Company Limited	Toronto, Ont.
Canadian Marconi Company	Montreal, Que.
Canadian Radio Manufacturing Corp'n. Limited	Toronto, Ont.
Canadian Westinghouse Company Limited	Hamilton, Ont.
Cossor (Canada) Limited[1]	Halifax, N.S.
Delhi Metal Products Limited[1]	Delhi, Ont.
Dominion Electrohome Industries Limited	Kitchener, Ont.
Hunt Capacitors (Canada) Limited	Ajax, Ont.
Neosid (Canada) Limited	Toronto, Ont.
Northern Electric Company Limited	Belleville, Ont.
Philco Corporation of Canada Limited	Toronto, Ont.
R.C.A. Victor Company Limited	Montreal, Que.
Sparton of Canada Limited[1]	London, Ont.
Standard Television Products Limited	Kitchener, Ont.

[1]Not reporting for 1955.

ROYAL COMMISSION ON CANADA'S ECONOMIC PROSPECTS

Confidential Questionnaire for Compilation of Over-all Electronics Industry Data

(Individual company figures will be retained in strictest confidence and only over-all industry totals and averages will be used in the Commission's study of Canada's' Electronics Industry)—Not to include electrical apparatus and power equipment, white goods or appliances (other than radio, T.V. and Phonos).

A. *Breakdown of Sales Dollar for Fiscal Years*

1. Net Sales	
(a) Gross sales not including sales and excise taxes paid and less returns and allowances	$.....
(b) Service and parts in connection with sales in (a)	$.....
2. Other Income	$.....
Total 1 and 2	$.....
3. Wage and Salaries	$.....
4. Employee Benefits	$.....
5. Materials (including raw materials, finished and semi-finished parts, materials consumed in processing and packaging and shipping material; but not including shop and factory supplies to be included in 6 or substantially complete end products to be included in 7)	$.....
6. Other expenses (including shop and factory supplies, power, water, municipal taxes, maintenance repairs to buildings, machinery and office equipment, administration and selling expenses not included in 3, including charitable donations and interest expense)	$.....
7. Substantially complete end products purchased for resale	$.....
8. Depreciation	$.....
9. Taxes on Income (Dominion and Provincial)	$.....
10. Dividends (declared on Preferred or Common shares)	$.....
	$.....
11. Retained in Business (that amount of year's income not paid out in dividends)	$.....
Total 3-11 (should equal total 1 and 2)	$.....

B. *General Information*

12 Percentage of Net Sales (total of 1 (a) and 1 (b) to Government) ..... %

13. Amount Paid in Sales and Excise Taxes $. .....

14. Cost of product engineering, development and research $.....

15. Total value of capital expenditures $.....

16. Number of employees in 1955 (average over 12 months)

hourly-paid	Male	.....
	Female	.....
salaried	Male	.....
	Female	.....

17. Average hourly wage-rate in 1955 (inclusive of employee benefits) $. .....

18. Total investment in plant and equipment (investment after deducting depreciation in land, buildings and equipment) $.....

19. Total investments (total assets less depreciation, and actual liabilities other than funded or long term indebtedness) $..... ....

Company Name:..... Date: .....

Appendix B

ELECTRONIC COMPUTERS

An electronic computer is an electronic device or group of devices which can receive information into its circuitry, perform mathematical or logical operations entirely within itself and deliver information out of its system in some usable form. If given proper instructions, electronic computers can solve problems much more rapidly and accurately than human operators.

Basically the electronic computer is not unlike an ordinary desk calculator. It can perform the same functions, e.g. addition, subtraction, multiplication and division. The following features of the modern electronic computer, however, give it special usefulness.

(1) The ability to store large quantities of numeric and alphabetic information for future reference.

(2) The ability to make decisions or to choose, according to supplied criteria from among several possible courses of action. This feature permits the use of flexible machines turning out varied end products.

(3) The ability to perform long sequences of functions without human intervention. These sequences can be repeated as often as desired.

(4) The ability to correct its own errors, called feedback. A computer having feedback can check for accuracy the dimensions or composition of products being manufactured against given standards, and adjust the machine it supervises without intervention of a human operator.

All functions are carried out at a tremendous speed: a typical large computer can multiply approximately 830 pairs of 5-figure numbers in one second.

The electronic computer does not operate by itself but is surrounded by a multitude of associated equipment for input, output and storage of information, a substantial part of it electronic.

There are two basic kinds of computers: the analogue and digital electronic computer.

In an analogue computer, input is a physical quantity, such as an electric current or moving mechanical parts, output is a number, and the calculator follows some mathematical law which it was specifically instructed to follow. For example, an automobile speedometer is a mechanical analogue computer that measures a force developed by the turning of the driveshaft and converts it into a specific number on the dial. In the same way the gasoline gauge provides a constant analogy to the vehicle's gasoline reserve. In these examples the answer is implicit in the design of the computer.

In a digital computer, input and output data must be in the form of numbers and the computer follows the laws of arithmetic. It can be used to solve complicated mathematical problems.

When many calculations must be made which follow a specific mathematical law or series of laws, the analogue computer is adequate and usually less complicated than the digital. On the other hand, when a series of problems involves different laws or a different sequence of laws, the digital computer is far more adaptable, because of its inherent flexibility. Digital computers can be manufactured in large quantities with only minor modifications to meet particular needs. In contrast, analogue computers must be individually designed for each specific use.

In the U.S. already over 3,000 computers of all sizes are in operation. Together with those to be delivered within the next two years, they represent a $1 billion investment.

Computers are now used in petroleum refineries to balance the variables involved in refining; e.g., the grades and amounts of crude oil pumped in, the plant's characteristics and the types of specifications of finished petroleum products required. The computer will interpret and account for all the constantly changing factors that occur rapidly and simultaneously in a refinery and in this way increase production efficiency.

A major chemical company in the U.S. uses a computer for technical calculations, general accounting records, financial reports, departmental expense reports, production cost reports and plant service accounts. In addition the computer is used for the preparation of statements of sales, costs of goods sold, gross profit by products and over-all sales analysis.

A leading car maker is using a computer to work out the cheapest distribution pattern from plant to dealer. Some 8,000 unknowns are involved, details of plant production schedules, orders, inbound freight costs for parts, assembly plant production costs, cost of shipping finished cars, and the like. The use of a computer to work out the problem has resulted in substantial savings in distribution costs.

