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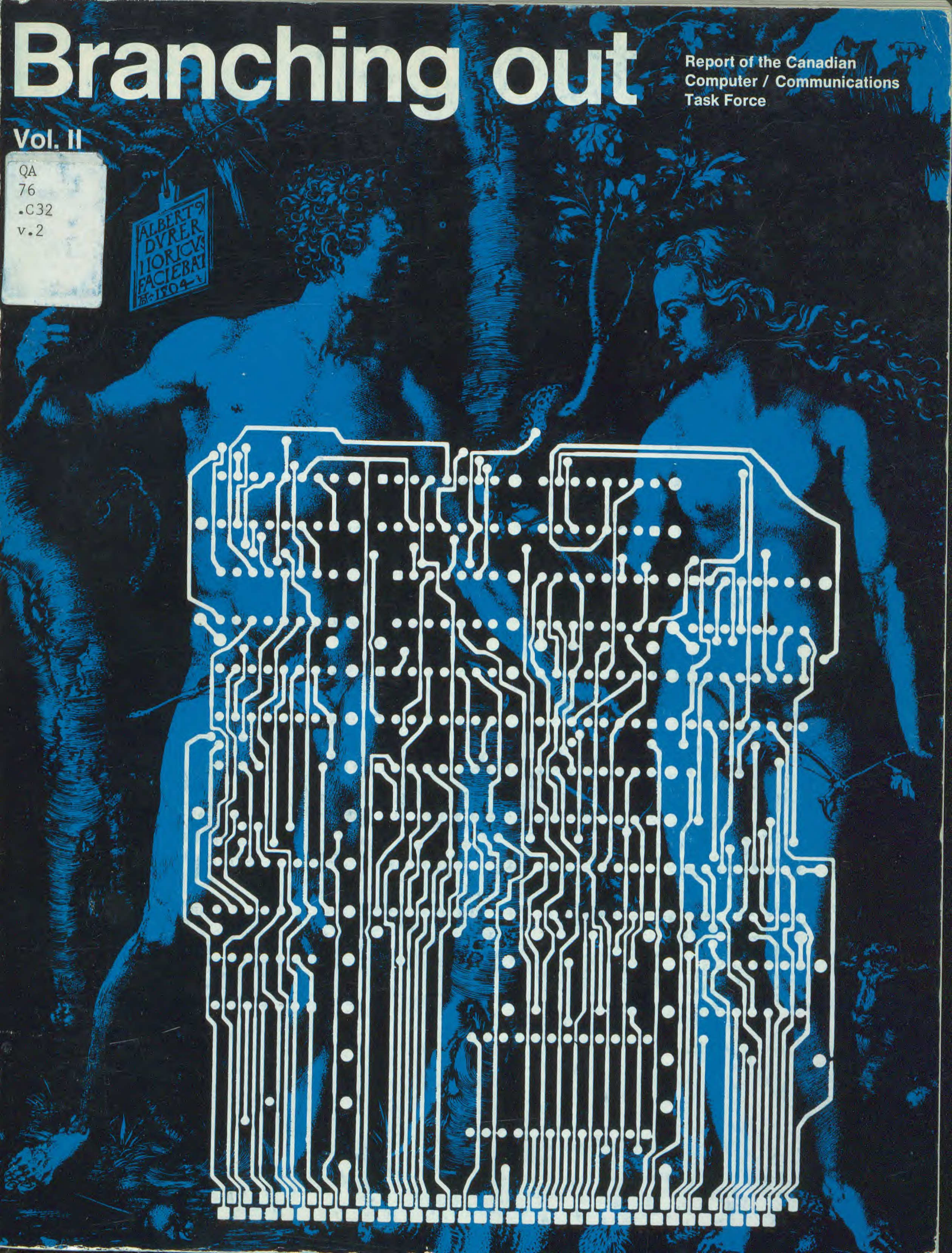
Report of the Canadian Computer / Communications Task Force

Vol. II



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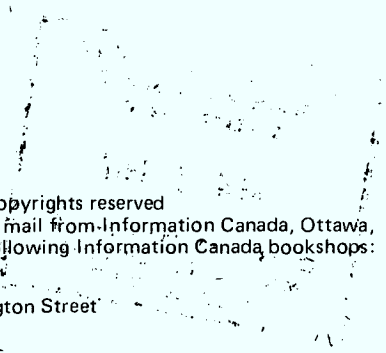

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Report of the Canadian Computer / Communications Task Force

Vol. II

Canada - Computer/ Communications Task Force

Department of Communications
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This Report in all its aspects represents the work of an independent Task Force. The views expressed are not necessarily those of the Department of Communications or of the Government of Canada.

VOLUME II

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Preface

Volume II of this Report consists of two parts.

Part A contains a background paper on the present jurisdictional and legal aspects of computer/communications in Canada, which is necessary to an understanding of implications and recommendations in Volume I. It provides an overview of the present jurisdictional setting, describes the present roles of the regulatory agencies affecting computer/communications and comments on a number of legal issues.

Part B comprises three studies which provide a picture of the present involvement and future possibilities of computer/communications methods in fields of broad social significance. The survey areas, financial transactions, education, and health care, were selected because of their great public interest and social importance, and because they are being markedly affected by the introduction of computer methods.

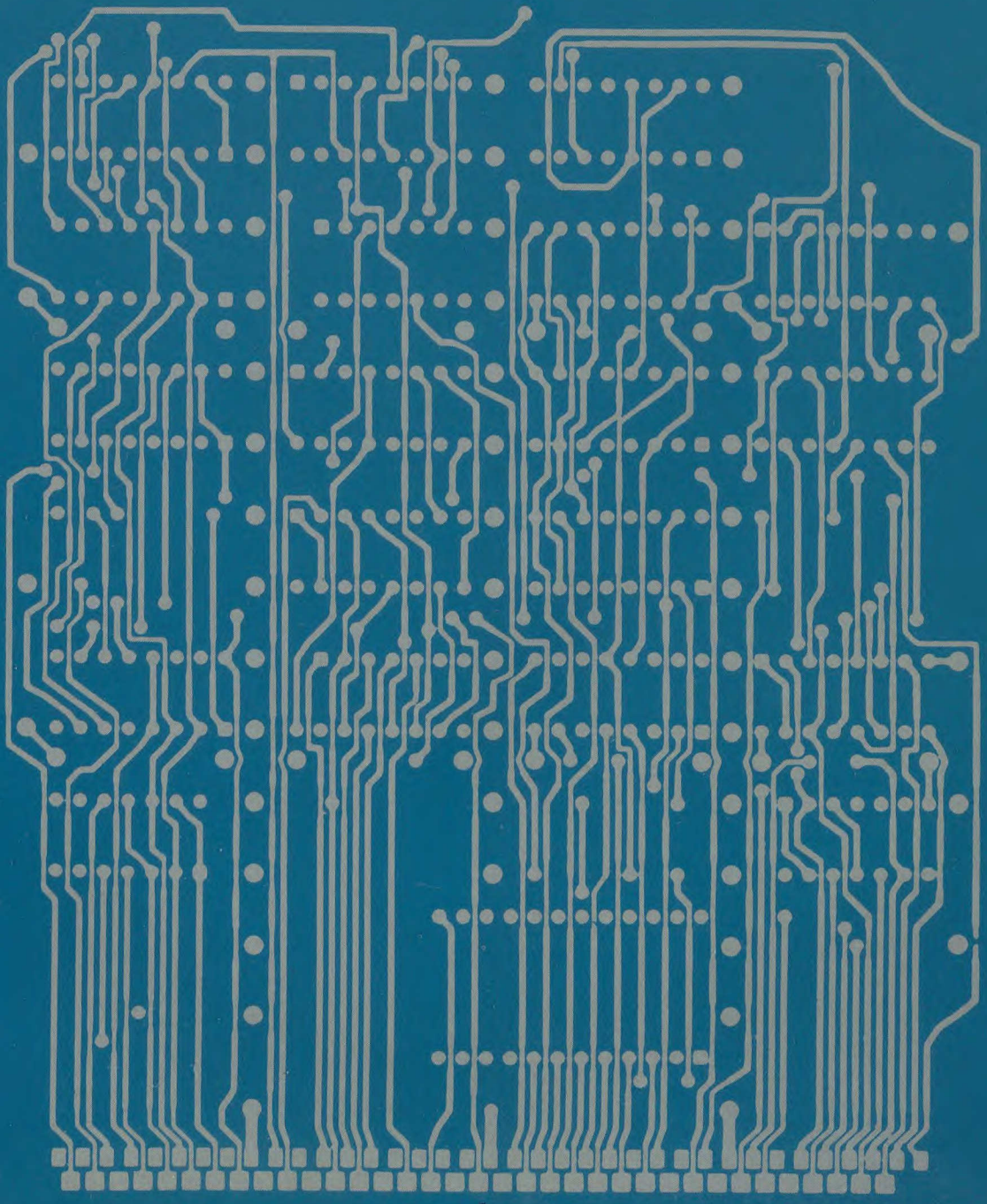
It is emphasized that these three studies are not intended to be a comprehensive treatment of the fields nor are these intended to add significantly to the technical knowledge of computer applications in these particular fields. The sole purpose of the surveys was to identify the extent to which computer/communications methods have been and are being introduced into these areas in Canada and to obtain informed opinion on past experience and future expectations from those directly involved.

In this respect, the three studies represent background material to support the main mandate of the Task Force which is to develop recommendations for policies in the computer/communications field. If by the choice of words an impression is anywhere conveyed that these reports exceed the Task Force mandate and seem to indicate courses of action in the areas studied, this is unintentional and is due to the difficulties of keeping matters concerning specific technical means separate from those concerning the desired ends. Computer/communications is a tool for performing functions in a myriad of applications. The Task Force work has been concerned with the identification of common aspects in the application of this technology and recommending measures for its use to the greatest benefit of the people of Canada.

Part

A

Jurisdictional and Legal Aspects of Computer/ Communications in Canada



INTRODUCTION

One of the primary concerns expressed in Volume I of this Report is the role of government: How should it act? What can it do? What legislative or administrative measures should be taken? In answering these questions, it is obvious that a clear picture must be formed of the present jurisdictional and regulatory realities in the computer/communications industry. What legislation affects this industry? Is this legislation achieving its purpose? Are there any legal or institutional impediments to the growth or rationalization of the industry to which government should address itself? What administrative tribunals regulate sectors of the computer/communications industry? Is the jurisdiction of these agencies sufficient for them to discharge their role? Are the policies and practices of regulatory bodies, as developed over the last few decades, appropriate for the present and future needs of the computer/communications industry; and, more importantly, for Canadian society as a whole? What changes seem to be desirable?

These questions obviously raise complex implications for government policy, and they are central and critical issues in the present context. Providing added impetus to the work of the Task Force has been the realization that, in the jurisdictional and institutional area, rational and forward-looking government measures must be developed expeditiously, lest the new technology develops so rapidly that it overtakes the capacity of government to deal with it.

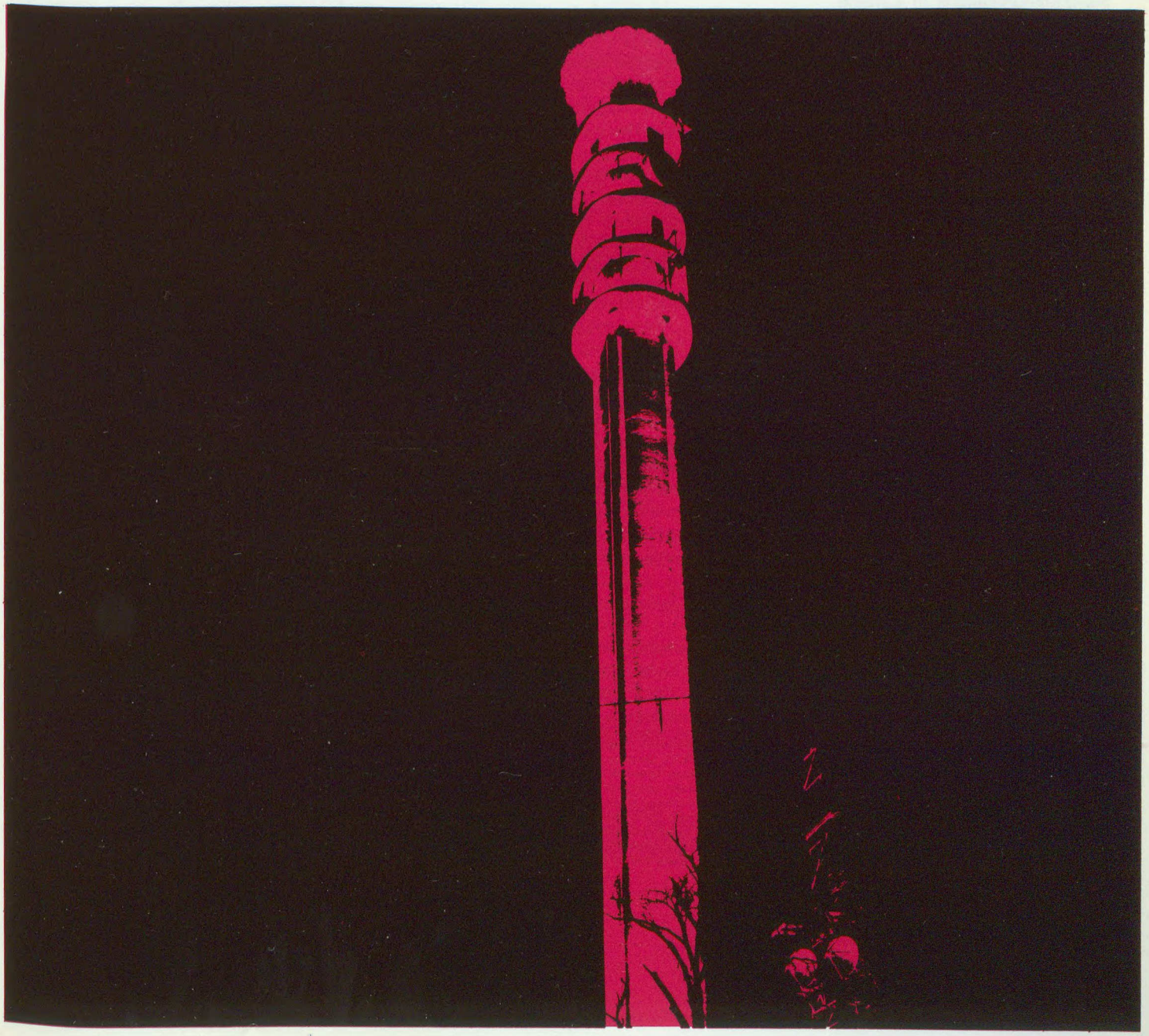
The purpose of this part is threefold: first, to briefly outline the nature of the legislation affecting the computer/communications industry in order to provide an overview of the present jurisdictional setting; second, to examine the present role of the administrative agencies affecting computer/communications; and finally, to comment on a variety of constitutional and jurisdictional issues raised by the role of computer/communications in Canada. No recommendations as such are contained in this part, but the issues raised have been dealt with in recommendations in Volume I.

In examining these issues, it becomes immediately apparent that the present legislative framework for computer/communications in this country is complicated by the fact that the industry now operates at the level of an interface between two technologies which have begun to progressively overlap. One of these, the technology of telecommunications, has traditionally been viewed as a utility and has been subject to government regulation and in a number of cases to direct government operating control. The other technology — data processing — has evolved in a competitive framework, subject to little if any government regulation beyond the requirements imposed by legislation of general application. In reviewing the present legislative framework of the computer/communications industry, it is therefore useful to separate the two service components, and review them individually.

Accordingly, in the discussion which follows, the data communications sector of the industry is separated from the data processing sector for the purpose of analysis, and the legal issues relating to each are discussed in separate

sections. It is recognized that it is virtually impossible to make a clear distinction between the two sectors — computers are increasingly being used for "communications" functions as well as "processing" functions — but for regulatory purposes, the distinction is frequently a critical one. It is anticipated that as government intensifies its concern with the problems of the computer/communications industry, it will become of even greater importance to establish definitions for these and other matters in order to clarify the precise bounds of government regulation. Consequently, although no attempt is made at this point to define once and for all the functions of "data communications" and "data processing", reference is made in the notes to a number of statutory and administrative definitions that may serve as broad useful guide-lines.[1] The problems of interpretation raised by these definitions effectively illustrate the need for careful statutory drafting in the near future, so that definitions are employed that are as free from ambiguity as language permits, and that can be understood and uniformly applied by all interested parties.

[1] At present, there is no commonly accepted definition for either "data communications" or "data processing" that effectively distinguishes between the two without unduly limiting the scope of either term. The problem of adequate definition arises in a variety of other contexts in the telecommunication industry as well, and may be highlighted by an examination of the problem of defining the meaning of "telecommunications carrier": see *Telecommission Study 1(c)*. In the Radio Act, the term "telecommunications" is given an expansive definition, viz. "Any transmission, emission or reception of signs, signals, writing, images of sounds or intelligence of any nature by wire, radio, visual or other electromagnetic system". A similarly expansive definition is provided in the analogous American legislation where communications by wire or radio is defined to mean: "the transmission of writing, signs, signals, pictures, and sound of all kinds...between the points of origin and reception of such transmission, including all instrumentalities, facilities, apparatus and services (among other things, the receipt, forwarding and delivery of communications) incidental to such transmission". A number of other definitions add an additional parameter by defining the term "communications" to mean: "the transmission of messages between two or more points by wire, radio or other electromagnetic system, wherein the content of the message remains unaltered". The distinction between data communications and data processing has been drawn for regulatory purposes by the FCC, for the purpose of its policy relating to carrier entry into data processing. The FCC defines "data processing" as "the use of a computer for the processing of information as distinguished from circuit or message-switching. 'Processing' involves the use of the computer for operations which include, among other things, the functions of storing, retrieving, sorting, merging and calculating data, according to programmed instructions." A variety of other authorities have also attempted to define such terms as "computer", "voice communications", "remote access" for regulatory purposes, but all of these definitions suffer from problems of ambiguity and imprecision.



