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ABSTRACT

To identify problems regarding economic development, the Committee for Scientific and Technical Personnel conducted an educational and occupational survey of each member country of the Organisation for Economic Cooperation and Development (OECD). The specific purpose of the surveys was to gather comparative data on the training and utilization of technicians in each member country. Major sections of each survey are: (1) The Structure of the Educational System, (2) Training of Technicians and Other Technical Manpower, and (3) Functions of Technicians. Related surveys for each of the following countries, Denmark, Spain, France, Netherlands, Switzerland, Yugoslavia, United Kingdom, Portugal, and Italy, are available in this issue as VT 015 717-VT 015 725 respectively. (JS)

DOCUMENT

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THE EDUCATION, TRAINING AND FUNCTIONS OF TECHNICIANS

CANADA

DIRECTORATE FOR SCIENTIFIC AFFAIRS

ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

SCIENTIFIC AND TECHNICAL PERSONNEL

THE EDUCATION, TRAINING AND FUNCTIONS OF TECHNICIANS

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2, rue André-Pascal, Paris-16e

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PREFACE

The OECD Committee for Scientific and Technical Personnel has given considerable attention to the question of technician training and utilisation which is a key problem in the economic development of Member countries and has on several occasions drawn attention to the need for an adequate supply of and proper training for skills at this level.

To clarify the situation as far as possible and to establish a solid base for discussion, the Committee has instituted a series of surveys in Member countries describing and analysing training conditions.

The material obtained is classified according to a standard pattern throughout, so that comparisons can be drawn between countries. The completed surveys were used as basic working documents for "Confrontation Meetings", between two or more countries. These meetings were held under a neutral chairman and were attended by teams of specialists from participating countries. Delegates discussed each other's training systems and the various problems which arise and endeavour to reach conclusions on questions of policy and to find solutions to technical difficulties.

The present publication, the fourth of a series, is a revised version of the working document used at the confrontation meeting between Canada and Denmark, held in Paris in March 1965. The conclusions of this meeting are given in Appendix IX.

The Report is an accurate reflection of the situation as it

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existed in 1964. However, the rapid expansion of facilities has continued. As of September 1966, 955 construction projects on new and existing schools, providing some 380,000 new student places, were in various stages of completion. The total cost of these projects is estimated at $1,250,000,000, of which the federal contribution is $680,000,000. These figures indicate the extent to which the programme has grown, and should be compared with those given in paragraph 3 of Appendix II.

This report, prepared for publication by Mr. S. Syrimis, Consultant to the Science Directorate of OECD is based on the original surveys on "Training and Functions of Technicians" prepared by Dr. H. W. French, Her Majesty's Chief Inspector, Department of Education and Science, United Kingdom and Prof. Bruce A.McFarlane, Chairman of the Department of Sociology, Carleton University, Ottawa, Canada(1). The Secretariat wishes to acknowledge its indebtedness to the Canadian authorities for their help and co-operation throughout the preparation of this study.

(1) Dr. McFarlane was assisted in the field by David Millet, Assistant Prof. of Sociology, University of Ottawa, and George Torrance, graduate student, Dept. of Sociology, Princeton University, U.S.A. In addition, Dr. Oswald Hall, University of Toronto, acted as a consultant.

Part One

THE STRUCTURE OF THE EDUCATIONAL SYSTEM

I. General data - The place of technical education in the educational system

1. Canada is a federal state consisting of ten provinces and two sparsely populated northern territories. Responsibility for education is entrusted to the provincial governments for the provinces and to the Federal Government for the territories. There are thus 10 independant local authorities as far as education is concerned, each one with its own administrative structure and legislation. This autonomy which has resulted in considerable diversity in the organisation and structure of education at all levels, may be explained by the historical development of the country as well as by the contrasts existing between the different provinces as regards their social, ethnical and religious homogeneity and their degree of industrialisation.

2. In most provinces the school law states that children of school age do not have to attend public school so long as they are receiving efficient instruction elsewhere. This led to the establishment of a variety of private schools in all provinces, some under church

auspices, some under private auspices. Outside Quebec, where approximately 10 per cent of the school children are enrolled in private schools, only about 3 per cent of primary and secondary pupils are in private institutions, more than half of which are Roman Catholic. Many private schools also provide technical and other vocational courses at secondary and post-secondary levels, either in daytime or evening classes, or through correspondance courses.

3. The role of the Federal Government as regards educational activities as a whole is relatively small, and is actually limited to responsibility for the education of Indians, Eskimos and members of the Armed Forces and their dependants, and to providing grants for the development of technical and vocational education and training and for scholarships and research and to universities and colleges.

4. The first important manifestation of official interest to a technical and vocational education policy in Canada at national level occurred in 1913, when a Royal Commission report recommended the establishment of a complete system of technical and vocational education under provincial control, supported by federal, provincial and municipal contributions. The implementation of these recommendations was delayed and there was no significant development in this field before 1961.

5. The Technical and Vocational Training Assistance Act, which became effective on 1st April, 1961, provides for federal/provincial agreements operative over a six-year period. Under the terms of the Act, the Federal Government undertakes to contribute 75 per cent of the approved capital expenditure of the province for technical and vocational training during the first two years of the agreements, and 50 per cent during the remaining period for which they are operative. This Act has resulted in the establishment of some 500 new training centres, including many for technicians, at a cost to date of about $500 million. Further details on the magnitude and nature of programmes covered by the Act are given in Appendix II, page 77.

6. The main school courses provided by the present educational system as a whole are summarised below, while technical and vocational courses are further described under the appropriate headings

in the text. Appendix I illustrates in simplified diagrammatic form the structure of technical education within the framework of the educational system.

(a) Primary level - compulsory period

At present, school attendance in the various provinces is compulsory from the age of six to the age of fifteen or sixteen, which means that all children receive at least some secondary education in addition to their elementary schooling. This elementary education covers 7 years for the province of Quebec, and 8 years in the other provinces.

(b) Secondary level

There are many different types of educational institutions at secondary level. In several regions are found schools which are entirely academic in character, technical and other vocational schools which offer only a technical and/or vocational programme, and comprehensive schools which offer several combinations of these two programmes. The main types of secondary schools are:

(i) In Quebec

1. Secondary schools (écoles secondaires) : general, vocational or comprehensive four year schools (grades 8 up to and including 11) leading to the junior matriculation certificate. An additional year (grade 12) is required for the senior matriculation certificate.

2. Classical colleges (collèges classiques) : eight-year academic secondary schools which combine both secondary and post-secondary programmes starting at grade 8 (paragraph 45).

3. Trade schools:
(i) Trade courses (cours de métiers) : two-year vocational courses at lower secondary level (grades 8 and 9).

(ii) Technical courses (cours techniques) : two-year courses at upper secondary level (grades 10 and 11).

4. Secondary schools for home economics (écoles moyennes familiales) : four-year vocational training schools for home economics (grades 7 up to and including 11).

5. Institutes of home economics (instituts familiaux) : advanced three-year vocational training schools for home economics (grades 10, 11 and 12).

(ii) In the other provinces

1. High schools : secondary schools with four or five-year courses of academic, commercial, technical or comprehensive types leading to junior or senior matriculation respectively.

2. Junior high schools : lower general secondary schools comprising the two upper grades of the regular eight-year elementary school and the first grade of high school (grades 7, 8 and 9).

3. Senior high schools : upper general secondary schools, (grades 10,11 and 12).

4. Technical, vocational and commercial high schools : secondary schools with four-year courses emphasising vocational subjects (grades 9 up to and including 12).

5. Trade schools : two-year vocational training schools, (grades 11 and 12).

(c) Post-secondary level

Courses normally requiring a full secondary education certificate for admission but concluding at a level lower than university, are classified as post-secondary and are given by the following types of institutions :

(i) Technical institutes or institutes of technology (Instituts de technologie, for Quebec) : two to three-year post-secondary institutions offering technical and/or other vocational courses at upper-technician level (grades 12 to 14).

(ii) Junior colleges : two-year, (grades 12 and 13), not awarding degrees and found in provinces other than Quebec; some combine two upper years of high school and the first year of undergraduate study; others have a high school department affiliated to a university. Graduates of Junior Colleges may transfer to universities or colleges for further studies (paragraph 41).

(iii) Teacher-training colleges : in Quebec the "écoles normales" are four-year institutions covering the grades 12 up to and including 15, while in other provinces "teacher colleges" are one-year (grade 13) post-secondary institutions.

(iv) Schools for Nurses (écoles d'infirmières in Quebec) : special three-year post-secondary schools.

(d) Higher education

Canadian universities may be English language, French language or bilingual. The French language institutions are mostly related to the church and have been organised in a similar way to the universities in some European countries. Most of the English language universities were founded as a result of a variety of needs and aspirations on the part of provincial institutions similar to those in England and Scotland. The length of studies at university level varies from 3 to 5 years (paragraph 44).

II. Vocational orientation and guidance

7. In Canada, vocational orientation and guidance are not organised as a regular school service. The facilities available in this field vary from province to province, but as a general rule most elementary and high schools now have teachers specifically trained in counselling.

In addition, engineering and other professional institutions in co-operation with the Canadian Broadcasting Corporation, try to develop programmes which will help the public to a better understanding of the opportunities available to young people.

8. Practical subjects, to give some sort of professional initiation to pupils are not normally included in the curricula of primary and general secondary school. However, in Quebec a significant effort has been made in this field. A very important report was published in 1962 by the "Comité d'étude sur l'enseignement technique et professionnel" under the chairmanship of Mr. A. Tremblay. The basic conclusion of this report is that no child should leave school before receiving a minimum amount of vocational training, and the educational system should be so organised that every child may be offered, at the appropriate stage, the vocational training suitable to his aptitudes. The Tremblay report proposed that the final year of primary school (7th grade) should be an observation period. The Committee concluded that, by the age of 14 or 15, about 25 per cent of the children derive more benefit from education with a vocational bias than from general education. It was therefore proposed to organise vocational training stages parallel with each general education stage, at the end of which students are advised either to proceed to the next general educational stage or to switch over to the vocational training side. Promotion from one vocational stage to the next should depend upon proficiency. The organisation of vocational training stages (paliers) is planned as shown in Table 1 below. The 'Tremblay' report has been supplemented by the report of the "Commission Royale d'Enquête sur l'Enseignement" under the chairmanship of Mgr. Alphonse-Marie Parent. Further details on the content and recommendations of this report will be found in Appendix IV. (page 89).

Table 1

Proposed vocational training stages in Quebec

Stage (Palier)	Conditions of admission	Length of course	Age at end of course	Objective
1st	Not less than 14 years old; not after 8th grade.	2 years	16-17	Introduction to work.
2nd	Not before 9th grade	2-3 years	17-18	Apprenticeship to a trade.
3rd	Not before 11th grade	2-4 years	19-21	Training as a technician
4th	Not before 13th grade	3-5 years	22-24	University training

III. Authorities in charge of education - Co-ordinating and planning mechanisms

(a) Educational authorities

9. Formal education at elementary and secondary levels is under the jurisdiction of the provincial Departments of Education which function according to provincial school laws. The provincial departments deal with the various grants, administer teacher-training colleges, issue teacher certificates, prepare curricula for elementary and secondary schools, prescribe textbooks or lists of books, employ school inspectors or superintendents, conduct final examinations and confer certificates on successful candidates.

10. Secondary schools are supported by the revenue from local taxes, grants from the provincial government and, in a few cases, school fees. In addition, grants for vocational secondary schools (including the vocational departments of high schools) covering instruction,

building and equipment, are made from federal funds (paragraph 4).

11. Both the organising and financing of higher education, although under the jurisdiction of the provincial governments, are noticeably different from those of elementary and secondary education. The grants made by the Federal Government to universities and colleges are distributed by the "National Conference of Canadian Universities" on a per capita basis, by province, and according to student enrolment per institution. Most of the universities have also conducted financial campaigns to help their expansion during the past twelve years, and it is expected that many more campaigns of this type will be undertaken in the near future.

12. The situation in several provinces is still intricate. In the province of Quebec for instance, the provision of technical courses is not the sole responsibility of one Ministry. The majority of trade schools and institutes of technology are under the control of the Ministry of Youth (Ministère de la Jeunesse) now called the Ministry of Education, but certain institutions come under the direction of other Ministries. For example, Institutes of Agriculture are controlled by the Ministry of Agriculture, certain commercial, industrial and agricultural courses at secondary level are under the control of the Department of Education, and certain Apprentice Training Organisations come under the supervision of the Ministry of Labour.

13. As there is no Federal Minister of Education, responsibility for implementing the Technical and Vocational Training Assistance Act (Appendix II, page 77) lies with the Federal Minister of Labour; his Department includes a Technical and Vocational Training branch, which handles the day-to-day administration of the Act and its associated agreements. Furthermore, the Department provides a stimulus to provincial activities in technical and vocational education, which it co-ordinates to some extent, but has little formal contact with the Universities.

(b) Advisory and co-ordinating bodies

14. The following bodies exert, in an advisory capacity, influence on matters relating to technical and vocational education.

(i) The National Technical and Vocational Training Advisory Council

This Council was authorized by the Vocational Training Co-ordination Act of 1942 for the purpose of surveying the field of technical and other vocational training, of maintaining and supervising the development of all forms and types of training, and of assisting the administration of the Vocational Training Assistance Act. The Council consists of representatives from the provincial governments, labour management, women's organisations and other groups concerned with training in Canada. Sub-committees have been appointed and deal with specific problems of (i) rehabilitation training of veterans; (ii) agricultural and rural training; (iii) apprenticeship and industrial training; (iv) assistance to vocational schools.

(ii) The National Advisory Committee on Technological Education

The rapid increase in the number of Institutes of Technology and in enrolment over recent years led to the establishment of a special body, the "National Advisory Committee on Technological Education" (NACTE) which advises the National Technical and Vocational Training Advisory Council and the Minister of Labour on all matters related to technological education. The Committee is composed of representatives of management, labour, provincial departments of education, institutes of technology and national associations concerned with technological education.

(iii) The Canadian Education Association (CEA)

This is an organisation through which the provincial Departments of Education can make their official education policy known. It employs several full-time officials including an executive secretary and a research officer.

(iv) The "National Research Council" and the "Canada/Council" stimulate higher education by providing scholarships and fellowships but have no co-ordinating or statistical functions.

(v) The Dominion Bureau of Statistics endeavours to provide up-to-date information on the school population, the number of graduates etc., but lacks certain basic data, and, because of rapid developments, the information provided is soon out-of-date.

(c) Planning procedures

15. The "Economic Council of Canada" is the federal instrument responsible for the economic planning for the whole country. There seems to be a lack of co-ordination, however, between economic and educational planning, and little attempt has been made to adapt the latter to the future manpower needs of the country on either a national or provincial basis. As a general rule, planning for higher education has been given serious consideration and, in some instances an attempt has been made to plan educational development ten to fifteen years in advance. However, these plans are mainly in answer to social pressure for the greater expansion of universities, and the provincial legislations which provide most of the funds are largely influenced by the educational aspirations of the population.

Part Two

TRAINING OF TECHNICIANS AND OTHER TECHNICAL MANPOWER

IV. Definition and grading of technicians - Standardised qualifications

16. The Canadian National Technical and Vocational Training Advisory Council divides technicians into two types according to the following definitions:

(i) Technician "is a person who has acquired the ability to perform scientific and/or engineering tasks of a specialised non-professional nature which, in their execution, require an intensive application of a comprehensive knowledge of the mathematics, science, systematised procedures and techniques related to the particular speciality". This suggests that the level of formal education which is generally required for technician status in Canada is a minimum of two full years of a specialised form of education, or an acceptable equivalent, following the acquirement of secondary-school graduation level with credits in mathematics, science, and English or French language.

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(ii) Technologist is a technician whose speciality is one of the recognised technologies, for example : mechanical technology, electrical technology, food technology.

17. It is evident that the term "technician" covers the lower technician level while the term "technologist" corresponds to the upper technician level. For the lower technician status however the requirements of a minimum of two full years of a specialised form of post-secondary education or an acceptable equivalent excludes many persons employed in industry at a technician level; in particular it does not take into account those who go into employment directly from vocational high schools at approximately the age of 18.

18. As regards the standardisation of qualifications, provincial autonomy in education matters results in considerable differences in technician programmes, as shown by (a) and (b) below.

(a) Content of courses

19. The duration and content of technician courses vary considerably between provinces. There are, for instance, marked differences in concepts of what constitutes a suitable course for technicians, concerning the orientation of courses, the allocation of time between theory and practical work, etc. Entrance requirements for technician courses are not the same even for different colleges in the same province. The National Advisory Committee on Technological Education (NACTE) is anxious to ensure that the diplomas issued by all Institutes of Technology are recognised as equivalent throughout the country. One of its most important tasks is therefore to achieve a greater measure of agreement than exists at present concerning the knowledge expected of a "technologist" at the end of his course, and the curriculum content necessary to impart this knowledge.

20. In higher education there are also marked differences, even within the same province. The Universities, although generally financed by the provincial governments, are considered as self-governing institutions free to set their own syllabuses, select their students, organise their examinations and appoint their academic staff.

(b) Final examinations

21. In Canada, there is no formal examination common to all provinces. However, several technician associations lay down requirements for the various grades of membership for both qualifications and practical experience. The "Ontario Association of Certified Engineering Technicians and Technologists" (see Appendix IV) provides a typical example of this. Admission requirements may consist of the possession of specified qualifications or the passing of examinations set by the Association. Preparation for these examinations can be ensured by any method, including correspondence tuition.

(c) Certificates and diplomas

22. Technician Certificates and Diplomas are issued by each institution; official inter-provincial recognition has not yet been established.

V. Lower-level technician courses within the "formal" educational system

23. As lower-level technician courses carried out in vocational or trade schools are difficult to define, it is preferable to list a few examples. These are given in Table 2.

24. It will be seen that all these courses are much shorter than the two or three year courses leading to the "Technologist" qualification, and that the entrance requirements are lower. On the other hand, the courses differ from trade and craft courses since they normally require a better standard for admission and include more theoretical study. The Secretarial course for example is considered to be at "lower technician" level because it requires a grade XI or XII entry standard, (as compared with grade X for the basic office studies course in the same establishment) and because

it involves more study of such subjects as business English and Shorthand and includes Commercial Law, Systems Control, etc. The Radio and Television Servicing course may equally well be considered a craftsman or a technician course. It has been included under the latter category as it requires much more theoretical understanding than, for example, a course in Sheet Metal work, although it certainly requires much craft skill as well. The course consists of seven "units of instruction" namely : Direct Current, Alternating Current, Basic Electronics, Radio Servicing, including DC-AC Automobile, Transistors, Audio Units, Television and Citizens and Civil Communications. Much of the total instruction time (1200 hours) is taken up by practical work and towards the end of the course

Table 2

Examples of lower-level technician courses

Course	Duration (months)	Entrance requirements
1. Radio and television servicing	10	Grade X, 17 yrs. age
2. Air conditioning and refrigeration	10	Grade X, 17 yrs. age
3. Clinical laboratory and X-ray	7	Grade XII, two maths, chemistry, one other science, plus Grade XI physics
4. Mechanical drafting	10	Grade XI or grade X at 60% level, 17 yrs. age
5. Architectural drafting	10	As for mechanical drafting
6. Dental office assistant	9	Grade XII, 18 yrs. age
7. Electricity and industrial electronics	11	Grade XII, with maths and physics
8. Electronics	11	Grade XII, with maths and physics
9. Secretarial	11	Grade XI (XII preferred) 17 yrs. age

students are able to construct receivers according to given specifications using the theory they have been taught. Students have also acquired a logical fault-finding procedure based on an understanding of electronic theory, and it would seem reasonable to regard such men as technicians rather than craftsmen.