Other uses of electronic computers include inventory control, payroll accounting, continental defence systems and the automated production of automobile engines. New applications are steadily being developed. Main uses in Canada at the present time include those in oil refining and in the production of automobile engines.

The development of the computer has induced the setting up of service centres. Companies that have not enough work to justify the cost of their own computer can buy time on the staffed computer of the centre.

Appendix C

MILITARY ELECTRONIC EQUIPMENT

Prior to World War II very little military equipment was produced in Canada, but after the outbreak of the hostilities the industry switched rapidly to the manufacture of electronic equipment for military use. After the war the production of military equipment was practically abandoned again, to be resumed only upon the outbreak of the Korean War. In the years that followed a substantial amount of military equipment was turned out for N.A.T.O. countries.

The use of electronics in defence equipment is steadily increasing. Applications include radar, communication equipment, navigation systems, gunfire control systems, underwater systems and guided missile controls.

The cost of electronic equipment as a percentage of the total cost of military aircraft has risen steadily in the past and will likely rise further in the future. The electronic equipment of the CF-100 all-weather interceptor, presently in use by the R.C.A.F. costs over $100,000. It is expected that the cost of electronic equipment for the CF-105, the probable successor to the CF-100, will be in excess of $300,000.

The greater part of the cost of guided missiles is accounted for by electronic equipment. Electronic devices are needed for guidance, stabilization and flight control, for engine control, system programming, flight simulation and range testing. In addition, manufacturers of guided missiles must install computers to solve the equipment problems of flight research.

Estimated expenditures on aircraft and missiles by the U.S. armed forces for the fiscal years 1956 to 1958 show the increased emphasis on guided missiles.

	1956 est.	*1957 est.*	*1958 est.*
		(million dollars)	
Aircraft	6,880	6,571	5,000
Guided missiles	918	1,276	2,800
Research and development[1]	1,370	1,430	2,000

[1]Includes research and development on missiles of about $250 million annually.

No estimates are available for Canada, but our guided missile programme is known to be expanding materially.

The Mid-Canada line and DEW line (Distant Early Warning) now being installed from coast to coast in the North of Canada are essentially radar systems for early detection of all aircraft entering the North American continent. The two systems will supplement the Pinetree radar system, which stretches from coast to coast just north of Montreal. With the increasing

speed of aircraft the Pinetree line has become inadequate. Recently it was announced that the 3,000 mile DEW line, which will cost $400 million, is to be extended by 1,500 miles to cover the Aleutian Islands.

A system, called SAGE (Semi-Automatic Ground Environment) is now under development. It will comprise the radar systems, discussed in the foregoing, plus many more which feed data into a computer. This computer will then instruct interceptors, guided missiles or other weapons along precise lines.

Sales of military electronic equipment to the Canadian Department of Defence Production are running at an estimated rate of $110 million per year. A substantial part of these deliveries, however, originates from imports.

In view of the trend to guided missiles, supersonic aircraft, automatic gunfire and bombing control, and reliable countermeasures, all of which are essentially electronic systems subject to rapid obsolescence, the demand for military electronic equipment should take an even increasing share of future defence expenditures. It is important to note in passing that the electronic component of defence equipment is increasing with extreme rapidity.

Appendix D

OTHER STUDIES TO BE PUBLISHED BY THE ROYAL COMMISSION

Output, Labour and Capital in the Canadian Economy —
by Wm. C. Hood and Anthony Scott

Canadian Energy Prospects —
by John Davis

Progress and Prospects of Canadian Agriculture —
by W. M. Drummond and W. Mackenzie

The Commercial Fisheries of Canada —
by The Fisheries Research Board and The Economic Service of The Department of Fisheries of Canada

The Outlook for the Canadian Forest Industries —
by John Davis, A. L. Best, P. E. Lachance, S. L. Pringle, J. M. Smith, D. A. Wilson

Mining and Mineral Processing in Canada —
by John Davis

Canadian Secondary Manufacturing Industry —
by D. H. Fullerton and H. A. Hampson

The Canadian Primary Iron and Steel Industry —
by The Bank of Nova Scotia

The Canadian Automotive Industry —
by The Sun Life Assurance Company of Canada

The Canadian Agricultural Machinery Industry —
by J. D. Woods & Gordon Limited

The Canadian Industrial Machinery Industry —
by Urwick, Currie Limited

The Canadian Electrical Manufacturing Industry —
by Clarence L. Barber

The Canadian Primary Textiles Industry —
by National Industrial Conference Board (Canadian Office)

The Canadian Construction Industry —
by The Royal Bank of Canada

The Canadian Chemical Industry —
by John Davis

The Service Industries —
by The Bank of Montreal

Probable Effects of Increasing Mechanization in Industry —
by The Canadian Congress of Labour, now
The Canadian Labour Congress

Labour Mobility —
by The Trades and Labour Congress of Canada, now
The Canadian Labour Congress

Skilled and Professional Manpower in Canada, 1945-1965 —
by The Economics and Research Branch, Department
of Labour of Canada

Transportation in Canada —
by J-C. Lessard

Industrial Concentration —
by The Canadian Bank of Commerce

Housing and Social Capital —
by Yves Dubé, J. E. Howes and D. L. McQueen

Financing of Economic Activity in Canada —
by Wm. C. Hood with the collaboration of
J. V. Poapst and L. M. Read

Certain Aspects of Taxation Relating to Investment in
Canada by Non-Residents —
by J. Grant Glassco of Clarkson, Gordon & Co.,
Chartered Accountants

Consumption Expenditures in Canada —
by David W. Slater

Canada's Imports —
by David W. Slater

The Future of Canada's Export Trade[1] —
by R. V. Anderson

Canada-United States Economic Relations[1] —
by Irving Brecher and S. S. Reisman

Canadian Commercial Policy[1] —
by J. H. Young

Some Regional Aspects of Canada's Economic Development —
by R. D. Howland

The Nova Scotia Coal Industry —
by Urwick, Currie Limited

Canadian Economic Growth and Development from 1939 to 1955 —
by J. M. Smith

[1]This is one of a series of three studies on Canadian international economic relations prepared under the direction of S. S. Reisman.