Chapter IV of Volume I gave some indication of the growing significance of the data communications segment of the computer/communications industry. Except where communication with computers is limited to the same building or complex of buildings, the transmission links between computers and users are normally furnished by the telecommunications carriers. The regulation of "data communications" in Canada is therefore based upon the regulation of the carriers providing such service. Since data communications is only one component of the over-all telecommunications service provided by the carriers, an enquiry into the regulation of data communications inevitably leads to an enquiry into the general jurisdictional framework for the regulation of telecommunications in Canada.

In contrast to the situation in the United States, where jurisdiction is split between local (intrastate) and long-distance (interstate) service, the regulation of telecommunications in Canada is exercised at present on a carrier-by-carrier basis, with each carrier subject to rate regulation in respect of all its services by either a provincial or federal regulatory tribunal. The particulars of the specific legislation that relates to the regulation of the telecommunications carriers have been examined in more detail in *Instant World* and in certain supporting Telecommission studies.[2] The following summary is restricted therefore to a description of aspects of the jurisdictional framework which touch directly on the questions dealt with in this report, namely, the provision of data communications and the review by the present regulatory agencies of computer/communications services.

1. DATA COMMUNICATIONS SUPPLIERS

Although there are literally hundreds of telecommunications carriers in Canada, the vast bulk of telecommunications service is provided by only 15 major telephone systems[3] and by the consortium of the two railway companies, Canadian National/Canadian Pacific Telecommunications. Two other carriers, Canadian Overseas Telecommunications Corporation and Telesat Canada, although given the power to deal directly with customers, have acted so far (save with respect to the CBC) as "carrier's carriers". These 18 major carriers are listed in the Appendix, along with notes as to their present size, operating territory, and ownership. The salient facts may be summarized as follows:

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[2] See *Instant World: A Report on Telecommunications in Canada* (Ottawa, Information Canada, 1971), pp. 187-227 and *Telecommission Studies 1(a), 1(b), 1(d),* and *8(a).*

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[3] The basis for the selection of 15 "major" telephone companies was an annual operating revenue in excess of $1 million in 1970, the most recent year for which figures are available. See *Telephone Statistics: Preliminary Report on Large Telephone Systems, 1970* (Ottawa, Statistics Canada (Catalogue 56-202), November, 1971), and *Telephones and Cable Statistics, 1970* (Ottawa, Statistics Canada (Catalogue 56-201), October, 1971). Of these 15 systems, eight operate as members of the Trans-Canada Telephone System, a voluntary association set up to provide co-ordinated telephone service across the country. These 8 systems are British Columbia Telephone Company, Alberta Government Telephones, Saskatchewan Telecommunications, Manitoba Telephone System, Bell Canada, The New Brunswick Telephone Co. Ltd., Maritime Telegraph and Telephone Co. Ltd., and Newfoundland Telephone Co. Ltd. The remaining telephone systems listed, Okanagan Telephone Company, edmonton telephones, Thunder Bay Telephone System, Northern Telephone Limited, Téléphone du Nord de Québec Inc., Québec Téléphone, and Island Telephone Company Ltd., come to individual agreements with the connecting TCTS members regarding calls originated or received in their territories. See *Instant World, supra,* note 2 at pp.67-71.

The telephone systems listed in the Appendix account for 98% of the cost of plant for the telephone industry in Canada, 98% of the total revenue, and 99% of the total salaries and wages reported by all telephone systems. When supplemented by CN/CP Tel, these systems account for virtually all significant data communications activity in Canada.

Of the 18 carriers listed, only five — Bell Canada, British Columbia Telephone Company, CN/CP Tel, COTC, and Telesat Canada — are regulated federally.[4] However, these five carriers account for well over 75% of the operating revenues of the 18 systems. Of the revenues indicated for the 15 telephone systems in the Appendix, some 4% (or about $60 million in 1970-71) was derived from the transmission of data, including TWX, and from the rental of related equipment (much of this is not necessarily computer-related); in the case of CN/CP Tel, data communications (excluding such services as public message telegraph and video relay, but including TELEX) account for just over 50% of its revenue (or about $60 million).

The major telecommunications carriers identified in the Appendix are owned by a variety of interests. Bell Canada, a widely-held Canadian-owned public company, owns or controls the majority of the shares in six others of the carriers listed — Northern Telephone Limited, Téléphone du Nord de Québec Inc., The New Brunswick Telephone Company, Limited, The Island Telephone Company Limited, Maritime Telegraph and Telephone Company Limited, and Newfoundland Telephone Co. Ltd. Three other companies — British Columbia Telephone Company, its subsidiary Okanagan Telephone Company, and Québec-Téléphone are controlled by General Telephone and Electronics Corporation, a U.S.-owned communications conglomerate. Three carriers — Alberta Government Telephones, Saskatchewan Telecommunications, and Manitoba Telephone System — are Crown Corporations of the three Prairie provinces; two carriers — edmonton telephones and Thunder Bay Telephone System — are municipally owned. CN/CP Tel and Telesat Canada show mixed public and private involvement as well, while COTC is a federal Crown Corporation.

The services provided by the telecommunications carriers listed in the Appendix have different competitive characteristics. At one end of the scale are the monopoly services, *i.e.*, public telephone and message telegraph. These are traditional common carrier services, with a long history of government regulation on such matters as rate of return, discrimination and, in certain cases, obligation to extend service. In the middle of the scale are a variety of so-called private-line services which are available on the basis of limited carrier competition in Canada. These services include private-line voice or teletype (no access to the public telephone network), and line-switched

[4] The term "regulation" is here used to denote present statutory potential rather than practical regulation in the administrative sense. All five carriers are incorporated at the Federal level but only Bell Canada, B.C. Telephone, and CN/CP Tel are regulated in practice by the Canadian Transport Commission. COTC, although subject to CTC rate regulation under the *Telegraphs Act*, does not file its tariffs at present; these are determined instead by negotiations with connecting overseas carriers. Telesat Canada is also outside CTC jurisdiction at present.

services (such as TWX or Telex, Data Telex, and Broadband Exchange). Competition between telephone and telegraph companies is limited with regard to many of these services, because of the distinguishing technical characteristics which each of them offer. Furthermore, although the two carrier groups employ independent long-haul facilities across Canada, CN/CP Tel finds it necessary to negotiate for the use of local telephone distribution facilities. However, for most data transmission requests that do not require access to the public telephone network, the two carrier groups consider themselves directly competitive.

At the end of the scale which represents full competition are a variety of telecommunications services that have as their distinguishing feature the lack of reliance on long-haul microwave links or local loop facilities. These include mobile radiotelephone, marine radiotelephone, radio paging and private in-house communications systems. There is substantial competition in many Canadian markets, with a number of non-carrier entrants competing directly with telephone and telegraph companies. These services, when provided by such non-carriers, are unregulated at present, although it is still necessary for them to obtain radio licences from the federal Department of Communications. Significant expansion of services is limited however by their inability to obtain interconnection with carrier distribution facilities except on a dedicated basis. None of these services constitutes a significant element in the computer/communications industry at present.

So far, Canadian regulatory policy has not had to deal with the development of specialized common carriers with independently owned and operated microwave routes, such as that recently authorized in the United States by the Federal Communications Commission in its decision relating to Microwave Communications, Inc.[5] On the other hand, private microwave systems have been authorized by the DOC for remote resource companies, right-of-way companies (hydro, rail, oil and gas), and broadcasting undertakings (studio-transmitter links, re-broadcaster links, CATV system relays). The present over-capacity of the transcontinental microwave systems in Canada and the impending completion of the Telesat Canada satellite system, make it unlikely that additional long-haul microwave competition will develop in the near future, at least on a common carrier basis (although foreseeable reductions in microwave hardware costs may bring increasing pressure for the allowance of private non-carrier intra-city hops).

Local distribution facilities for data transmission continue to be a carrier monopoly in Canada. One possible exception to this is the developing cable television industry which jointly uses carrier poles and ducts for its coaxial cable distribution systems to residential homes. However, restrictions in the present contracts with the telecommunications carriers preclude cable television operators from providing two-way or point-to-point service and this, among other factors, has effectively limited their communications function to the provision of one-way transmission of video channels, which offer programs of either an entertaining or educational nature.

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[5] (1969), 10 F.C.C. 2d 953. See the discussion further below.

2. TELECOMMUNICATIONS REGULATORY AGENCIES

As already noted, the business of transmitting messages for the general public has traditionally been viewed as a public utility in Canada, particularly with respect to public telephone and telegraph service. Accordingly, the carriers identified above are, with only a few exceptions, regulated on such matters as rate of return and service discrimination by independent regulatory bodies, created for this purpose by either the federal or provincial legislatures. The role and jurisdiction of these regulatory agencies is confusing, and in order to facilitate comprehension, a tabular comparison has been prepared in Table 1. As indicated in this table, Bell Canada, B.C. Telephone and CN/CP Tel are at present regulated by a federal tribunal, the Canadian Transport Commission; COTC and Telesat Canada, while unregulated at present, could readily be subjected to CTC review. The remaining 13 telephone systems, all of which are provincially incorporated, are regulated (except for edmonton telephones and Saskatchewan Telecommunications which are self-regulated) by provincial utility boards. There are nine such provincial boards actively involved in telephone regulation at present.

Except for the Ontario Telephone Service Commission, none of the 10 administrative agencies involved in the regulation of telecommunications carriage in Canada is devoted solely to matters of communications. Typically, telephone or telegraph service is dealt with as part of a larger jurisdiction which also embraces such utilities as rail transport and electric power. In some cases, no specific reference to telecommunications as such is made in the enabling statutes, beyond the inclusion of such service within the general definition of public utility. Recently, however, there has been an increased interest shown, at both the federal level and by some of the provinces, in the idea of separating "communications" matters from the rest of utility regulation, in order to permit federal or provincial communications policy to give them separate emphasis and attention. This shift in approach reflects a growing realization that a number of the developing problems in the communications field are specialized and unique, not only with regard to the computer/communications sector but in such areas as educational broadcasting and cable television.

Since 10 administrative agencies are involved in telecommunications carrier regulation in Canada, it is difficult to summarize the nature of government involvement in the review of carrier practices in a brief section. Instead, a variety of distinct regulatory questions — foreign attachments, interconnection, shared use of lines, carrier entry into data processing, and the role of alternative specialized carriers — are singled out for separate discussion in the following pages. It may be useful at this point, however, to set out some of the highlights of telecommunications regulation in Canada, particularly with regard to the review of data communications rates and service offerings. In the notes below, the role of the federal regulatory body, the Canadian Transport Commission, is described in greater detail because of the dominance of Bell Canada, B.C. Telephone and CN/CP Tel in the data communications field. Added notes touch on the role and jurisdiction of the nine provincial regulatory agencies.

The primary focus of the regulatory jurisdiction of the 10 administrative agencies relates to the rates charged by the carriers for public telephone or telegraph service. Each of the agencies regulates the rate of return of the respective carriers under their jurisdiction on the basis of over-all revenues and expenses, rather than distinguishing between rates of return for particular services. The general mode of regulation, called "rate-base regulation", is to limit the total annual allowed revenue of the regulated firm to a sum equal to the sum of the annual operating expenses and a specified percentage of the book value of the invested capital (the "rate-base"). The earnings of each carrier are therefore proportional to the absolute size of the rate-base. Under the present statutes, carriers are typically limited to a "just and reasonable" rate of return, which is generally taken to mean a rate of return comparable to that which the carrier would have been able to obtain had it invested its money in enterprises of a similar nature and risk.[6] Although increased interest has been shown by some of the regulatory commissions in determining the rate of return for individual classes of service, none of the agencies have completed their pending studies on this issue. Until valid cost-allocation studies of this kind are completed, the extent of cross-subsidization, if any, between data and voice service, between various categories of private-line service, or between long-distance and local exchange service, will remain a matter of dispute.

The jurisdiction of the various boards and commissions to review or revise data communications tariffs varies considerably. Since the revisions to the Railway Act in 1970[7] (R.S.C. 1970, c.R-2), the Canadian Transport Commission has had jurisdiction to review and revise all tolls or charges made by Bell Canada, B.C. Telephone or CN/CP Tel "...to the public, or to any person for use or lease of a telephone (or telegraph) system or line, or any part thereof, for the transmission of a message by telephone (or telegraph), for installation and use or lease of any instruments, lines or apparatus attached to, or connected or interconnected in any manner whatever with, a telephone (or telegraph) system, for any services provided by the company through the facilities of a telephone (or telegraph) system, or for any services provided by the company through the facilities of a telephone (or telegraph) business." This clearly embraces all data communications services of any kind, whether or not they are offered to the public, and whether or not they are routed through the public telephone exchange.

The situation with regard to the provincial boards is different.[8] None of the statutes distinguish between "data" and "voice", and in five of the provinces (Alberta, Manitoba, New Brunswick, Prince Edward Island, and Nova Scotia)

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[6] *Northwestern Utilities Limited* v. *City of Edmonton*, [1929] S.C.R.186, per Lamont J. at 193; *B.C. Electric Rly. Co. Ltd.* v. *Public Utilities Commission of B.C.*, [1960] S.C.R. 837. For a general discussion of the rate-setting practices of the carriers, see the briefs submitted to *Telecommission Study 7(a)(b)*.

[7] S.C. 1969-70, c.20, ss. 1 and 2 (Proclaimed in force August 1, 1970).

[8] For more specific details, see Figure 11, and *Telecommission Study B(a)*: Appendix.

the telephone companies are brought under regulatory jurisdiction by virtue of their falling within the definition of a "public utility" — which includes "systems for the transmission of telephone messages, directly or indirectly, to or for the public". Although these statutes then permit the boards to regulate all rates or tariffs charged by the utility, without limiting this to public telephone tariffs, a number of the boards have read such a limitation into the statute and declined to review tariffs that are not charged generally to the public, or, in the case of Nova Scotia, that are not "voice" services. In Ontario, this limitation in jurisdiction is made explicit in the Telephone Act, and the Ontario Telephone Service Commission is confined to reviewing rentals or charges "for supplying telephone exchange service and all services associated therewith". Dedicated data offerings may therefore fall outside the jurisdiction of the Commission in some circumstances. The only real concern expressed by the boards in these six provinces in regard to private-line data communications or other specialized services has been that they should not constitute a burden on the traditional public telephone service. In the remaining provinces where regulatory boards are active (British Columbia, Quebec and Newfoundland), the statutes confer a broad jurisdiction over rates which clearly covers private-line services as well as the public telephone. However, even in these cases, although all tariffs relating to data services are filed for approval, the various boards have not so far made any attempt to segregate the cost or revenues of data communications services in evaluating the over-all rate of return of the companies under their jurisdiction.

All of the administrative agencies have been given a jurisdiction to review and, if necessary, revise tariffs where these are found to be unjustly discriminatory or preferential. As indicated above, some of the agencies involved have read "tariffs" to exclude private-line services, but because of the broad jurisdiction of the Canadian Transport Commission, it can be said that the bulk of data communications services provided in Canada are subject to such review. It is important to note that discriminations or preferences as such are not precluded; these are only made unlawful when they are "unjust", "unreasonable", or "undue". Where services are basically similar, differences in pricing must be justified by either considerations of cost (*i.e.*, direct and indirect burden on the network) or by the existence of a competitive necessity (*i.e.*, where certain customers have a substitute source of supply to which they will shift unless the discrimination is maintained and where the discrimination thus benefits other users by increasing the usage and efficiency of the system). Most complaints regarding discrimination have so far been based on alleged misclassification of users among the public telephone rate classes (*e.g.*, business instead of residential; inclusion of suburban customers within local calling areas); none has been directed towards the definition of the rate classes in general or towards data communications tariffs in particular. The latter area is one of exceptional complexity, because many of the tolls include special charges levied for custom assemblies, and have been largely determined by mutual negotiation. The task of establishing broad classes of data tariffs is even more difficult, because of the conflicting claims of large and small users for rate reductions on the basis of volume of use or different technical characteristics. Recent

regulatory decisions in the United States relating to the TELPAK classifications highlight these issues. The problem is further complicated by the desire of Canadian carriers to implement temporary or conditional rate adjustment in selected areas for the purpose of "market testing". Such rate changes are at present precluded, except where justified by demonstrable cost differentials, and even then lengthy filing and approval procedures are required before they can go into effect.

The jurisdiction of the various agencies over international or interprovincial tariffs is perhaps the most uneven aspect of their mandate. Because the carriers in Canada are accountable to a single regulatory authority only, either federal or provincial, no regulatory supervision is exercised at present by any agency over interprovincial or international rates, save to the extent that the revenue from the domestic portion of such services contributes to a particular carriers's over-all rate of return. (The exceptions to this are with respect to Bell Canada tolls between Ontario and Quebec, and with respect to CN/CP Tel tolls across the country; only the railway consortium at present offers cross-country service by itself.) The existing Canadian facilities for international telecommunications traffic have been described in more detail elsewhere[9] and will only be briefly noted here. In the "continental" system, except for Alaska, international data traffic using the telephone carriers is effected through facilities of TCTS, with various border-crossings provided by a number of member companies operating in provinces with land borders with the United States. Rates are based on the airline distance between designated rate centres, as settled in negotiations between TCTS members and A.T.&T. Canadian-U.S. data traffic using the telegraph carriers is exchanged between CN/CP Tel and Western Union through facilities owned by Western Union in Minneapolis. Again rates are set by negotiation between the carriers providing the services, although the contracts require prior filing with CTC and FCC for approval. In the "overseas" telecommunications system, service is provided to about 200 overseas territories by COTC through international gateway switching-centres in Montreal and Vancouver, accessing both submarine cables and satellite circuits. Some terminal rights have also been granted to foreign-owned international carriers. Data rates for such international services are determined by bilateral agreements between the international carriers and have not been subject to any regulatory supervision in Canada.