25. In some provinces high school courses either exist or are being planned, and offer technical and vocational biased courses as an alternative to the usual more academic courses. The revised four-year and five-year programmes recently established in the province of Ontario might be considered as an example of this trend. In this province it is possible to select, in both the four- and five-year programmes, a course in any one of three branches: Arts and Sciences; Business and Commerce; Science, Technology and Trades. The five-year programme is designed for students of good ability whose aim, after obtaining the Secondary School Graduation Diploma on the successful completion of grade 12, is to proceed to grade 13, which in turn leads to "Secondary School Honours Diploma" and to such studies as are required for entrance to a University, Teachers' College or other Higher Education Institution. The main objective of the five-year scheme is to provide pupils with the ability to qualify eventually at professional, rather than technician, level. But there are "safety-nets" built into the system, allowing students who do not qualify for entry to grade 13, but reach certain standards in grades 11 and 12, to be admitted to special one-year courses with a strong vocational bias.

26. The four-year courses are specifically designed for pupils who do not normally aim at higher studies. Apart from those students taking the Arts and Science option, the courses are designed to provide not only a good general secondary education but also a specialised skill. Pupils who satisfactorily complete the four-year programme qualify for the Secondary School Graduation Diploma, and are eligible for admission to the above-mentioned vocational one-year courses.

27. Table 3 gives an indication of the content of a four-year high school course; further information on both the four- and five-year courses, as well as other high school courses, may be found in Appendix V.

Table 3

Four-year science, technology and trade course (Ontario)

Subjects	Grades - Instruction periods per week				Special vocational course
	9th	10th	11th	12th	
Mathematics	5	5	5	5	5
Science	5	5	5	5	
Economics	-	-	-	5	5
Technical subjects(1)	10	15	19	19	32
Other subjects(2)	25	20	16	16	3 (English)
Total	45	45	45	45	45

(1) In the 10th, 11th and 12th grades, 5 of these periods may be devoted to Art, Music, Commerce, Agriculture or a foreign language.

(2) Other subjects include: English, History, Geography, Physical Education, French and Group Guidance.

28. Arrangements similar to the above are in force in the province of Alberta, where the general objectives of the courses are much the same as those in Ontario. The courses available at the Victoria Vocational High School, Edmonton, for example, include four-year technical matriculation and four-year business matriculation courses starting at grade 10. They both meet the University of Alberta entrance requirements but, at the same time, their vocational content is such that, after three years, students can qualify for direct employment or for exemption from the first year of an Institute of Technology course. There are also three-year courses with a lower, grade 9, entrance requirement, and which provide a fair amount of technical competence and similar first-year exemption at the

Institute of Technology level. As a general rule, the courses in Alberta have a heavier overall technical bias than those in Ontario.

29. The "vocational and trade schools" are mainly responsible for the lower-level technician courses, the craftsman courses and, in certain cases, upper-level technician courses. The latter have usually grown up within the schools because, at the time, there was no separate "Institute of Technology" to house them, and normally move out when such institutions become available. Many "high schools" are also equipped to run technical and vocational courses at craftsman and lower technician level.

VI. Upper-level technician courses within the formal educational system

30. Upper-level technician courses are generally held by the "Institutes of Technology". In some cases, these Institutes retain the trade work and become joint "Craftsman-Technician" training establishments. This is particularly true of the province of Quebec, where there are at present 35 such institutes with a total enrolment of over 14,000 students.

Upper-level technician courses covers the following main fields:

(i) Administration
(ii) Aeronautical technologies
(iii) Agricultural technologies
(iv) Applied arts
(v) Architectural technologies
(vi) Automotive technologies
(vii) Chemical technologies
(viii) Civil technologies
(ix) Engineering technology
(x) Electrical technologies
(xi) Electronic technologies
(xii) Food technologies

(xiii) Forest technologies
(xiv) Mechanical technologies
(xv) Medical technologies
(xvi) Mining technologies
(xvii) Petroleum technologies
(xviii) Navigation

These are broken down into narrower specialisations as indicated in Appendix VI, 2 (page 101) where the number of institutes available, selected time-tables and curricula outlines for two courses are also given.

31. One of the institutes offers 23 different courses at upper technician level but the majority of them offer 8 to 10; some provide only three and there are specialised institutions, e.g. in agricultural technology, paper making, land surveying, etc. which offer only the course appropriate to their specialisation at this level. Five such institutes exist in Quebec (Marine, Paper, Applied Arts, Graphic Arts, Textiles, but very few in other provinces).

32. In view of the degree of provincial autonomy enjoyed in Canada, it is not surprising to find that the structure of the courses varies considerably between provinces. Even the admission qualifications are not exactly the same for similar courses in different colleges. At one college, for example, it is very difficult to obtain admission to most courses without having satisfactory passes in about eight appropriate subjects at grade 13 level. At another college in the same province, the official basic requirement is an over 60 per cent average in grade 12, with particular ability in mathematics and relevant sciences, although it is advisable to have a better qualification than this to be accepted. Another province requires grade 12 passes but claims that its grade 12 equals the grade 13 of its neighbour. Yet another province asks for "grade 12 or better preferred and certain subjects postulated"; but examples of students having left at grade 11 were found in the class. In Quebec, entry to the "Instituts de Technologie" is commonly after grade 12, with passes in Maths and Science (or other especially relevant courses after grade 11), on passing an entrance examination. There is a preparatory one-year course for selected students who have completed only two or three years of the secondary school course, (i.e. grades 9 or 10) instead of four or five.

33. Another very obvious difference is that, while in some provinces courses with a particular objective require three years of full-time study, in others courses with the same objective, and starting from substantially the same level, take only two years. This may mean only 1,800 class hours for the two-year courses, but allow 2,700 for the three-year ones.

34. Furthermore, if we compare the content of the two and three-year courses we find that there are marked differences between the provinces as regards the concepts of what constitutes a suitable course for technicians at this level. For example, some three-year courses give much greater emphasis to basic mathematics and science than do some of their two-year counterparts, which concentrate on specialised and practical work. There are cases where laboratory work and workshop practice in the two-year courses exceed 41 per cent of the total instruction periods. The structure and content of certain three-year courses approach those of the university while there are others which emphasise practical and specialised work to an ever greater extent than do the above-mentioned two-year courses. On the other hand, some courses might be criticised on the grounds that trainees have done far too little practical work to warrant the title of technician at the end of the course.

35. In Quebec, upper-level technician courses are more orientated towards craft than the majority of those elsewhere in Canada. These courses are not restricted to Institutes of Technology, for some trade schools also provide the first two years of the three-year courses. On the other hand, many Institutes of Technology also offer trade courses.

36. The structure and curricula vary little between one Institute of Technology and another in the province of Quebec except, of course, where the specialisations differ; even in this case there is much common ground, and the classroom subjects tend to be the same for all students. (Appendix VI) It is mainly in the workshop and technology sections of the courses that the differences appear. In the preparatory year, which in certain cases precedes the three-year course, the student spends several periods in a variety of workshops. He is thus able to select the studies for which he is best suited, and in the succeeding three years the workshop time is spent in the shops relevant to his choice.

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37. NACTE is anxious to ensure that graduates of all Institutes of Technology will receive inter-provincial recognition. For this purpose, some yardstick, in terms of both duration and content of courses, must be agreed upon. NACTE suggests that "education in the appropriate discipline beyond the junior matriculation level should be based upon mathematics, science and a language and should have a minimum duration of 2,400 hours, either part-time or full-time". With a maximum of 30 class-conduct hours a week, this figure implies 80 weeks. Most institutes operate at present 30 to 32 weeks a year, which means that the 2,400 hour figure is well exceeded in the three-year courses, but not reached in most of the two-year ones. Some colleges intend to retain the two-year course structure, but to increase the working year to 40 weeks, in order to reach the 2,400 hour figure.

38. "Wastage" from technician courses is a major problem for Canada. An average of 40 per cent drop-outs is not unusual and only in a very limited number of cases has it been possible to trace the educational and occupational careers of such "failures". A main reason for this high wastage appears to be the inability of the students to cope with the course.

39. It is worth mentioning the industry's point of view on "how the Canadian Institutes of Technology may best serve the Canadian Economy" as expressed by its official representative (D.B. Best, Personnel Superintendent, Telephone Contract Division, Northern Electric Co. Ltd.) in a statement to NACTE at a conference in Ottawa (early 1963) :

"There will be, I think, little disagreement with my view that Canadian Institutes of Technology may best serve Canada by producing graduates who in numbers, quality and fields of specialization, match the requirements of the Canadian economy both now and in the future ... It still appears that most of the programmes and standards of the schools are not co-ordinated. It is obvious that competition between individual institutes, provinces, and even groups of graduates, exists to the detriment of the overall purpose ... It is encouraging to note that professional institutes and organisations such as the Chambers of Commerce and the Canadian Manufacturers' Association have attempted to co-ordinate and synthesize the thinking of their members so that common aims for technical education may be determined and pursued.... One of the primary purposes of an Institute of Technology should be that its product will fill the gap between the operating and skilled trades levels in industry and the level of professionally qualified engineers and scientists. While these technicians must be trained in a fashion which will permit achievement of a reasonably high level of academic competency and potential, nevertheless their training must be such that they can become of almost immediate practical use without an extensive period of post-graduate orientation and development ... It apparently is not always realized even in education circles that the "technologist" should be trained in such fashion that he will be regarded not as "less than an engineer" but rather "different to an engineer"... Technological institutes must develop curricula which should be strict and rigid with respect tothe basic disciplines of mathematics, science and language, while at the same time the degree and nature of specialization must not only be in accordance with the accepted present needs of industry, but permit future flexibility.... Perhaps the most important contribution that industry could make would be through its participation in the continual planning, up-grading and revision of courses of technical study in as full a fashion as would be compatible with the principles of academic freedom ... If technological institutes are to best serve the Canadian economy then they themselves must play an important part in bringing together "town and gown", beyond ensuring industrial participation in the planning and development of curricula, Institutes of Technology should search for all means of establishing strong but informal relationships between individual staff members and those representatives of industry who are in a position to supply on a continuing basis, information concerning changing requirements, technological developments, and the effect which new techniques or products may have on the future needs of industry for technical graduates ".

VII. Vocational courses at craftsman level within the educational system

40. Vocational courses at craftsman level and lower-level technician courses are held mainly by Vocational and Trade Schools and by Secondary (High) Schools. The duration is usually two years and the entrance requirements 8 to 9 years of basic education (age 14 to 15). For Quebec, special arrangements have been proposed (paragraph 8).

VIII. Technical courses at university level

41. In Canada, an institution of higher education is usually considered to be one that offers one or more years beyond the most advanced high school grade in the province in which it is located, with all or part of the work offered being considered as a credit for a university degree. Within this definition it is possible to distinguish:

(i) Degree-granting universities or colleges offering courses leading to degrees in one or more fields of study;

(ii) Colleges offering work up to degree level but which do not grant the degrees earned. Students usually receive their degrees from the parent university to which the colleges are affiliated;

(iii) Colleges offering fewer than the accustomed number of years required for a first degree.

Students at these institutes, which are often called Junior colleges, may transfer to colleges or universities in order to continue their degree courses. In addition, some junior colleges may offer the last year or two of secondary school, as well as post-secondary technical and/or other vocational courses of one or more years' duration, but students taking these courses do not usually proceed to more advanced education after graduation. Junior colleges, Technical Institutes and some other institutions have been classified in this report as post-secondary level (paragraph 6).

42. Much of the higher professional and technical education is provided by university institutions, especially courses leading to professional qualifications. Both universities and colleges have usually enjoyed a high degree of autonomy throughout the years. The Federal Government, although not legally responsible for the administration of education is considered to some extent as likely to influence developments through grants and other payments by several of its departments and agencies; provincial governments exert more direct influence on policy and administration and a number of them have created higher education planning boards with university representation during the past few years.

43. Entrance requirements vary from province to province and among institutions, the "junior matriculation" level being the lowest. This level is normally attained at the age of 17 or 18 on completion of grade 11 in some provinces, or grade 12 in others. A further year of secondary schooling leads to "senior matriculation" level, which for credit purposes may be roughly considered as equivalent to the first year of a four-year degree course in arts; in most provinces it is required as a minimum for admission to architecture or to engineering and applied science faculties.

44. The course for a first bachelor degree in engineering, agriculture, commerce and business administration and other professional faculties normally lasts four years, but five years are required for a first degree in architecture. The honours bachelor degree which demands greater specialization in one or two subjects requires an additional year. A master's degree is usually obtained one year after an honours degree or two years after a pass degree and the doctorate in a minimum of two years after the master's degree.

45. In Quebec the "Baccalauréat ès Arts" degree, is obtained after a course of eight consecutive years, following seven years of elementary schooling, which is given by the "Collèges Classiques" or their equivalent. This course is continuous and students have to start with the first of the eight years. In this respect it has differed largely from the English-language educational system, where there is a division between high school and college, although recent developments in Quebec indicate that this difference is

being gradually eliminated, as more and more students from secondary schools (écoles secondaires) register now in the fifth year of the classical course, which corresponds to the first year of arts course. Candidates for faculties other than arts may or may not be required to have the "Baccalauréat ès Arts" for admission.

46. Engineering courses at university level normally do not include any practical work and graduates often find it difficult to accomplish the transition from university to industry. To make it easier, certain large industrial enterprises have devised several schemes to provide summer employment for science and engineering students. The "training plan for engineering under-graduates" of the Northern Electric Company, for instance, which was inaugurated in 1953 is a good example of this type of activity. This plan provides summer employment for an average of 60 students each year, the majority being recruited from Canadian and a few from British and Continental universities. The plan has been designed to satisfy several objectives such as : (i) to provide the undergraduate with the opportunity to gain industrial experience including an understanding of the practical problems and the variety of activities which an engineer has to expect in a large manufacturing organization; (ii) to supplement the student's formal academic training; (iii) to provide much needed summer employment; (iv) to give the students the opportunity to assess the Company as a potential permanent employer. On the other hand, the Company too has an opportunity to consider, prior to graduation, persons whom it may wish to employ permanently. The training plan embraces formal work assignments, training courses, lectures, tours and other scheduled group activities.

47. The reputation of the older universities in Canada is firmly established; the fact that their degrees are sought after both in Canada and abroad, particularly in the United States, bears witness to the quality of the education offered. However, there is some concern in various provinces about the high rates of wastage and the number of examination failures at degree level which, in certain engineering faculties, is as high as 50 per cent of the candidates. The main reason for this high wastage appears, as in the case of upper-level technician courses, to be the inability of the students to cope with the course. Several universities, e.g. the University

of Western Ontario, are now considering radical reform as regards both their selection methods and the engineering curricula.

IX. Technical teaching staff

48. A recent survey at the federal level to which eight provinc responded produced interesting information and brought to light significant aspects of the problem of recruitment and training of teachers and instructors in technical and vocational high schools, institutes of technology and adult vocational centres. The results of this survey, taken from a publication of the Department of Citizenship and Immigration(1) are summarized below, supplemented by some additional information.

(a) Technical and Vocational High Schools

49. The minimum requirements for the initial appointment of teachers of business and commercial subjects vary between provinces from the completion of a full commercial course at high school level to a bachelor's degree. Five provinces insist that business and commercial teachers undergo formal teacher-training before their appointment; in two provinces this training is compulsory either before or after entering the profession; one province makes no such stipulation. The usual length of formal training is one year. Business experience ranging on an average from two to five years is required in most cases. Provinces which accept the shorter period of formal training and practical experience consequently demand a larger amount of formal teacher-training.

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(1) Technical and Vocational Education in Canada. Issue No. 7, fall-winter 1965/66.

50. Minimum starting salaries for teachers of business and commercial subjects range from $3,000(1) to $4,000 with six of the eight provinces reporting initial salaries of less than $4,000. Seven provinces reported maximum salaries in excess of $7,5000, the highest being $10,000.

51. Requirements for trade and technical teachers are much more uniform. Five provinces specify the "journeyman's" level in designated trades and three others imply that similar qualifications were required. Four provinces insist on a bachelor's degree either before or following appointment and the remaining provinces encourage teachers to undertake training at least to a first degree level with appropriate specialisation. A usual prerequisite to appointment is three to five years practical experience but four provinces consider one year as sufficient. Only one province does not require teacher-training for trade or technical teachers; the rest specify that at least two summer sessions of additional teacher-training is required. The question of additional experience in industry, after entering the teaching profession, received only vague reference in the reports, which merely mentioned that additional trade experience was encouraged.

52. Trade and technical teachers appear to fare better than their colleagues in business education as regards salaries, which range from $3,500 to $10,000; five provinces indicate minimum salaries exceeding $4,000.

53. Teachers of related subjects are usually academic teachers who have entered the field of technical and vocational education. Only two provinces reported that they encourage teachers of related subjects to undergo training in technical matters or to undertake periods of employment in industry. Salaries for related subject teachers range from $2,800 to $10,000.

(b) Institutes of Technology

54. Institutes of Technology have two distinct categories of technical-teachers. One is composed of graduates of engineering

(1) 1 US dollar = 1,081 Canadian dollars.

colleges or faculties and the other of individuals having technician or equivalent status. Usually three to five years of appropriate experience in industry is required of teachers in either category but in two provinces this goes up to seven or eight years. In all provinces pedagogy courses lasting from two weeks to a year are obligatory, but not prior to initial appointment.

55. All provinces appear to recognize the need for technical teachers to spend additional time in related work within industry. Particularly interesting is the fact that in one province appointments are made on a five-year basis; renewal depends on whether at least two summers have been spent in acquiring additional business or industrial experience. However, it seems that few provinces have organised programmes whereby technical teachers return to business and industry to practise their former occupations, and none encourages teachers to undertake consultative work or research of any kind.

56. Salaries for teachers of technical subjects in Technical Institutes vary from $4,600 to $10,000 with a median of $6,600 a year. Seven provinces reported top salaries in excess of $8,000. Industrial experience in some provinces does not count for increments; in others, a certain number of years in industry - three, for example, may be considered to merit one increment.

57. In most provinces teachers at Institutes of Technology are classed as provincial civil servants whilst, in general, those in high schools are not. This results in different salary scales in the two cases and usually a teacher who is qualified to work in both a high school and an Institute of Technology, receives a higher salary in the former.

58. Earnings in education are generally lower than those in industry for equivalent qualifications. A case study on the 1954 graduating class of engineers and scientists carried out by the Economics and Research Branch of the Department of Labour (The Early Post-Graduate Years in the Technical and Scientific Professions in Canada, April 1959) gave the following interesting information on the earnings of professional engineers. "The 1954 graduating class obtained their highest salaries in 1957 from industry (median $5,301) with those employed by governments receiving 12 per cent less than in industry (median $4,676) and those in educational institutions receiving 25 per cent less than in

industry (median $3,945). In government service, those employed by municipalities received the highest median salary ($5,050) and those by provincial governments the lowest ($4,370). In Education, graduates employed by universities received a median salary of $4,312, while those employed by high schools received $3,722.

59. Teachers of mathematics, physics, chemistry, English, etc. at Institutes of Technology must have a university degree with the appropriate specialization, and a teaching certificate. Six provinces reported salary ranges comparable to those for technical teachers.

(c) Adult vocational training centres

60. Instructors in adult vocational training centres are required to have journeyman's standing or equivalent, and three to five years' experience. Only in two provinces is a teaching certificate a prerequisite to obtaining a teaching post, although teachers must undergo teacher training lasting from two weeks to one year.

61. All provinces indicate that instructors are encouraged to return periodically and regularly to industry, but only one province makes the necessary provision for this; it requires instructors to spend at least two summers in every five-year period in approved business, industrial or service liaison studies. Salaries for instructors at Adult vocational training centres range from $4,000 to $10,000.

62. Teachers of related subjects generally come from schools and other traditional sources and therefore hold degrees with specialization in an appropriate area and a teaching certificate. They are encouraged to undertake additional training in their particular field and, in one or two cases, are provided with opportunities for formal training.