Table I

CANADIAN PRODUCTION OF ELECTRONIC EQUIPMENT

(thousands of dollars)

	Radio receiving sets	T.V. receiving sets	Record players	Radio trans'm equip. for civil use[a]	Radio communication equip. for military use[a]	Radar[a]	Radio capacitors	T.V. equip. other than complete sets	Vacuum tubes	Electronic transformers	All other electronic equip.	Grand total
1933.....	4,401	—	b	b	b	—	b	—	1,089	75	594	6,159
1934.....	8,196	—	b	b	b	—	b	—	1,484	160	574	10,414
1935.....	9,493	—	b	b	b	—	b	—	1,275	123	1,463	12,354
1936.....	11,388	—	b	b	b	—	b	—	1,630	187	587	13,792
1937.....	11,697	—	b	b	b	—	379	—	1,827	248	1,160	15,311
1938.....	8,802	—	b	b	b	—	300	—	1,201	160	1,432	11,895
1939.....	8,678	—	b	b	b	—	411	—	1,338	124	1,267	11,818
1940.....	11,268	—	b	b	b	—	576	—	1,887	214	2,413	16,358
1941.....	9,215	—	b	b	b	b	631	—	1,802	279	5,217	17,144
1942.....	4,682	—	b	b	b	b	1,204	—	3,601	406	26,670	36,563
1943.....	19	—	—	b	55,378	c	1,611	—	9,747	472	1,787	68,974
1944.....	—	—	—	130	92,982	c	3,762	—	13,753	926	3,225	114,778
1945.....	979	—	492	938	33,724	c	1,055	—	11,023	976	2,449	51,686
1946.....	15,760	—	1,992	1,215	5,516	—	1,935	—	2,452	358	5,780	35,008
1947.....	33,063	—	1,926	3,164	2,400	—	2,095	—	3,799	605	6,103	53,155
1948.....	25,411	1	561	2,717	149	—	1,166	—	1,867	333	3,856	36,061
1949.....	29,412	2,010	1,314	3,146	1,080	—	1,824	2	3,305	426	4,828	47,347
1950.....	33,498	7,765	1,057	2,311	2,539	—	2,270	165	5,871	505	6,269	62,250
1951.....	29,635	12,902	1,412	3,530	12,589	c	2,525	365	6,282	922	8,703	79,135
1952.....	22,179	30,073	1,718	5,293	16,401	26,504	2,507	634	7,131	1,403	9,256	123,099
1953.....	28,021	81,305	2,096	6,285	20,746	31,442	4,271	1,527	14,012	3,329	14,589	207,623
1954.....	16,509	105,682	2,939	5,218	31,198	28,781	4,930	4,284	14,125	4,250	24,637	242,553
1955p.....	19,125	129,081	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	22,000	n.a.	n.a.	300,000

p = preliminary

a. These figures do not represent the total output in Canada as these items are also produced as minor products by companies not classified in "The electrical apparatus and supplies industry."

b. Included in "All other electronic equipment."

c. Included in "Radio communication equipment for military use."

Source: Dominion Bureau of Statistics: "The electrical apparatus and supplies industry."

Table II

CANADIAN PRODUCTION OF CONSUMER HOME PRODUCTS

	Radio receiving sets		T.V. receiving sets		Record players		Total
	(1,000 units)	($1,000[a])	(1,000 units)	($1,000)	($1,000 units)	($1,000[a])	($1,000[a])
1925.....	49	2,278	—	—	n.a.	n.a.	n.a.
1926.....	42	2,253	—	—	n.a.	n.a.	n.a.
1927.....	48	3,749	—	—	n.a.	n.a.	n.a.
1928.....	81	7,486	—	—	n.a.	n.a.	n.a.
1929.....	150	15,604	—	—	n.a.	n.a.	n.a.
1930.....	170	19,197	—	—	n.a.	n.a.	n.a.
1931.....	292	18,556	—	—	n.a.	n.a.	n.a.
1932.....	121	6,809	—	—	n.a.	n.a.	n.a.
1933.....	112	4,401	—	—	n.a.	n.a.	n.a.
1934.....	189	8,196	—	—	n.a.	n.a.	n.a.
1935.....	191	9,493	—	—	n.a.	n.a.	n.a.
1936.....	254	11,388	—	—	n.a.	n.a.	n.a.
1937.....	289	11,697	—	—	n.a.	n.a.	n.a.
1938.....	243	8,802	—	—	n.a.	n.a.	n.a.
1939.....	349	8,678	—	—	n.a.	n.a.	n.a.
1940.....	485	11,268	—	—	n.a.	n.a.	n.a.
1941.....	386	9,215	—	—	n.a.	n.a.	n.a.
1942.....	177	4,682	—	—	n.a.	n.a.	n.a.
1943.....	1	19	—	—	—	—	19
1944.....	—	—	—	—	—	—	—
1945.....	50	979	—	—	n.a.	492	1,471
1946.....	603	15,760	—	—	n.a.	1,992	17,752
1947.....	984	33,063	—	—	91	1,926	34,989
1948.....	639	25,411	—	1	29	561	25,973
1949.....	791	29,412	9	2,010	75	1,314	32,736
1950.....	821	33,498	33	7,765	44	1,057	42,320
1951.....	628	29,635	49	12,902	60	1,412	43,949
1952.....	568	22,179	142	30,073	76	1,718	53,970
1953.....	737	28,021	392	81,305	75	2,096	111,422
1954.....	488	16,509	611	105,682	116	2,939	125,130
1955p.....	579p	19,125p	852p	129,081	n.a.	n.a.	n.a.

p = preliminary

a. In factory prices.

Source: Dominion Bureau of Statistics: "The electrical apparatus and supplies Industry."