The terms and conditions of international or interprovincial data tariffs raise a number of important questions with regard to the Task Force work. First is the disparity between American and Canadian long-distance rates and the possibility of using American long-distance facilities for data communications networks in order to take advantage of cost differentials. A second question is the influence of the terms and conditions of the tariffs on the use of data communications facilities by Canadian customers to access computers in the United States; or in the interprovincial context, where the customers are located in remote areas of Canada, to access computers in urban centres in Canada. Where data communications services are combined with data processing services, the problem of setting appropriate rate structures is made even more difficult.

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[9] See *Instant World*, pp. 82-87, and *Telecommission Studies 3(a), 3(c), 3(d),* and *3(e)*

The present jurisdiction of the regulatory agencies to deal with these issues is conflicting and inadequate. At the federal level, section 320(11) of the Railway Act (R.S.C. 1970, c.R-2) requires Bell Canada, B.C. Telephone, and CN/CP Tel to file with the Transport Commission for prior approval all "contracts, agreements and arrangements" between the company and any other carriers for the regulation and interchange of communications services, for the division of tolls, or with regard to the management or operation of the interconnecting systems. None of these contracts have in fact been reviewed actively by CTC, and in any case it is debatable whether CTC could alter tolls on a selective basis, or have substantial influence on rates or practices of the interconnecting carriers beyond its immediate jurisdiction. Although CTC has the authority to require B.C. Tel, Bell, or CN/CP Tel to interconnect with other carriers making application to this effect, this power is limited to interconnection between non-competing carriers, and moreover, cannot be ordered save upon the initiation of a carrier not under federal jurisdiction. (The provisions of the Bell Act regarding interconnection are discussed further below.) At the provincial level, all of the agencies[10] except in Nova Scotia and Newfoundland can "order" the carriers under their control to interconnect with outside telephone carriers (although this is frequently restricted to the carriage of "telephone messages"), but again the jurisdiction to review specific point-to-point tolls, or the uses to which the connections are put, is limited and confusing. The lack of a co-ordinated authority over the tariffs and conditions for international and interprovincial data traffic, and over the uses to which customers may put such links, is one of the more pressing jurisdictional issues relating to computer/communications in Canada.

Finally, the regulatory agencies have a variety of ancillary powers over the carriers, some of which touch on the provision of data communications. The Canadian Transport Commission reviews issues of stock or debentures by Bell Canada and B.C. Telephone and, in the case of the latter company, any acquisition of shares or assets of companies with similar objects. The Bell Act also contains a limited provision obligating Bell Canada to furnish "telephone service" to those tendering the applicable rates within areas in which a general service is given.[11] It may be argued that this does not extend to specialized data communications equipment or services. No powers are given to CTC over "adequacy of service", or to approve major capital expenditures prior to their being incurred. CTC's sole authority over such matters is its power to disallow excessive expenditures when reviewing the company's rate of return, and the Commission has many times reiterated its philosophy that "its powers are regulative and corrective, and that they are not managerial."[12]

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[10] In Saskatchewan and New Brunswick, the power to require interconnection with outside telephone companies must be exercised by the provincial cabinet.

[11] *Bell Canada Act*, S.C. 1880, c.67, as amended by S.C. 1902, c.41, s.2. See also *Metcalfe Telephone Ltd.* v. *McKenna* and *Bell Telephone Company of Canada*, [1964] 76 S.C.R. 202.

[12] *Review respecting the Bell Telephone Co. of Canada* (1966), 56 J.O.R.R. 535 at 718; *Review Respecting the British Columbia Telephone Co.* (1966), 56 J.O.R.R. 369 at 517-518. See, to the same effect, *Tinkess* v. *Bell Telephone Co.* (1916), 20 C.R.C. 249; *Point Grey* v. *B.C. Telephone Co.* (1928), 34 C.R.C. 175; *York* v. *Bell Telephone Co.* (1928), 34 C.R.C. 170; *Bell Telephone Co.* v. *Cities of Toronto, Montreal, Ottawa, et al* (1950), 40 J.O.R.R. 314.

At the provincial level, considerably more authority is given to the public utility boards with regard to such matters as adequacy of service and construction expenditures, although again this is frequently limited to expenditures relating to the provision of public telephone service. The precise details of these ancillary powers are provided with respect to each provincial utility board in the Appendix, to which reference should be made. In particular, the powers of the Quebec Public Service Board and the Ontario Telephone Service Commission are substantial in the areas of adequacy of service, extension of service or systems, and accounting practices.

3. FOREIGN ATTACHMENTS

One of the contentious issues in the data communications field is the extent to which communications customers may be permitted to attach non-carrier provided devices directly to the telephone network. Traditionally, the telecommunications carriers have emphasized that they provide a telecommunications "service" rather than simply communications facilities. Consequently, they have usually insisted on providing end-to-end communications capacity through carrier owned and controlled equipment at each stage of the communications process. Customer owned terminal equipment, usually referred to as "foreign attachments", have normally been prohibited or severely restricted by carrier tariffs; in some cases, provincial legislation further limits their use. Such restrictions have been variously defended on the grounds of the need for system integrity, which might be jeopardized by excessive signal levels or interference with the automatic switching, signalling and charging equipment; by the problems created by the divided responsibility for operational standards and maintenance; and by the need to protect the carriers' freedom to innovate and introduce network improvements. The basic regulatory question is whether these restrictions, which arguably add to both cost and inconvenience to certain users, extend the carrier monopoly past what is reasonably necessary to prevent harm to the network.

The issue of foreign attachments is particularly topical in light of the recent liberalization of A.T.&T. tariffs in the United States, impelled by the decision of the Federal Communication Commission in the *Caterfone* case.[13] Since this decision, revised tariffs filed by A.T.&T. have allowed customers for the first time to attach their own equipment to the switched telephone network, subject to three basic restrictions which are still the subject of controversy; first, such equipment must limit power output and distribution according to certain guide-lines; second, electrical (as opposed to acoustic) coupling must be done through an appropriate carrier-provided protective interface device, and third, only A.T.&T., supplied network-control signalling units may be used.

[13] *In the Matter of Use of the Carterfone Device in Message Toll Telephone Service* (1968), 13 F.C.C. 2d 420.

It is appropriate here to examine the jurisdiction of the Canadian regulatory agencies to rule on such questions, or even to consider complaints touching on this issue. At present, the jurisdiction of the various agencies to rule on foreign attachment policy is ill-defined and, in most cases, ineffective. At the federal level, the Railway Act gives no general powers to the Canadian Tranport Commission with respect to foreign attachments, except to the extent that provisions prohibiting such attachments could be considered discriminatory. However, the Bell Canada Act, as amended in 1968[14] provides that any equipment, apparatus, line, circuit or device not provided by Bell Canada may only be connected or attached to or used in connection with the facilities of Bell in conformity with ''reasonable requirements as may be prescribed by the Company''. The Transport Commission is given the power to determine whether or not such requirements of Bell are reasonable and may disallow such requirements if it considers them unreasonable or contrary to the public interest. It should be added however that the position of Bell Canada under this legislation is by no means clear and recent litigation[15] has raised the issue of whether or not Bell is required to prescribe any reasonable requirements at all.

At the provincial level, the situation is straight-forward. No provincial agency in Canada has the power to require foreign attachments to be connected to the utilities under its jurisdiction. On the contrary, a number of the statutes specifically prescribe that no foreign attachments shall be permitted without the permission of the particular utility, and some include penalties for such connection. Details with respect to these restrictions are contained in the Appendix.

4. INTERCONNECTION

An issue which is directly related to the foreign attachment question is the problem of determining when interconnection should be effected between the telecommunications carriers' networks and between their networks and private communication systems owned and maintained by customers. The interconnection issues cannot be described in simple terms; there are many different types of interconnection problems, each with different economic effects and different technical parameters to be considered. The regulatory questions involved are complex, and range from problems of technical interference or incompatibility to allegations of economic ''cream-skimming'' and interference with the rate-averaging concept.

Of interest here is the present jurisdiction of the Canadian regulatory agencies to examine these questions and rule on whether or not carriers should grant or deny interconnection. As with the foreign attachment issue, the provisions

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[14] S.C. 1880, c.67, as amended by S.C. 1948, c.81 and S.C. 1967-68, c.48, s.6.

[15] See *E.J. Piggott Enterprises Ltd., carrying on business as Perception Industries Inc. v. Bell Canada* (Ontario High Court, adjourned upon consent pending consideration by Canadian Transport Commission, Nov. 24, 1971); *Canadian Cable Television Assn. et al v. Bell Canada* (complaint filed with Canadian Transport Commission, January, 1972).

in the present statutes are both ill-defined and inadequate. Although many of the statutes allow the regulatory agency to order interconnection between the telephone systems under its jurisdiction and other utilities, a similar power does not exist with respect to interconnection between the carrier system and communications systems of non-utility customers. At the federal level, the revisions to the Bell Act referred to in the earlier section on foreign attachments do provide the Canadian Transport Commission with an arguable jurisdiction to require Bell to interconnect with other communications systems, subject to reasonable requirements to be arbitrated by the Commission, but this is by no means clear and is still the subject of controversy.

Under the provincial statutes, the jurisdiction of the provincial utility boards in Canada to deal with interconnection problems is, as noted above, inadequate except for interconnection between utilities. In one or two provinces, the boards are given the authority to order the telephone systems under their jurisdiction to "provide service", but it is questionable whether this applies to anything more than traditional public telephone service and would afford little assistance to private data communications network operators seeking to interconnect with the public switched-network, or other private networks which also make use of carrier facilities.

5. LINE-SHARING AND RE-SALE

One of the developing regulatory issues is the extent to which the carriers should be required to permit line-sharing or re-sale. Line-sharing, as the term implies, involves the shared use of a communications channel or group of channels by more than one user. Such usage makes possible the re-sale for profit of line capacity freed by sharing. Data communications users favour sharing, because it allows communications costs to be reduced by avoiding the need to buy more communications capacity than is required. The regulatory issues are particularly complex, because the freedom for users to derive their own subchannels also raises the possibility of the eventual entry by non-carriers into message-switching services, and this again raises difficult questions with regard to pricing and competition.

Among the regulatory issues to be considered is the possibility of cross-subsidization between regulated carrier services and data processing services, the question of preferential or discriminatory treatment, the impact of the economies of scale available to the carriers on regional and national competition and the effect of carrier entry on Canadian ownership and control. These issues are discussed in more depth in Telecommission Study 5(a),(c),(d),(e), and in Chapter IX, Volume I. The present status of the TELPAK case in the United States illustrates the basic inadequacy of the regulatory agencies to deal with some of the economic questions raised by the suggestion that lines be shared or re-sold.[16] In Canada, the regulatory agencies can only review or revise tariffs containing restrictions against line-sharing or wholesaling where these tariffs are excessive, inadequate, or

[16] (1970), 23 F.C.C. 2d 606

unjustly discriminatory. Since it has been the practice of the carriers to apply a prohibition of re-sale across the board, it cannot be said that their tariffs relating to this question are discriminatory. Given the fact that the regulatory agencies in Canada have little or no power to require the filing of new classifications of tariffs, it does not appear that the question of line-sharing or re-sale can be dealt with by these agencies until the carriers decide of their own volition to liberalize the present restrictions, or substantive amendments are made to the statutes creating the respective agencies.

6. CARRIER-ENTRY INTO DATA PROCESSING

One of the most critical questions in computer communications policy is the extent to which the telecommunications carriers should be permitted to enter into the data processing field.

In the United States, rules have recently been enacted by the FCC permitting carriers into commercial data processing only on condition that "complete separation" between the carriers and their data processing affiliates be maintained, including a prohibition of the sale of EDP services by the affiliate to their related carriers.[17] A.T.&T. and its affiliated companies are in any case precluded by a 1956 consent judgment from engaging in any other business than "the furnishing of regulated common carrier services", which effectively prevents them from offering data processing services. In Canada, the 1968 amendments to the Bell Canada Act stipulate that the Company shall "act solely as a common carrier, and shall neither control the contents nor influence the meaning or purpose of the message emitted, transmitted or received...." Although it is unlikely that this restriction applies to Bell-related companies, it may operate as a significant inhibition to the provision of data processing services by Bell Canada itself.

What is the jurisdiction of the regulatory agencies in Canada to impose guidelines similar to those adopted by the FCC, or in fact to implement policy decisions with respect to this area at all? At present, the ability of the Canadian agencies involved to deal with these questions is quite inadequate. As outlined in the Appendix, some of the provincial utility boards have the jurisdiction to approve the acquisition or sale of parts of the undertaking of the telephone carriers within their jurisdiction. At the federal level, CTC approval is required if B.C. Telephone desires to acquire the shares or assets of companies with similar objects. But except for these restraints, little or no jurisdiction resides in the present administrative agencies to rule on the question of entry by the telecommunications carriers into the data processing field. Whether such entry is accomplished by the setting up of a separate corporate subsidiary, or through the organization of a separate operating division of the telephone company, no general regulatory review exists at present in Canada with respect to the issues of competition policy noted above. Moreover, the lack of involvement of the existing agencies with cross-subsidization problems to date does not augur well for their capacity to deal even with such questions as the burden which may be imposed upon the public telephone service by carrier entry into data processing.

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[17] *Regulatory and Policy Problems Presented by the Interdependence of Computer and Communications Services and Facilities*, Docket 16979, F.C.C. 70-338 (Released April 3, 1970).

7 ALTERNATIVE SPECIAL CARRIERS

A final regulatory question relating to data communications in Canada is the extent to which government policy allows or precludes the development of specialized common carriers, offering transmission facilities to computer/communications customers. This issue has surfaced a number of times before the FCC in the United States,[18] and it may be useful to discuss the present legal and regulatory constraints upon diverging or similar policies in the Canadian context. In examining the existing legal framework, however, one is confronted with an interesting anomaly in Canadian telecommunications utility regulation. In the United States, no telecommunications common carrier may construct lines or commence business without first obtaining a certificate of "public convenience and necessity" from the appropriate regulatory agency which may grant or deny it on the basis of hearings at which all affected interests can be heard. In Canada, except in limited contexts, no such requirement exists.

If radio frequency spectrum space is needed, the firm must of course obtain a licence from the federal Department of Communications, and this may operate as a considerable constraint in areas where spectrum space is crowded, or where alternative service is available from existing carriers. Organizations seeking to offer transmission and distribution facilities based on wire or cable links, however, are the present outside federal jurisdiction, except where such links connect one province with another or extend across provincial or international boundaries. In such cases, the sole legal restriction on the ability of would-be common carriers to enter the field of telecommunications using cable or wire is the necessity of obtaining a corporate charter with such powers. Because of this legal hiatus, it is fair to say that the most significant restraint on the development of specialized common carriers is the myriad of economic and financial barriers to their entry. This is particularly true in the case of local loop distribution, for it is largely impractical on both an economic and political basis, because of the need for municipal easements, for would-be carriers to develop their own distribution facilities.

The lack of a unified regulatory practice in Canada requiring the issuance of a certificate of public convenience or necessity has led to the result that franchising requirements are sporadic, uneven, and in many cases, nonexistent. Since part of the Task Force mandate was to examine the need for specialized data communication networks in Canada, and to canvass the legal or regulatory constraints or incentives for these developments, the lack of a clear jurisdiction at any regulatory level to deal with these issues constitutes one of the more obvious institutional problems recognized in this Report.

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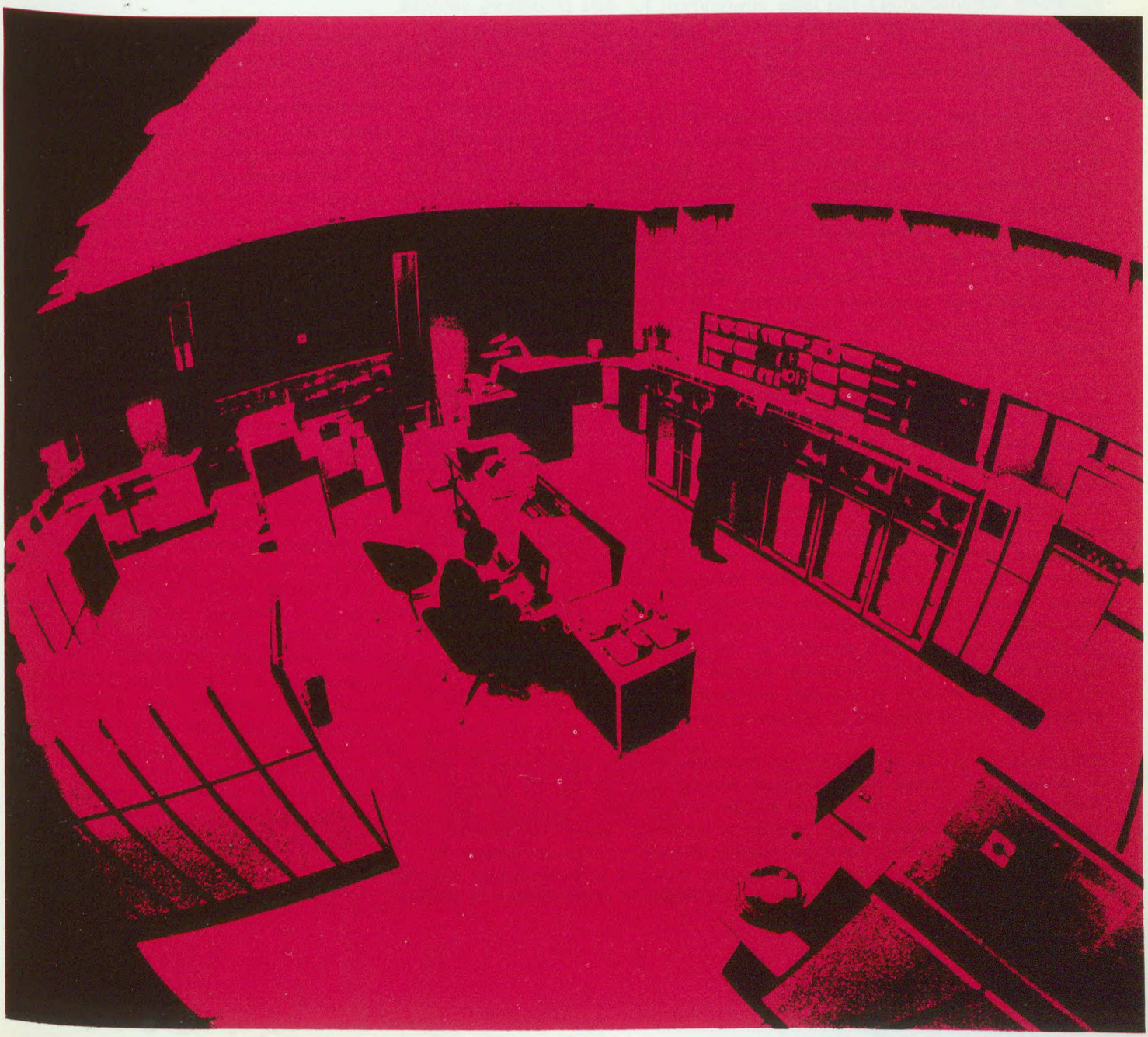
[18] See *Microwave Communications Inc.* (1969), 18 F.C.C. 2d 953, and *Specialized Common Carrier Services* (1971), 29 F.C.C. 2d 870.