X. Training outside the formal system

(a) Apprenticeship

63. An apprenticeship scheme has been operating under federal-provincial agreements for a period of over 20 years. A permanent advisory body at national level, the "Committee on apprenticeship and industrial training", which is a sub-committee of the National Technical and Vocational Training Advisory Council (paragraph 14,i) co-ordinates provincial activities and advised the Council on matters related to apprenticeship and other types of industrial training. The number of apprentices in training has increased during the past 20 years at a rate of about 10 per cent per year; at the end of 1962 there were over 20,000 apprentices registered in the 9 provinces participating in the Apprenticeship Training Agreement (Appendix II, page 82). In Quebec, apprenticeship training is shared under programmes 3 and 5 of the Technical and Vocational Training Assistance Act.

64. Although the structure of apprenticeship courses may vary from trade to trade and from province to province, apprenticeship courses in engineering trades generally last three years, after nine years of basic education; in other trades the period may vary from 1.½ to 5 years.

65. Several types of programmes are in use, depending mainly on the nature and pattern of industry in each particular area. The following, which have been tried in the province of Nova Scotia, appear to have a more or less universal application.

(i) Day release - This is mainly applied when the industrial establishments in the area employ substantial numbers in each of the various trades. The apprentices normally attend school one day a week and are trained on the job for the rest of the week.

(ii) Block release - This has been successfully established in certain provinces for the auto-vehicle repair and the construction trades. Under this scheme, apprentices attend school for five to seven weeks each year and are trained on the job for the rest of the year.

(iii) Evening classes - Apprentices attend such classes usually for three evenings a week while working in industry during the day. This pattern has been found suitable for upgrading workers, who may have had several years practical experience in apprenticeable trades, but need supplementary theoretical training to qualify as foremen.

(iv) Correspondence courses - Apprentices study theory by correspondence during their spare time while being trained in industry during normal working hours. This has been applied in areas where firms are more or less isolated.

(v) Pre-employment courses - Candidates take a full-time pre-apprenticeship course which normally lasts six weeks before they are placed in industry. This appears to be a most satisfactory training procedure for developing competent craftsmen.

(b) Training within industry other than apprenticeship

66. Although organised technician training programmes within industry are not common in Canada, two surveys conducted in 1959 and 1963 show an improvement during this period of four years. Both surveys were restricted to four major industrial groups: mining, manufacturing, transportation and communication, and public utilities. The 1963 survey showed that only 13.5 per cent of the establishments employing technicians have any arrangement for training courses. A specific example is the training scheme offered by industrial firms under which technical school graduates or equivalent are given a well-planned training course enabling them to become qualified electrical tradesmen after two and a half years. The first part of the course is common to both and whether a trainee ultimately qualifies as a tradesman or as a technician depends mainly on the ability he shows.

69. Programme 4 of the Technical and Vocational Training Assistance Act (Appendix II, page 80) deals with training within industry in general but concentrates mainly on supervisory and up-grading courses. This is a small programme, the federal share for 1962/1963 being only $56,500 and the number of trained persons in the supervisory field, just over 2,000 for the period ended 31st March, 1963. However the Canadian authorities realised the increasing importance of in-plant and co-operative training as a means of keeping abreast of rapid economic and technological developments. In December 1963 they therefore amended the legislation on programme 4 of the Technical and Vocational Training Assistance Act. The period during which the federal government would share costs at the 75 per cent rate, was extended from two years to such time as this contribution reaches $480 per person in the 15-19 age group, as recorded in the 1961 Census. Thereafter, and until the agreement expires (1967), the federal contribution will fall back to the 50 per cent rate. This amendment had considerable impact on this particular training scheme and has contributed to its substantial expansion since then.

(c) Training of the unemployed

68. Programme 5 of the Technical and Vocational Training Assistance Act (Appendix II, page 81) provides for the training of the unemployed. Under this programme, provincial governments provide a wide range of general educational and occupational courses of varying length and structure, depending mainly on the estimated needs for different kinds of trained workers in the community in which the training is being given, or in other communities where labour shortages exist. The courses are open to people of 16 years of age and over, who are registered for employment with the National Employment Service, and last from 6 to 12 months. Trainees may be: (i) workers who have no particular skills and wish to better themselves; (ii) persons whose skills are no longer required because of changes in industry; (iii) workers who require refresher courses or need to be brought up-to-date on new methods and techniques in their trade; (iv) persons who wish to enter entirely new lines of work.

(d) Adult training

69. Adult training is partly covered by programmes 4 and 5 of the Technical and Vocational Education Assistance Act (paragraphs 46 and 47). Evening classes for adults are also offered at many Trade Schools and Institutes of Technology. Although a few provide lower-level technician courses, it is not generally possible to obtain upper-level technician qualification in this way. Most of the evening courses are either for craftsmen or are "ad hoc" courses on individual subjects. Table 4 below summarises adult education activities for the years 1959/1960 and 1960/1961.

Table 4

Adult education activities (1959/60, 1960/61)

Part-time enrolment	1959/60	1960/61
1. Academic subjects	155,729	169,155
2. Vocational and professional training	278,704	289,106
3. Informal courses	229,613	450,551
Total enrolment (1 to 3)	664,046	908,812
4. Attendance at public lectures	2,698,034	3,713,905

Source: Canada Year Book, 1963/64.

(e) Correspondence courses

70. Correspondence courses on technical and vocational subjects became the responsibility of the National Technical and Vocational Training Advisory Council in 1948, and an interprovincial committee was formed to urge the development and promotion of such courses. Programme 8 of the Technical and Vocational Training Assistance Act

deals with this matter, although to only a limited extent (Appendix II).

71. It is impossible to estimate the number of students taking correspondence courses in Canada, or to guess the number who seek to pass technician level examinations by this method. The whole scheme attracts some 8,000 students but this number is no doubt far exceeded by those who take correspondence courses privately and also in establishments which may be based in the U.S.A. This probably includes the majority of students aspiring to be technicians through correspondence courses, especially in electrical and electronic subjects.

72. Special correspondence courses are also offered and conducted by certain Institutes of Technology. One of these, for example, holds courses in Mathematics and Power Plant Engineering which attract nearly a thousand students. In general, the pass rate for correspondence courses in Canada is undoubtedly much higher than is usual for correspondence courses. Tuition grants and other facilities provided by companies and employers help confirm the belief some hold in the effectiveness of correspondence course tuition.

XI. Commercial education

73. Trade courses at secondary (lower-technician) level are held by trade schools, vocational schools and high schools, together with other technical and vocational courses. At post-secondary (upper-technician) level, certain Institutes of Technology offer such courses in specific fields e.g., management, accountancy, secretarial science, etc. Examples of time-tables at both high-school and post-secondary levels may be found in Appendix VII.

XII. Agricultural education

74. Agricultural courses at secondary level normally last two years (grades 10 and 11) and lead to a Diploma in Agriculture. In the province of Quebec these courses are under the control of the Department of Education. Two Institutes of Technology, both in Quebec, specialise in agricultural and forestry technologies and are under the Ministry of Agriculture. Agriculture was the economic sector where federal provincial co-operation first started (1913). The legislation which was the forerunner of the present training programme came in 1919, with the passing of the Federal Technical Education Act.

XIII. Hotel, catering and tourism courses

75. Courses in hotel trades, catering and tourism are normally run by trade, vocational and high schools (secondary level) together with other technical and vocational courses and by the Institutes of Technology (post-secondary level). The latter at present cover hotel, restaurant and resort administration, commercial cooking and home economics. There are also several training centres which offer short courses in specific subjects in these fields. The "Quetico" centre at Atikokan, Ontario, for instance, is an example. The centre operates a residential adult education institution with a broad programme including community leaders, industrial managers and supervisors, artistic craftsmen, etc. and a special course for tourist-guides. This course is an intensive one (6½ days a week, 10 hours a day), lasts one month and covers a variety of topics including cookery, first aid, forest fire prevention, emergency repair of equipment, etc. The course is operated under programme 8 of the Technical and Vocational Training Assistance Act.

Part Three

FUNCTIONS OF TECHNICIANS

76. In Canada, as in other countries, occupation of technicians appears, because of its very nature, as subservient to the profession of engineering. It has recently emerged to (i) take over many of the standardised technical duties of the professional engineer; (ii) cope with technical duties which have arisen because of technological innovation and change; (iii) fill in the ever-widening gap of technical skills and knowledge between the skilled craftsman and the professional engineer; (iv) provide trained assistance for professional engineers and other applied scientists.

77. This part of the report deals with a summary of the "Enquiry into the Functions of Technicians in Industry in Canada" (DAS/ST/64.69, Part II) initiated by OECD. The survey was carried out in three industrial fields: the manufacture of electronic measuring instruments, the manufacture of machine-tools, and the supply and distribution of electricity.

XIV. Technicians and their occupations

(a) Firms visited - distribution of the labour force

78. The firms visited were selected among the most successful and progressive in the country; the size and location of the firms were also taken into account since it was considered that problems of recruitment and consequent utilization of skilled technical personnel might depend upon these variables.

79. Five electronic measuring instrument firms were visited: two big firms located in large metropolitan areas, a small firm in a large metropolitan area, a medium-sized establishment (division of a very large firm) in a medium-sized city, and a small firm in a small city.

80. Three firms were selected whose main activity was the production of machine tools. There are a number of other firms in Canada, usually very large ones, which manufacture machine tools and special machinery, but in these firms machine tools represent only a small part of their total production. Two of the firms selected were in large metropolitan areas, and the third was located in a smaller town in a highly industrialized region of the country.

81. Only one firm concerned with the supply and distribution of electricity was visited. This firm is one of the largest of its kind in Canada and among the first to take up nuclear power development.

82. During the enquiry, difficulties were encountered in deciding who were technicians and how they differed from skilled craftsmen. This problem did not arise when differentiating between technicians and professional engineers, because members of a professional engineering association were immediately placed outside the scope of the study. However, instances were found where technicians and professional engineers were carrying out similar duties.

83. Sixty "formal" interviews were held with the supervisors and technicians concerned with the posts being examined. A considerable amount of time was spent in each firm to arrive at a working definition of the term "technician" as understood by the firm in question. In some instances, particularly in the larger firms, the

personnel department had defined "technicians" but only for salary and not technical-production purposes.

84. Table 5 shows the distribution by category of skill and size of firm of the employees in the firms visited. It will be noted that: (i) the technician force represents about 17 per cent of the total staff of the firms examined; (ii) the technician: professional engineer ratio is approximately 2 to 1.

(b) Position of the technician in the firms visited

85. An analysis of the labour force in the firms examined shows that the function and position of technicians depend on a variety of factors, namely:

(i) The proportion of technicians in the total staff

There is a marked difference in the proportion of technicians in the total staff employed by each of the three firms. In general, the proportion of technicians is highest in firms manufacturing electronic instruments, followed by those supplying and distributing electricity, with the machine tool industry coming third. This, of course, has a direct influence on the function and position of the technicians within the firms concerned. The smaller the proportion of technicians to skilled craftsmen, for example, the more important their role and function in the production process, with a consequent improvement in their position.

(ii) The proportion of technicians to professional engineers employed

Only in two instances did the proportion of professional engineers equal or exceed that of technicians. In the firms dealing with the supply and distribution of electricity (C-1) the proportions were about equal when using the firm's definitions, and in Firm A-4, heavily engaged

Table 5

Distribution of employees by category of skill and size of firm

	A1	A2	A3	A4	A5	Total A1-A5		B1	B2	B3 (3)	Total B1-B3		C1(4)	Grand Total	
Professors of English and scientists	46	80	8	164	1	299	9%	2	1	-	3	0.6%	900	1,202	9%
Technicians	275	265(1)	32	129	3	704	21%	8	28	-	36	7%	900-9%	2,340	17%
Skilled craftsmen	78		25	25	16			75	200	-	275	5%			
Semi-skilled workers	170	718(2)	10	44	23	1,145(2)	33%	25	32	-	58	11%	3,900(2)	5,440(2)	39%
Unskilled workers	11		5	-	20			14	48	-	62	11%			
Other employees	533	624	46	78	4	1,285	37%	34	71	-	105	20%	3,600	4,990	35%
Total employees	1,113	1,687	126	440	67	3,433		159	380	-	539		10,000	13,972	

A. Manufacturing of electronic measuring instruments

B. Manufacturing of machine-tools

C. Supply and distribution of electricity

Percentages are in respect of total employees

(1) Excluding draughtsmen.

(2) Including semi-skilled and unskilled workers

(3) Not available.

(4) Approximate numbers.

in research, professional engineers represented 37 per cent and technicians 29 per cent of total employees. In each of these cases the personnel department concerned has a relatively clear-cut definition of the technician, his function and his duties; although for salary purposes, these definitions clearly limited the functions of technicians within the firm. In firms where proportion of technicians in the total labour force was much larger than that of professional engineers, the technicians had much wider scope to utilise their skills and knowledge. This was particularly true of firms in the machine tool industry where, to all intents and purposes, technicians were carrying out engineering functions.

(iii) The size of the firm

In general, the smaller the firm, the greater the scope for technicians to use their skills and knowledge. This is due partly to the continuous personal contact between technicians and professional engineers, and partly to the fact that the potential of technicians is more likely to be recognised in a small firm, where there is not much departmentalisation. In many instances technicians in smaller firms were doing work which company officials, frequently professional engineers, stated would normally be performed by professional engineers.

Technicians employed in small firms also appeared to be more independent in their jobs, e.g. in determining the time limits for the job, incorporating their own ideas and methods of work, questioning the professional engineers' plans, etc.

(iv) The nature of the job and/or products

The jobs and products of the two firms A-4 and A-5 in the electronic instrument manufacturing group, differ somewhat from those of the other three and also differ from each other in the nature of the opportunities they provide for technicians. In firm A-4, which is heavily engaged in research and therefore has a higher proportion of professional engineers than technicians, the latter are always viewed as assisting the professionals. On the other hand, in firm A-5, where the main emphasis is on the development of specialised electronic measuring instruments, the technicians, because of their background of practical experience, are viewed and known as "engineers" by other personnel within the firm, including professional engineers. In these two instances the size of the firms, including the minute division of labour in the larger one, is also important.

In general, technicians in the machine tool industry appeared to be carrying out engineering functions with only periodic supervision from the professional engineers who tended to be concerned mainly with sales and administration.

(c) Education background - further training

86. A striking feature of the educational background of the technicians interviewed is the wide variety of educational patterns and routes which have been followed. In very few cases did the technicians appear to have followed a direct path to their present post. This is probably a reflection of the fact that the origins of the technicians' posts in industry are very recent, and consequently also the sources of recruitment for the posts, for example, via the skilled trades. The younger technicians trained in Canada are more likely to have entered employment by a relatively direct educational route, generally via secondary school, institute of technology, and a junior technician's post. More than one half the technicians interviewed were educated outside Canada, that is, they were post-war immigrants, of whom approximately two thirds came from Great Britain and the remainder from continental Europe.

87. There were some differences in the educational background of Canadian and overseas-educated technicians; the former had followed a more academic type of programme at secondary school, while most of the latter had attended a technical or trade-school on completing their elementary school education. To this extent, the Canadian-

educated technicians had received a much less specialised early education than had their overseas-educated co-workers. This may be partly due to the shortage of technical schools in Canada until very recently.

88. A number of the firms visited provide in-plant formal training for their employees. The courses, which are designed to improve knowledge of the technicians, may be given by senior personnel in the firm or by qualified instructors from outside, e.g. university professors, representatives from supply firms, etc; the length may vary from an occasional two or three days to annual periods of three weeks of classroom instruction. The former type was found in electronic instrument firms, and the latter in the electricity supply and distribution enterprises; the machine tool firms offer little or no formal training of this type, although occasionally, as in other industrial groups or firms, technicians are sent away to one of their material suppliers or customers for a short term (three- or four-day courses, to make them conversant with some new material or applications).

89. In addition to this type of firm-sponsored courses, some technicians attend evening classes at institutes of technology or universities; in all instances the firms encourage their employees to attend such courses and contribute financially. Some technicians take these courses to prepare for the examinations set by one of the provincial professional associations, in the hope of becoming professional engineers. This is a difficult, long and arduous route to professional status, however, and few (perhaps 2%) of Canadian-educated professional engineers acquire professional membership by this means.

90. A number of the technicians interviewed, especially those in the machine tool industry, had served an apprenticeship for one of the skilled trades at some point in their career. Some aspects of the further training of technicians are given in tabular form in Table 6.

91. One of the most striking features of the whole enquiry was the importance to all types of technicians of a sound knowledge and good grounding in general mathematics and, to a less extent, in mechanical drawing. The survey respondents believe that the importance of mathematics as a part of the technician's equipment is

increasing at the same time as the complexity of the mathematical knowledge required. This opinion was expressed by many of the staff at all levels and was frequently used by management to illustrate the difficulties of on-the-job training and the up-grading of employees by the firm if those concerned did not have a good "basic" education. The concept of a good "basic" education was also referred to by the employers to show how promotion possibilities for technicians were frequently limited, even in areas peripheral to technical work, because this education was lacking; it appears social adaptability was thought by management to be equated with good "basic" education.

Table 6

Further training of technicians in the firms visited

Firm(*)	Number who have received some in-plant formal training	Number who have served an apprenticeship	Number who are at present attending evening classes
A 1	1	1	2
A 2	1	1	1
A 3	1	-	2
A 4	4	2	2
A 5	-	2	-
B 1	-	1	1
B 2	-	3	1
B 3	1	1	-
C 1	6	3	7
Total	14	14	16

(*) A. Manufacturing of electronic measuring instruments
B. Manufacturing of machine-tools.
C. Supply and distribution of electricity.

XV. Careers and status of technicians

92. For Canadian-educated technicians, on-the-job training and up-grading were the usual means of acquiring their skills, only the very youngest having obtained much of their technical knowledge by full time attendance at an institute of technology. On the other hand, the British- and Continental- trained technicians questioned in the survey had generally acquired their skills and knowledge through apprenticeship or other training in industry while at the same time attending courses at a technical college in the evenings or on a day-release basis. As more opportunities for full- and part-time study at technician level are made available in Canada, the pattern followed by the younger technicians may become more wide-spread than the older, on-the-job pattern of training.

93. The older technicians interviewed in the survey showed a high rate of job mobility, whether they were Canadian-educated or immigrants. According to many senior officials, especially in the machine tool industry, this mobility is a desirable trait, for only through extensive and varied practical experience can good technicians be formed.

In addition to this technicians saw job mobility as a means whereby they could improve their position in the technical work world and a change in employer was usually associated with an increase in salary and status.

94. Job experience is also an extremely important element in the technician's vocational background, especially in the machine-tool industry. In electronic instrument manufacturing firms and the electricity firm, although practical experience was considered important, it was felt that a good formal technical education was more so apart from design-technicians, for whom job experience and formal technical education were considered of equal value.

95. Throughout the enquiry, whether talking to professional engineers, senior management technicians' supervisors or technicians, the researchers were conscious of the low ceiling placed on the technician's career if he remained in the purely technical sphere of industry. Concern was shown by both management and the techniciars on this score.

96. In firms where the proportion of technicians to professional engineers is high the technicians have relatively good opportunities for advancement until about the age of forty or so, at which time they would be supervising a team of technicians. After that point however, no matter what their skills, knowledge or abilities, they find the road to further advancement on this technical side of industry blocked because they are not members of a professional engineering association. In firms where the proportion of professional engineers is high technicians' job ceilings are lower and are reached at the comparatively early age of thirty to thirty-five.