Table III

CANADIAN PRODUCTION OF VACUUM TUBES

	Radio & T.V. receiving tubes		Other vacuum tubes[a]	Total
	(1,000 units)	($1,000)	($1,000)	($1,000)
1929	2,924	3,100	175	3,275
1930	3,116	3,181	257	3,438
1931	3,297	2,298	110	2,408
1932	2,747	1,611	74	1,685
1933	1,731	1,023	66	1,089
1934	2,368	1,390	94	1,484
1935	2,184	1,181	94	1,275
1936	2,952	1,546	84	1,630
1937	3,321	1,760	67	1,827
1938	1,970	1,108	93	1,201
1939	2,527	1,247	91	1,338
1940	4,118	1,814	73	1,887
1941	3,268	1,497	305	1,802
1942	3,442	1,278	2,323	3,601
1943	4,106	2,256	7,491	9,747
1944	5,905	3,746	10,007	13,753
1945	5,679	3,281	7,742	11,023
1946	5,933	2,438	14	2,452
1947	7,985	3,747	52	3,799
1948	4,041	1,831	36	1,867
1949	4,683	2,787	518	3,305
1950	8,182	4,964	907	5,871
1951	9,977	5,216	1,066	6,282
1952	7,221	4,673	2,458b	7,131
1953	12,803	8,477	5,535	14,012
1954	11,369	6,608	7,517	14,125
1955	16,000e	9,300e	12,700e	22,000e

e = estimate

a. Includes rectifier, transmitting and special purpose tubes and since 1949 television picture tubes.

b. Among which 120,000 television picture tubes valued at $2,325,000.

Source: Dominion Bureau of Statistics: "The electrical apparatus and supplies Industry."

Table IV

FLUCTUATIONS IN THE PRODUCTION OF THE CANADIAN ELECTRONICS INDUSTRY AS COMPARED TO THOSE IN THE PRODUCTION OF ALL CANADIAN MANUFACTURING INDUSTRIES

	All manufacturing industries		Electronics industry	
	($ million)	(index 1937-39 = 100)	($ million)	(index 1937-39 = 100)
1929.....	3,883	112	15.5	119
1930.....	3,280	94	23.0e	177
1931.....	2,555	73	22.0e	169
1932.....	1,980	57	9.5e	73
1933.....	1,954	56	6.2	48
1934.....	2,394	69	10.4	80
1935.....	2,654	76	12.4	96
1936.....	3,002	86	13.8	107
1937.....	3,625	104	15.3	118
1938.....	3,338	96	11.9	92
1939.....	3,475	100	11.8	91
1940.....	4,529	130	16.4	126
1941.....	6,076	175	17.1	132
1942.....	7,554	217	36.6	282
1943.....	8,733	251	69.0	531
1944.....	9,074	261	114.8	883
1945.....	8,250	237	51.7	398
1946.....	8,036	231	35.0	270
1947.....	10,081	290	53.2	409
1948.....	11,875	341	36.1	277
1949.....	12,480	359	47.3	364
1950.....	13,818	397	62.3	479
1951.....	16,392	471	79.1	608
1952.....	16,983	488	123.1	947
1953.....	17,785	511	207.6	1,597
1954.....	17,498	503	242.6	1,866
1955.....	n.a.	n.a.	300.0e	2,308

e = estimate

Source: Dominion Bureau of Statistics.

Table V

CANADIAN RATES OF CUSTOMS DUTY FOR MACHINERY AND EQUIPMENT USED IN THE ELECTRONICS INDUSTRY

(percentage)

Tariff item		British Preferential	Most Favoured Nation	General
427	All machinery, composed wholly or in part of iron or steel n.o.p., and complete parts thereof.....	10	22.5	35
427a.	All machinery, composed wholly or in part of iron or steel n.o.p. of a class or kind not made in Canada; complete parts of the foregoing.....	free	7.5	35
427k.	(1) machinery of a class or kind made in Canada for working metal by turning, milling, grinding, drilling, boring, planing, shaping, shearing or pressing and accessories and attachments therefore; parts of the foregoing.....	10	22.5	35
	(2) same as (1) of a class or kind not made in Canada.....	free	7.5	35
445k.	Electric apparatus and complete parts thereof n.o.p.....	15	22.5	30
445n.	Electrical instruments and apparatus of precision of a class or kind not made in Canada, e.g., meters or gauges for indicating and/or recording.....	free	15	30

Source: The Customs Tariff Act.

Table VI

PRICES OF SOME BASIC MATERIALS USED IN THE MANUFACTURE OF ELECTRONIC EQUIPMENT[a]

Commodity	Market	Terms of delivery	Prices 1935 Av.	1938 Av.	1951 Av.	1952 Av.	1953 Av.	1954 Av.	1955 Av.
Aluminum (ingots)	Canada	delivered	19.5	22.0	17.0[b]	18.0[b]	19.0	19.0	20.5
	U.S.	delivered	20.5	20.0	18.0	18.4	19.9	20.2	21.2
	U.K.	delivered	21.9	21.3	15.5	19.5	21.4	19.6	20.8
Copper (electrolytic)	Canada	del. at Toronto	7.8	9.9	27.7	28.5	30.0	29.2	36.6
	U.S.	Prompt del. at N.Y.	8.8	10.1	24.4	24.4	28.4	29.8	32.1
	U.K.c	spot at London	6.9	8.7	28.8	32.4	31.8	31.0	43.7
Lead	Canada	del. at Toronto	3.1	3.3	18.4	16.2	12.9	13.3	14.4
	U.S.	spot at St. Louis	3.9	4.6	17.3	16.3	13.3	13.9	14.9
	U.K.	spot at London	3.1	3.3	20.2	16.8	11.4	12.0	13.2
Zinc (prime Western)	Canada	del. at Toronto	3.1	3.4	19.9	17.5	11.9	10.7	12.3
	U.S.	f.o.b. East St. Louis	4.3	4.6	18.0	16.2	10.9	10.7	12.3
	U.K.	spot at London	3.1	3.0	21.4	18.7	9.3	9.7	11.3
Steel (cold rolled sheets, base prices)	Canada	f.o.b. mill	n.a.	n.a.	5.15	5.34	5.47	5.40	5.47
	U.S.	f.o.b. mill	2.95	3.31	4.35	4.46	4.67	4.86	5.14
	U.K.	f.o.b. mill	n.a.	3.39	3.99	4.98	5.15	5.23	5.84

a. Cents per pound at official exchange rate.

b. F.o.b. smelter.

c. Standard copper.

Sources: Northern Miner, American Metal Market, American Bureau of Metal Statistics, Minerais & Metaux.