1. PRESENT LEGISLATION

As noted in the introduction to this Report, the data processing industry in Canada has evolved in an entirely different legal framework from that applicable to the telecommunications carriers. While the carriers have been viewed as utilities and made subject to substantial government regulation, the data processing service industry has been characterized by intense competition in a variety of areas and little if any direct government regulation or involvement. (Note that in the discussion below, the concentration is placed upon the data processing service industry, rather than such sectors as mainframe manufacturing.) The legal environment for data processing services has reflected the number of entrants in the industry, the specialization of a number of these firms, and the rapid pace of technical and economic change that has characterized industry-growth.

What is this legal environment? At present the only legislation directly affecting the development and rationalization of the data processing industry relates to such matters as criminal law and restraint of trade. The discussion which follows therefore relates more to legal questions arising out of the relationship between entrants in the data processing field (*e.g.*, competition policy, private contractual rights) than to legal questions arising out of the role of government as regulator. In the following sections, brief comments are addressed to the ambit of the present competition legislation, the effect of the proposed new competition legislation, the computer and the law of privacy, the question of tort liability for computer misuse, and, finally, the protection of computer software.

Competition policy in the data processing industry is governed at present by the terms of the Combines Investigation Act (R.S.C. 1970, c.C-23). Although the Act applies only to articles and not to services its provisions nevertheless have wide applicability to marketing practices in the data processing industry. The Act makes it an indictable offence to conspire, combine or agree to (1) limit unduly the facilities for transporting, producing, manufacturing, supplying, storing, or dealing in any article; (2) restrain or injure trade or commerce in any article; (3) prevent, limit or lessen, unduly, the manufacture or production of any article or enhance unreasonably the price thereof; or (4) prevent or lessen, unduly, competition. These provisions relating to unlawful combinations, to the extent that they touch upon the provision of computer peripheral equipment, data terminals or the rental thereof, software when reduced to physical form, or similar matters, may affect in considerable degree the capacity of entrants in the data processing industry to compete unfairly or to combine for the purpose of restricting competition.

Other sections of the Act make it an indictable offence for persons to engage in certain discriminatory trade practices. Among other things, for example, it is made an indictable offence for any person to be a party to any sale that discriminates to his knowledge, directly or indirectly, against competitors of the purchaser in that any discount, rebate, allowance, price concession or other advantage, is granted to the purchaser over any such advantage available at the time of the sale to such competitors. Again, it is an offence to engage

in a policy of selling goods in any area of Canada at prices lower than those charged elsewhere by the seller, having, or designed to have, the effect of substantially lessening competition or eliminating a competitor in such part of Canada. It is further made an offence to engage in a policy of selling goods at prices unreasonably low, having, or designed to have, the effect of substantially lessening competition or eliminating a competitor. The ambit of the offence is limited, in that the act must be part of a policy of discrimination, but a number of possible practices in the data processing industry, where these relate to the supply or rental of articles, are touched by these sections.

The Act also restrains to some extent monopolistic practices, although these provisions have been severely truncated by court decisions. It is made an indictable offence, however, for any person to be party or privy to, or knowingly assist in, or in the formation of, a merger or monopoly. It is also made an indictable offence to participate in re-sale price maintenance agreements, or acts done by dealers in furtherance of re-sale price maintenance. Further sections in the Act provide that customs duties may be reduced, or removed from any imported article where these duties have facilitated the operation of a combine at the expense of the public. In addition, patents or trade-marks may be declared void in whole or part where they are used to restrain or injure trade or commerce, or to unduly restrict competition. Under the Act, injunctions may be obtained to restrain anyone convicted of one of the above-mentioned offences from continuing or repeating the offence, or performing any act directed toward such continuation or repetition, and an order may be obtained directing the dissolution of any merger, trust or monopoly.

One of the difficult questions in antitrust law in Canada is the extent to which it applies to regulated industries. Where legislation relating to selected industries specifically promotes or sanctions trade practices which are prohibited by the Combines Investigation Act, the cases indicate that this may constitute a defence under the latter act. The Director of Investigation and Research for the Combines Investigation Branch has commented, relating to the present state of confusion in administrative responsibility, as follows: "The telecommunications industry is an example of an industry which is in part subject to the regulation by a government agency, in part subject to the Combines Investigation Act, and in part subject to neither of these forms of control."[19] While the manufacture and sale of communication equipment, data processing equipment, and peripheral devices, is subject to the Act, the provision of many communication services, to the extent that they are not dealt with by the administrative agencies regulating the utilities providing them, may also be exempt from any other regulation relating to competitive practices. Service bureau facilities, using remote links, are therefore in a confusing middle area of the law, relatively untouched by the present jurisdiction of the regulatory agencies, and in many respects outside the purview of the Combines Investigation Act.

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[19] Evidence of D. Henry, Q.C. before the House of Commons Standing Committee on Transport and Communications. *Minutes of Proceedings and Evidence*, December 7, 1969, p. 386.

2. THE PROPOSED NEW COMPETITION ACT

Following the release of the Interim Report of the Economic Council of Canada on Competition Policy (July 1969), suggested new legislation to replace the present Combines Investigation Act was placed before Parliament in the summer of 1971. Although, at the time of writing, Bill C-256 (The Competition Ac is undergoing revision, and the Bill is expected to be reintroduced in altered form in the next session, it may be appropriate to comment in a general way on the impact of the basic changes that Bill C-256 represents to the data processing industry.

The most significant change made by the proposed Competition Act is that services are included along with commodities in all relevant contexts. The new Act would therefore embrace software supply houses, service bureaux, applications services consultants, and other service sectors of the data processing industry, whether or not such services are associated with physical commodities or articles. Other departures in the proposed legislation include the creation of a Competitive Practices Tribunal to administer a number of civil law provisions introduced in the Act for the first time, and more detailed descriptions of prohibited trade practices. The Tribunal would be given the authority to rule on the acceptability of mergers, export and specialization agreements, franchise arrangements and other trade practices, subject to detailed criteria for exemption. Penalties for non-compliance would be increased, and would include provision for the award of double damages to parties injured by those convicted of prohibited offences.

Under the draft legislation, a wide variety of trade practices would be reviewable, including price discrimination, tied sales, directed selling, exclusive dealing, delivered pricing, and refusal to deal, some of which have been the subject of specific complaints to the Task Force. The language employed in the proposed Act is complex, and with regard to each of these practices, criteria for specific exemptions are set out in detail. Since the actual wording of the prohibitions and exemptions is currently undergoing revision it may be premature to elaborate on the likely effects of the legislation in particular cases. Nevertheless, the ambit of many of the sections is so broad, it is possible that their effect might prevent or impede certain practices which might be in the best interests of increased competition. One example is the development of computer services consortia. In a typical case, two or more companies (which may or may not themselves be competitive) may jointly agree to combine their in-house data processing facilities into a separate commercial organization for the purpose of obtaining access to a larger computer on an assured basis for developing specialized programming, and for economies of scale. This is a particularly effective means for Canadian industry to achieve cost-savings which are available in the ordinary course of events to the larger U.S. companies. Under the initial draft of the competition legislation, however, it is debatable whether such an arrangement would be permissible. Similar problems might occur with regard to the formation of industry-wide committees to set up detailed technical specifications to be adopted by data communications or data processing suppliers. Whether or not,

for example, technical or economic criteria adopted by the industry for network interconnection would fall within the exemption given for agreements on "product standards" remains a difficult question.

The relationship of the proposed Act to regulated sectors of the computer/communications industry is set out in section 92 of Bill C-256. The Act is declared to be inapplicable to agreements or "courses of conduct" where the persons involved "are expressly required or authorized to do so by an enactment" of the federal or provincial legislatures or by any regulation, order, rule or other instrument made pursuant to such an enactment, and the arrangement or course of conduct "is expressly required to be supervised and regulated, on a continuing basis, by a board, commission or other public body appointed... pursuant to such enactment and that is charged with the duty of protecting the public interest." It is clear from this section that the Act applies to the telecommunications carriers with respect to all rates, agreements and practices that are not specifically sanctioned by a regulatory board expressly authorized to supervise or regulate such practices. Given the limitations of the present jurisdiction of the CTC and the various provincial utility boards to review many carrier activities (as noted in the earlier discussion), the Act would appear to have wide applicability to many of the issues of competition policy involving the carriers which are dealt with in this Report. In this respect, the relationship between the new competition legislation, and the statutes relating to communications utility regulation in Canada, would not be unlike the relationship in the United States between the administration of S.2 of the Sherman Act and S.7 of the Clayton Act by the Department of Justice Antitrust Division, and the administration of the Communications Act by the Federal Communications Commission: each would have their role to play, but each would also need to take into account the statutory policies sought to be implemented by the other agency.

3. COMPUTERS AND PRIVACY

Although the bulk of this Report has focussed on what may be termed the public or regulatory aspects of computer/communications, a variety of private law issues remain to be considered. One of these is the impact of computers and communications systems upon the privacy of Canadian individuals. Early in the work of the Task Force it was realized that this issue was so important and complex that it deserved separate study and attention. Accordingly, a separate task force was formed under the joint sponsorship of the Department of Communications and the Department of Justice, to study and report independently on the question of computers and privacy.

A list of issues relating to computers and privacy of the individual is contained in the terms of reference of that task force:

"In general, to consider privacy and the issues raised by possible invasions of privacy through the collection, storage, processing and the use of data contained in automated information and filing systems. And in particular:

- To examine the types of personal information collected for, stored in, proceeded by and distributed by automated information systems, both private and public, today and in the future;
- to examine, in terms of their implications for privacy and dignity and related values, the procedures and mechanisms for the collection, storage, processing and distribution of personal data in automated information systems;
- to examine and evaluate security procedures and mechanisms employed to prevent unauthorized access to automated information systems;
- to examine and evaluate possible measures, whether juridical, regulatory, technical or professional which might ensure reasonable protection of the privacy of persons about whom information is maintained in automated files, and to evaluate potential constraints whether commercial, legal, or constitutional, against the application of these measures."

The role of the law in privacy problems is still in a rudimentary stage of development. The often used quotation "a man's home is his castle" is attributed to Sir Edward Coke, who voiced the sentiment in the seventeenth century. This principle reflects a British tradition of architectural or spatial privacy which has been supported by the common law in a variety of ways. The issue of information privacy, or the treatment of personal information, is different from that of spatial privacy in several respects, the most obvious being that, while two people cannot possess or occupy the same space, two people can possess the same information without it being altered in any way.

The rights of an individual with respect to information about himself have not thus far been defined in Canadian or English law, though the concept of a "right of privacy" has developed a considerable literature in the United States. Bills recently enacted in the B.C. and Manitoba legislatures are aimed primarily at providing some protection from abuses by investigative and credit reporting agencies. The privacy law in British Columbia requires no proof of damage in order that action be brought. A number of bills specifically concerned with data banks and privacy have also been introduced by private members in other provinces and in the federal Parliament, although these have not been acted upon to date. There is of course protection afforded by the common law for a number of situations related to privacy, such as libel, slander, breach of confidentiality (generally applicable to lawyers, physicians, bankers, employees and spouses) and negligent mis-statements.

In Quebec, some protection of privacy has been afforded under the aegis of Article 1053 of the Civil Code, a general provision which states that "every person capable of distinguishing between right and wrong is responsible for damage caused to another by his fault, whether by his acts, his carelessness, his negligence or his incompetence."

Brandeis has described privacy as "the right to be left alone". In terms of information (as opposed to spatial) privacy, a strict definition would describe a state in which no information is demanded or given. Thus, strictly speaking, a study of informational privacy would concern itself only with information accretion or collection. In practice, normal usage extends the definition to considerations of confidentiality (or how the data are handled, once collected), data accuracy and rights of access, rights to change or amend content of file and control distribution, and security (or the degree of protection given the data). Because it is expected that the Report of the Privacy and Computers

Task Force will be available in the near future, no further discussion of these issues is set out in this Report.

4. DATA PROCESSING AND PROBLEMS OF LIABILITY

A related question that has given some reason for concern is the adequacy of contractual or tort remedies in the event that computers are misused, or where computer users are misled as to the effectiveness of a computer system and suffer damage when it fails to meet the promised specifications. Although very few cases have reached the courts involving damage caused by computer systems, the possibility of harm arising through the use of such systems has become progressively greater as the computer has become both more sophisticated and more pervasive. Many examples of the potential for damage have been suggested:

> "An explosion causing expensive damage to persons and property occurs in a chemical plant controlled by a computer. A commercial bank using an electronic check-processing and bookkeeping system incorrectly refuses to pay a check drawn by a business customer, who consequently loses a potentially profitable transaction. Computer malfunction in a business management system injures a customer's credit. A railroad classifying its freight cars by computer control erroneously designates a car containing fragile merchandise for rough handling and thereby damages the car's contents. A mistake by the railroad computer...causes loss of a customer's car and costly nondelivery of needed raw materials. Relying on a computer to calculate steel girder specifications for a skyscraper, an engineering firm inadvertently misses an error and the building collapses during construction. A rapid transit district uses a central computer; it malfunctions and several trains pile into each other. Through a data processing error, a private hospital releases a patient infected with a contagious disease and he passes that disease on to others."[20]

The resolution of these problems, were they to arise, would take place within the existing legal framework of contractual and tortious remedies, since no special branch of the law deals specifically with data processing. Depending on the fact situations, and on the terms of the warranties contained in the relevant leasing or other contracts, liability might be traced back to computer manufacturers, owners, lessees, users, operators, consultants or programmers for what their computers do or fail to do. Although it is doubtful whether these parties are prepared at present to deal with such claims, most of them are becoming increasingly aware of the potential for liability. It is likely that the problem of liability for computer use or misuse will become increasingly critical as the new technology develops.

5. THE PROTECTION OF COMPUTER SOFTWARE

A further question that has received increased attention from lawyers acting for firms involved in data processing relates to the protection of computer programs and software from misappropriation. Although this problem has been more closely studied in the United States and the United Kingdom, it has recently surfaced in Canada through the activities of the Economic Council and the Canadian Patent Office. The basic question is whether or not the product of commercial software sellers should be protected from unpaid appropriation through one of the statutory forms of protection (patent,

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[20] Brown, "The Computer and the Law of Torts," ch. 3 in *The Law of Computers* (Ann Arbor, Institute of Continuing Legal Education, 1971) at p. 46.

copyright or whether such vendors should be obliged to rely, where they find it necessary and feasible, on contractual clauses in their lease or sale contracts, or on confidentiality and trade-secret protection. Because of the inadequacies of the latter forms of protection, and the inadequacies of copyright law, there has been considerable pressure from software houses for a recognition of the inventive process in software creation by allowing computer programs to be patentable.

The position in other countries is mixed. Up to 1969 in the United States, computer programs were denied patent protection, following the recommendation of the President's Commission on the Patent System,[21] on the basis that a series of commands in program language were purely mental steps. Since then however three court cases[22] have overruled the Patent Office's stand and allowed patents on programs. In the United Kingdom, following a decision of the British Patent Office in 1966,[23] guide-lines were issued in 1969 which allow patent applications for computer programs to be approved, subject to their being framed within the limitations as to form contained in the British legislation.[24]

The position in Canada has just recently changed so as to allow patent protection along the lines permitted in the United Kingdom. Up to late 1971, patent protection for computer software was precluded by a guide-line issued by the Commissioner of Patents,[25] and this ruling was supported by the Economic Council in its Report on Intellectual and Industrial Property.[26] Since that time, however, the Commissioner of Patents has ruled that, although claims to a computer program *per se* are not patentable, claims to a new and novel method for controlling a machine (*i.e.*, a process for conditioning the operation of a data processor) are patentable.[27] This essentially parallels the English position, which denies patents to computer programs or algorithms alone, but permits them where claims are framed to embrace the use of a computer by controlling it or operating it, according to an algorithm, in a certain new and novel way.

[21] *Report of the President's Commission on the Patent System* (Washington, U.S. Government Printing Office, 17 November 1966).

[22] *In re Prater and Wei* (1969), 162 U.S.P.Q. 541; *In re Mahoney* (1970), 164 U.S.P.Q. 572; *In re Musgrave* (1970), 167 U.S.P.Q. 280.

[23] *Slee and Harris's Application*, [1966] R.P.C. 194.

[24] *Official Patents Journal* (U.K.), 5 March 1969, p. 683.

[25] Notice of the Commissioner of Patents (Canada), July 1970.

[26] Economic Council of Canada, *Report on Intellectual and Industrial Property* (Ottawa, Information Canada, March 1971), pp. 101-104.

[27] *Official Patents Journal* (Canada), January, 1972.

This chapter is concerned with the issue of the constitutionality of present or proposed federal or provincial legislation affecting the computer/communications industry. Most of the problems addressed in this Report have important repercussions on a local or regional, as well as on a national, basis. With this in mind, the Task Force has been conscious of the need to establish as clearly as possible the respective roles of the provincial and federal governments at both the constitutional and administrative level.