97. The size of the firm also affects career opportunities for technicians. In small firms, whether the number of professional engineers is large or small, the able technicians find their opportunities to advance very limited, and the small firms tend to lose their most able technicians to the larger firms where opportunities seem better. Those who move, soon discover, however, that while there are relatively more opportunities for advancement, the fact that they are not members of a professional association prevents their advancement. In many instances the next post up the ladder to which the technician should aspire is defined as one wherein the occupant must be a member of a professional association, regardless of the duties entailed. On a number of occasions the officials interviewed claimed that this was necessary because the incumbent of the position frequently had to deal with professional engineers from other firms and, to quote one of them, "They all like it better that way".

98. In order to advance his career the able technician has virtually to leave the purely technical side and enter the administrative career line in sales or in some other white-collar capacity. According to some of the younger technicians this poses a problem: Should they continue the long and uncertain struggle to professional recognition of their skills by part-time evening study of technological subjects or should they improve their prospects by taking courses in business administration and hence facilitate their transfer from the technical side of industry before they are too old?

99. The technicians encountered were generally uncertain of and dissatisfied with their status in industry; they are the real marginal men of industry, neither skilled tradesmen nor recognised as engineers. Most of the younger technicians, and those slightly

older, saw their present positions as a step in their career to somewhere else, either as a stepping stone along the limited path of technical-engineering work, or as a means for eventual transfer to the administrative-managerial, non-technical side of the firm. The older technicians were much less enthusiastic about the possibility of changing their status. This led the interviewers to use the terms "the go-getters and the resigned" to identify the younger and older technicians.

100. Many of the technicians, including the younger ones, felt frustrated because, as they frequently pointed out to the interviewers, the caste-like barrier of professional membership effectively prevents their ascent up the technical ladder to senior posts and, the firm's vested interest in their technical skill and knowledge makes it unlikely that they will not be directly applicable. Most of the senior officials, including the professional engineers, agreed with the technician's assessment of this situation. Some of these officials reported that part of the technicians' dissatisfaction is minimized by paying them "high wages" compared to skilled tradesmen. Others stated that they have attempted "to create a feeling of pride and satisfaction in being a technician" among the technicians; that is, to have the technicians accept the status quo and regard their status as an end in itself.

101. In one of the provinces wherein some of the firms were located the provincial association of professional engineers has helped to bring into being an association of technicians in affiliation with the professional engineers. They took this action because, in the late 1950's, a group of graduates from one of the better known technical institutes attempted to form an association and become known as professional technicians with the letters designate, P. Tech. This led the professional engineers to establish a Certification Board consisting of eight professional engineers and two technicians. This board certifies three grades of technicians (technician grade 1, 2 and 3, each with certain minimum educational and experience requirements) leading eventually to the higher certification of engineering technologist. To this end they have issued examination syllabuses and set examinations for the certification of the technicians. Very few of the technicians interviewed, outside of those working for the electricity firm, knew much about

this board or had any intention of being certified, nor could see any purpose in joining.

102. It appears that while the ostensible purpose of the Certification Board is to provide technicians with a recognized status, its function, whether intentional or not, may be to identify them more completely and make it even more difficult for them to advance up the technical ladder. On the other hand, if the Certification Board succeeds in having the certified technician status recognised by a large proportion of both employers and technicians it may function, in the long run, so as to make the body of workers now classified as technicians into a more integrated, self-conscious group than was evident during the enquiry. This cohesiveness could lead them eventually to recognise that they have problems in common and, because of numbers and the feeling of consensus, provide a basis for their solution. The solution may even move in the direction which the Certification Board was originally designed to keep within bounds.

103. In summing up, technicians' prospects for promotion depend upon a number of factors, the main of which are:

(i) The size of the firm where they are employed: the larger the firm, the greater the opportunity of achieving supervisor's status and/or transferring to one of the many non-technical administrative posts;

(ii) The proportion of technicians to professional engineers employed by the firm: the higher the proportion of technicians, the greater the opportunity of obtaining a supervisor's post; the higher the proportion of professional engineers the smaller the opportunity of obtaining one;

(iii) The extent of their specilization: the more highly specialized they are, the more limited their advancement within the firm and, in some cases, a high degree of specialization limits their job mobility;

(iv) The degree to which the able technician can be recognised: the wide variety of educational backgrounds and the lack of any clear-cut nationally recognised certification to use as a standard (as for example, the HNC in Great Britain) limits the technician's easy transfer from one firm to another.

104. To minimize some of the problems outlined above and provide some form of substitute fo. a recognized certificate, one of the larger electronic instrument firms has devised the following "Job and Man Factor Analysis System".

Job factors:
1. Mental development regard for the job;
2. Technical complexity of the job;
3. Level of judgement required;
4. The mental and visual effort required;
5. The physical-manipulative effort required;
6. The loss-work (monetary) responsiblity;
7. Business relations involved;
8. Working conditions - hazards.

Man factors:
1. Technical education;
2. Technical experience (total);
3. Technical aptitude;
4. Ingenuity and resourcefulness shown;
5. General effectiveness.

Annual assessments are made of the technicians and their posts, and changes in salary status and advancement are based on the assessments made by the members of the Personnel Department in conjunction with the technicians' supervisors. The firm concerned felt that it was a useful device and the research team could have passed judgement on its efficiency only if they had had time to make an extensive study of the records. It was a firm however, in which both the technicians and the senior managers were concerned over the lack of opportunities available for the highly experienced, able and ambitious technician.

105. While the foregoing shows the problems associated with the technician's possibilities of promotion primarily from the technician's point of view, in many instances a closer examination of his post and the actual nature of the duties rather than their appearance, shed a slightly different light upon the situation. For instance, from the point of view of the experienced professional engineers, the technician's job, while appearing to be very varied, was frequently repetitious, involving constant reference to a few

well-learned techniques. A technician who may often appear to have a range of responsibility and considers that he has, is in reality limited to a fairly well-defined set of choices within strict and narrow bounds, when a closer examination is made.

106. The technician's job does not provide an opportunity for wide outside contacts, but when this does occur, was apparently limited to routine matters. In general, while a technician's work does involve grappling with some abstractions, it is the intricacies of the skills rather than the depth of knowledge required, which is most important.

107. When technicians are carrying out their duties and, at the same time, attending evening classes as preparation for membership in one of the professional associations, it is not difficult to see why internal differences arise between management, employee-professional engineers and technicians. The technicians consider they are able to fill the posts above them, whereas the management and professional engineers assess them and their potential primarily in terms of the immediate duties they are being asked and permitted to perform.

108. To a large extent the technicians interviewed see themselves as second-class citizens in industry, with little hope of changing their status unless they change their occupation (sales, administration, etc.) or are able to qualify through years of part-time study for membership in a professional engineers' association. These negative attitudes were found among the younger technicians, whether Canadian or overseas educated, who resented the relative lack of opportunity for the ambitious technician to up-grade himself to the professional engineer level and the other factors which limited technician's opportunities for advancement. Needless to say, there is bound to be some "feed back" of these negative attitudes. This will limit to some extent the impact of the educational and other authorities who are attempting to make technical high school courses, technical institute courses and technical occupations in general more attractive to young people presently in school hence, affect recruitment to the occupation.

Part Four

GENERAL INFORMATION - STATISTICAL DATA

XVI. The financial situation

(a) Industry and trade

109. Canada's vast heritage of natural resources, some of which have not been tapped or even definitely located, continues to form the solid basis of her national wealth. At the same time, manufacturing and various secondary industries have rapidly developed (Table 7) especially since the war, and are playing an increasingly important role not only in domestic economy but in Canada's international trade as well.

110. The highest growth rate was in the electric power and gas utilities industry with an average annual compound growth rate of nearly 10 per cent during the post-war period, and 8.3 per cent for longer term growth (1935-1962) (Table 8); large scale hydro-electric power development and the expansion of natural gas distribution helped to sustain this remarkable performance. The mining and construction industries ranked second and third respectively. All three industries have been strongly affected by technological advances, new discoveries and a fairly well-sustained demand for

their products. Manufacturing and trade expanded at roughly the same average rate of nearly 5 per cent during the 1935-1962 period, while agriculture showed a low rate of expansion with a pronounced, irregular fluctuation in output. The contribution made by the three productive sectors to the national economy over the 1935-1962 period is shown in Table 9.

111. An exceptionally large proportion of Canadian industry is foreign-owned; the pattern and origin of this ownership and the extent of control vary considerably. Although estimates of the proportion of firms thus owned and controlled differ according to the criteria adopted, a figure of 60 per cent is frequently quoted.

112. Canada's structure of foreign trade is typical of an agricultural country which is rich in mineral and forest resources and is at the same time developing industrially. In 1962, mineral exports covered nearly 33 per cent of total exports, and agricultural and forestry products about 47 per cent, the remaining 20 per cent being mainly manufactured goods (Table 10). The total export of goods and services amounted to an average of 20 per cent of GNP for the period 1959-1963(1).

113. Imports include mainly fuels and lubricants,industrial materials such as machinery and parts, construction materials, and consumer goods, i.e. foods, beverages, cars, clothing, distributed as shown in Table 11. Total imports amounted to an average of 23 per cent of GNP during the 1959-1963 period(1).

(b) National income and public expenditure on education

114. Canadians have achieved a high standard of living comparable to that in the United States. Wages and salaries are somewhat lower than in the United States but so, on the whole, are living costs. Weekly earnings (industrial average) were 83.4 Canadian dollars in 1963.

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(1) Economic surveys by the OECD, Canada, 1964.

115. Education is of vital concern to Canada; about 30 per cent of the population are at present engaged in some form of educational activity either as students, teachers or administrators. Educational costs are, therefore, a considerable factor in governmental budgets and form the largest single item of expenditure for most municipal councils. While the national income nearly doubled during the 1950-1960 decade, the amount devoted to education calculated as a percentage of national income, increased during the same period from 3.2 per cent to 5.3. per cent. (Table 12).

116. The contribution of the Federal Government to the country's educational and other cultural activities is given for the year 1959 in Table 13. The present Technical and Vocational Training Assistance Act, which is valid for the period 1961-1967, provides that the Federal Government will finance 75 per cent for the first two years and subsequently 50 per cent of any investment projects for the construction, extension or modernisation of secondary schools providing technical education, trade schools and institutes of technology (paragraph 5). Capital expenditure for the various training projects is summarised in Appendix II.

Table 7

Quantity indexes of gross domestic product at factor cost by industry of origin, 1935-62 (1949=100)

	1935	1950	1955	1960	1962
1. Primary Sector	75.5	111.3	124.5	124.6	135.2
(i) Agriculture	95.0	106.2	132.4	128.0	134.7
(ii) Forestry	59.2	118.9	135.7	141.8	140.5
(iii) Fishing	72.4	108.9	105.6	104.1	130.4
2. Secondary Sector	43.1	108.9	160.7	215.9	240.2
(i) Mining(1)	60.8	109.5	185.2	253.3	287.4
(ii) Manufacturing(2)	39.0	106.2	134.7	149.3	164.9
(iii) Construction	33.5	106.7	139.8	163.0	171.0
(iv) Gas, electricity	39.1	113.2	183.3	298.0	337.7
3. Services	50.2	105.2	132.9	160.5	172.4
(i) Transport, storage communications	43.2	103.3	133.6	163.9	179.2
(ii) Trade	45.1	106.9	132.0	156.6	166.8
(iii) Finance, insurance, real estates	58.4	105.6	136.5	169.5	182.9
(iv) Public administration and defence	47.9	106.6	156.3	177.8	187.9
(v) Other	55.7	103.3	119.9	147.4	158.2
Gross domestic product	49.7	106.4	136.3	158.5	171.4

(1) Contract drilling, apart from drilling for oil and gas, is not included here but is included in the gross domestic product.

(2) Repair service establishments classified under manufacturing are not included here, but are included in the gross domestic product.

Source: Canada Year Book, 1963-64.

Table 8

Growth rates of the main industrial groups
1935-62 and 1946-62

Industry	Average annual compound rate of growth	
	1935-62	1946-62
1. Agriculture	0.9	1.3
2. Mining	7.3	9.3
3. Manufacturing	5.0	3.9
4. Construction	6.7	5.8
5. Electric power and gas utilities	8.3	9.7
6. Trade	5.2	4.1
Gross domestic product	4.4	4.2

Source: Canada Year Book, 1963-64

Table 9

Percentage contribution of the productive sectors to the gross domestic product (1935-62)

	1935	1950	1955	1960	1962
1. Primary Sector	44.7	34.2	29.8	24.8	24.6
2. Secondary Sector	25.8	33.5	38.5	43.0	44.2
3. Services	29.7	32.3	31.7	32.2	31.2
	100.0	100.0	100.0	100.0	100.0

Table 10

Exports (1954-1962)

(in millions of Canadian dollars)(1)

	1954	1960	1961	1962
1. Farm and fish products	984	1,018	1,299	1,264
2. Forest products	1,365	1,587	1,623	1,701
3. Minerals and mineral products	917	1,814	1,858	2,063
4. Chemical and fertilizers	153	238	251	248
5. Other manufactures and miscellaneous	441	600	724	902
6. Exports of foreign products	65	129	140	169
Total exports	3,926	5,387	5,895	6,348

Table 11

Imports (1960-1962)

(in millions of Canadian dollars)(1)

	1960	1961	1962
1. Fuels and lubricants	478	473	487
2. Industrial materials	1,455	1,552	1,727
3. Investment goods	1,675	1,824	1,981
4. Consumer goods	1,829	1,866	2,004
5. Special items	46	53	60
Total imports	5,483	5,771	6,258

Source: Canada Year Book, 1963-64.

(1) 1,081 Can. dollar - 1 U.S. dollar

Table 12

National income and public expenditure on education (1950-1960)

Year	National income (thousand of Can. dollars)	Total expenditure on education (thousand of Can. dollars)	Expenditure on education as a % of national income
1950	14,128,000	454,000	3.2
1956	23,118,000	824,783	3.6
1960	27,323,000	1,434,606	5.3

Source: Unesco Statistical Year Book, 1963

Table 13

Total expenditure on education and cultural activities by source of funds, 1959

(in thousands of Canadian dollars)

	Provincial govt.	Federal govt.	Other sources (1)	Totals
1. Elementary and gen. secondary education	468,935	47,653	639,936	1,156,524
2. Vocational training of which:(2)	32,808	10,794	6,216	49,818
Institutes of technology	(8,623)	(2,134)	(1,254)	(12,011)
3. Higher education	91,887	55,588	61,232	208,707
4. Cultural activities(3)	10,168	7,477	14,468	32,113
Totals	603,798	121,512	721,852	1,437,162

(1) Local taxation, fees, miscellaneous.

(2) Includes: Institutes of technology, apprenticeship, trade training, handicapped, health and welfare personnel, etc.

(3) Includes: Adult education, fine arts, handicrafts, Unesco grant, etc.

Source: Canada Year Book, 1963-64.

XVII. Educational statistics

117. General trends in education are given in Table 14. Enrolments in primary education dropped from 81.9 per cent of total enrolments in 1951 to 73.7 per cent in 1962 while during the same period enrolments in secondary and higher education rose from 15.8 per cent to 23.3 per cent and 2.3 to 3.0 per cent respectively.
118. A summary of basic data on education for the school year 1961/1962 is given in Table 15. According to these data enrolment in technical and vocational courses as a whole did not exceed 4.5 per cent of the total school and university population.
119. At present, there are 37 institutions providing post-secondary technical courses in Canada. Eleven of these are concerned almost exclusively with post-secondary technical education, 25 provide extensive training in trades and other occupations as well as post-secondary technical courses, the remaining one providing university courses in addition to those for technicians.
120. Total enrolment in the above-mentioned institutions was close to 14,000 in 1963 (table 16) compared with about 2,400 in 1952 and 700 in 1942. About 80 per cent of the 1963 graduates received the 2,400 hours of formal instruction recognised by NACTE as the desirable minimum for technician status. (paragraph 37) These institutions now produce about 2,400 technicians a year, and with the present training facilities their output could increase to 4,400 by 1967.
121. Full-time university-level enrolment has continued to increase each year during the past few decades and the 1962/1963 figure of 141,388 may well double in about ten years. In addition to full-time students there were 44,048 part-time students, including 5,351 graduates in attendance during the regular 1962/1963 winter session and 7,522 students taking university-level correspondence courses. Table 17 indicates the distribution of full-time university students by discipline for the year 1960. Enrolment in engineering faculties amounted to 14.2 per cent of total university enrolments.

Table 14

Full-time enrolment in primary and secondary schools, universities and colleges (1951-1962)

Level of education	1951		1955		1959		1962	
	Students	%	Students	%	Students	%	Students	%
1. Primary(1)	2,235,095	81.9	2,726,762	80.1	3,208,269	78.0	3,480,485	73.7
2. Secondary	432,053	15.8	608,683	17.8	802,690	19.5	1,097,714	23.3
3. Universities and colleges	63,483	2.3	72,737	2.1	101.934	2.5	141,388	3.0
Total	2,730,631	100.0	3,408,182	100.0	4,112,893	100.0	4,719,587	100.0

(1) From kindergarten to and including grade 8 in all provinces except Quebec where grade 8 is included in secondary education.

Source: Canada Year Book, 1963-1964.

Table 15

Summary of basic data on education (1961/62)

Branch of education	Schools	Teachers	Enrolment	Enrolments %
1. Primary	26,219	124,266(1)	3,320,974(1)	70.0
2. Secondary general(2)		49,917	1,047,820	22.1
3. Technical and Vocational			212,432	4.5
(i) Trade courses (pre-employment 1960/61)	-	-	25,973	
(ii) Trade courses (Apprenticeship)	-	-	15,914	
(iii) Vocational high school courses	-	-	127,195	
(iv) Post-secondary courses (Institutes of Technology)	-	-	11,178	
(v) Private business schools	-	-	18,612	
(vi) Private trade schools	-	-	13,560	
4. Teacher Training	154	2,351	31,157	0.7
(i) Colleges	126	1,796	20,435	
(ii) Faculties	28	555	10,722	
5. Higher	354	-	128,894(3)	2.7
Total (1 to 5)			4,741,277	100.0
6. Adult Education (part-time 1960)	-	-	885,176	
(i) Universities	-	-	191,836	
(ii) Provincial governments	-	-	693,340	

(1) Taken from Unesco Statistical Year Book, 1963.

(2) Includes: Public and separate, private, overseas, Indian and special schools (blind, deaf).

(3) Full-time enrolment.

Source: Canada Year Book 1963-64.

Table 16

Full-time day enrolments in the institutes of technology (1963)

Fields	Number of different courses	Total enrolment	Final year enrolment	Graduated in 1963
1. Administration	9	1,608	347	183
2. Aeronautical technologies	2	244	55	58
3. Agricultural technology	1	124	-	-
4. Applied arts	11	1,171	261	192
5. Architectural technologies	2	367	94	56
6. Automotive technologies	2	787	171	156
7. Chemical technologies	6	1,067	238	152
8. Civil technologies	6	1,005	200	153
9. Electrical technologies	2	1,857	386	354
10. Electronic technologies	4	2,704	617	449
11. Food technologies	2	129	34	4
12. Forest technology	1	63	17	9
13. Mechanical technologies	14	2,443	523	463
14. Medical technologies	3	129	18	25
15. Mining technology	1	122	42	38
16. Petroleum technology	2	99	26	17
17. Engineering technology	1	76	14	11
18. Navigation	1	34	8	11
Total	70	14,029	3,051	2,331

Table 17

Distribution of university students by field of study (1960)

Field of study	Actual number	Percentages
1. Humanities	44,696	41.9
2. Education	11,587	10.9
3. Fine arts	1,131	1.1
4. Law	2,480	2.3
5. Social sciences	9,024	8.5
6. Medicine	9,036	8.5
7. Natural sciences	9,937	9.2
8. Engineering	15,190	14.2
9. Agriculture	3,038	2.9
10. Not specified	492	0.5
Total	106,611	100.0

Source: Basic facts and figures, Unesco, 1962.