Table VII

CANADIAN PRODUCTION, TRADE AND DOMESTIC DISAPPEARANCE OF ELECTRONIC PRODUCTS

Years	Gross value of Canadian production	Imports	Exports	Domestic[a] disappearance	Imports as % of domestic disappearance	Exports as % of Canadian production
		(millions of dollars)			*(percentage)*	
1929....	15.5	10.7	—	26.2	40.8	—
1933....	6.2	1.2	0.2	7.2	16.7	3.2
1934....	10.4	1.9	0.2	12.1	15.8	1.9
1935....	12.4	2.0	0.2	14.2	14.1	1.6
1936....	13.8	2.7	0.3	16.2	16.7	2.2
1937....	15.3	3.4	0.3	18.4	18.6	2.0
1938....	11.9	3.0	0.3	14.6	20.6	2.5
1939....	11.8	3.4	0.2	15.0	22.7	1.7
1940....	16.4	4.2	0.2	20.4	20.6	1.2
1941....	17.1	5.4	0.9	21.6	25.0	5.3
1942....	36.6	7.8	22.1	22.3	34.9	60.9
1943....	69.0	22.4	36.8	54.6	40.9	53.0
1944....	114.8	33.5	52.8	95.5	35.0	46.0
1945....	51.7	15.9	36.9	30.7	57.0	71.5
1946....	35.0	12.3	9.7	37.6	33.9	27.6
1947....	53.2	15.7	3.4	65.5	24.0	6.4
1948....	36.1	9.7	2.8	43.0	22.5	7.8
1949....	47.3	12.7	3.3	56.7	22.4	7.0
1950....	62.3	18.1	3.9	76.5	23.7	6.2
1951....	79.1	25.5	4.0	100.6	25.3	5.1
1952....	123.1	35.9	14.9	144.1	24.9	12.1
1953....	207.6	78.0	25.4	260.2	29.9	12.2
1954....	242.6	90.5	9.7	323.4	28.0	4.0
1955p...	300.0	95.1	7.3	387.8	24.5	2.4

p = preliminary

a. Domestic disappearance is defined as the gross value of Canadian production plus imports minus exports.

Source: Dominion Bureau of Statistics and calculations of Canadian Business Service.

Table VIII

SUMMARY OF CANADIAN IMPORTS OF ELECTRONIC PRODUCTS

(thousands of dollars)

Years ended Mar. 31	From U.S.	From U.K.	From other countries	Total
1927	3,512	145	55	3,712
1928	4,494	149	37	4,680
1929	7,072	142	53	7,267
1930	11,961	120	73	12,154
1931	8,680	105	56	8,841
1932	4,266	49	34	4,349
1933	1,117	48	7	1,172
Years ended Dec. 31				
1933	1,185	49	4	1,238
1934	1,746	99	8	1,853
1935	1,887	107	7	2,001
1936	2,533	131	5	2,669
1937	3,112	241	7	3,360
1938	2,744	209	5	2,958
1939	3,294	127	8	3,429
1940	4,022	206	7	4,235
1941	5,263	155	1	5,419
1942	7,570	261	4	7,835
1943	21,839	519	—	22,358
1944	32,556	988	—	33,544
1945	14,220	1,628	4	15,852
1946	11,881	346	31	12,258
1947	15,245	435	53	15,733
1948	8,937	787	14	9,738
1949	12,310	395	27	12,732
1950	16,705	1,288	110	18,103
1951	23,628	1,677	223	25,528
1952	33,438	2,090	376	35,904
1953	73,542	3,872	575	77,989
1954	83,966	5,524	973	90,463
1955	88,130	5,696	1,301	95,127

Source: Trade of Canada.

Table IX

CANADIAN IMPORTS OF RADIO-RECEIVING SETS

(Tariff item 445d Statistical class No. 6173)

	From U.S.		From U.K.		From other countries		Total	
	(1,000 units)	($1,000)	(1,000 units)	($1,000)	(1,000 units)	($1,000)	(1,000 units)	($1,000)
1937a.....	5	136	—	1	—	—	5	137
1938.....	8	184	—	—	—	—	8	184
1939.....	10	207	—	1	—	—	10	208
1940.....	7	165	—	3	—	—	7	168
1941.....	2	109	—	—	—	—	2	109
1942.....	1	72	—	17	—	—	1	89
1943b.....	3	2,245	1	34	—	—	4	2,279
1944b.....	1	1,019	—	46	—	—	1	1,065
1945b.....	1	471	—	37	—	—	1	508
1946.....	23	801	—	2	—	—	23	803
1947.....	68	2,213	—	1	—	—	68	2,214
1948.....	2	267	—	3	—	1	2	271
1949.....	2	187	—	16	—	—	2	203
1950.....	3	206	—	48	—	—	3	254
1951.....	9	550	—	32	—	1	9	583
1952.....	17	1,154	2	190	—	1	19	1,345
1953c.....	23	1,204	1	37	—	13	24	1,254
1954.....	14	852	1	43	1	26	16	921
1955.....	37	1,185	1	36	2	84	40	1,305

a. Prior to April 1, 1937 incorporated in "Radio and wireless apparatus n.o.p."

b. Dollar values indicate that in these war years D.B.S. was recording imports of military-type radio receivers rather than home sets.

c. Includes television receivers prior to 1953.

Source: Trade of Canada.

Table X

CANADIAN IMPORTS OF TELEVISION RECEIVING SETS

(Tariff item 445d Statistical class No. 6174)

	From U.S.		From U.K.		From other countries		Total	
	(1,000 units)	($1,000)	(1,000 units)	($1,000)	(1,000 units)	($1,000)	(1,000 units)	($1,000)
1953a.....	15	1,936	2	317	—	—	17	2,253
1954.....	19	2,075	—	4	—	1	19	2,080
1955.....	6	512	—	1	—	—	6	513

a. Prior to 1953 incorporated in "Radio receiving sets."

Source: Trade of Canada.