What level of government, provincial or federal, has jurisdiction in any given case to legislate, or create new administrative frameworks affecting computer/communications? It is not an overstatement to say that this issue has constituted one of the most sensitive and difficult problems dealt with by the Task Force. On many of the most fundamental questions, no common agreement exists. The task of the constitutional lawyer is rendered more difficult by the fact that the activities and social interests affected by computer/communications touch almost every sector of industry and society, and effectively cut across many of the traditional jurisdictional boundaries. Again, many of the questions that can be posed have received little if any direct judicial attention in Canadian courts, and it is therefore necessary to consider a wide variety of judicial precedents from analogous fields. These precedents, depending on their limitations and ambiguities, may or may not be persuasive in determining the results where the computer/communications industry is involved.

It is also important to distinguish between the prediction of court decisions, *i.e.*, the determination of whether the present Canadian courts would uphold suggested legislation as *intra vires*, and the more sensitive question of the optimum distribution of legislative powers on political or administrative grounds. This section deals primarily with the former question--namely, the extent to which the provisions of the Canadian constitution relating to the division of legislative powers affect the jurisdiction of the federal and provincial governments over computer/communications. In areas where the present constitutional framework leads to unworkable or impractical divisions of legislative responsibility, however, there will inevitably develop a need for the various levels of government to work out more effective administrative arrangements on a co-operative basis, in the light of each government's perceived needs and concerns.

This process involves many more considerations than just computer/communications, and the recommendations of the Task Force; such co-operation will undoubtedly need to take place in the wider context of communications policy as a whole. With this in mind, it is important to realize that the comments relating to intergovernmental co-operation and adjustment that appear are not based on an over-all review of communications policy, but are limited to the narrower issues presented by the computer/communications industry. Despite this limitation, comments are made upon jurisdictional shortcomings, where these appear to touch directly on the issues confronting federal or provincial government policy-makers with regard to this industry.

Keeping these preliminary observations in mind, it is now appropriate to examine the present constitutional framework for computer/communications, in the light of the terms of the *British North America Act* and the decided cases. Not surprisingly, the B.N.A. Act of 1867 makes no explicit references to either ''computers' or ''communications'; the only direct reference to telecommunications, as now defined, is the use of the word 'telegraphs'' in section 92 (10) (a). The disposition for constitutional purposes of areas such as electronic data processing where technology has created entirely new vocabularies, is made on the basis of the general wording found in Sections 91 and 92. Although the reader is referred elsewhere for a fuller treatment of the basic principles of Canadian constitutional law,[28] it may be useful to summarize the elements of the constitutional framework that touch directly or indirectly on computers and communications systems.

One may begin by observing that there is no inherent constitutional value in either of the terms ''computer' or ''communications''. The determination of constitutional jurisdiction rests on a variety of factors, ranging from the nature and purpose of the particular legislation, to the nature and purpose of the business or operation sought to be regulated. In each case, the functional and territorial attributes of the computer/communications system must be carefully examined, along with such matters as the type and location of the customers, the kind of remote links employed (if any), and the nature and intent of the particular legislation.

The most useful starting point for an analysis of the basic regulatory authority over computer/communications systems is paragraph 92(10) of the B.N.A. Act. This paragraph confers exclusive jurisdiction over ''local works and undertakings'' to the provinces, subject to certain exceptions which are assigned exclusively to the Dominion Parliament through the operation of paragraph 91(29). The exceptions of interest are s.92(10)(a): ''...Telegraphs, and other Works and Undertakings connecting the Province with any other or others of the Provinces, or extending beyond the limits of the Province''; and s. 92(10)(c): ''Such works as, although wholly situate within the Province, are before or after their execution declared by the Parliament of Canada to be for the general Advantage of Canada or for the Advantage of Two or More of the Provinces.'' The basic question that must therefore be asked with respect to any particular computer/communications system, service, or enterprise is whether or not the system can properly be characterized as an interprovincial work or undertaking, within the meaning of s.92(10)(a), or whether it is the subject of a declaration under s.92(10)(c). If either is the case, the system will be exclusively within federal jurisdiction. If not, and the system can properly be characterized as a ''local work or undertaking'' (which also assumes that the system lacks such dimensions of national importance as to attract federal jurisdiction under the residual power), the provinces will have exclusive authority to pass legislation with respect to such systems.

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28 For general treaments see *Instant World*, pp. 205-211. *Telecommission Study* 1(a), and Laskin, *Canadian Constitutional Law*, 3rd. ed. rev. (Toronto, Carswell, 1969). More specialized background can be found in McNairn, ''Transportation, Communication and the Constitution: The Scope of Federal Jurisdiction'' (1969) 47 *Can. Bar Rev.* 355; Grant, ''Constitutional Jurisdiction and the Radio Frequency Spectrum,'' Chapter 2 in *Canadian Broadcasting Law and Administration* (Toronto, CCH Canadian, forthcoming); and Lederman, ''Telecommunications and the Federal Constitution of Canada'', in *Telecommunications in Canada* (Toronto, Methuen, forthcoming).

The declaratory power under s.92(10)(c) may be dealt with briefly. Since 1867, this power has been exercised some 470 times with regard to a wide variety of works.[29] In the computer/communications field, the only significant declarations have been in the special Acts constituting Bell Canada and British Columbia Telephone Company.[30] All the works of these companies have been declared to be for the general advantage of Canada and consequently their data communications and data processing operations come exclusively under federal jurisdiction, whether or not they are "interprovincial" in character. Although the point has never been expressly determined, it does not appear that these declarations apply to data communications, or data processing operations of wholly-owned or partly-owned subsidiaries of Bell Canada or B.C. Telephone (e.g., Newfoundland Tel or Okanagan Tel). Such operations would need to fall within the terms of s.92(10)(a), *e.g.*, by constituting an interprovincial undertaking, or being closely integrated with such an undertaking, to be clearly within federal jurisdiction.[31] It should also be added that the last exercise of the federal power under s.92(10)(c) occurred in 1961, and its use as a unilateral device for obtaining regulatory jurisdiction has been largely abandoned in sensitive or controversial areas. In consequence, the Task Force has not considered the possibility of the future use of s.92(10)(c) for constitutional purposes in the computer/communications field. Instead, where valid areas of federal concern exist, the Report focuses on the use of the existing constitutional powers, combined, where necessary, with intergovernment co-operation and mutual adjustment.

The problem of determining when a computer/communications work or undertaking falls within the meaning of s.92(10)(a) is more difficult, but the basic principles can be briefly summarized. To begin with, it appears clear that persons in the business of offering computer services through the use of a stand-alone computer, operated on an over-the-counter basis at one or more locations, would *prima facie* be subject to exclusive provincial jurisdiction. Such computers, and the services involved, would probably constitute local works or undertakings within the meaning of s.92(10), save where they were declared works under s.92(10)(c) (as for example those of Bell Canada or B.C. Tel), or works operated as integral parts or businesses otherwise subject to exclusive federal jurisdiction (*e.g.*, chartered banks, airlines, or federal government operating agencies). This would probably apply even if many of the customers of the over-the-counter service brought their work in from outside the province concerned.

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[29] See generally Laskin, *supra* at 504; MacDonald, "Parliamentary Jurisdiction by Declaration", 1 D.L.R. 1; Schwartz, "Fiat by Declaration – s.92(10)(c) of the British North America Act" (1960), 2 *Osgoode Hall* L.J. 1; Hanssen, "The Federal Declaratory Power under the British North American Act" (1968) 3 *Man. L.J.* 87; and Lajoie, *Le Pouvoir Déclaratoire du Parlament* (Montréal, Les Presses de l'Université de Montréal, 1969).

[30] Section 6 of the *Railway Act*, R.S.C. 1970, c.R-2, also declares that the railways and connected works of CNR and CPR are works for the general advantage of Canada, but this would not appear to operate as an effective declaration with respect to their independent communications operations: see *C.P.R.* v. *A.-G.B.C.*, [1950] 1 D.L.R. 721, [1959] A.C. 122. The point is academic in any case since the CN/CP Telecommunications operations clearly fall within the scope of s.92 (10)(a).

[31] As *fell* for determination, for example in *R.* v. *D.L.R.B. ex parte Dunn* (1963), 39 O.L.R. (2d) 346, and v. *O.L.R.B. ex parte Northern Electric*, [1970] 2 O.R. 654, with mixed results.

When data communications links are added to the computer, the situation becomes considerably more complex. Among the questions that must be addressed are the following: How closely integrated are the data communications facilities with the data processing facilities? Who owns or provides each? What is the mode of electronic transmission? Are the remote links provided by a telecommunications carrier and, if so, is the carrier subject to federal or provincial regulation? Are the remote facilities co-used for other purposes, and is it possible to separate the computer/communications undertaking functionally or operationally? Do the links extend across provincial borders, or connect one province with another? How often or regularly are the interprovincial links used? Who effectively manages, markets, or controls the undertaking?

Most of these questions arise because of the language of S. 92(10)(a), which refers to works or undertakings *connecting* one province with others or *extending* beyond the physical limits of a single province. While works are normally considered physical installations, an undertaking has been defined judicially as "an arrangement under which...physical things are used".[32] The determination of when a data communications network involving computer terminals in more than one province constitutes an interprovincial undertaking requires a close look at the nature of the "arrangement" in each case.

An initial difficulty is the question of the physical connection. The language of s. 92(10)(a) suggests that a border connection between two entities offering an interprovincial service through the joint use of each other's facilities would give rise to federal jurisdiction. On the other hand, it has been held that a highway is not an interprovincial work or undertaking where it runs to a provincial border and there abuts on a highway of the adjacent province.[33] Again, the connection between a "local" railway and a railway declared to be for the general advantage of Canada has in one case been held not to subject the former to federal jurisdiction in the absence of common or integrated operation.[34] The relevance of these cases to communications is still a matter of dispute. TCTS members have contended that the holdings in these cases apply to the operations of the provincially incorporated telephone companies so as to bring them totally within provincial jurisdiction.[35] Other commentators, basing their argument on a variety of cases relating to

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[32] Per Lord Dunedin in the *Radio References*, [1932] A.C. 304 at 315.

[33] *S.M.T. (Eastern) Ltd.* v. *Ruch*, [1940] 1 D.L.R. 190.

[34] *Montreal* v. *Montreal Street Railway*, [1912] A.C. 334.

[35] For the basic conflict, see *Telecommission Study* 1(a).

railways, pipelines and electric power networks,[36] have contended that the interdependence and integration of the telephone systems in an operational sense subjects them to federal jurisdiction, at least with respect to interprovincial tolls, and possibly with respect to their entire operations.[37]

It is clear from such cases that integration of management or operational dependence or control is a critical factor in determining whether otherwise "local" systems constitute part of an interprovincial undertaking. The place of incorporation, federal or provincial, of the relevant company will not determine the regulatory jurisdiction under which its works or undertakings fall.[38] Nor will the fact that two distinctly separate activities are carried on by the same company suffice to integrate them for jurisdictional purposes.[39] The critical factor appears to be integration of operation in the practical or working sense and, where this exists, the courts have been willing to ignore the separate corporate identities of parent and subsidiary companies, and have treated them as a single entity for jurisdictional purposes.[40] Corporate objects or powers have not been determinative, except where they have constituted evidence of integration of management or operation.

The extent and nature of the extraprovincial activity has also been the subject of comment in the cases. The well-known *City of Toronto* v. *Bell Telephone* case held that the Bell undertaking could not be broken down into separate local and long-distance businesses, so as to subject the company to different legislative jurisdictions: the integration of services was sufficient to require them to be treated as one undertaking.[41] Since s. 92(10)(a) refers to the work or undertaking as such, and not to its interprovincial features, the courts have held that a work or undertaking falls completely within federal jurisdiction if it has some interprovincial extensions in practice. But what constitutes sufficient extra provincial activity to bring s. 92(10)(a) into play? This is particularly relevant to data communications networks, which may be used heavily and continually on a local basis, but with provision for occasional connections to subscribers in other provinces.

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[36] *Hewson* v. *Ontario Power Co.*, [1905] 36 S.C.R. 596; *Ottawa Valley Power Co.* v. *H.E.P.C.O.*, [1936] 4 D.L.R. 594; *Luscar Collieries Ltd.* v. *McDonald. British Columbia Power Corp.* v. *A.-G.B.C.*, [1963] 47 D.L.R.2d 633

[37] See Lederman, *op. cit., supra*, note 28. *Telecommission Study 1(a). City of Toronto* v. *Bell Telephone Co.*, [1905] A.C. 52.

[38] *C.P.R.* v. *A.-G.B.C.*, [1950] A.C. 122, [1950] 1 D.L.R. 721.

[39] See cases cited in notes 31 and 38 above.

[40] *R.* v. *O.L.R.B. ex parte Northern Electric*, [1970] 2 O.R. 654, 11 D.L.R. (3d) 640.

[41] *City of Toronto* v. *Bell Telephone Co. of Canada*, [1905] A.C. 52.

On this issue, the provincial courts have generally taken the position that, at least with regard to transportation undertakings, the percentage of the company's traffic which crosses a provincial boundary is not decisive, but the character of the traffic must satisfy certain standards of regularity in service offered.[42] Until recently, this question has not reached the Supreme Court of Canada, but in the *Agence Maritime* case, decided in 1969, the Court appears to have accepted the guide-lines developed in the lower courts.[43] Mr. Justice Fauteux did not examine in depth the question of what interprovincial service would be regarded as "reasonably regular" for the purpose at hand. He cited with approval, however, a lower court decision to the effect that extraprovincial business (here by a shipping line) need not be made in accordance with a printed time-table to satisfy the test, so long as the carrier offers constant and uninterrupted extraprovincial service to all those who ask for it.[44]

How do these principles apply to computer/communications networks? In a typical configuration, a service bureau may offer access on a time-sharing basis to its computer data bank and central processing unit to anyone from outside the province prepared to lease a dedicated direct line to its establishment. Alternatively, the service bureau may itself lease dedicated lines across the country, and propose that customers lease private lines to connection centres set up on the network by the service bureau. The cases suggest that if the extra-provincial activity is sufficiently regular and there is an interdependence and integration between the component parts of the network, the network will fall under federal jurisdiction. The ownership of the various component parts need not necessarily be in the same hands; what is important is the extent to which the parts have been organized under a common control to facilitate simultaneous interaction with the computer.

It should be noted at the same time that the above discussion does not necessarily preclude the possibility of distinguishing the question of jurisdiction over provincial telephone companies, where such companies merely provide physical facilities and no marketing or management, from the question of jurisdiction over the computer/communications network itself. The distinction is best seen in comparing the *Ruch* case with the *Winner* case; in the former,[45] it was held that highways abutting on provincial borders were not in themselves subject to federal jurisdiction; in the *Winner* case,[46] it was held

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42 See, for example, *R. v. Toronto Magistrates*, [1960] O.R. 497, 25 D.L.R. 2d 161; affirmed sub nom *Re Tank Truck Transport Ltd.*, [1963] 1 O.R. 272, 36 D.L.R. 2d 636; *R. v. Cooksville Magistrate's Court*, [1965] 1 O.R. 84, 46 D.L.R. 2d 700.

43 *Agency Maritime Inc. v. C.L.R.B.*, [1969] S.C.R. 851, 12 D.L.R. 3d 722.

44 (1969), S.C.R. 851 at 857-58, 12 D.L.R. 3d 722 at 726-7.

45 *S.M.T. (Eastern) Ltd. v. Ruch*, [1940] 1 D.L.R. 190.

46 *A.-G. Ont. v. Winner*, [1954] 4 D.L.R. 657, [1954] A.C. 541.

that an operator using these same highways to serve customers in more than one province was carrying on an interprovincial undertaking within the meaning of s.92(10)(a). The recent Supreme Court of Canada decision relating to *GO Transit* held, on the other hand, that the fact that a local service co-uses the physical lines of an interprovincial carrier *ipso facto* renders it subject to federal control.[47] These results suggest that it is not impossible to separate the jurisdiction over the physical plant from the jurisdiction over the undertaking using such plant, but that a provincial carrier that becomes directly involved in designing, managing or marketing an undertaking using integrated computer/communications facilities in more than one province may find itself under federal jurisdiction in respect of such activity.
Left relatively untouched in the foregoing discussion has been the problem of the degree of integration required for a computer/communications network to constitute a definable "undertaking". The example posed above was relatively free from doubt; dedicated private lines and terminals designed specifically for computer interaction were involved, and the use of such lines was regular and continuing. A much more difficult problem is posed when remote-access is available only through the regular telephone system and the use of the computer even on this basis is sporadic and occasional. The dividing line between these two configurations is likely to be a difficult one to draw and must await further judicial determination.

A further comment may be addressed to the question of concurrent powers. Although the B.N.A. Act speaks of "exclusive" jurisdiction over local or interprovincial undertakings, this is subject to the exercise of a variety of other legislative powers that have direct or indirect relevance to computer/communications systems. With regard to interprovincial undertakings, exclusive federal jurisdiction relates to "all matters which are a vital part of the operation of an interprovincial undertaking as a going concern."[48] But provincial legislation touching on such matters as taxation, workmen's compensation, tort liability, and the collection of data, would likely be upheld in the absence of conflicting federal legislation.[49] In addition, the use of national computer/communications systems by provincial institutions (*e.g.*, hospitals, schools, municipalities, motor vehicle registration, the administration of justice) would be subject to provincial direction.

At the same time, computer/communications networks or computer data banks that are "local", and hence under provincial jurisdiction are also subject to some concurrent federal controls. The use of radio frequency

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[47] *The Queen* v. *Board of Transport Commissioners*, [1968] 65 D.L.R. 2d 425.

[48] Per Martland J. in *Commission du Salaire Minimum* v. *Bell Telephone Co. of Canada*, [1966] S.C.R. 767 at 772, 59 D.L.R. 2d 145 at 148.

[49] The various cases are collected in Grant, *op. cit. supra*, note 28.

spectrum by such networks would be licensed federally, for example;[50] in addition, such networks or data banks would be subject to the federal Criminal Code, the Combines Investigation Act, the Patent Act, the Copyright Act, and other federal statutes relating to such matters as taxation, customs tariffs, and the census. The use of local networks or data banks by federally regulated institutions (*e.g.* chartered banks, airlines, federal government departments) would also be presumably subject to federal direction.