XVIII. Population and manpower statistics

122. Canada has an overall area of 9,974,375 sq. km. with a density of population not exceeding 2 inhabitants per sq. km. Population increased by approximately 240 per cent during the period 1900-1961, the gain of 34 per cent registered during the first decade of the century being greater than in any other census period up to 1961, (Table 18). During the past decade (1951/1961) the concentration of population in urban communities resulted in an overall increase in the urban population of 45 per cent; during the same period, the rural population as a whole fell by 20 per cent. Total immigration into Canada for the period 1900-1961 is recorded as nearly 6.5 million persons. In 1965 58.5 per cent of the population reported

English as their mother tongue, 28.1 per cent French, and 13.5 per cent other languages. English and French are the two "official languages".

123. The civilian non-institutional population aged 14 years or over which amounted to 12,224,000 in 1962, showed an increase of 39.2 per cent during the period 1946-1962 (Table 19) while, during the same period, the labour force rose by only 37.1 per cent. Thus the percentage of the population 14 years or over in the labour force, which was 55.0 per cent in 1946, dropped to 54.1 per cent in 1962; this amounts to about 35 per cent of the total population. Unemployment rates were higher in 1962 (5.9 per cent of the labour force) than in 1946, the great majority of unemployed in both years being unskilled workers. As from 1953 there was a rapid increase in job opportunities for women, particularly married women, and female participation in the labour force rose from 23.4 per cent in 1953 to 29.1 per cent in 1962.

124. Employment in agriculture and other primary industries dropped between 1946 and 1962 from 29.4 to 13.3 per cent of the labour force, i.e. declined by some 45 per cent. During the same period employment in the secondary and tertiary (trade and services) sectors increased by 1.3 and 14.8 per cent respectively. (Table 20).

125. Little information is available concerning the magnitude and distribution of technical manpower, especially at technician level. Technician requirements seem to have been inadequately examined at both federal and provincial levels with the result that substantial programmes for technician training have been launched on the basis of impressions of need - which of course may not necessarily be wrong - rather than in response to a factual assessment. Canadian authorities have now realised the importance of "labour market" information to the efficient planning of technical and vocational education, and measures are being taken to strengthen and develop the potential of the "National Employment Service" to provide such information. This service was transferred in 1965 to the Federal Department of Labour, having formerly been part of an independent Unemployment Insurance Commission.

126. In 1960 Canadian scientific manpower consisted of 65 per cent university engineers, 18 per cent natural scientists and 18 per cent agricultural scientists (Table 21). No substantial changes in the occupational breakdown were envisaged in 1963, when the agricultural/

industrial sector employed 60 per cent of the scientific manpower and the service sector the remainder. A breakdown by type of manpower per sector of economy showed that the proportion of natural and agricultural scientists was slightly higher in services than in agriculture/industry, but that more than two-thirds of the engineers were employed in the industrial sector (Table 22). See pages 64-69, extracted from the OECD study "Resources of Scientific and Technical Personnel in the OECD area" which illustrate the shortage/surplus situation of scientific and technical personnel at upper-technician and university levels.

127. The shortage/surplus situation of scientific and technical personnel in April 1962 as reported by the Canadian authorities, shows a certain amount of contrast for some levels of training or skills. The increasing demand during the past few years for qualified engineering and scientific technicians (upper-level technicians) at a level immediately below that of the professional is still in excess of supply, and reports of shortages throughout industry are widespread. According to estimates by experts of the Department of Labour, for the year 1962 the Canadian economy could readily have absorbed 8,500 technicians, with a ten per cent per annum increase, that is almost double the number which the educational system should be able to supply as from 1967.

128. On the other hand, the situation for professional level staff with a first or bachelor's university degree is fairly well balanced. Some shortages have been reported in specific engineering and scientific fields, and some surpluses are occurring in others. At the higher level of technical proficiency, requiring at least a second degree but more often specialisation to the doctoral level, demand continues to exceed supply, employers indicating that shortages of highly qualified specialists are retarding the development of new scientific projects.

129. Over the past five years there has been increasing use by Canadian industry of technically trained persons at the technician level. The greater demand for technicians, which has resulted in a large measure from industry efforts towards the better utilisation of professional manpower, has been exceeding the new supply graduating from the country's Institutes of Technology. This situation of tight supply is likely to continue for a number of years.

130. The greater use of technicians, many in jobs formerly carried out by professionals, has resulted in some easing of the demand for engineers and scientists at this lower level of professional competency. The normal overall growth of demand throughout the country has thus been met to some extent by improved utilization and this has helped appreciably to maintain overall supply and demand in a generally balanced position. However, in specific fields there is an increasing number of instances where the situation is tightening, for example, chemical industry and chemical and electrical engineering. The increasing demand for professionally trained persons in these fields reflects the present stage of the country's industrial development where the focus is predominantly on the chemical and petroleum industries and on the expansion and transmission of hydro-electric power.

Table 18

Total population(1) and percentage increase over preceding census
(1900-1961)

Year	Population	Percentage change
1901	5,371,315	11.1
1911	7,206,643	34.2
1921	8,787,949	21.9
1931	10,376,786	18.1
1941	11,506,655	10.9
1951	14,009,428	21.8
1961	18,238,247	30.2
1964	19,237,000(2)	

(1) Figures prior to 1951 do not include population of Newfoundland which was not part of Canada until 1949.

(2) Taken from the "Economic Surveys by the OECD, Canada, 1964".

Source: Canada Year Book 1963-1964.

Table 19

Estimates of the civilian labour force (1946-1964)

(in thousands)

Year	Civilian population (14 yrs. of age or over)	Total employed	Un-employed	Total labour force	Participation rate
1946	8,779	4,666	163	4,829	55.0
1956	10,805	5,585	197	5,782	53.5
1958	11,357	5,695	432	6,127	54.0
1960	11,789	5,955	448	6,403	54.3
1961	12,010	6,049	469	6,518	54.3
1962	12,224	6,217	391	6,608	54.0
1964(1)	12,745	6,595	325	6,920	54.3

(1) Figures for 1964 were taken from the draft report, "Examination of Canada", report by the Canadian Authorities, 1965.

Source: Canada Year Book 1963-64.

Table 20

Percentage breakdown of employed population by sector and activity (1946-62)

Sector and activity	1946	1956	1960	1962
1. Primary	29.4	18.5	14.8	13.3
(i) Agriculture	25.4	13.9	11.3	10.5
(ii) Other primary industries	4.0	4.6	3.5	2.8
2. Secondary	30.8	33.1	31.7	32.1
(i) Manufacturing	26.0	25.7	24.7	25.2
(ii) Construction	4.8	7.4	7.0	6.9
3. Tertiary	39.8	48.4	53.5	54.6
(i) Trade	12.3	15.8	16.5	16.1
(ii) Transportation and other utilities	8.1	8.9	8.6	8.5
(iii) Finance, insurance and real estates	2.6	3.5	3.8	4.0
(iv) Other services	16.8	20.2	24.6	26.0
	100.0	100.0	100.0	100.0

Source: Canada Year Book, 1963-64.

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Table 21

Employment of scientists and engineers (1960,1963)

	1960	1963(1)
1. Natural scientists	14,000	16,550
2. Engineers	51,500	60,400
3. Agricultural scientists	14,000	15,250
Total	79,500	92,600

(1) Estimates based on 1960 figures.

Source: Resources of scientific and technical personnel in the OECD area (OECD, Paris).

Table 22

Breakdown of scientists and engineers by occupational field and by sector of economy, 1963(1)

(percentages)

	Natural scientists	Engineers	Agricultural scientists	Total
1. Agriculture and industry(2)	47	69	40	60
2. Services(3)	53	31	60	40
	100	100	100	100

(1) Estimates based on 1060 figures.

(2) Includes commerce, transportation, storage and communications.

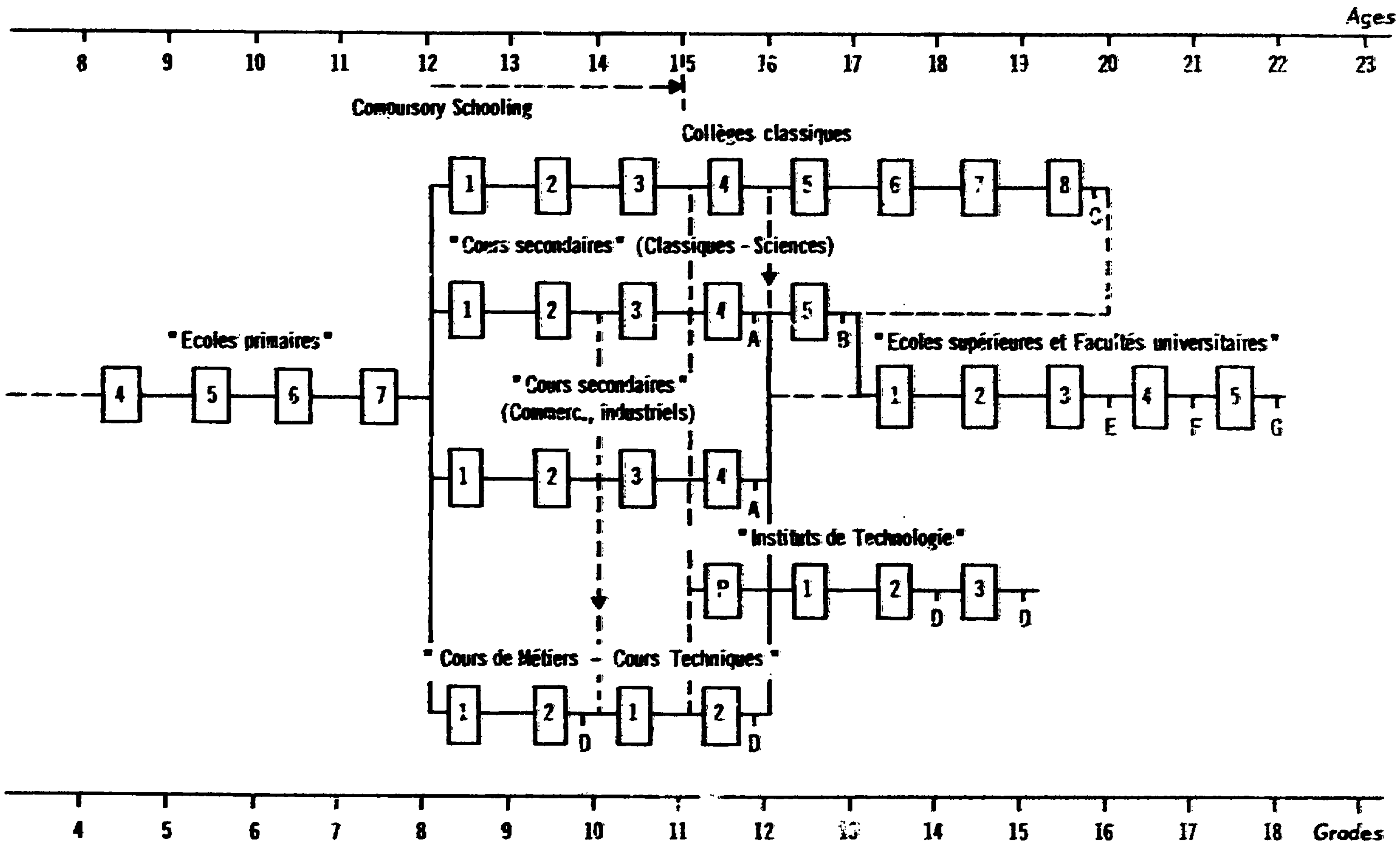
(3) Includes armed forces.

Source: Resources of scientific and technical personnel in the OECD area (OECD, Paris).

Appendix I

TECHNICAL AND VOCATIONAL COURSES WITHIN THE EDUCATIONAL SYSTEM

1. PROVINCE OF QUEBEC

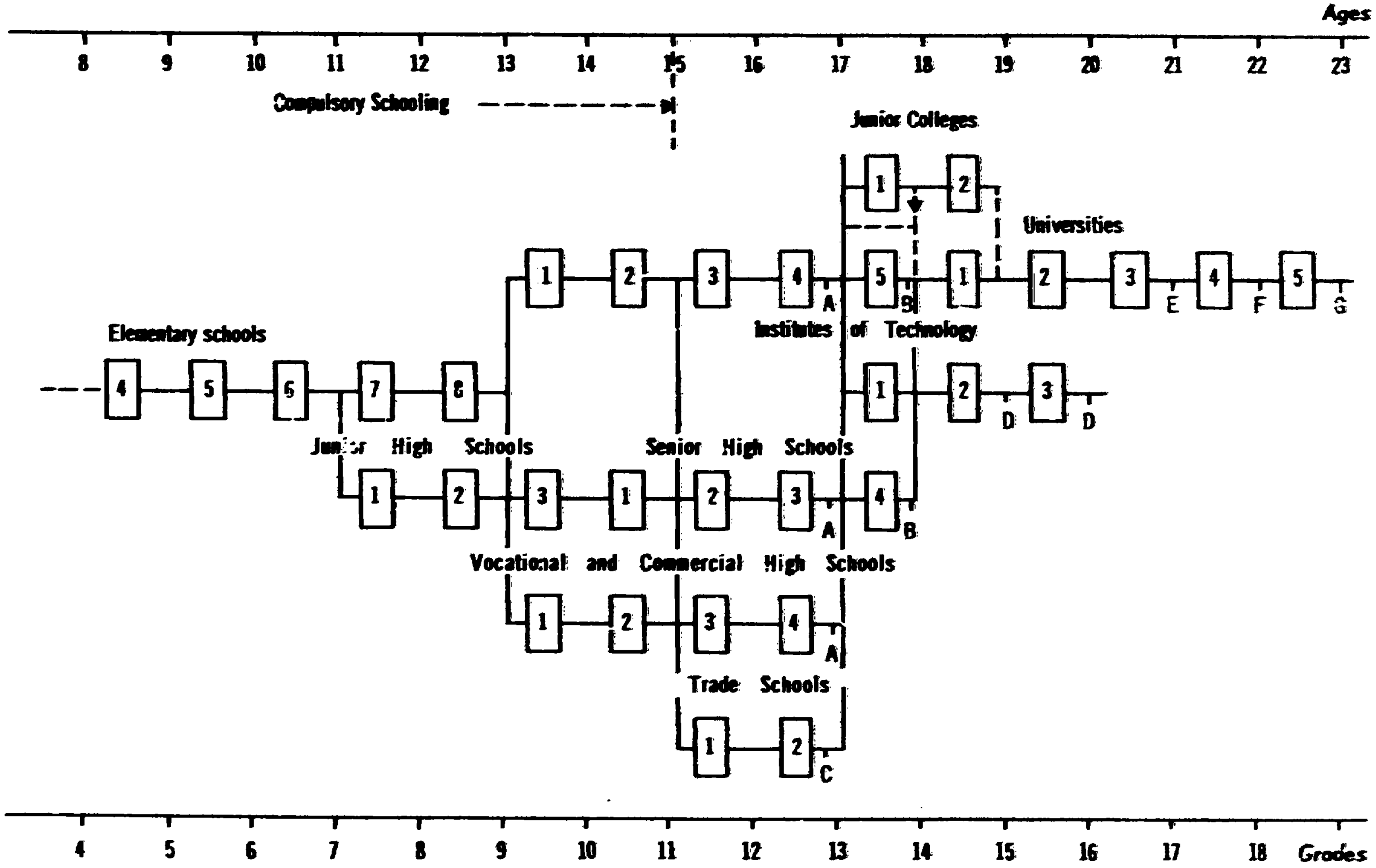


P = Preparatory year.
A = Junior matriculation certificate ; B = Senior matriculation certificate ; C = Baccalauréat ; D = Graduation certificates or Diplomas ;
E, F, G = First Bachelor degree in Arts (E), Engineering, Commerce, Agriculture (F), Architecture (G).

Appendix I

TECHNICAL AND VOCATIONAL COURSES WITHIN THE EDUCATIONAL SYSTEM

2. OTHER PROVINCES



A = External exam and certificate at Junior Matriculation level; B = Senior Matriculation; C = Graduation certificate or diploma; D = Graduation certificate or Diploma; E, F, G = First Bachelor degree in : Arts (E); Engineering, Commerce, Agriculture (F); Architecture (G).

Appendix II

THE TECHNICAL AND VOCATIONAL TRAINING ASSISTANCE ACT

The Federal Government, recognising vocational training as an important part of the economic development of the country, contributes substantially to the maintenance and development of vocational training institutions. Its participation goes back half a century to the years immediately preceding the first world war. In 1913, the Agriculture Instruction Act made available $10,000,000 to promote projects in agricultural training; the Technical Education Act of 1919 provided a similar amount for the development of industrial and technical education and introduced the principle of "matching" provincial capital expenditures. The Vocational Training Co-ordination Act of 1942, together with specific agreements signed by most of the provinces, established federal contributions towards vocational training for both capital and operational expenditures. This Act was replaced in December 1960 by the Technical and Vocational Training Assistance Act, which provides financial support for the provinces under two separate agreements, namely, the Technical and Vocational Training Agreement, which is the basic agreement and extends over the period 1st April, 1961 to 31st March, 1967 and the Apprenticeship Training Agreement, which covers a period of ten years.

(a) The Technical and Vocational Training Agreement

The new agreement changes fundamentally the basic policy of federal financial assistance. A substantial innovation for instance is the payment by the Federal Government of 75 per cent of the total capital expenditure incurred by a province in building and equipping vocational training institutions up to 31st March, 1963, and 50 per cent thereafter during the life of the agreement. The Minister of Labour has recently announced that an amendment will be introduced for the continuation beyond 31st March, 1963 of the 75 per cent federal contribution up to a specified total for each province (see paragraph 5 in the text).

The capital expenditure programme under the new Act has given a tremendous impetus to the development of training institutions in Canada. By 31st March, 1963, some 513 construction projects on new and existing schools, providing places for 138,000 additional students, were in various stages of completion. The total cost of these projects is estimated at $508,000,000 of which the federal contribution is some $323,000,000. In addition to contributing towards capital expenditures, the Federal Government shares also in the operating costs of the various programmes conducted under the Agreement.

(b) Programmes under the Technical and Vocational Training Agreement

Ten different programmes are provided under the Technical and Vocational Training Agreement, as described below. All are closely correlated with the common objective of training the country's labour force at all levels below university, and in all fields.

Programme 1: Technical and vocational high schools

This programme includes instruction given in any regular secondary school whether technical, vocational or comprehensive, where the syllabuses contain full-time courses in which a minimum of 50 per cent of the school time is spent on instruction preparing for an occupation. Over the six-year period of the Agreement, the Federal Government will contribute up to a total of $15,000,000 to the provinces on a cost-sharing basis not exceeding 50 per cent of provincial expenditure. Of the total 513 projects approved under the Agreement, 285 concern either major additions to existing vocational high schools or new buildings.

Programme 2: Technician training

One of the most rapidly expanding occupational fields in Canada is that of technician. In recent years, a number of institutes of technology at the post-secondary level have been established to help meet this growing need. Programme 2 covers engineering science, business or other fields requiring advanced theoretical and practical training below the professional level. The Federal Government contributes 50 per cent of provincial costs. In 1962, four institutes of technology were in various stages of construction and additions were being made to 13 existing institutes. Additional facilities have been provided under 16 projects covering the construction of combined trade schools and institutes of technology. A total amount of $80,000,000 has been allocated for this programme(1) which provides for nearly 15,000 new student places.

Programme 3: Trade and other occupational training

This programme has a triple objective: (i) to assist employed persons wishing to upgrade their skills; (ii) to help those about to enter employment and (iii) to provide training for individuals wishing to retrain for a change of occupation. To qualify for training under this programme, candidates must have left elementary or secondary schools and be over the compulsory school attendance age. The Federal Government pays 50 per cent of provincial costs. At the end of March 1963, there were 6,319 students enrolled in

(1) Technical and Vocational Education in Canada, Vol. 2, No. 1, 1963 (Department of Labour).

trade school courses under programme 3, exclusive of trainees who were unemployed or who were receiving training under other programmes. Annual enrolments continue throughout the school year in courses ranging in length from five days to two years.