Table XI

CANADIAN IMPORTS OF RADIO TUBES[a]

(Tariff item 445d Statistical class No. 6166)

Years ended Mar. 31	From U.S. (1,000 units)	From U.S. ($1,000)	From U.K. (1,000 units)	From U.K. ($1,000)	From other countries (1,000 units)	From other countries ($1,000)	Total (1,000 units)	Total ($1,000)
1927.....	n.a.	106	n.a.	22	n.a.	6	n.a.	134
1928.....	n.a.	183	n.a.	24	n.a.	3	n.a.	210
1929.....	n.a.	220	n.a.	26	n.a.	1	n.a.	247
1930.....	n.a.	551	n.a.	29	n.a.	—	n.a.	580
1931.....	n.a.	216	n.a.	21	n.a.	—	n.a.	237
1932.....	88	83	—	10	—	—	88	93
1933.....	65	56	—	5	—	—	65	61
Years ended Dec. 31								
1933.....	119	84	—	—	—	—	119	84
1934.....	266	154	—	1	—	—	266	155
1935.....	460	247	1	11	—	—	461	258
1936.....	564	265	2	25	—	—	566	290
1937.....	483	281	1	10	—	—	484	291
1938.....	440	212	—	1	—	—	440	213
1939.....	1,124	582	1	4	—	—	1,125	586
1940.....	989	494	—	1	—	—	989	495
1941.....	1,496	798	—	4	—	—	1,496	802
1942.....	1,298	1,106	1	3	—	—	1,299	1,109
1943.....	2,137	2,705	4	31	—	—	2,141	2,736
1944.....	3,921	5,914	4	26	—	—	3,925	5,940
1945.....	1,668	2,346	42	128	—	—	1,710	2,474
1946.....	1,488	1,162	—	4	—	—	1,488	1,166
1947.....	3,701	1,750	1	2	—	—	3,702	1,752
1948.....	937	710	—	1	1	1	938	712
1949.....	1,307	1,284	2	17	1	7	1,310	1,308
1950.....	1,694	1,592	66	39	52	22	1,812	1,653
1951.....	2,530	3,310	22	25	23	17	2,575	3,352
1952.....	2,706	4,855	22	59	24	46	2,752	4,960
1953.....	12,335	14,230	24	450	100	38	12,459	14,718
1954.....	6,871	8,476	26	206	316	121	7,213	8,803
1955.....	13,682	12,324	19	105	691	205	14,392[b]	12,634

a. Includes radio transmitting and special purpose tubes. Does not include television picture or camera tubes.

b. Includes approximately 12 million receiving tubes.

Source: Trade of Canada.

Table XII

CANADIAN IMPORTS OF PARTS FOR RADIO RECEIVING SETS

(Tariff item 445o Statistical class No. 6175)

(thousands of dollars)

Year	From U.S.	From U.K.	From other countries	Total
1939[a]	274	4	—	278
1940	720	5	—	725
1941	964	6	—	970
1942	916	5	—	921
1943	1,473	1	—	1,474
1944	2,040	—	—	2,040
1945	1,125	—	—	1,125
1946	2,471	—	6	2,477
1947	2,562	6	7	2,575
1948	1,969	4	—	1,973
1949	2,886	8	—	2,894
1950	4,101	53	5	4,159
1951	3,845	116	93	4,054
1952	3,168	66	178	3,412
1953	10,508	189	193	10,890
1954	10,444	404	209	11,057
1955	7,807	713	382	8,902

a. Prior to April 1939 incorporated in "Radio and wireless apparatus n.o.p."

Source: Trade of Canada.

Table XIII

CANADIAN IMPORTS OF PARTS FOR RADIO TUBES

(Tariff item 445p, q, and s—Statistical class No. 6176)

(thousands of dollars)

Year	From U.S.	From U.K.	From other countries	Total
1939[a]	103	1	—	104
1940	225	—	—	225
1941	745	—	—	745
1942	1,117	1	—	1,118
1943	2,558	1	—	2,559
1944	3,600	—	—	3,600
1945	1,398	4	—	1,402
1946	644	—	—	644
1947	512	—	—	512
1948	274	—	—	274
1949	590	—	—	590
1950	1,205	—	—	1,205
1951	1,597	2	1	1,600
1952	1,870	1	6	1,877
1953	3,644	1	11	3,656
1954	4,763	7	6	4,776
1955	6,250	5	14	6,269

a. Prior to April 1939 incorporated in "Radio and wireless apparatus n.o.p."

Source: Trade of Canada.

Table XIV

CANADIAN IMPORTS OF SOUND EQUIPMENT

(Tariff item 445k Statistical class No. 6177)

(thousands of dollars)

Year	From U.S.	From U.K.	From other countries	Total
1948[a]	347	3	—	350
1949	602	20	—	622
1950	727	13	1	741
1951	1,120	15	1	1,136
1952	1,290	49	16	1,355
1953	1,921	69	3	1,993
1954	2,518	125	51	2,694
1955	2,686	83	38	2,807

a. Prior to 1948 in "Electrical apparatus n.o.p."

Source: Trade of Canada.

Table XV

CANADIAN IMPORTS OF RADIO AND WIRELESS APPARATUS n.o.p.

(Tariff item 445d Statistical class No. 6167)

(thousands of dollars)

Years ended Mar. 31	From U.S.	From U.K.	From other countries	Total
1927	2,457	96	21	2,574
1928	3,384	104	3	3,491
1929	5,602	90	—	5,692
1930	9,869	74	33	9,976
1931	7,737	66	42	7,845
1932	4,004	32	31	4,067
1933	1,005	36	2	1,043
Years ended Dec. 31				
1933	1,064	44	1	1,109
1934	1,554	85	3	1,642
1935	1,607	86	2	1,695
1936	2,169	87	1	2,257
1937[a]	2,506	214	2	2,722
1938	1,919	195	1	2,115
1939[b]	1,768	110	1	1,879
1940	2,024	192	—	2,216
1941	2,428	128	1	2,557
1942	4,152	220	4	4,376
1943	12,797	451	—	13,248
1944	19,873	916	—	20,789
1945	8,667	1,459	—	10,126
1946	5,384	315	13	5,712
1947	6,486	392	30	6,908
1948	4,859	768	12	5,639
1949	6,435	331	17	6,783
1950	8,264	1,104	81	9,449
1951	12,082	1,463	87	13,632
1952	20,129	1,716	127	21,972
1953	38,604	2,783	308	41,695
1954	53,258	4,700	496	58,454
1955	55,879	4,706	417	61,002

a. In April, 1937 the imports of radio receivers were put into a separate classification.

b. In April, 1939 the imports of parts for radio receivers and tubes were put into separate classifications.