As noted in *Instant World,* telecommunications services are "profuse, various, complex, interdependent, and of vital concern to all the people of Canada."[51] When telecommunications services are allied with those of the computer, both the provinces and the federal government have legitimate concerns which require mutual co-operation in order that the goals of each can be achieved. The constitutional framework in Canada is in the process of considerable adjustment in response to these needs and the need for co-ordination of the various concerns and approaches has never been more pressing.

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50 *Re Regulation and Control of Radio Communication.* [1932] A.C. 304. [1932] 2 D.L.R. 81.

51 *Instant World.* p.211.

APPENDIX TO PART A

APPENDIX 1

TABULAR SUMMARY OF REGULATORY JURISDICTION OVER MAJOR CANADIAN TELECOMMUNICATIONS CARRIERS

NAME OF CARRIER	SIZE, OPERATING TERRITORY, OWNERSHIP (1970 figures)	INCORPORATING LEGISLATION	REGULATORY AGENCY RESPONSIBLE FOR GENERAL RATE REVIEW, APPLICABLE STATUTES
A. TELEPHONE COMPANIES (in order of no. of telephones)			
Bell Canada	Canada's largest carrier; operates in Ontario, Quebec with 6,007,507 telephones; $936.6 million in operating revenues. Publicly held; 95% Canadian owned. AT&T interest is 2.1% of outstanding shares.	S.C. 1880, c.67, as amended (12 amendments have been made so far). S.C. 1882, c.95, s.4, declares the works authorized to be for the general advantage of Canada. S.C. 1967-68, c.48, s.6 permits foreign attachments subject to CTC review; forbids Bell from controlling contents of messages.	Canadian Transport Commission (Telecommunication Committee). See *Railway Act*, R.S.C. 1970, c.R-2; *National Transportation Act*, R.S.C. 1970,c.N-17.
British Columbia Telephone Company	Operates in British Columbia with 982,503 telephones; $168.9 million in operating revenues. Controlled 51.3% by General Telephone & Electronics Corp., a New York company through a Quebec subsidiary, Anglo-Canadian Telephone Company.	S.C. 1916, c.66, as amended in 1940-41, c.36, 1947, c.86, 1957, c.40, and 1960, c.66. Section 2 declares the works authorized to be for the general advantage of Canada. S.C. 1960, c.66, s.1 precludes company from acquiring shares of carrier companies without CTC approval.	Canadian Transport Commission (Telecommunications Committee). See *Railway Act*, R.S.C. 1970, c.R-2; *National Transportation Act*, R.S.C. 1970, c.N-17.

NATURE OF PRESENT REGULATORY JURISDICTION
OVER DATA COMMUNICATIONS,
FOREIGN ATTACHMENTS, INTERCONNECTION

Under ss.320 & 321 of the Railway Act, CTC may review and revise all "telegraph and telephone tolls" charged by the company, as defined in s.2. Such tolls must be just, reasonable and non-discriminatory. Up to 1970, this did not apply to charges for leasing or using telephone wires "where no toll is charged to the public", but this private line exemption was removed on August 1, 1970. CTC thus has power to review all of Bell's data communication services where these use its telephone plant or facilities. CTC can permit separate classifications and rates for message services and review boundaries of base rate areas. CTC has so far limited its review to overall rate of return only, and not return on individual services, but it has begun to hear complaints relating to specific tariffs and restrictions, particularly PBX and CATV pole use. The Bell Act permits foreign attachments subject to reasonable requirements to be set up by the company and arbitrated by CTC, requires Bell to act "solely as a common carrier", without the power to "control the contents" or "influence the meaning or purpose" of messages, and obligates Bell to furnish telephones upon request to any person in its service area. CTC can also review agreements between Bell and connecting carriers, and (under the Bell Act) any capital issues by Bell. On January 12, 1972, the CTC announced its decision to undertake a study on cost accounting procedures of the telecommunications carriers, which is expected to include an analysis of cost separations and cross subsidization, if any, between individual voice and data services.

Under ss.320&321 of the Railway Act, CTC may review and revise all "telegraph and telephone tolls" charged by the company, as defined in s.2. Such tolls must be just, reasonable and non-discriminatory. Up to 1970, this did not apply to charges for leasing or using telephone wires "where no toll is charged to the public", but this private line exemption was removed on August 1, 1970. CTC thus has power to review all B.C. Tel's data communication services where these use its telephone plant or facilities. CTC can permit separate classifications and rates for message services and review boundaries of base rate areas. CTC has so far limited its review to overall rate of return only, and not return on individual services but it has begun to hear complaints relating to specific tariffs and restrictions, e.g. hotel PBX. CTC can also review agreements between B.C. Tel and connecting carriers and (under the B.C. Tel Act) any acquisition of shares or assets of companies with similar objects, and any capital issues by B.C. Tel. CTC has no specific powers to compel interconnection with non-carriers or to rule on foreign attachments save through the revision of suggested tariffs where such tariffs are discriminatory. On January 12, 1972, the CTC announced its decision to undertake a study on cost accounting procedures on the telecommunications carriers, which is expected to include an analysis of cost separations and cross subsidization, if any, between individual voice and data services.

Alberta Government Telephones	Operates in Alberta with 510,266 telephones; $109.9 million in operating revenues. A Crown Corporation of the province of Alberta.	*Alberta Government Telephones Act*, R.S.A. 1970 c.12, as amended in 1971, c.2	Alberta Public Utilities Board. See *Public Utilities Board Act*, R.S.A. 1970, c.302, as amended.
Manitoba Telephone System	Operates in Manitoba with 435,606 telephones; $58.6 million in operating revenues. A Crown Corporation of the province of Manitoba.	*The Manitoba Telephone Act*, R.S.M. 1970, c.T-40, as amended in 1971, c.82, s.55.	Manitoba Public Utilities Board. See *Public Utilities Board Act*, R.S.M. 1970, c.P-280.
Saskatchewan Telecom-munications	Operates in Saskatchewan with 314,981 telephones; $50.5 million in operating revenues. A Crown Corporation of the province of Saskatchewan.	*The Saskatchewan Tele-communications Act*, R.S.S. 1965, c.42, as amended in 1966, c.7, 1968, c.62, 1969, c.52, 1971, c.46.	Self-regulated through cabinet-appointed board of directors, the Minister of Telephones, and a select standing committee of the Saskatchewan Legislature.
Maritime Telephone & Telegraph Company Limited	Operates in Nova Scotia with 281,363 telephones; $44.0 million in operating revenues. Owned 52.4% by Bell Canada since 1966, subject to limitation of votes to 1,000 shares.	Stat. N.S. 1910, c.156 as amended (15 amendments have been made so far). Stat. N.S. 1966, c.5,s.1, precludes any one person from voting more than 1,000 shares at any meeting of the company.	Nova Scotia Board of Commissioniers of Public Utilities. See *Public Utilities Act*, R.S.N.S. 1967, c.258, as amended in 1970, c.65.

Under the Public Utilities Board Act, the Board is given the authority to revise AGT's tolls or charges if they exceed what is just and reasonable, or if they are unjustly discriminatory. Since the definition of a public utility includes "any system...for the conveyance of telegraph or telephone messages", it is arguable that both public and private line services, whether voice or data, come under Board jurisdiction. The question has not yet been raised however, since the Board presently regulates AGT on the basis of its overall rate of return. Separate service offerings have not been the subject of direct regulation to date, although AGT is required to file its schedule of rates with the Board for approval. The Board has a general supervisory power, and can direct AGT with respect to its accounting practices, extension of its works or systems, maintenance of "safe, adequate and proper service", and classification of individual rates. AGT must also seek Board approval for debenture issues. Joint use of poles, wires or equipment by public utilities can also be ordered by the Board, and the Board can order interconnection between telephone systems and arbitrate the conditions therefor. No interconnection with non-carriers can be ordered however and the AGT Act prohibits attachments not owned by the corporation except with AGT permission.

Under s.77 of the Public Utilities Board Act, the Board may review and revise all rates and tolls charged by MTS as a public utility, i.e. as a system for the transmission of telephone messages directly or indirectly, to or for the public. Tolls or individual special rates can be revised by the Board if they are unjust, unreasonable, insufficient, or unjustly discriminatory or 'preferential'. Some technical regulation as to methods, standards and safety is also allowed, but the Board has no direct jurisdiction to review capital issues or construction expenditures save to the extent that rate regulation affects such matters. Arguably, the Board might be able to exercise jurisdiction over the rates for private line services, including dedicated data offerings, but such rates are not at present reviewed by the Board and the Board's jurisdiction is unclear. Interconnection may be ordered between MTS and other public utilities but not to non-carriers. MTS may prohibit foreign attachments if in its opinion such would injuriously affect its equipment. No review power over such matters is given to the Board, save in regard to discrimination.

No independent agency reviews Sask Tel tariffs, but as a matter of policy, any significant adjustments are referred to the directors and responsible minister and often to Cabinet for approval. Similarly, significant capital issues or construction projects are submitted for the approval of the directors and the Minister. The Sask Tel Act requires all rates for its services to be published, save where special agreements for particular services are negotiated. Save through an appeal to cabinet, Sask Tel cannot be required to interconnect with other carriers or non-carriers or to permit the use of foreign attachments. However, other telephone systems in Saskatchewan can be required by the Minister of Telephones to interconnect with Sask Tel.

The Nova Scotia Board is given the power to review and approve any rate of charge made by MT&T for any services performed or facilities provided by it as a public utility under the Act. Tolls must be submitted to and approved by the Board and must not be unreasonable or unjustly discriminatory. The Board is also given authority to control and regulate technical and safety matters, the issuance of securities, accounting procedures, and expenditures on capital construction over $5,000. Although it is not clear that its jurisdiction is so limited, the Board has restricted its review to voice services, either private line or public switched, and has not seen fit to regulate other uses of MT&T facilities, e.g. for data communications services. Rates for non-regulated services, including TWX, are therefore not submitted for approval. Interconnection of MT&T facilities with those of rural telephone companies may be ordered by the Board, but otherwise the MT&T Act appears to give an unlimited right to the Company to refuse to permit foreign attachments or interconnection.

New Brunswick Telephone Company Limited	Operates in New Brunswick with 225,121 telephones; $40.8 million in operating revenues. Owned 51% by Bell Canada.	Stat. N.B. 1888, c.78, as amended in 1907, c.58 and 1949, c.67.	New Brunswick Board of Commissioners of Public Utilities. See *Public Utilities Act*, R.S.N.B. 1952, c.186, as amended; *Telephone Companies Act*, R.S.N.B. 1952, c.226, as amended.
edmonton telephones	Operates in City of Edmonton with 218,022 telephones; $20.3 million in operating revenues. A municipal telephone system owned by the City of Edmonton.	Operated under authority granted the City under the *Municipal Telephone Act*, R.S.A. 1955, c.218.	Rates fixed by the elected representatives of the City of Edmonton.
Québec-Téléphone	Operates in eastern Quebec with 133,867 telephones; $26.1 million in operating revenues. Controlled by General Telephone & Electronics Corp., a New York company, through a Quebec subsidiary, Anglo Canadian Telephone Company.	Constituted under the *Telegraph and Telephone Companies Act*, R.S.Q. 1964, c.286.	Quebec Public Service Board. See *Public Service Board Act*, R.S.Q. 1964, c.229.
Newfoundland Telephone Company Limited	Operates in Newfoundland with 92,991 telephones; $17.5 million in operating revenues. Owned 99.6% by Bell Canada since 1962.	Stat. Nfld. 1925, n.10 as amended (7 amendments have been made so far). Name changed from the Avalon Telephone Company Ltd. in 1970.	Newfoundland Board of Commissioners of Public Utilities. See *Public Utilities Act*, Stat. Nfld. 1964, no.39, as amended in 1966, no.26 and 1969, no.7.

The New Brunswick Board is given the authority to review and revise all rates or tolls charged by N.B. Tel as a public utility, i.e. as a person owning plant or equipment for the conveyance of telephone messages to or for the public. Such tolls and any practices of N.B. Tel can be modified by the Board if they are unreasonable, insufficient or unjustly discriminatory; in addition the Board can order extension of service to an area. Although the Board arguably possesses such jurisdiction, it has ruled on a variety of occasions beginning in 1962 that any services provided by N.B. Tel that are not connected for intercommunication with the company's general local or long distance telephone network are not subject to its regulation. Hence the Board does not review private line services of N.B. Tel, whether voice or data. The Board has reviewed the company's rate of return only *in toto* and has not required N.B. Tel to separate out the costs for its non-regulated services; in 1969, however, it requested the company to study this question further. Under the Telephone Companies Act, N.B. Tel can be required to interconnect with other telephone companies by the provincial cabinet but this does not apply to non-carriers. No power is given to the Board to compel N.B. Tel to interconnect or to rule on foreign attachments save through the revision of suggested tariffs for public services where such tariffs are discriminatory.

Under the Public Utilities Board Act, telephone systems owned by municipalities only fall within Board jurisdiction where such municipalities have passed a by-law to this effect. The City of Edmonton has not so far submitted its system to Board jurisdiction and hence edmonton telephones is largely self-regulated. The Board does however arbitrate interconnection disputes between AGT and edmonton tel. Rates for edmonton tel services are subject only to council approval, and save through an appeal to council, edmonton tel appears to have an unlimited right to refuse to permit foreign attachments or interconnection with non-carriers.

Québec Tel comes under the jurisdiction of the Board, as operating ''any service for the transmission by wire or wireless of telegraphic or telephonic messages, or by the two means combined''. Rates and contracts of Québec Tel must be fair and reasonable, and must be filed and approved by the Board. The Board can also require the company to adopt measures relating to such matters as quality of service, equipment, apparatus, extension of works or systems, message routes, reports to be made, and conditions and practices respecting rates or prices. Private lines services, whether voice or data, are therefore directly under Board jurisdiction, and although the Board has to date been concerned chiefly with overall rate of return, it proposes to evaluate individual service offerings, including remote access data processing, more closely. The Board's approval is required for cessation of operations, extension of service, and any merger or sale affecting public service. The Board can compel interconnection between Québec Tel and other public services, but no other power with regard to interconnection or foreign attachments is given to the Board.

No public utility (which includes Newfoundland Tel) may charge compensation for any service performed by it whether for the public or under contract without the approval of its rates or tolls by the Board. The Board may investigate and make orders to remedy unreasonable or discriminatory rates or practices or inadequate service. Board approval is also required for construction expenditures in excess of $25,000, and for abandonment of service, changes in equipment type, and transfer of any of the undertaking. Hence all data communication services are reviewed by the Board although ''non-telecommunications services'' (e.g. directory advertising) are unregulated. The Newfoundland Telephone Act prohibits attachments not owned by the company except with company permission. Joint use of poles or wires by public utilities may however be arbitrated by the Board.

Thunder Bay Telephone	Operates in the City of Thunder Bay with 56,134 telephones; $3.4 million in operating revenues. A municipal public utility owned by the City of Thunder Bay.	A public utility operated under authority granted the City under the *Telephone Act*, R.S.O. 1970, c.457, s.27 and the *Public Utilities Act*, R.S.O. 1970, c.390, Parts III and IV.	Ontario Telephone Service Commission. See*Telephone Act*, R.S.O. 1970, c.457; *Public Utilities Act*, R.S.O. 1970, c.390, Parts III and IV.
Okanagan Telephone Company	Operates in south central British Columbia with 55,181 telephones; $6.0 million in operating revenues. Owned 100% by B.C. Telephone Company since 1966.	Stat. B.C. 1907, c.35 as amended by 1913, c.90, 1937, c.80, 1951, c.100.	British Columbia Public Utilities Commission. See *Public Utilities Act*, R.S.B.C. 1960, c.323, as amended.
Téléphone du Nord de Québec Inc.	Operates in northwestern Quebec with 49,959 telephones; $7.4 million in operating revenues. A subsidiary of Northern Telephone Limited, which is controlled by Bell Canada.	Constituted under the *Telegraph and Telephone Companies Act*, R.S.Q. 1964, c.286.	Quebec Public Service Board. See *Public Service Board Act*, R.S.Q. 1964, c.229.
Northern Telephone Limited	Operates in northern Ontario with 48.241 telephones; $4.6 million in operating revenues. Owned 88% by Bell Canada since 1966.	Holds private charter issued under the *Telephone Act*, R.S.O. 1970, c.457, s.87.	Ontario Telephone Service Commission. See *Telephone Act*, R.S.O. 1970, c.457.

Thunder Bay Tel, as a public utility carried on under s.27 of the Telephone Act, is subject to the authority of the Commission, which can require rates and tolls to be revised if they are discriminatory, excessive, or insufficient. The definition of "rates" limits the jurisdiction of the Commission to rentals or charges "for supplying telephone exchange service and all services associated therewith". Dedicated data offerings may therefore fall outside Commission jurisdiction in some circumstances; such offerings are presently filed with the Commission although no active regulation of private line services has been undertaken to date. The consent of the Commission is required for acquisition or sale of telephone undertakings, for the provision of non-interconnection or joint use agreements with other utilities. The Commission may compel telephone service to be furnished upon request, make orders with respect to adequacy of service, require interconnection with other telephone systems, and can regulate accounting practices, and the type of construction and maintenance. Foreign attachments which injure or damage the system are prohibited and the Act requires the utility to "own and maintain all equipment...operated in connection with the system", unless otherwise consented to by the Commission. Interconnection with non-carriers cannot be ordered.

Under the Public Utilities Act, the PUC regulates Okanagan Tel as a person owning equipment or facilities for the conveyance of messages or communications by telephone or telegraph, where such service is offered to the public or any corporation for compensation. All rates, tolls and practices of Okanagan Tel must be just, reasonable, and not unjustly discriminatory. Although rates for private line services, whether voice or data, are filed with the Commission and subject to its approval, the PUC has made no attempt to segregate their cost and revenues when regulating Okanagan's overall rate of return. The Commission is given the power to determine standards of service, to require joint use of poles, wires or equipment by public utilities, to require interconnection between telephone systems (for the conveyance of messages only), and to order extension of service. No other power with regard to interconnection or foreign attachments is given to the Commission.