Programme 4: Training in co-operation with industry

This consists of : training to enable employees to upgrade their skills including basic training in mathematics, science and languages; retraining for those requiring to learn new skills or occupations, and supervisory training. Projects undertaken under this programme are developed jointly by the province and one or more employers or industries in the particular area. Training may be provided in public or approved private schools, in industrial establishments by means of full-time or part-time, day or evening, day release, sandwich or on-the-job types of programmes, or by correspondence courses. The Federal Government contributes 50 per cent of provincial expenditures on approved training programmes. A significant development in this connection is an experimental co-operative scheme in the Leaside area of Toronto, which began in January 1963. Three companies working in co-operation with unions, the provincial and federal governments, and local school board officials are providing a six-month course to upgrade their workers in mathematics, science and English to a level where they can undertake further training and retraining in specific skills. Trainees include men and women from a cross-section of the workers, ranging in age up to 45, who have completed grades 8 or 9. The new courses are designed to raise the levels of attainment in the subjects given by two school grades, and the Ontario Department of Education has agreed to issue an Equivalency Certificate on a subject-grade basis when the trainee completes a course. Basic training to prepare for skill development programmes is also being provided in other provinces for employed as well as unemployed workers.

Programme 5: Training for the unemployed

This programme is to provide training for unemployed persons to improve their employment opportunities by increasing their basic education, trade, technical or occupational competence. Training under this programme may be of the "refresher" type or training for employment in an occupation previously followed by the trainee. The Federal Government may provide up to 75 per cent of training costs when a minimum number of training days is given by a province in each fiscal year; otherwise, the federal share is 50 per cent. The number of unemployed workers being trained through this programme has multiplied many times over recent years. In 1964, almost 50,000 persons took part in this training which covered 115 occupations and was provided in 300 centres scattered across the country. Furthermore, over 16,000 persons were registered in basic education courses, considered as a prerequisite for many types of skill development.

Programme 6: Training for the disabled.

This programme provides for technical or other vocational training, retraining, or vocational assessment of any disabled person who, because of a continuing disability, requires training to fit him for employment in a suitable occupation. One half of the provincial costs of approved programmes is contributed by the Federal Government. Disabled persons given training in the fiscal year 1962/1963 numbered 2,966, compared with 2,675 in the previous fiscal year.

Programme 7: Training for technical and vocational teachers

This programme covers training for technical and vocational teachers and for supervisors and administrators of technical and vocational programmes. The federal share is 50 per cent. Teacher training programmes have been expanded in most provinces to meet both immediate and long-term needs in this field. Although at present a number of short courses are being held to meet immediate needs, there is a definite trend towards at least one year of pre-service teacher training for those who wish to teach in secondary or adult vocational schools.

Programme 8: Training for federal departments and agencies

This programme provides training for members of the Armed Services and the Civil Service and may be requested by any department or agency of the Federal Government. The Federal Government contributes up to 100 per cent of training costs, when the programme is provided by a province.

Programme 9: Student Aid

Under this programme, financial assistance may be given to students at the university and to nurses in training. At the discretion of the province, assistance may take the form of either a grant or loan, or a combination of both. The federal contribution is limited by a fixed allotment.

In addition to the above programmes the Federal Government contributes up to 50 per cent of the provincial costs of preparing printing and servicing technical and vocational correspondence courses.

(c) The Apprenticeship Training Agreement.

Since 1944, this agreement has provided for a federal reimbursement of 50 per cent of provincial expenditures for training apprentices in classes or supervising them on the job. Apprentices must be registered with the provincial Departments of Labour in designated trades. The purpose of this agreement is to encourage and assist the development of organized training for apprentices in all skilled trades. There were 20,576 apprentices registered in eight provinces by 30th June, 1962. Quebec is not included in the Apprenticeship Agreement(1) and Prince Edward Island signed in 1962. In 1960, the number of registered apprentices was 9,482, which means that over the period 1950/1962 the number had more than doubled; apprenticeships completed went from 1,807 to 4,400.

(1) See paragraph 5 in the text.

Appendix III

CLASSIFICATION OF ENGINEERING TECHNICIANS AND TECHNOLOGISTS

(Ontario Association of certified engineering technicians and technologists)

Engineering Technician Grade 1

(a) Minimum educational qualifications
The Ontario secondary school graduation diploma or equivalent provided the applicant has taken the science and mathematical subjects of grade XII

and

(b) Minimum practical experience : two years(1)

(1) Practical experience must be under approved professional engineering guidance.

Engineering Technician Grade 2

(a) Minimum educational qualification
Grade XIII technical, or
Grade XIII general course (English composition, English literature, algebra, geometry, trignometry, physics and chemistry), or

The Advanced Technical Evening Class (First certificate), or
Ordinary National Certificate (UK), or
Other certificates of equivalent standing

(b) Minimum practical experience : two years(1)

Engineering Technician Grade 3

(a) Minimum educational qualification
Completion of one year of an Engineering Course in a recognised university, or
Completion of a two-year Technical Institute Course or equivalent, the admission requirement to which is complete grade XII standing, or
Higher National Certificate (UK), without endorsements, or satisfactory completion of examinations acceptable to the Certification Board.

(b) Minimum practical experience : two years(1)

Engineering Technologist

(a) Minimum educational qualification
Completion of the first two years of an Engineering Course in a recognised university, or Diploma from an Ontario Institute of Technology (three-year course), or
Other Institutes of equivalent standing, or

Practical experience must be under approved professional engineering guidance.

Higher National Certificate (UK), with endorsements satisfactory to the Certification Board, or Examinations established by the Certification Board.

(b) Minimum practical experience(1)
Two years for graduates of an Ontario Institute of Technology (three-year course).
Two years for candidates who have successfully passed the Certification Board examinations.
For others a period satisfactory to the Certification Board.

Branches: Aeronautical, Chemical, Civil, Electrical, Electronic, Gas, Instrument, Mechanical and Metallurgical Technology.

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(1) Practical experience must be under approved professional engineering guidance.

Appendix IV

TECHNICAL EDUCATION AT SECONDARY LEVEL IN QUEBEC AS ENVISAGED IN THE "PARENT" REPORT(1)

One of the most important tasks which future educational planners will have to face in Quebec is that of bringing together technical and general education. Technical culture is a fundamental part of contemporary humanism and cannot be ignored by the other types of culture neither can it ignore them. Everyone should participate one way or another in the development of our society through either practical or intellectual activities. Everyone should be able to understand the practical background on which our work is based and the technical civilization in which we live.

The integration of technical education into the system of general secondary education in the regional comprehensive schools will have a dual purpose, namely :(i) students oriented towards technical education will also take cultural subjects; (ii) those who are preparing for an academic career should also have some contact with technical culture. To achieve this dual purpose, the commission proposes the following system.

(1) Taken from: "Les problèmes de l'enseignement au Quebec, - analyse du Rapport Parent - La documentation francaise - Notes et Etudes Documentaires", 30th December, 1965.

The syllabus for all students entering secondary school should be largely the same in 7th and 8th grades whatever their orientation may be. The common part of this programme should cover about two-thirds of the total instruction time, the rest being devoted to optional subjects. The common subjects will be : mother tongue, mathematics, second language, science, history, geography, music, art and physical education while the optional subjects will be divided into four categories, namely humanities, sciences, technology and general culture. The time allocated to the optional subjects will be divided into four, each stage lasting one semester and comprising, apart from the main subject, two or three hours per week of practical work or related theory in such subjects as wood-work, metal-work, dress-making, home-economics, etc. In this way, each child will have practice in 4 different fundamental techniques during the 7th and 8th grades.

Subsequently, all pupils, including those preparing for the university, will continue to take practical subjects throughout their secondary schooling, for at least one hour per week.

At the end of the eighth grade, the less-gifted pupils should be advised to take a special course for initiation to employment, or to enrol in any of the simple apprenticeship courses available in several fields. The initiation course should consist of approximately 50 per cent of basic education subjects such as mother tongue, second language, physical education, history, geography, civics, religion, trade unionism, banking and Civil services, and 50 per cent practical work or related theory. Those not taking the initiation course would be given the option of choosing a three-year technical or vocational course (grades 9, 10 and 11), leading to a profession in the various technical, commercial, agricultural or other vocational fields indispensable to modern society. During the 9th grade, 20 per cent of the time should be given to a systematic exploration of the various trades, including workshop practice, visits to industry, etc. Technical optional subjects should constitute 20 per cent of the curriculum in grade 10, and 60 per cent in the final year. A secondary education certificate (technical) will be awarded in respect of these specialized programmes.

Graduates of the above technical course may : (i) join the labour force; (ii) enrol in a special vocational school to obtain further qualifications; (iii) enrol in an institute of technology for higher technical studies.

Appendix V

LOWER-LEVEL TECHNICIAN COURSES

1. General time-table for two-year vocational courses - Quebec

Subjects	Instruction periods per week		Total (units) (1)	%
	1st yr.	2nd yr.		
a. General subjects(2)			18	28.5
(i) Mother tongue	2	2	4	
(ii) Second language	2	2	4	
(iii) Sociology and introduction to business	1	2	3	
(iv) Arithmetic	4	-	7 (iv and v together)	
(v) Algebra and trigonometry	-	3		
b. Technological subjects and practical work			45	71.5
(i) Industrial drawing(2)	3	3	6	
(ii) Technology of the trade	2-10	2-9	39 (ii and iii together)	
(iii) Laboratory and workshop practice	10-18	10-17		
Total	32	31	63	

(1) 1 unit = 40 periods of instruction (approximately)

(2) Common to all vocational courses.

2. <u>Time-table for a five-year course in sciences, technology and trades at high-school level</u>

(Ontario)

Subjects	Instruction periods per week-grades			
	9	10	11	12
a. Compulsory subjects	35	35	17	17
(i) English	7	8	8	8
(ii) Second language(1)	5	5	-	-
(iii) History	4	4	5	5
(iv) Geography	4	4	-	-
(v) Physical education	4	4	4	4
(vi) Mathematics	5	5	-	-
(vii) Science	5	5	-	-
(viii) Group guidance	1	-	-	-
b. Optional subjects	10	10	10	10
Any one of:				
(i) Technical subjects	(10)	(10)	(10)(2)	(10)(2)
(ii) Home economics	(10)	(10)	(10)	(10)
(iii) Vocational art	(10)	(10)	(10)	(10)
Any three of:			18	18
(i) Mathematics (geometry, algebra)	-	-	(6)	(6)
(ii) Science (physics, chemistry)	-	-	(6)	(6)
(iii) Geography	-	-	(6)	(6)
(iv) Second language(1)	-	-	(6)	(6)
Total	45	45	45	45

(1) French, Latin, German, Spanish, Italian, Russian.

(2) In grade 11 a pupil may select two from the following technical subjects: architectural drawing, mechanical drawing, electricity, electronics, industrial chemistry, industrial physics, machine-shop. One of these subjects must be continued in grade 12 and the other completed in grade 11. A further technical subject must be selected in grade 12.

See paragraphs 3 and 4 below for special one-year courses.

General remarks

The five-year programme leads to the secondary school Honour Graduation Diploma and enables pupils of good general ability to qualify for admission to a university course, institute of technology or other further studies for which successful completion of work in grade 13 is required. It also offers to those who, though not entering such careers, desire the advantages of secondary education to grade 13 level, the opportunity to take courses of particular interest or value for a future vocation. A pupil who successfully completes four years of the five-year programme (grades 9 to 12 inclusive) will be awarded a Secondary School Graduation Diploma qualifying him for admission to grade 13 of any regular high-school course. He may also be admitted to a special one-year technical course or to courses in business, commercial work, home economics or vocational art (see below).

Similar five-year programmes are offered in arts and sciences, and business and commerce.

3. Special one-year technical course

(i) English composition	3 periods/week
(ii) Economics	5 " "
(iii) Mathematics or science	5 " "
(iv) Technical subjects	32 " "
Total	45

Pupils will specialize in one of the technical subjects available and will complete all the work normally studied in that subject in grades 11 and 12. In addition, pupils must select one or more related technical subjects for which a total of 5 periods per week will be taken from the time allotted to technical subjects.

The minimum requirement for admission to this course is the successful completion of the four-year programme (see below) in any branch or of grade 11 requirements together with grade 12 standing in English, mathematics, science and physical education in the five-year programme of any branch.

4. Special one-year commercial course

(i)	Shorthand	10 periods/week
(ii)	Typewriting and office practice	13 periods/week
(iii)	Book-keeping	6 periods/week
(iv)	Business mathematics	3 periods/week
(v)	Penmanship	2 periods/week
(vi)	Correspondance and spelling	4 periods/week
(vii)	Economics and law	4 periods/week
(viii)	Physical education	3 periods/week
Total		45

Pupils who have satisfactorily completed grade 11 or grade 12 of any approved five-year programme, or grade 12 of a four-year programme, are eligible for admission to this course and on completing it successfully may receive the Secondary School Graduation Diploma (Commercial).

5. Time-table for a four-year course in science, technology and trades at high-school level (Ontario)

Subjects	Instruction periods per week-grades			
	9	10	11	12
a. Compulsory subjects	35	30	26	26
(i) English	7	8	7	7
(ii) French	5	-	-	-
(iii) History	4	4	5	-
(iv) Geography	4	4	-	-
(v) Physical education	4	4	4	4
(vi) Mathematics	5	5	5	5
(vii) Science	5	5	5	5
(viii) Group guidance	1	-	-	-
(ix) Economics	-	-	-	5
b. Optional subjects				
Any one of:	10	10	14	14
(i) Technical subjects	(10)	(10)	(14)	(14)
(ii) Home economics	(10)	(10)	(a)	(a)
(iii) Vocational art	(10)	(10)	(14)	(14)
Any one of:	-	5	5	5
(i) Art	-	(5)	(5)	(5)
(ii) Music	-	(5)	(5)	(5)
(iii) Agriculture	-	(5)	(5)	(5)
(iv) Commercial subjects	-	(5)	(5)	(5)
(v) French	-	(5)	(5)	(5)
(vi) Another language(b)	-	(5)	(5)	(5)
(vii) Geography	-	-	(5)	(5)
(viii) Further technical subjects, home economics or vocational art	-	(5)	(5)	(5)
Total	45	45	45	45

(a) Special arrangements for home economics

(b) German, Greek, Latin, Spanish, Italian, Russian.

General remarks

The four-year programme offers both basic secondary-school subjects and specialized instruction in technical subjects, home economics or vocational arts for pupils who have special aptitude in one of these fields and who expect to enter employment for where these subjects will be of direct practical value. Pupils who complete this programme satisfactorily are awarded a Secondary School Graduation Diploma, and may then take a special one-year course in business, commercial subjects, technical subjects, home economics or vocational arts (see 3, 4 above).

Similar four-year programmes are offered in arts and science, and business and commerce.

6. Time-table for a two-year vocational course

	Instruction periods per week-grades	
	9	10
(i) English	7	7
(ii) History and geography	7	7
(iii) Mathematics	5	5
(iv) Science	4	4
(v) Group guidance	1	1
(vi) Physical education	4	4
(vii) Practical subjects	17	17
Total	45	45

General remarks

Pupils who have gained admission to a secondary school but plan to leave school for employment after 2 years may take the above two-year programme associated with the four-year programme in one of the three branches available.

A pupil who has completed one or two years of a two-year programme and has shown superior ability may be transferred to the four-year programme of the branch concerned, subject, if necessary, to repeating all or a portion of a year's work in the latter programme.

Pupils who conform to the requirements of a two-year programme and complete the courses successfully may be granted, on the recommendation of the principal, a "Department Certificate of Studies".

7. Radio and television servicing pre-occupational course (Saskatchewan)

Length of course: 10 months.
Admission: Grade 10, and be at least 17 years of age.

Units of instruction

(i) Direct current;
(ii) Alternating current;
(iii) Basic electronics;
(iv) Radio servicing, including AC DC automobile;
(v) Transistors;
(vi) Audio units;
(vii) Television;
(viii) Citizens and civil communications.

During the last 10 weeks of the course, students, after consultation with the senior instructor, may take unit (vii) or (viii).

Appendix VI

UPPER-LEVEL TECHNICIAN COURSES

1. Institutes of technology and comparable establishments (1963)

Province	Institution
Newfoundland	Newfoundland College of Trade and Technology, St. Johns.
Nova Scotia	Nova Scotia Land Survey Institute, Lawrencetown. Nova Scotia Institute of Technology, Halifax.
New Brunswick	New Brunswick Technical Institute, Moncton. St. John Technical Institute, Saint John.
Quebec	Institute of Graphic Arts, Montreal. Institute of Applied Arts, Montreal. Papermaking Institute of the Province of Quebec, Three Rivers. Institute of Textiles, St. Hyacinthe. Marine Institute, Rimouski. Institute of Technology, Armida. Institute of Technology, Chicoutimi. Institute of Technology, Hull. Institute of Technology, Lauzon. Institute of Technology, Laval, Montreal. Institute of Technology, Montreal. Institute of Technology, Quebec. Institute of Technology, Rimouski. Institute of Technology, Shawinigan. Institute of Technology, Sherbrooke.

Province	Institution
Quebec(Cont.)	Institute of Technology, Three Rivers. Institute of Agricultural Technology, St. Hyacinthe. Institute of Agricultural Technology, La Pocatière. Institute of Technology, Sept Iles.
Ontario	Northern Ontario Institute of Technology, Kirkland Lake. Lakehead College of Arts, Science and Technology, Port Arthur. Provincial Institute of Mining, Haileybury. Ryerson Polytechnical Institute, Toronto. Hamilton Institute of Technology. Western Ontario Institute of Technology, Windsor. Eastern Ontario Institute of Technology, Ottawa.
Manitoba	Manitoba Institute of Technology, Winnipeg.
Saskatchewan	South Saskatchewan Institute of Technology, Moose Jaw. Central Saskatchewan Institute of Technology, Saskatoon.
Alberta	Southern Alberta Institute of Technology, Calgary. Northern Alberta Institute of Technology, Edmonton.
British Columbia	British Columbia Institute of Technology, Burnaby(1).

(1) Under construction.