Source: Trade of Canada.

Table XVI

CANADIAN IMPORTS OF PHONOGRAPHS, GRAMOPHONES AND PARTS

(Tariff item 597a (2) Statistical class No. 9120)

(thousands of dollars)

Years ended Mar. 31	From U.S.	From U.K.	From other countries	Total
1927.....	949	27	28	1,004
1928.....	927	21	31	979
1929.....	1,250	26	52	1,328
1930.....	1,541	17	40	1,598
1931.....	727	18	14	759
1932.....	179	7	3	189
1933.....	56	7	5	68
Years ended Dec. 31				
1933.....	37	5	3	45
1934.....	38	13	5	56
1935.....	33	10	5	48
1936.....	99	19	4	122
1937.....	189	16	5	210
1938.....	429	13	4	446
1939.....	360	7	7	374
1940.....	394	5	7	406
1941.....	219	17	—	236
1942.....	207	15	—	222
1943.....	61	1	—	62
1944.....	110	—	—	110
1945.....	213	—	4	217
1946.....	1,419	25	12	1,456
1947.....	971	34	16	1,021
1948.....	416	8	—	424
1949.....	326	3	3	332
1950.....	492	31	1	524
1951.....	691	24	23	738
1952.....	473	9	2	484
1953.....	655	26	9	690
1954.....	796	35	63	894
1955.....	593	47	161	801

Source: Trade of Canada.

Table XVII

CANADIAN IMPORTS OF PHONOGRAPHS COIN OPERATED

(Tariff item 597a (2) Statistical class No. 9124)

(thousands of dollars)

Year	From U.S.	From U.K.	From other countries	Total
1947[a]	751	—	—	751
1948	95	—	—	95
1949	—	—	—	—
1950	118	—	—	118
1951	433	—	—	433
1952	499	—	—	499
1953	840	—	—	840
1954	784	—	—	784
1955	894	—	—	894

a. Included in "Phonographs, gramophones and finished parts" prior to 1947.
Source: Trade of Canada.

Table XVIII

SUMMARY OF CANADIAN EXPORTS OF ELECTRONIC PRODUCTS

(thousands of dollars)

Year	Countries U.S.	U.K.	Other	Total Incl. of re-exports	Re-exports
1934	37	84	59	180	37
1935	63	69	77	209	46
1936	51	157	131	339	49
1937	60	99	99	258	57
1938	76	33	170	279	80
1939	83	15	101	199	84
1940	47	43	79	169	42
1941	159	429	313	901	134
1942	19,713	1,473	928	22,114	126
1943	27,981	5,225	3,560	36,766	539
1944	19,203	23,466	10,098	52,767	1,246
1945	3,651	25,659	7,581	36,891	848
1946	1,099	7,893	757	9,749	360
1947	464	359	2,589	3,412	396
1948	481	71	2,265	2,817	299
1949	642	136	2,697	3,275	255
1950	2,048	40	1,797	3,885	445
1951	2,073	109	1,854	4,036	553
1952	6,842	2,344	5,692	14,878	543
1953	13,251	5,947	6,177	25,375	1,423
1954	6,676	128	2,888	9,716	1,335
1955	3,840	161	3,252	7,253	1,433

Source: Trade of Canada.

Table XIX

CANADIAN EXPORTS OF RADIO RECEIVING SETS

(Statistical class No. 6450)

Year	*To U.S.*		*To U.K.*		*To other countries*		*Total* Incl. of re-exports		Of which re-exports	
	(1,000 units)	($1,000)	(1,000 units)	($1,000)	(1,000 units)	($1,000)	(1,000 units)	($1,000)	(1,000 units)	($1,000)
1939a	—	9	—	8	—	10	1	27	—	8
1940	—	3	—	7	—	16	1	26	—	2
1941	—	1	—	—	7	168	7	169	—	1
1942	—	—	—	2	3	58	3	60	—	1
1943	—	1	—	—	—	3	—	4	—	1
1944	—	—	—	—	—	11	—	11	—	—
1945	—	—	—	—	1	1	1	1	—	—
1946	—	2	—	—	14	425	14	427	—	1
1947	2	50	—	—	53	1,598	55	1,648	2	43
1948	1	31	—	5	27	868	28	904	—	10
1949	1	23	—	2	32	1,404	33	1,429	—	3
1950	11	273	—	1	26	990	37	1,264	—	8
1951	6	268	—	—	30	951	36	1,219	—	18
1952	5	276	—	1	29	1,177	34	1,454	—	13
1953	9	288	—	1	15	721	24	1,010	—	16
1954	6	231	—	1	10	1,294	16	1,526	—	10
1955	3	125	—	—	8	858	11	983	1	28

a. Prior to 1939 included in "Radio and wireless apparatus n.o.p."

Source: Trade of Canada.

Table XX

CANADIAN EXPORTS OF RADIO AND WIRELESS APPARATUS n.o.p.

(Statistical class No. 6460)

(thousands of dollars)

Year	To U.S.	To U.K.	To other countries	Total Incl. of re-exports	Total Of which re-exports
1934[a]	35	84	56	175	35
1935	46	69	76	191	46
1936	49	157	129	335	47
1937	58	99	98	255	56
1938	70	33	168	271	78
1939[b]	65	7	89	161	70
1940	34	36	56	126	35
1941	148	426	121	695	121
1942	19,676	1,471	853	22,000	204
1943	27,960	5,225	3,531	36,716	530
1944	19,161	23,466	10,068	52,695	1,231
1945	3,607	25,659	7,518	36,784	835
1946	1,018	7,891	208	9,117	324
1947	291	359	782	1,432	286
1948	377	66	1,349	1,792	251
1949	563	134	1,067	1,764	225
1950	1,723	39	795	2,557	424
1951	1,764	109	889	2,762	509
1952	6,515	2,343	4,487	13,345	507
1953	12,895	5,898	5,450	24,243	1,316
1954	6,379	140	1,583	8,102	1,268
1955	3,594	140	2,379	6,113	1,310

a. Prior to 1934 included in "Telegraph and telephone apparatus."

b. In 1939 radio receiving sets were put into a separate classification.

Source: Trade of Canada.