Téléphone du Nord de Québec comes under the jurisdiction of the Board, as operating "any service for the transmission by wire or wireless of telegraphic or telephonic messages, or by the two means combined". Rates and contracts of the company must be fair and reasonable, and must be filed and approved by the Board. The Board can also require the company to adopt measures relating to such matters as quality of service, equipment, apparatus, extension of works or systems, message routes, reports to be made, and conditions and practices respecting rates or prices. Private line services, whether voice or data, are therefore directly under board jurisdiction, and although the Board has to date been concerned chiefly with overall rate of return, it proposes to evaluate individual service offerings, including remote access data processing, more closely. The Board's approval is required for cessation of operations, extension of service, and any merger or sale affecting public service. The Board can compel interconnection between the company and other public services, but no other power with regard to interconnection or foreign attachments is given to the Board.

Under the Telephone Act, Northern Tel is subject to the authority of the Commission, which can require rates and tolls to be revised if they are discriminatory, excessive or insufficient. The definition of "rates" limits the jurisdiction of the Commission to rentals or charges "for supplying telephone exchange service and all services associated therewith". Dedicated data offerings may therefore fall outside Commission jurisdiction in some circumstances; such offerings are presently filed with the Commission although no active regulation of private line service has been undertaken. The consent of the Commission is required for acquisition or sale of telephone undertakings, for debenture or capital stock issues, for changes in company by-laws, and for interconnection or joint use agreements with other utilities. The Commission may compel telephone service to be furnished upon request, make orders with respect to adequacy of service, require interconnection with other telephone systems, and can regulate accounting practices, and the type of construction and maintenance. Foreign attachments which injure or damage the system are prohibited and the Act requires the company to "own and maintain all equipment...operated in connection with the system", unless otherwise consented to by the Commission. Interconnection with non-carriers cannot be ordered.

Island Telephone Company Limited	Operates in Prince Edward Island with 34,132 telephones; $3.9 million in operating revenues. Owned 56% by Maritime Telegraph & Telephone Co. Ltd.	Stat. P.E.I. 1929, c.30 as amended (7 amendments have been made so far).	Prince Edward Island Public Utilities Commission. See *Public Utilities Commission Act*, R.S.P.E.I. 1951, c.133 as amended; *Electric Power and Telephone Act*, R.S.P.E.I. 1951, c.49.

B. OTHER TELECOMMUNICATIONS CARRIERS

Canadian National/ Canadian Pacific Telecom-munications	Provides a nationwide telecommunications service, including public message-telegraph, Telex, and Broadband Exchange Service. CNT also offers public telephone service to 35,000 subscribers in parts of Newfoundland, Yukon and N.W.T. $435.2 million in plant; $100.8 million in operating revenues. A consortium of the telecommunications departments of CNR (a federal Crown corporation) and CPR (a Canadian publicly-owned transportation company).	Not separately incorporated. A consortium of the tele-communications departments of the C.P.R. (see S.C. 1880, c.1, as amended) and the C.N.R. (see S.C. 1919, c.13, as amended - now R.S.C. 1970, c.C-10).	Canadian Transport Commission (Telecommunication Committee). See *Telegraphs Act*, R.S.C. 1970, c.T-3; *Railway Act*, R.S.C. 1970, c.R-2; *National Transportation Act*, R.S.C. 1970, c.N-17.
Canadian Overseas Telecom-munications Corporation	Provides overseas telecom-munications links to most parts of the world, other than U.S., through interconnections with the global networks of submarine cables, HF radio circuits, and the INTELSAT satellites. $123.0 million in plant, $32.7 million in operating revenues. A federal Crown corporation.	*Canadian Overseas Telecommunications Corporation Act*, R.S.C. 1970, c.C-11. Section 3(9) requires the corporation to comply with any directions given to it by the cabinet or the Minister of Communications.	Canadian Transport Commission (Telecommunication Committee). See *Telegraphs Act*, R.S.C. 1970, c.T-3, Part III; Railway Act, R.S.C. 1970 c.R-2; *National Transportation Act*, R.S.C. 1970, c.N-17.

The PUC is given power to regulate public utilities by the Electric Power and Telephone Act, which allows the PUC to review and remedy rates, tolls and practices which are unreasonable, insufficient, or unjustly discriminatory, and to prescribe conditions to ensure that Island Tel furnishes reasonably adequate service and facilities if such service is inadequate or unobtainable. Island Tel falls within the definition of a public utility, as a person owning plant or equipment for the conveyance of telephone messages to or for the public. Although the PUC appears to have sufficient jurisdiction to regulate data services, whether or not private line, it has to date regulated Island Tel only with regard to its overall rate of return. The PUC has stated however that it expects no class of service to be subsidized by any other, and it is specifically given the power (so far not exercised) to fix and determine a separate earnings base for each type of service furnished or supplied to the public. PUC approval is required for the installation of equipment which is not of a uniform design and the product of a standard manufacturer, for the construction or alterations of any plant at a cost exceeding $1,000, and for the sale of any part of the undertaking. The PUC can require Island Tel to interconnect or share use of its facilities with other public utilities furnishing telephone or hydro service, but no other power with regard to interconnection of foreign attachments is given to the Commission.

Under ss.320 & 321 of the Railway Act, CTC may review and revise all "telegraph and telephone tolls" charged by the two companies, whether separately or as a consortium. (Both CPR and CNR are also subject to CTC review in respect of their rail, shipping, and air operations.) Such tolls must be just, reasonable and non-discriminatory. Up to 1970, this did not apply to charges for leasing or using telecommunications links "where no toll is charged to the public", but this private line exemption was removed on August 1, 1970. CTC thus has power to review all of CN/CPT data communication services, including services such as Telex and Data Telex exempted prior to 1970. Although tariffs for these services are filed with CTC, however, the Commission has not actively regulated in this area to date, since rates are presently being set on a competitive basis. CTC has no specific powers to compel CN/CPT to interconnect with other carriers or to rule on foreign attachments save through the revision of suggested tariffs where such tariffs are discriminatory. On January 12, 1972, the CTC announced its decision to undertake a study on cost accounting procedures of the telecommunications carriers, which is expected to include an analysis of cost separations and cross subsidization, if any, between individual voice and data services.

COTC is brought under the jurisdiction of CTC in respect of its tariffs for messages by virtue of both the Telegraphs Act and the Railway Act. Under the latter Act, such tariffs must be just, reasonable and non-discriminatory, although CTC can permit separate classifications and rates for message services. COTC has not in fact filed its tariffs with the Commission, nor has the Commission requested it to do so, although CTC appears to have the power to require COTC tariffs to be filed and approved, both in respect of public services and private line offerings. In most cases, data communications customers do not deal directly with COTC but instead are billed directly by the domestic carriers providing the links to the COTC gateways. CTC has no specific powers to compel interconnection between COTC and carriers or non-carriers or to rule on foreign attachments save through the revision of suggested tariffs where such tariffs are discriminatory. COTC is however subject to directions from the Minister on such matters.

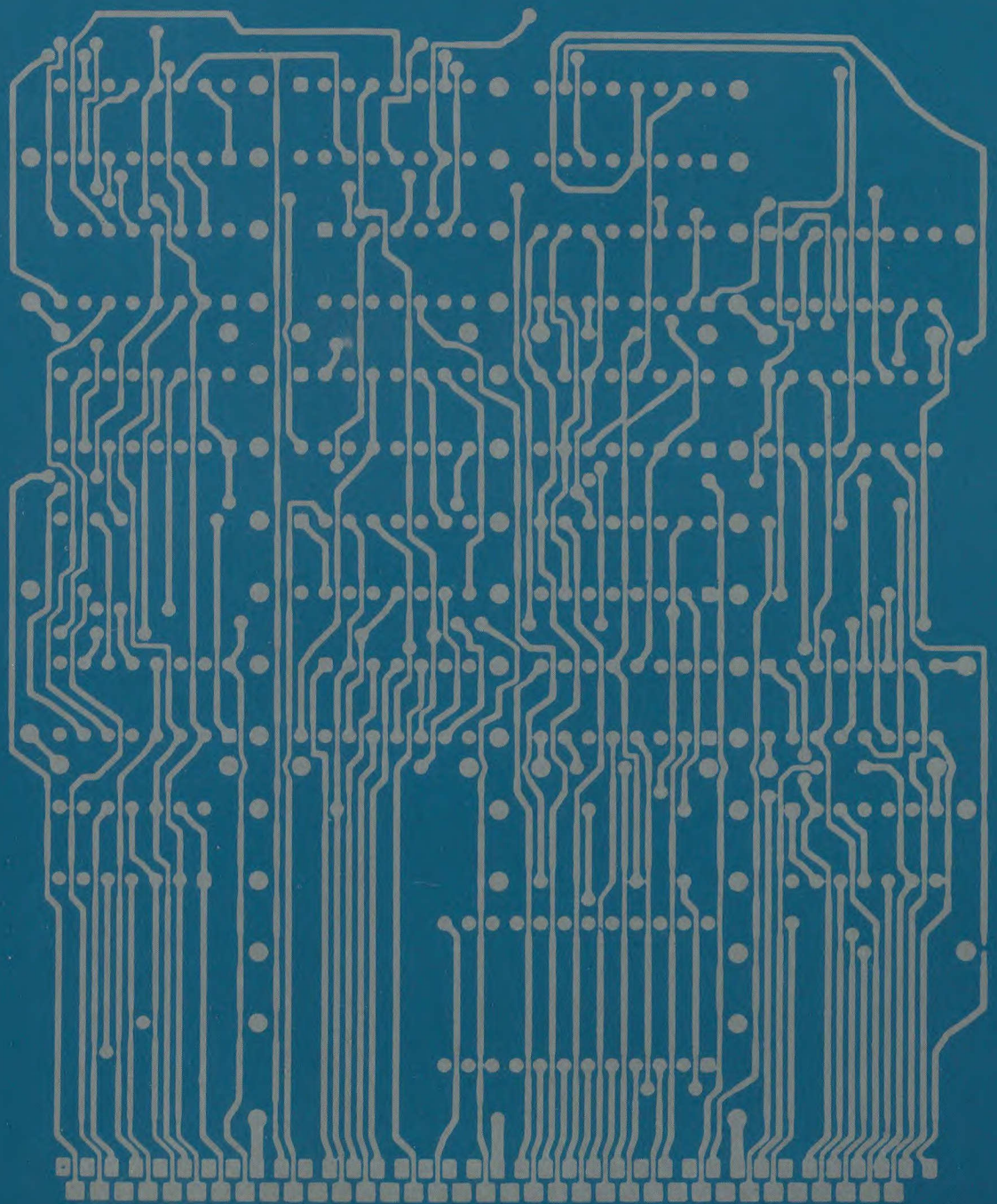
Telesat Canada	Canadian corporation created in 1969 to establish and maintain a commercial system of domestic satellite communications in Canada. ANIK I satellite expected to begin operations in 1973. $60 million share capital split equally at present between Government of Canada and 13 approved telecommunications carriers. Remaining $30 million expected to be raised from public through debt or equity issue. Able to lease up to 10 channels at about $3 million each.	*Telesat Canada Act*, R.S.C. 1970, c.T-4. The company is declared in s.34 to be neither an agent of Her Majesty nor a Crown corporation.	No general regulatory review at present. Certain powers are given to the Minister of Communications under the *Telesat Canada Act* to approve construction contracts, financing share transfers, and negotiations with foreign states. Telesat is also subject to licensing procedures under the *Radio Act*, R.S.C. 1970, c.R-1, for its use of rf spectrum.

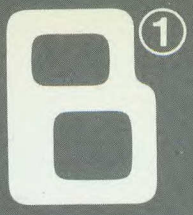
No statutory restrictions apply to Telesat Canada at present with respect to its tariffs, and it is presumably free, subject to direction from its 11-man board of directors, to set whatever rates or conditions its customers are prepared to accept. The present system configuration of Telesat is such that most customers will need to deal separately with the carriers in order to obtain microwave backhauling and local loops. In addition, Telesat has so far required that any customer lease a minimum of one rf channel. It may be noted in passing that, depending on the interpretation of the term ''telephone system'' in s.320(1) of the Railway Act, it is possible that Telesat's rates fall under the jurisdiction of the CTC. The point is an academic one at present, however, since the Telesat customers (the carriers and the CBC) have significant negotiating power of their own because of the competitive alternatives. In any case, Bell, B.C. Tel, and CN/CPT contracts with Telesat would presumably be reviewable under s.320(11.

Part

8

Applications of Computer/ Communications in Canada in Three Fields of Social Significance





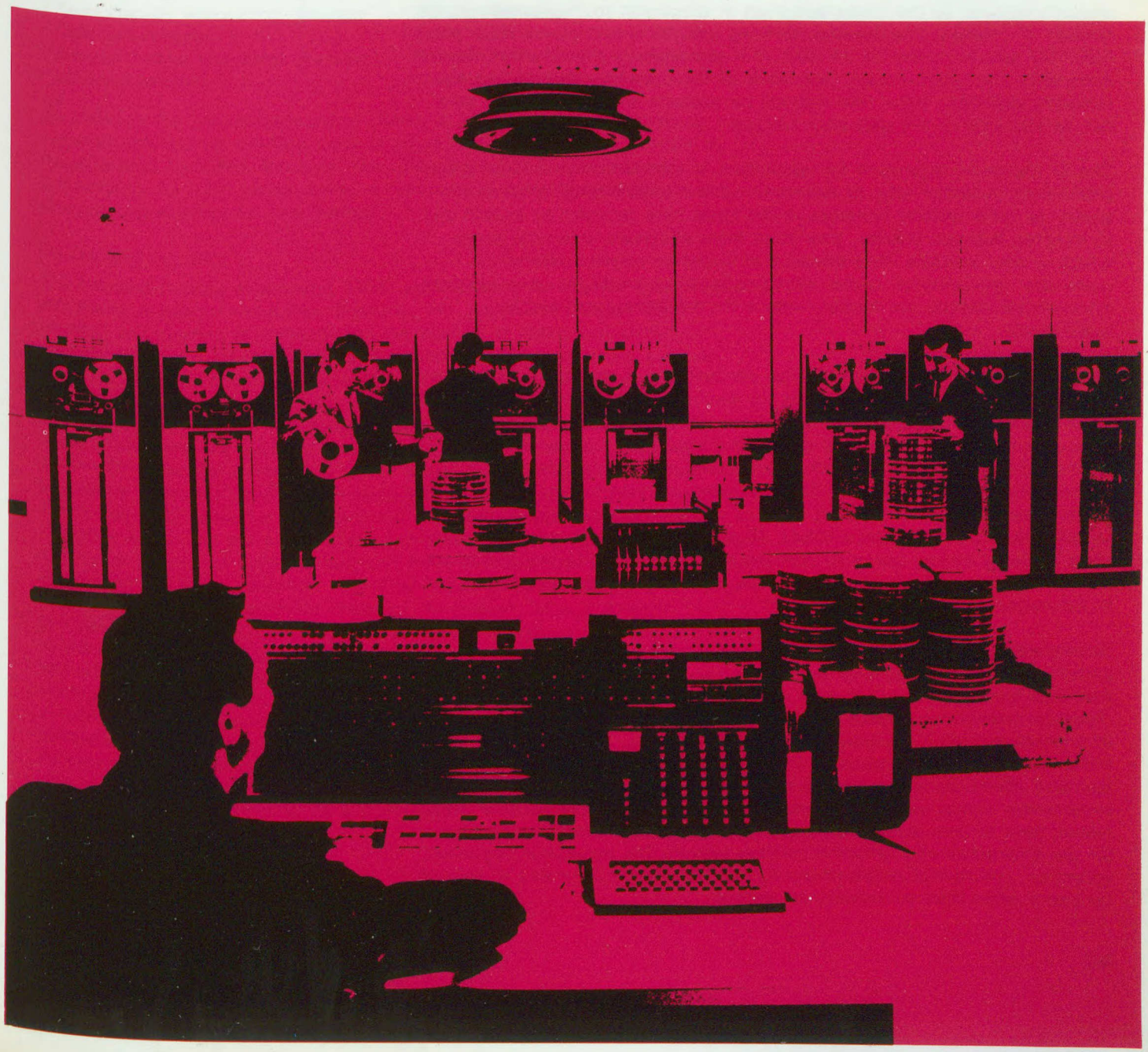
Automation of Payments
and Credits

INTRODUCTION

This study contains the results of an investigation into the use of computers and communications for the provision of financial and financially-related services. More specifically, the study attempts to achieve the following objectives:

- To project and explain changes in the Canadian payments and credit system, based on the use of computer/communications;
- to estimate the demand for equipment, skills and telecommunication facilities necessary to develop, implement and operate the new systems;
- to identify problems which in the present or the future, are likely to inhibit the development of an electronic payments/credit system;
- to assess the probable economic and social effects of an electronic payments/credit system.

Chapter I
Current Status of Bank Automation



1. BACKGROUND

The current phase of bank automation in Canada began in 1963 with the introduction of magnetic ink character recognition (MICR) reader-sorters and business computers. Because of the predominant use of the cheque in our payments system, much of the initial effort was directed toward mechanization of cheque-handling. Paper handling has always been a huge and growing problem in the banking industry, as evidenced by the increase in the number of cheques cashed through the clearing system. The volume has risen from 300 million cheques in 1950 to 1.3 billion in 1970. If the number of people employed by the banks had risen in proportion to the increase in the number of cheques, the Canadian banking industry would now employ about 190,000 people instead of 93,000. It is estimated by the Canadian Bankers' Association that approximately two-thirds of the Canadian chartered banks' operating expenses, other than interest on deposits and income-taxes paid, can be allocated to the payments function.