2. Number and nature of courses available
Full-time day enrolments in technician courses

Course	No. of institutions	Duration (yrs)	Graduated in 1963	Final year enrolment 1963	Total enrolment 1963
Administration					
General	6	2-3	104	183	1,008
Industrial production	1	2	-	-	17
Printing management	1	3	4	15	61
Food service supervision	1	2	-	-	6
Hotel, restaurant and resort administration	1	3	15	16	68
Merchandising	2	2-3	23	63	163
Resources management	1	2	-	-	23
Accountancy	2	2	17	39	99
Secretarial science	4	2-3	20	31	163
Aeronautical technologies					
General	3	3	49	39	203
Aircraft maintenance	1	2	9	16	41
Agricultural technology					
General	2	3	-	-	124
Applied Arts					
Journalism	1	3	19	33	119
Radio and television	1	3	37	33	121
Photographic	2	2-3	12	16	84
Interior decorating	1	3	19	40	147
Furnishing and interior design	1	3	18	17	73
Home economics (fashion)	1	3	8	14	70
Home economics (pre-school)	1	2	23	16	19
Ceramics, enamelling and weaving	1	3	3	4	13

Course	No. of institutions	Duration (yrs.)	Graduated in 1963	Final year enrolment 1963	Total enrolment 1963
Applied Arts					
Draughting	2	2	15	27	91
Graphic arts	2	3	27	55	265
Commercial art, fine art, crafts	1	4	11	6	169
Architectural technologies					
General	4	2-3	48	80	329
Drawing	1	2	8	14	38
Automotive technologies					
General	9	3	137	146	727
Automotive service	1	2	19	25	60
Chemical technologies					
General	5	3	50	81	368
Industrial	3	3	27	32	268
Industrial laboratory	2	2	30	50	154
Textile	2	3	12	37	109
Chemistry and dyeing	1	4	11	13	50
Papermaking	1	3	22	25	118
Civil technologies					
General	6	2-3	42	65	334
Construction	3	2	2	12	56
Land surveying	3	2	22	30	87
Woodworking	11	3	65	59	338
Furniture making	1	4	22	34	168
Materials	1	2	-	-	22
Electrical technologies					
General	18	2-3	340	358	1,782
Industrial	2	2	14	28	75

Course	No. of Institutions	Duration (yrs.)	Graduated in 1963	Final year enrolment 1963	Total enrolment 1963
Electronic technologies					
General	19	2-3	430	584	2,561
Marine	1	2	-	-	6
Instrumentation and control	3	2-3	11	25	112
Wireless telecommunication	1	2	8	8	25
Food technologies					
Commercial cooking	1	2	-	15	32
Home economics (food)	1	3	4	19	97
Forest technology					
General	1	2	9	17	63
Mechanical technologies					
General	10	2-3	87	153	751
Marine engineering	1	3	7	7	28
Heavy duty equipment	1	2	-	-	20
Power plant	1	2	12	11	27
Machine shop	12	3	204	192	1,039
Tool making	2	3	41	42	42
Pattern making	5	3	19	14	40
Metallurgy	3	3	24	27	111
Blacksmithing	1	3	1	-	3
Foundry	5	3	4	2	14
Welding	9	3	13	20	116
Sheet Metal	5	3	22	19	78
Refrigeration and air conditioning	6	2-3	21	31	135
Plumbing and heating	2	3	8	5	39
Medical technologies					
Medical laboratory	2	2	25	18	91
X-ray	1	2	-	-	26
Dental	1	2	-	-	12

Course	No. of institutions	Duration (yrs.)	Graduated in 1963	Final year enrolment 1963	Total enrolment 1963
Mining technology					
General	2	2-3	38	42	122
Petroleum technologies					
General	1	2	11	23	60
Gas	2	2-3	6	3	39
Engineering technology					
(not specified elsewhere)	2	2-3	11	14	76
Miscellaneous					
Navigation	1	2	11	8	34
Totals	-	2-3-4	2,331	3,051	14,029

3. <u>General time-table for an institute of technology course</u>

(Quebec)

Subjects	Instruction periods per week							Total (units) (2)
	1st year			2nd year		3rd year		
	1	2	3	1	2	1	2	
1. Languages(1)	-	4	4	2	2	1	1	14
(i) French	-	2	2	1	1	-	-	6
(ii) English or other language	-	2	2	1	1	1	1	8
2. Mathematics, science and drawing(1)	19	17	18	19	19	15	13	120
(i) Algebra, analytical geometry, calculus	2	2	2	2	2	2	1	13
(ii) Trigonometry	2	2	2	-	-	-	-	6
(iii) Geometry	2	2	2	4	4	2	1	17
(iv) Chemistry	2	2	2	3	3	-	-	12
(v) Physics	4	4	4	6	6	4	4	32
(vi) Descriptive geometry and industrial drawing	7	5	6	4	4	7	7	40
3. Special subjects(1)	1	1	1	1	1	4	5	14
Industrial geography, history of technol. industrial law, accounting, sociology	1	1	1	1	1	4	5	14
4. Technical subjects	12	12	12	15	15	17	17	100
(i) Technology of the trade	3 to 8			3 to 9		1 to 9		
(ii) Workshop & laboratory pract.	4 to 9			6 to 12		8 to 16		
Total	32	34	35	37	37	37	36	248 (3,240 periods approx.)

(1) Subjects common to all branches

(2) 1 Unit = 13 periods of instruction (approximately).

4. Content of certain subjects

(a) Subjects common to all specialities

(i) Algebra: 1st year: 60 periods

Factors (Compound expressions divisible by $x \pm a$). - Literal equations. - Quadratic equations (one unknown). - Quadratic literal equations. - Higher degree equations. - Review of equations involving surds. - Problems leading to quadratic equations. - Simultaneous quadratic equations. - Theory of indices. - Logarithms. - Exponential equations. - The slide rule.

(ii) Geometry: 1st year: 60 periods

Areas of polygons, lines and planes in space. Dihedral angles. Polyhedrals. Lateral and total areas, volumes of prisms, pyramids and frustums. - Cylinder, frustum of cone, sphere, zones. Simpson's formula. - Volume of irregular solids.

(iii) Trigonometry: 1st year: 60 periods

Elementary principles. - Solution of right triangle based on the six fundamental relations. Trigonometric functions of angles from 0° to 360° plus. Compound angle relations. Sum and difference of two angles. Drawing curves: sine, cosine, tangent, etc. - Solution of oblique triangles using the sine and cosine law. - Using logarithms to solve oblique triangles.

(iv) Mathematics: 2nd year: 60 periods

Arithmetical progressions. Geometrical progressions. Variation. Graphs. Graphical solution of first, and second degree equations. Analytical Geometry: Distance between two points. Dividing a line in a given ratio. Area of a triangle. Slope of a line. Angle between two straight lines. - Equation of the straight line:

$$y - yi = m(x-xi); \quad \frac{y - yi}{x - xi} = \frac{yi - y2}{xi - x2}; \; Ax + By + C = 0.$$

Distance from a point to a straight line. - Equations of the circle, the parabola, the ellipse, and the hyperbola.

(v) Mathematics; 3rd year: 45 periods

Limits. - Indeterminate forms. - Four step method of calculating the derivative. Formulas of differentiation: derivative of a constant, of a sum, of a product, of a quotient, of a function. - Geometric interpretation of the derivative. - Problems on maxima and minima, on rates of change, on instantaneous velocity, and on acceleration.

(vi) Industrial geography; 3rd year: 15 periods

Its importance. - Elements of production. - Required conditions for economic growth. - Coal: its importance, problems of production, transportation, trading.- Petroleum. - its importance, problems of production. - Electricity: problems of production, potential, world output. - Iron: cast iron, steel, world production, sales. - Non-ferrous metals. - Lumber: types of wood, producers, forest conservation. - Rubber: history, production, synthetic. - Principal industrial countries.

(vii) Industrial history: 3rd year: 15 periods

A brief summary of incentives to industry; slow beginning of industry through the ages until the 18th century. - Conditions essential to the creation and expansion of large-scale industry. England, cradle of industry. - The French Revolution. The American Revolution. - Industrialization of other countries. Industrialization of Canada from the beginning to the last world war, present conditions.

(viii) Industrial law; 3rd year: 15 periods

Introduction. - Origins of our laws. - Three authorities: executive, legislative, judicial. - The courts of law. Contracts: four conditions. Sales, employment and enterprise contracts. - Business forms: one person owner-ship, partnerships, corporations. Financing; shares, negociable instruments, bills of exchange, cheques, notes. - Insolvency provisions. The Lacombe law. Employment: collective agreements, minimum wages, - restrictions based on age and sex. - Unions: labour disputes, arbitration. - Industrial safety: liabilities and compensation.

(ix) Chemistry and laboratory; 1st year, all specialities: 60 periods

The atom. - Classification. Atomic numbers. - Atomic and molecular weights. Chemical symbols. - Equations. Laws. Mathematics. - Solutions. - Colloids. - Suspensions. Sulphur. Nitrogen. - Carbon oxides. - Sodium. - Potassium. Ionization. Acids. Bases. Chemistry of minerals. Metals: definition, alloys, and metallurgy. - Laboratory.

2nd year; all specialities: 90 periods

Organic Chemistry: General notions. - Hydrocarbons. - Petroleum. - Heat of reaction of hydrocarbons. - Alcohols. Organic acids. - Ethers, aldehydes, ketones. Esters and fats. Cellulose and by-products. - Benzene and by-products.

(b) Specialization industrial chemistry

(i) Quantitative analytical chemistry; 2nd year: 60 periods

The solutions. - The law of chemical equlibrium. - The law of equilibrium applied to ionization. - The law of equilibrium applied to precipitation. - The law of equilibrium applied to complex ions.

Laboratory work: 270 periods

Preparation of solutions. Gravimetric and volumetric analysis. Analysis of sodium hydroxide, of hydrochloric and of oxalic acids. - Preparation and titration of decinormal solutions. Analysis of hydrogen peroxide. - Titration of chlorine in a mixture of salts, in water, and in sodium hypochlorite. Estimation of metal content in various ores.

Technology applied to analytical procedure and laboratory practice: 30 periods

Theoretical fundamentals of quantitative analysis. - Laboratory procedure applied to gravimetric and volumetric analysis. Preparation of normal solutions of acids and bases. Preparation of normal solutions of oxidizing and reducing agents. Sensitivity and limits of use of indicators.

(ii) Quantitative analytical chemistry; technology; 3rd year: 30 periods

The law of equilibrium applied to complex ions (following the law of equilibrium applied to hydrolysis. - Electrochemical theory of redox reactions.

(iii) General chemistry - laboratory; 1st year: 240 periods

The preparation of reagents. - The main operation of the laboratory. - Glass working. - The setting of apparatus. The changes of matter. Oxygen. - Water. - Hydrogen. Acids, bases and salts. - Chlorine, halogens. - Sulphur, sulphurous anhydrid, sulphurous acid, sulphuric acid. - Ammonia. - Nitric acid, nitric oxide. - Nitrogen. - The series of activity of metals. - Properties of solutions. Carbon dioxide. - Carbon. - Qualitative analysis: the reagents, practical basis of analysis, the main procedures, anions and cations, analytical outline, dissolution, fusion and disintegration, practical analysis.

(iv) Industrial chemistry; 2nd year: 30 periods

Introduction. - Chemical, physical and mechanical properties of metals. - Metallurgy: concentration, pulverization and separation of ores, pyrometallurgy, electrometallurgy, metallurgical production. - Iron, cast iron and steel.

3rd year: 60 periods

Iron, cast iron and steel. Allotropic forms of iron. The iron diagram. - Carbon. - Metallurgy of non-ferrous metals. - The main inorganic non-metallic industries.

(v) Industrial chemistry of foods; 3rd year: 30 periods

Notions on micro-organisms. - Bacteria, yeasts, mildews. Methods of coloration. - Cultures. - Effects of environment on bacteria. - Sterilization. - Disinfection. - Bacteriology of water, of milk and related compounds, of foods. - Foods and alimentation. - Inorganic foods. - Blycides, lipides, and proteins. - Vitamins, enzymes. - The study of some of the most important foods.

Laboratory: 88 periods

Use of the microscope. - Culture mediums. - The autoclave. The distribution of bacteria. Bacterial motion. Preparation and fixation of bacteria. Methods of coloration. Mortal temperature. Effects of physical conditions on the bacteria. Effects of the hydrogen ions on the bacteria. Action of the bacteria on sugars. Bacteriological analysis of water. The numbering of bacteria in milk. Yeasts and mildews. Titrated solutions. Titration of nitrogen. Incineration. Reductive action of the carbohydrates. The identification of the carbohydrates. Sugars. Fats. Analytical indexes of fats and oils.

(vi) Nuclear chemistry; 3rd year: 30 periods

Natural radioactivity and the structure of the atom.

Natural and artificial transmutations. - Artificial radioactivity. The transuranic elements. - A corollory on the modern methods of chronology.

(vii) Organic chemistry: 2nd year: 60 periods

Introduction. - Saturated and non-saturated hydro-carbons. The halogen derivatives of hydrocarbons. - Monohydric alcohols. Ethers. - Aldehydes and ketones. Salts of organic acids. Mono-carbozylic acids. - Lipides. The anhydrides of organic acids. Halogen acids. - Amines and diamines. Amino acids. Proteins. Nucleoproteins. - Cyanides and isocyanides. - Other organic nitrogen compounds.

3rd year: 60 periods

Carbohydrates and related compounds. - Aliphatic compounds of sulphur, of phosphorus and of arsenic. Introduction to the study of cyclic compounds. - Aromatic hydrocarbons. - Halogen derivatives of aromatic hydrocarbons. Aromatic amines. Aromatic alcohols. - Aromatic aldehydes and ketones. Aromatic acids and their derivatives. - Aromatic compounds with mixed groups. - Aromatic compounds with double and triple ring. - Heterocyclic compounds. - Synthetic polymers. - Dyes. The terpenes and related compounds. - The alkaloids. - Aromatic compounds of arsenic, of mercury and of bismuth. - Typical reactions. - Plant and animal pigments. - Enzymes, vitamins and hormones. - Summary of the nomenclature.

3rd year: technology: 30 periods

Practical laboratory technique in organic chemistry. Methods of purification. - Analytical techniques. - Synthetic techniques. - Analysis of gases: absorption methods, combustion methods, volumetric methods. - Practical calculations.

3rd year: laboratory: 165 periods

The calibration of a thermometer. - Mixed melting point. Analytical tests. Preparation and study of the properties of an alkane, of an alkene, of an alkine, of an alcohol, of an ether, of an halogen derivative. - Aldehydes and ketones. Monocarboxylic acids. - Ethanoic acid. - Preparation and study of the properties of an ester, of an amide, of an aliphatic amine, of an imide, of a nitrile, of a nitro derivative, of an aromatic amine, of a sulphonic acid, of a phenol. - Diazotation. - Preparation of a heterocyclic compound. - The reactions of isomerism. - The reactions of polymerism and of polycondensation. - The extraction of chlorophyll. - The alkaloids.

(viii) Physical chemistry: 2nd year: 60 periods

Dimensions and units. - Gases. - Physical properties and molecular structure. - The solid state. - The liquid state. Practical calculations.

3rd year: 60 periods

The solutions. - Properties of non-electrolytic solutions. Velocity of reaction. - Practical calculations.

3rd year: laboratory: 77 periods

Vapor density. - Density in gases. - Surface tension. Viscosity. - Index of refraction. - The lowering of the freezing point. - The elevation of the boiling point. - The lowering of the vapor pressure by a dissolved substance. Distillation. - Distribution of a substance between two non-miscible liquids. The diagram of phases. - Reactions of the first order. - Reactions of the second order. - The electromotive force.- Electrolytic equilibrium. - Indicators, buffer solution and the colorimetric determination of the pH's. Analytical tests of petroleum and its derivatives. - Analytical tests of points. - Colorimetry. - Gazometry.

5. Time-table for a 2-year course in mechanical technology

(Southern Alberta Institute of Technology, Calgary, Alberta)

Subjects	Total instruction periods		
	1st year	2nd year	Total
1. Language			
English	90	90	180
2. Mathematics and science			
(i) Mathematics	120	120	240
(ii) Physics	90	90	180
3. Technical subjects and practical work			
(i) Mechanical drafting and design	210	180	390
(ii) Strength of materials	-	90	90
(iii) Metallurgy	-	60	60
(iv) Electrical lab. and theory	60	-	60
(v) Machines and mechanisms	60	-	60
(vi) Machine-shop theory and materials	90	90	180
(vii) Machine-shop laboratory	180	180	360
(viii) Welding lab. and theory	-	60	60
Total	900	960	1,860

6. Course outline of the 2-year course in mechanical technology (5 above)
(Content of certain subjects)

(a) First year

(i) Machines and mechanisms: 60 periods

A study of various types of mechanical equipment, their function, construction, and principles of operation. Whenever possible or necessary, actual equipment will be dismantled, the components studied and then re-assembled. These studies will include: drives such as flat and V-belt, gear trains, chains, cables, couplings, clutches, splines, screws, cams, universal joints, etc.: sleeve, ball and roller bearings, and lubricating systems: transmissions, differentials, pumps, blowers, hoists, jacks, hydraulic equipment: internal combustion engine, steam engine, pressure vessels, etc.: pipe threads, fittings, joints and couplings. Students will be required to make observations and prepare reports. Several industrial plants will be visited.

(ii) Machine shop laboratory: 180 periods

Practical shop work involving the use of hand tools, measuring instruments and basic machine tools. Emphasis is placed on a thorough understanding of processes and problems connected with the making of machine parts. Several industrial plants will be visited.

(iii) Machine shop theory and materials: 90 periods

A study of machine shop tools and equipment, and machining methods and processes to develop a thorough understanding of the manufacturing process. It covers established standards, machine shop terminology, etc. This unit is closely correlated with the practical work in the machine shop.

The section on machine shop materials covers the sources and production of common metals and alloys used in the production of machine parts; it also includes a study of the mechanical properties of metals, and the effects of cold forming and heat treatment.

(iv) Electrical theory and laboratory: 60 periods

Theory:

Basic concepts pertaining to voltage, current, resistance, impedance, power, frequency; sources of electricity; single phase, three phase and uses; power, speed and torque relationships; safety precautions in handling electrical circuits and equipment; mention of the Canadian Electrical Code and conductor sizes.

Practical:

1. A.C. motors - (a) mechanical features, (b) electrical features, (c) controls, (d) protection.
2. D.C. motors - similar to the above; advantages and disadvantages as compared to a-c motors.
3. Rectifiers - (a) dry disc, (b) electronic.

(v) Mechanical drawing: 210 periods

Drawing instruments, their construction and use; geometric constructions; lettering; technical sketching; orthographic projection; axonometric projection; oblique projection; sectional views; dimensions and notes; tolerancing; intersections and developments; revolutions; threads, fasteners and springs; working drawings; blueprint reading; reproduction of drawings.

(vi) Mathematics: 120 periods

A study of the elementary functions of modern mathematical analysis with emphasis on the development of manipulative skills and including an introduction to the methods of the calculus: function, concept and notation; graphs, equations, derivatives and integrals of simple algebraic functions together with manipulative drills and applied problems; graphs, equations and derivatives of simple trigonometric functions with manipulative drills and applied problems; graphs, equations and derivatives of simple logarithmic and exponential functions; use of common and natural logarithms, and slide rule; applied problems.

(vii) Physics: 90 periods

Measurement; liquids at rest; properties of gases; temperature measurement, thermal expansion; heat quantities; heat transfer; vectors, forces at a point; velocity and acceleration; force and motion; friction; work and power; energy: elastic properties of solids.

(viii) English: 90 periods

This is an intensive course designed to improve students' critical thinking as well as their writing and reading skills. The course begins with instruction on how to study. It demonstrates how elementary logic, fundamental writing techniques, outlining, summarizing, paragraphing, vocabulary, grammar, spelling, capitalization, punctuation, are applied to the writing of short, informal library research reports, business correspondence, and technical explanations. It also includes critical evaluations of the structure and contents of published writings, especially in science and technology.

(b) Second Year

(i) Strength of materials: 90 periods

Statics; basic principles, resultants of forces, moments of forces; coplanar parallel force systems, beam reactions; coplanar concurrent force systems; coplanar, non-concurrent force systems, truss analysis.

Strength of materials; stress and deformation; riveted and welded joints, thin-walled pressure vessels; torsion; centroids and moments of inertia; shear and moments in beams; stresses in beams; deflection of beams; combined stresses.

(ii) <u>Machine shop laboratory: 180 periods</u>

A continuation of practical work in the shop as outlined in First Year, (ii) on more advanced work, including the use of milling machines, grinders, slotter, planer, and heat treating equipment. More emphasis will be placed on workmanship, procedures, and practices than in the first year. The work includes making of jigs and fixtures and toolmaking. Methods of reconditioning worn parts are also included.

(iii) <u>Machine shop theory: 90 periods</u>

This section is closely correlated to practical work in the shop and includes a study of the construction and operation of standard and specialized machine tools, and the design and making of punches and dies, jigs and fixtures, gears, etc. It includes inspection, shop layout, production planning, and estimating of costs. Various possible methods of doing a job are discussed. Use of handbooks and other reference materials is included.