Table XXI

CANADIAN EXPORTS OF PHONOGRAPHS, GRAMOPHONES AND PARTS

(Statistical class No. 9310)

(thousands of dollars)

Years ended Mar. 31	To U.S.	To U.K.	To other countries	Total Incl. of re-exports	Total Of which re-exports
1929[a]	10	15	83	108	8
1930	15	3	55	73	12
1931	39	2	25	67	37
1932	8	1	19	28	8
1933	2	1	7	10	2
Years ended Dec. 31					
1933	11	—	9	19	10
1934	2	—	3	5	2
1935	17	—	1	18	—
1936	2	—	2	4	2
1937	2	—	1	3	1
1938	6	—	2	8	2
1939	9	—	2	11	6
1940	10	—	7	17	5
1941	10	3	24	37	12
1942	37	—	17	54	21
1943	20	—	26	46	8
1944	42	—	19	61	15
1945	44	—	62	106	13
1946	79	2	124	205	35
1947	123	—	209	332	67
1948	73	—	48	121	38
1949	56	—	26	82	27
1950	52	—	12	64	13
1951	41	—	14	55	26
1952	51	—	28	79	23
1953	68	48	6	122	91
1954	66	11	11	88	57
1955	121	21	15	157	95

a. Not available prior to 1929.

Source: Trade of Canada.

SOME MAJOR COMPANIES IN THE ELECTRONICS INDUSTRY IN CANADA[a]

	City	Consumer home products	Industrial & mil. equip.	Compo-nents	Vacuum tubes	Owner-ship
Acme Electric Corp. Ltd.	Toronto			x		35% U.S. parent
Aerovox Canada Ltd.	Hamilton			x		100% U.S. parent
Canadian Admiral Corp. Ltd.	Port Credit	x				97% U.S. parent
Canadian Aviation Elects. Ltd.	Montreal	x	x			100% Canada
Canadian General Elect. Co. Ltd.	Toronto	x	x	x	x	99.3% U.S. parent
Canadian Marconi Company	Montreal	x	x	x		50.6% U.K. parent
Canadian Radio Mfg. Corp. Ltd.	Toronto	x	x	x	x	over 50% Dutch parent
Canadian Westinghouse Co. Ltd.	Hamilton	x	x	x	x	over 70% U.S. parent
Chisholm Industries Ltd.	Vancouver	x				over 50% Canada
Collins Radio Co. of Can. Ltd.	Toronto		x			100% U.S. parent
Cossor (Canada) Ltd.	Halifax		x			100% U.K. parent
Crosley Radio & Television Div.	Toronto	x	x			100% U.S. parent
Dominion Electrohome Inds. Ltd.	Kitchener	x	x	x		100% Canada
Hallicrafters Canada Ltd.	Toronto	x	x			100% U.S. parent

Table XXII (Cont'd.)

International Resistance Co. Ltd.	Toronto			x		100% U.S. parent
McKinnon Industries Ltd.	St. Catharines	x				100% U.S. parent
Northern Electric Co. Ltd.	Montreal & Belleville	x	x			57% Canada[b]
Philco Corp. of Canada Ltd.	Toronto	x				100% U.S. parent
Pye Canada Ltd.	Ajax	x	x			100% U.K. parent
R.C.A. Victor Co. Ltd.	Montreal	x	x	x	x	100% U.S. parent
Sparton of Canada Ltd.	London	x				100% U.S. parent
Standard Television Prods. Ltd.	Kitchener			x		over 50% Canada
Sylvania Electric (Canada) Ltd.	Montreal	x			x	100% U.S. parent

a. Major companies in one or more of the industry segments listed.

b. 57% owned by Bell Telephone of Canada, 43% by Western Electric.

Table XXIII

COMPANIES INCLUDED IN OUR SURVEY OF THE U.S. ELECTRONICS INDUSTRY

Admiral Corporation	Chicago, Ill.
Aerovox Corporation	New Bedford, Mass.
Aircraft Radio Corporation	Boonton Township, N.J.
Collins Radio Co.	Cedar Rapids, Iowa
Cornell-Dubilier Electric Corp.	South Plainfield, N.J.
Du Mont (Allen B.) Laboratories Inc.	Clifton, N.J.
Emerson Radio & Phonograph Corp.	Jersey City, N.J.
Erie Resistor Corp.	Erie, Pa.
Hallicrafters Co.	Chicago, Ill.
International Resistance Co.	Philadelphia, Pa.
Magnavox Co.	Fort Wayne, Ind.
Mallory (P.R.) & Co. Inc.	Indianapolis, Ind.
Motorola Inc.	Chicago, Ill.
Olympic Radio & Television Inc.	Long Island City, N.Y.
Philco Corporation	Philadelphia, Pa.
Pyramid Electric Co.	North Bargen, N.J.
Radio Condenser Co.	Camden, N.J.
Radio Corporation of America	Camden, N.J.
Raytheon Manufacturing Co.	Waltham, Mass.
Sprague Electric Co.	North Adams, Mass.
Standard Coil Products Co.	Melrose Park, Ill.
Sylvania Electric Products Inc.	Salem, Mass.
Trav-ler Radio Corp.	Chicago, Ill.
Zenith Radio Corporation	Chicago, Ill.

	1954	1955
No. of companies	24	24
No. of employees	202,775	216,175
Investment in land, buildings, and equipment (depreciated value)	$ 387 million	$ 400 million
Current and other assets	1,239 "	1,389 "
Total assets	1,626 million	1,789 million
Current liabilities	532 "	527 "
Net investment	1,094 million	1,262 million
Investment in land, buildings and equipment per employee	$ 1,908	$ 1,850
Total net investment per employee	5,395	5,838
Total sales (sales and service)	$ 3,004 million	$ 3,167 million
Sales per employee	$14,814	$14,650
Net profit from operations (before deducting income taxes)	$ 196 million	$ 218 million
Other income	10 "	14 "
Total net profit (before deducting income taxes)	$ 206 million	$ 232 million
Total net profit before taxes as a percentage of sales	6.85	7.32
Profit from operations as a percentage of sales	6.53	6.88
Total net profit before taxes as a percentage of net investment	18.83	18.39

Source: Trade of Canada.

HULL
EDMOND CLOUTIER, C.M.G., O.A., D.S.P.
QUEEN'S PRINTER AND CONTROLLER OF STATIONERY
1956