(iv) <u>Metallurgy: 60 periods</u>

Production of castings, forgings, rolled bars and sheets, wire, pipe, tubing, etc.; effect of carbon and alloys on steel; S.A.E. and A.S.T.M. numbering systems; properties of common metals and alloys, their usefulness and limitations; structures of metals; the effect of heat treating and cold working on mechanical properties; physical testing of metals; machinability, weldability, hardenability, corrosion resistance.

(v) <u>Mechanical drawing and design: 180 periods</u>

Review of work in unit (v) First Year; welding drawing; pipe drawing; production aids; sheetmetal drawing; shop processes; cams; gears; V-belt and roller chain drives; bearings; assembly drawing; design problems.

(vi) Mathematics: 90 periods

Analytical geometry of the conic sections and a further study of functions with emphasis on the calculus and applied problems; rate of change problems, differentials, approximations, maxima and minima, curve sketching, applied problems in maxima and minima, integration, definite integrals, summations, fundamental theorem, areas, volumes, centroids, moments of inertia; integration of trigonometric, logarithmic and exponential functions, applied problems; integration by substitution, integration by parts, integration by partial fractions, integration of inverse trigonometric functions; simple differential equations (time permitting).

(vii) Physics: 90 periods

Rotation of rigid bodies: momentum; uniform circular motion; projectile motion; vibratory motion; fluids in motion; thermodynamics; problems in applied mechanics.

(viii) English: 90 periods

This is an intensive course which aims at improving students' critical faculties and their writing, speaking and reading skills. The course begins with a review of library research reports, business correspondence and technical explanations. It includes study of the more important elements of report writing, methods of gathering report data, formal and informal report formats, and the uses of different types of reports - with emphasis on the formal technical report. It also includes a study on the organization and delivery of short speeches (including technical talks) and the conduct of business meetings. The structure and content of published writings, mostly in science and technology, are analyzed and evaluated. Selected readings are also assigned for book reports and class discussions.

(ix) Welding laboratory and theory: 60 periods

A study of oxy-acetylene welding and cutting and electric welding as it applies to machine construction, fabrication, and repair. This section is covered during the first two weeks of the school year, and includes up to thirty hours of practical welding experience.

Oxy-acetylene processes:

Properties of gases; effect of various types of flames on physical properties of a weld; cutting; low temperature brazing hard surfacing; applications to ferrous and non-ferrous materials, including advantages, limitations and costs.

Electric processes:

Types of arc welding equipment and their uses including manual, semi-automatic, automatic, and inert atmosphere; types of electrodes, their physical properties, and AWS classification; effect of multi-pass welding on weld quality hard surfacing; resistance welding; applications, including advantages, limitations and costs.

The course includes types of joints, jigging devices, distortion and its control, stress removal and heat treatments, design of welded structures for dynamic and static loading, testing of welded joints including nick break, guided bend tests, Magnaflux, and X-ray methods.

7. <u>Time-table for a 2-year course in industrial electrical technology</u>

(Northern Alberta Institute of Technology, Edmonton, Alberta)

First Year	Lect.	Lab.
1st quarter:		
(i) Orientation and guidance	1	-
(ii) Analytical geometry and basic trigonometry	3	-
(iii) Introductory technical English	3	-
(iv) Electricity and magnetism	3	-
(v) Elementary drafting	2	-
(vi) Codes and safety I	1	-
(vii) DC circuits and meters	4	10
Total, 1st quarter	17	13
2nd quarter:		
(i) Practical analysis	3	-
(ii) Communication skills	3	-
(iii) Liquids; gases; heat	3	-
(iv) Detailing	-	3
(v) Codes and safety II	1	-
(vi) DC and AC circuits I	5	10
(vii) Heating and control circuits I	-	2
Total, 2nd quarter	15	15
3rd quarter:		
(i) Equality	3	-
(ii) Data presentation	3	-
(iii) Mechanics	3	-
(iv) Electrical and mechanical drafting	-	3
(v) Codes and safety III	1	-
(vi) Electrical machines I	4	10
(vii) Electronics I	1	2
Total, 3rd quarter	15	15
Total, first year	47	43

Second year	Lect.	Lab.
4th quarter:		
(i) Trigonometry	3	-
(ii) Report project	-	3
(iii) Circular and vibratory motion	3	-
(iv) Codes and safety IV	1	-
(v) DC and AC circuits II	4	10
(vi) Instruments and measurements I	2	4
Total, 4th quarter	13	17
5th quarter:		
(i) Calculus I	3	-
(ii) Optics	3	-
(iii) Industrial relations	2	-
(iv) Codes and safety V	1	-
(v) Electrical machines II	5	10
(vi) Electronics II	2	4
Total, 5th quarter	16	14
6th quarter:		
(i) Calculus II	3	-
(ii) Solid state, electronics and electrochemistry	3	-
(iii) Codes and safety VI	1	-
(iv) Instruments and measurements II	2	4
(v) Industrial controls	4	10
(vi) Circuit design	1	2
Total, 6th quarter	14	16
Total, second year	43	47
Grand Total (Approximately 1,800 instruction periods).	90	90

8. Time-table for a 3-year course in mechanical technology

(Northern Ontario Institute of Technology, Kirkland Lake, Ontario)

Subjects	1st year		2nd year		3rd year		Total(1) (units)		
	A	B	A	B	A	B	A	B	A+B
1. General subjects	3	2	3	-	2	-	8	2	10
English	3	-	3	-	2	-	8	-	8
Physical	-	2	-	-	-	-	-	2	2
2. Mathematics and science	8	6	4	-	4	-	16	6	22
Mathematics	3	2	4	-	4	-	11	2	13
Chemistry	3	2	-	-	-	-	3	2	5
Physics	2	2	-	-	-	-	2	2	4
3. Technical and special subjects	7	4	12	11	10	14	29	29	58
Electricity	3	2	-	-	-	-	3	2	5
Electrical machines	-	-	2	-	-	-	2	-	2
Applied mechanics	2	2	-	-	-	-	2	2	4
Thermodynamics	-	-	2	-	2	2	4	2	6
Materials and machines	-	-	4	3	4	2	8	5	13
Manufacturing processes	-	-	2	3	-	-	2	3	5
Metallurgy and welding	-	-	2	5	-	-	2	5	7
Metrology	-	-	-	-	-	2	-	2	2
Machine and tool design	-	-	-	-	2	6	2	6	8
Mechanics of fluids	-	-	-	-	2	2	2	2	4
Economics	2	-	-	-	-	-	2	-	
Total	18	12	19	11	16	14	53	37	90(2)

A = Lecture, B = Laboratory or workshop.

(1) 1 Unit = 30 periods of instruction (approximately)

(2) 2,700 periods of instruction approximately

Prior to graduation, each student is required to submit a formal technical research report on a topic approved by the faculty.

9. Time-table for a 2-year course in mechanical technology
(South Saskatchewan Technical Institute, Moose Jaw, Saskatchewan)

Subjects	Total instruction periods						
	1st year		2nd year		Total		
	Lect.	Lab.	Lect.	Lab.	Lect.	Lab.	Lect.+Lab.
General subjects	104	26	0	0	104	26	130
English	78	-	-	-	78	-	78
Public speaking	26	-	-	-	26	-	26
Physical education	-	26	-	-	-	26	26
Mathematics and science	208	0	0	0	208	0	208
Mathematics	104	-	-	-	104	-	104
Physics	104	-	-	-	104	-	104
Technical and other special subjects	245	336	585	315	830	651	1,481
Descriptive geometry	44	86	-	-	44	86	130
Drafting	-	130	-	90	-	220	220
Mechanics (statics, dyn., fluid-mech.)	93	-	60	-	153	-	153
Thermodynamics	78	-	-	-	78	-	78
Heating and ventilation	-	-	90	-	90	-	90
Industrial electricity	-	-	90	30	90	30	120
Kinematics and machines	-	-	45	-	45	-	45
Machine design	-	-	45	-	45	-	45
Materials and strength of materials	-	-	90	-	90	-	90
Mechanical technology	-	-	-	90	-	90	90
Motors	-	-	60	-	60	-	60
Shopwork	-	-	-	105	-	105	105
Surveying	30	120	-	-	30	120	150
Technical report writing	-	-	60	-	60	-	60
Professional practice	-	-	15	-	15	-	15
Economics	-	-	30	-	30	-	30
Total	557	362	585	315	1142	677	1,819

Appendix VII

COMMERCIAL COURSES

1. Time-table for a four-year course in business and commerce at high school level (Ontario)

Subject	9	10	11	12
a. Compulsory subjects				
(i) English	7	8	8	8
(ii) French	5	-	-	-
(iii) History	4	4	5	-
(iv) Geography	4	4	-	-
(v) Physical education	4	4	4	4
(vi) Mathematics	5	-	-	-
(vii) Science	5	-	-	-
(viii) Group guidance	1	-	-	-
(ix) Economics	-	-	-	5
(x) Business and commercial subjects	10	-	-	-
(xi) Business or commercial subjects		10	18	18
(xii) Commercial mathematics	-	5	-	-
b. Optional subjects	-	10	10	10
Any two of:				
(i) Science	-	(5)	(5)	(5)
(ii) French	-	(5)	(5)	(5)
(iii) Latin	-	(5)	(5)	(5)
(iv) Another language(1)	-	(5)	(5)	(5)
(v) Geography	-	-	(5)	(5)
(vi) Art	-	(5)	(5)	(5)
(vii) Music	-	(5)	(5)	(5)
(viii) Industrial arts or technical subjects	-	(5)	(5)	(5)
(ix) Additional time in business or commercial subjects	-	(5)	-	-
(x) Home economics	-	(5)	(5)	(5)
(xi) Commercial mathematics	-	-	(5)	(5)
Total	45	45	45	45

(1) German, Greek, Spanish, Italian, Russian.

The 4-year programme (time-table 1) in business and commerce is designed for pupils who are specifically interested in these subjects and have the necessary aptitude to profit from a good secondary school education in basic subjects and the specialized skills that lead to employment in commerce and industry. Pupils who meet the requirements of the 4-year programme are awarded a Secondary School Graduation Diploma and are also eligible for admission to a special one-year course in business or commercial subjects, technical subjects, home economics, or vocational arts (see Appendix V, 3, 4).

2. Time-table for a 2-year course in secretarial science at post-secondary level

(South Saskatchewan Technical Institute, Moose Jaw, Saskatchewan)

Subjects	Total periods of instruction						
	1st year		2nd year		Total		
	Lect.	Prac.	Lect.	Prac.	Lect.	Prac.	Total
English	90	-	-		90	-	90
Physical education	-	30	-	-	-	30	30
Business English	45	-	-	-	45	-	45
Business mathematics	45	-	-	-	45	-	45
Economics	45	-	-	-	45	-	45
Secretarial science	60	90	90	45	150	135	285
Shorthand	120	150	30	120	150	270	420
Speech	45	-	-	-	45	-	45
Typewriting	30	120	60	90	90	210	300
Business administration	-	-	90	-	90	-	90
Business psych.	-	-	45	-	45	-	45
Commercial law	-	-	90	-	90	-	90
Secretarial accountancy	-	-	90	90	90	90	180
Total	480	390	495	345	975	735	1,710

The above course (time-table 2) is open to grade 12 graduates. The following are admissible to the 2nd year: (i) students who have completed grade 12 and have the commercial high school certificate; (ii) graduates of the special commercial course at high schools (grade 12) and (iii) secretaries and office workers with grade 12 shorthand and typing and two years' experience. Graduates in secretarial science are qualified for office positions and, upon proving their efficiency as stenographers, for more responsible and remunerative secretarial positions.

The business administration course (time-table 3) is intended to provide students with an understanding of business in general and the universal application of management principles. The programme is general in character and recognises the importance of an academic education as well as a knowledge of the areas specifically related to business.

3. Time-table for a 3-year course in business administration at post-secondary level

(Ryerson Institute of Technology, Toronto, Ontario)

Subjects	Instruction periods per week			
	1st year	2nd year	3rd year	Total (units)(1)
1. English	4	5	4	13
2. Mathematics	3	-	-	3
3. Mathematics of finance	-	4	-	4
4. Accounting	5	4	4	13
5. Cost accounting	-	-	3	3
6. Economic principles	3	-	-	3
7. Political and economic geography	3	-	-	3
8. North American economic development	-	3	-	3
9. Principles of government and political science	-	-	3	3
10. Business law	3	-	-	3
11. Business organisation	4	-	-	4
12. Business management	-	-	5	5
13. Psychology	-	3	-	3
14. Marketing	-	3	-	3
15. Advertising	-	-	3	3
16. Retail merchandising	-	3	-	3
17. Money, credit and banking	-	-	3	3
18. Statistics	-	3	-	3
19. System of procedures	-	-	3	3
20. Typewriting	3	-	-	3
Total	28	28	28	84(2)

(1) 1 Unit = 30 Instruction periods (approximately).

(2) Approximately 2,500 instruction periods in all.

Appendix VIII

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(i) Northern Alberta Institute of Technology; Edmonton, Alberta.

(ii) Southern Alberta Institute of Technology; Calgary, Alberta.

(iii) British Columbia Vocational School; Burnaby, B.Columbia.

(iv) Vancouver Vocational Institute; Vancouver, B. Columbia.

(v) Montreal Institute of Technology; Montreal, Quebec.

(vi) Shawinigan Institute of Technology; Shawinigan, Quebec.

(vii) Eastern Ontario Institute of Technology; Ottawa, Ontario.

(viii) Northern Ontario Institute of Technology; Kirkland Lake, Ontario.

(ix) Ryerson Institute of Technology; Toronto, Ontario.

(x) South Saskatchewan Technical Institute; Moose Jaw, Saskatchewan.

(xi) Central Saskatchewan Technical Institute; Saskatoon, Saskatchewan.

Appendix IX

CONFRONTATION MEETING BETWEEN CANADA AND DENMARK

Main points of discussion - conclusions

(Revised Version)

(a) Delineation of the category of skilled labour force under consideration

1. It was agreed that a "scholastic" definition of the technician should be avoided. The force under consideration was defined as that which lies between the skilled worker at the one end and the professional engineer at the other.

2. It was decided that although discussions should be focussed on engineering technicians, as information available was mainly in this field, technicians in other fields should be also covered as adequately as possible.

(b) Level of technicians - Certification - Training

3. It was agreed that the technician force should be classified in two main levels, provisionally termed the junior or lower technician level and the senior or upper technician level. The classification should be based not on functional assignments but on educational qualifications which need not necessarily be acquired in a formal way.

4. The titles used to define the various levels of technical personnel vary from country to country. In Denmark lower level technicians are defined as "technicians" or "technical assistants" while in Canada the term "technologist" is used for the upper level and the term "technician" for the lower. University engineers are defined as "engineers" or "academy engineers" in Denmark.

5. Difficulty was experienced in comparing the training programmes of the two countries because of differences in basic principles. The Danish system is mainly based on apprenticeship training while the Canadian is entirely institutional. After discussion it was agreed that though apprenticeship should not be a prerequisite for technician training a period of practical training in industry is essential. The Danish authorities have already realised this fact and are planning to reduce the apprenticeship period preceding technician training.

6. By comparing the "Teknikum Engineer" of Denmark with the "Technologist" of Canada it became evident that Senior Technician training should be a standardised post-secondary training of a less theoretical but positively more practical character than the university level training in parallel fields.

7. By studying the fields of activity of Junior technicians it was agreed that Junior technician training programmes should be flexible in character and duration, and should be particularly adapted to the needs of the individual trade in each country. A basic general education of at least 10 years was considered an essential prerequisite for the production of an adaptable "end product". This educational background together with the additional education and training acquired through the course proper, should bring the junior technician to an educational level comparable to that of a full secondary education.

Specific training programmes were further discussed on the basis of an illustrated exposé (projection of slides) by the Danish Delegation.

8. Standardised certification, already well ahead in Denmark, was considered essential not only at national level but also internationally. OECD was invited to assist Member countries in this respect.

(c) Vocational Guidance Service - Wastage from technical courses

9. Study of relevant information revealed that vocational guidance services in both countries are not adequately organised. It was decided that further steps should be taken to establish effective services in both the vocational guidance and the vocational selection fields.

10. Wastage from Senior Technician and University courses appeared to be a major problem, particularly in Canada. Many factors seem to influence this wastage; undoubtedly among them is the inadequate method of vocational guidance and selection.

It was decided that further investigation should be undertaken to define (i) the reasons for high wastage, (ii) what happens to the "drop-outs".

(d) Recruitment and training of technical teachers

11. In both countries recruitment of technical teachers presents difficulties because of the scarcity of properly qualified personnel and the competition from industry.

12. It was agreed that a technical teacher should:

(i) possess qualifications ensuring thorough theoretical and practical knowledge of the subject he is expected to teach;

(ii) have industrial experience in appropriate fields;

(iii) be familiar with basic educational principles and possess adequate knowledge of teaching methods and techniques;

(iv) be kept continuously aware of new developments in the educational and the industrial fields.

It was agreed that to ensure this represented an important area where further governmental action was necessary. OECD was invited to assist the countries in this field.

13. The possibility of securing part-time services of personnel from industry was discussed. It was agreed that this procedure though difficult to put into practice, at least so far as day courses are concerned, should be further explored; in effect it encouraged the person concerned to keep continuously up to date in both the theoretical and the practical sides.

14. Further discussion led to the conclusion that a reciprocal flow from industry to education and vice-versa is highly desirable. To ensure this, establishment of rules for recognition of a "continuity of service" (years of service, pension, etc.) would be necessary. In Denmark this problem is being tackled by the technicians' professional association.

15. Discussion on the status and salaries of technical teachers revealed that authorities in charge should be advised to work out salary scales, pension allowance, etc., competing with those in industry.

(e) Authorities in charge of technical and vocational education - Co-ordination of efforts

16. Provincial autonomy in Canada creates a special situation and makes comparison with Denmark or some other European countries difficult. Discussion led to the conclusion that although a decentralisation is for several reasons advisable, the existence of a central co-ordinating authority is indispensable to ensure the requirements of sound educational policy at national level and the desirable standardisation of qualifications as a pre-requisite for internal mobility.

(f) Status of technicians and their careers

17. An examination of the information available led to the conclusion that at present two types of technicians exist in each country, i.e.:

(i) those classified as technicians by virtue of their educational qualifications;

(ii) those who because of long experience and aptitude perform the duties of technicians, regardless of their formal qualifications.

The latter category however, was in each case created to meet the urgent requirements of the rapid industrial expansion with which the provision of educational facilities could not keep pace; this category is gradually fading out in both countries.

18. Discussion on the organisation and functions of technicians' professional associations led to the conclusion that the establishment of such associations should be encouraged as they greatly contribute to the social recognition of the professional status of this category of skilled personnel. The successful example of Denmark should encourage other countries to proceed in the same direction.

19. Discussion on the earnings of technicians in industry revealed that these largely depend on the personal ability of the individual and in some cases are higher than those of the professional engineers.

20. The limited possibilities existing in the two countries for promotion from skilled worker to Junior Technician to Senior Technician was shown to be a feature of the present situation. However, in Denmark, it appears that Teknikum Engineers have many more opportunities as compared to their Canadian counterparts (technologists) to undertake managerial or technical jobs, normally requiring an engineering degree, in industry.

21. It is recommended that promotion from one skilled category to another through further studies be encouraged and facilitated through inter-relating the structure and content of the training programmes. However, it should always be kept in mind that training for each skilled category is an entity in itself and cannot be regarded as part of another; consequently, unnecessary distortion of training programmes for the sake of continuity and transferability should definitely be avoided.

(g) Availability of statistical data.

In both countries the availability of statistical data to enable the planning and implementation of technician training programmes was shown to be inadequate or completely lacking. It was decided that efforts should be made to secure such data, which would be mainly based on the real needs of industry and not on the available capacity of the educational establishments. However, one of the main difficulties in estimating the needs of industry in skilled manpower was the hesitation of industry itself to make any firm statement regarding future needs; Research and Development Services were usually found to be more reliable sources for such information.

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