One of the prime arguments for automation is cost reduction through greater productivity. A further spur to automation is the critical need to conserve space; as many existing branches in the cities have no room to expand and to increase business volume, they must more effectively utilize the space which is now available. Diversification of customer services tailored to customers' requirements, better employee working conditions, and improved management control, are further reasons for the increasing need for automation.

Most of a bank's "production" is the processing and storage of information, which makes them prime candidates for electronic data processing (EDP). Since automation can provide a competitive advantage, there are many independent efforts underway to design and implement on-line banking systems. Systems-design approaches and development schedules vary dramatically from bank to bank. There is some aversion toward co-operative efforts, shared design or facilities such as might be co-ordinated through the Canadian Bankers' Association (CBA). At present, the pressure of increasing costs is clearly forcing banks to concentrate on their internal mechanization, which means a further limitation of those resources which could be applied to automated customer services.

Notwithstanding their rivalry, the banks find it essential to co-operate on certain rules and arrangements in order to provide a flexible, workable payments system. Because of their mutual dependence, they have some reciprocal arrangements, such as lending equipment or services in case of emergency and MICR encoding each others' cheques. Through the CBA, the banks have standardized much of their interchange of information. More co-operative efforts are almost certain to evolve in situations where there is recognizable mutual advantage. However, such changes must occur at their natural pace to gain acceptance and to undergo the development necessary for the emergence of a smoothly running system. The managerial, technical, economic, and human problems are too complex to be amenable to solution by means other than an evolutionary process.

2. INTERNAL APPLICATIONS

For a Canadian commercial bank, most of the costs, revenues and profits stem from branch activity, so it is in the branch-network that the greatest potential exists for automation. Branch-bank accounting and clerical activity can be roughly categorized into a number of functions. These are listed in approximate order of work volume, although some have greater or lesser significance, depending on branch business:

- Demand Deposit Accounting (DDA)
- Term Deposit Accounting (Savings)
- Liabilities (Loans)
- General Ledger (including checking of day's entries)
- Preparation of Branch Returns
- Foreign Exchange
- Teller Cash Control
- Money Orders, Drafts, Letters of Credit and Travellers Cheques
- Securities (safe-keeping and collateral)
- Safety-Deposit Boxes

To eliminate the clerical/accounting chores in a branch, it is necessary to automate information handling tasks in all of these areas, plus a number of miscellaneous functions. Naturally, the banks have first concentrated on mechanizing the most labour-intensive functions in order to capitalize on the greatest opportunities for cost savings.

(a) Demand Deposits

The Demand Deposit Accounting (DDA) application is the highest-volume data processing activity of the banks. Basically, this application involves the proofing and clearing of cheques and the posting of debits and credits to customer accounts maintained on a computer file. There are many auxiliary functions, such as printing statements and calculating service-charges.

The use of computers in this function has enabled banks to keep down the costs of providing the payment services they offer, in spite of increasing volume of transactions and rising labour costs. The current direct cost of processing a straightforward MICR-encoded cheque is about 13 1/2 cents versus about 45 cents for a cheque that must be handled manually on an exception basis. Still the labour cost of cheque-processing represents a substantial amount of the total cost and there is little scope for further automation of cheque-handling, except by reducing the proportion of uncoded items (for example, government cheques). At present, DDA is a batch-processing activity which is performed at night. The service is usually provided to branches by a bank-operated data centre in the large cities. Input cheques and other vouchers are picked up from the branches by courier after branch closing time and returned, together with various reports, the next morning. It is estimated that approximately 60% of Canadian bank branches are using computerized DDA service, and an increasing number of branches are being converted to this method. Since most of the branches served are in high population areas, perhaps 80 – 90% of all current accounts and PCA accounts are now maintained on a computer.

(b) Savings

Savings-accounts have a much lower turnover with most transactions being initiated over the counter in the branch with the teller updating the customer's passbook. This pattern of savings-account activity is not easily adapted to batch-processing on computers. It demands an on-line real-time approach. Several Canadian banks have on-line savings terminals in use either on an experimental or a production basis. In total, there are 460 bank branches with on-line savings systems — 305 are in Toronto and the other 155 are in Montreal and Quebec City. The service provides for account updating via keyboard entry, passbook updating, account status inquiry and summary reporting. The market for on-line savings systems is dominated by the IBM Service Bureau, especially in Toronto. NCR, Burroughs and GE-Honeywell also operate such systems.

At present, most on-line savings terminals are linked to computers on manufacturers' premises. Communications between terminal control units and the CPU are carried out on leased voice circuits. Several control units are connected into one line by means of bridges, thus lowering the total cost to the user.

Ultimately the on-line savings system will lose its identity as such, and merge into a complete on-line banking system. Because this application must be integrated with all the other activities of the banks, its future as a manufacturer-supplied service is limited in the long-term. Already, some banks are taking the service on an in-house basis.

On-line savings is the first banking computer application in Canada using remote terminals. In some cases, the branches using the system are reducing costs, but more important is the fact that the banks are gaining experience with on-line systems, evaluating their effect on employees and customers and laying the groundwork for an expanded set of applications. In general, the result has been that tellers enjoy using the system as well as appreciate the further benefit of being able to leave work earlier. When a bank is able to offer guaranteed working hours, the immediate result is improved staff morale and lower turnover. A further side benefit is derived from the exposure of the customer to the use of the computer in handling his money.

(c) Loans

Next in order of priority is the whole area of loans including mortgages, commercial and consumer credit. All banks are in various stages of converting to automated liability accounting. The bulk of loan processing is in the initial set-up, including the calculation of interest and the automatic deduction of payments from deposit accounts. Most of this processing can be done off-line, so that the liabilities application lends itself naturally at present to the batch-processing approach. Most banks will nevertheless eventually extend the loans system to their branches for remote inquiry and data input and reporting. Ultimately this will mean faster and more personalized service for the customer.

Credit evaluation or rating is closely related to loans. In the process of assessing the credit-worthiness of a customer, the banks at present use the services of a credit bureau, or refer to their manually-kept records for established customers. Since loan interest is the chief source of bank revenue, the loan-granting process is critically important and can be expected to undergo more automation in the future. (This is discussed in Chapter III, Section 2).

Another area of significant and rapid growth in consumer credit activity is the bank charge-card plans. Currently, in those banks participating in Chargex, the administration of the card operation is organizationally and functionally separated from other bank activities. For this reason, it is not discussed here. However, it is probably only a matter of time before credit extended through the use of the card will be integrated with the other financial activities of each customer.

Computers are now firmly ensconced in banking, and will become even more essential if costs are to be controlled in the face of the growing volume of transactions, the demand by customers for more and better services and the increasing cost of labour. In relation to the potential for automation, however, the banks have really only scratched the surface. Nevertheless, there appear to be no serious constraints on the continuing development and implementation of new computer applications. In time, all of the above areas, and more, will be mechanized.

3. IMPACT ON BANK PRODUCTIVITY

Since 1966, general interest rate levels have risen. This is reflected in the average return on assets, as well as by the fact that banks have had a larger participation in the consumer loan and residential mortgage business. Profit margins are primarily determined by the spread in the costs of and the return on funds. For the banks, the costs of borrowing have risen even faster than the rate of return, which more than offsets the potential increase in profits from this source. It can therefore be seen that the improvement in profit margins experienced by banks is due, in part, to increased operating efficiencies. The latter have been achieved largely through automation. The relative decline in employee expenses was a direct result of this increase in efficiency. In 1960, employee remuneration accounted for 35% of total operating expenses of $657 million, compared to 19% of total operating expenses of $3,063 million in 1970.

It is difficult to ascertain the direct benefit to the consumer from this productivity gain, because of the banks' recent emphasis on endeavouring to have services pay their own way in the form of service-charges. However, in view of the experience of other countries, it is safe to assume that had automation not occurred, the costs of processing the ever-increasing volumes of work would have been substantially greater. As new technology emerges, computer equipment has tended to become cheaper, relative to its ability to process work, while labour rates have continued to rise.

Furthermore, the consumer has enjoyed a substantial improvement in the use to which his funds have been put. The turnover ratio (value of cheques cashed/average of deposits) for current accounts and personal chequing accounts has increased from about 65 in 1961 to 116 in 1970. Because demand deposit balances are non-interest bearing, this increase in turnover has reduced the level of free balances available to banks for investment.

Today's bank customer is being billed for payment services more directly, in the form of service-charges, rather than indirectly through unearned interest on capital. This trend toward increasing the proportion of revenue earned through service-charges and fees will continue as consumers become more aware of the time-value of money, and banks become more aware of their unit costs.

4. AUTOMATED CUSTOMER SERVICES

Virtually all banking operations are performed on behalf of its customers. In this context, the term Automated Customer Services (ACS) is taken to mean computer applications performed by a bank on behalf of a customer who could perform these services for himself. In other words, it is not strictly necessary to be a bank in order to perform such a service. Any data involved in ACS belong to the customer rather than to the bank.

At present, most Canadian banks offer an account reconciliation service and a payroll service. These are the major applications, although at least two banks undertake billing for doctors.

Account reconciliation is a logical bank application, because no customer can economically justify the cost of the equipment necessary to read cheques. The service is treated as an extension of regular Current Account Services and consists of reading the customer's cancelled cheques to obtain their serial numbers, then using customer data to accumulate the value of all cheques still outstanding. The total of uncleared cheques is deducted from the account balance and then reconciled to company records in order to verify accounting accuracy.

Payroll is a much-used bank service because it lends itself to standardization as a package. It can be combined with a direct credit transfer to eliminate or reduce the need for cheques. The latter approach can potentially reduce the amount of unnecessary paper and the number of processing steps. The entry of banks into the area of payroll services is not a recent occurrence. They have been using such systems for many years: for example, the preparation of pay-envelopes containing cash.

All of the banks interviewed stated that it was their policy to require every service to be independently profitable. If the costing of these services is accurate, it follows that their prices are not subsidized by other bank services. The ability to offer lower prices than competitors is achieved by economies of scale, and by the efficiencies of internal paperless payment transfers.

Costs are not the primary factor in creating the demand for bank-operated ACS. More important are the following less tangible factors:

- The trust already established between the bank and its customer;
- the financial stability of a bank;
- extensive bank experience in accounting and financial matters,

generally, or possibly designed to the customer's specific requirements.

For these, and for other reasons which will be discussed in the next section, Canadian banks seem to be in an excellent position to capture a good proportion of the financial services market. Banks have not yet aggressively tackled this market for two main reasons. First, there is a more urgent need to automate the traditional banking functions, which necessitates the allocation of most resources to internal systems development. Second, the traditional conservatism in bank executive management has been heightened by the losses recently experienced by many U.S. banks in their ACS operations.

5. USE OF COMPUTER/COMMUNICATIONS

During the 1960's, bank computer activities were almost exclusively confined to batch-processing jobs, run on medium-size computers. Computer centres sprang up for local processing in the main cities. These centres still rely on courier services for the physical delivery of documents and reports to and from the branches which are near enough to meet the necessary schedules.

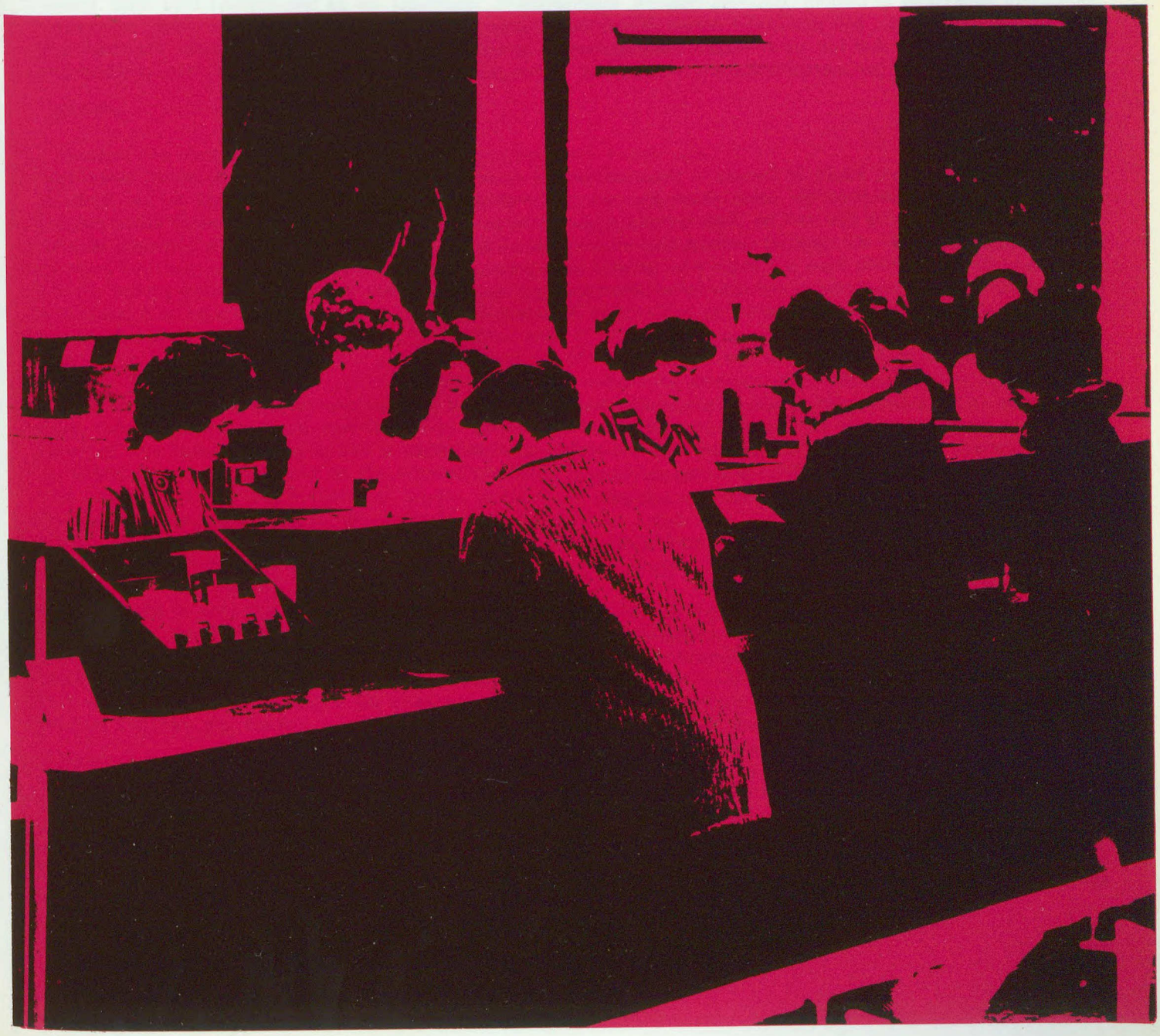
As the range of applications has expanded, bank computer centres have grown considerably larger. To accommodate many applications, and preparatory to going on-line with many of them, the banks are currently switching to large-scale computers.

In order to bring EDP to outlying branches, a beginning has been made in setting up data collection centres in medium-sized cities, such as Windsor. If this develops into a trend, it will lead to a substantial amount of remote batch-processing, requiring medium-speed communication lines. At the moment, the major banks are using medium-speed leased lines between some major cities, particularly Montreal and Toronto.

The on-line savings systems currently in operation use local voice-grade lines. So far as is known, none of these on-line systems yet employ long-haul communication facilities.

Current bank expenditures on computer operations are about 1.5 to 2.0% of operating revenues, and about 1.7 to 2.5% of operating expenses. In contrast, total labour costs represent approximately 19% of operating expenses. Annual expenditure on computer operations in banks is running at about $75 million. The equivalent annual rental for computers used by banks is $10-12 million, excluding data preparation equipment, terminals and computer service charges.

Banks, in total, employ about 600 systems analysts and programmers, and approximately 4700 operations and supporting staff.



A brief survey of foreign developments in automated payment-systems will place Canadian status and developments in perspective. As the world continues to develop into a closely-knit community and international payments are increasingly mechanized, Canada will find it necessary to participate in the establishment of systems, procedures and standards if it is to remain efficient and compatible in relation to other countries.

Several foreign developments in payment-systems provide insight into current trends and the general evolutionary pattern of events. However, foreign developments are not directly translatable into the Canadian framework because of differences in custom, business practice, institutional arrangements, geography, and population density. Thus, this chapter outlines the significant progress that has been made in the application of computers and communications to the payments-system and touches on the problem of international payments.

1. GREAT BRITAIN

British clearing banks are ahead of Canada in the development of on-line banking systems. This situation has some advantages for the Canadian banks because of the experience that can be obtained and applied here as a result of the similarity between the banking systems. One major problem in establishing on-line systems here is Canada's far greater geographical distances, a factor which tends to increase communication costs which, in turn, is an important reason for the time-lag in Canadian development.

The four major London clearing banks are already well into the conversion phase of their on-line systems, with complete automation of their facilities expected by 1973. Even though Britain is geographically compact, there is a tendency to establish regional centres. For example, Lloyd's Bank has computer centres in London and Birmingham, each of which uses two IBM System 360-65 computers. Over 800 branches are now on-line, and all 2350 branches have their work processed by computer.

Over-all, in 1969, banking accounted for 7 to 8% of user-investment in computers — over $130 million. The use of terminal devices has grown to represent about one-third of this total.

To speed up their credit clearing operation, the London Clearing Banks have co-operated in setting up the Interbank Computer Bureau which has since been incorporated under the name of BACS Ltd. (Bankers' Automated Clearing Service). The computer centre receives magnetic tapes, cards or paper tapes from each bank, with details of interbank standing orders, direct debits and bank GIRO credits which must be cleared from one bank's accounts to another. In 1971, approximately 10% of the volume of items cleared between banks entered the automated clearing-centre on magnetic tape instead of paper. When all banks have completed conversion, the production of vouchers will have been eliminated. The clearing banks have also extended this concept to debit items. Customers can send tapes to the bureau, thus eliminating the preparation and handling of vouchers.

There is a trend toward turning in-house computer departments into independent profit centres which offer services to other organizations, at least for automated customer services. Barclays and National Westminister have already entered the general computing service market through specialized subsidiaries.

The British banks have shown a readiness to work together to solve problems of common interest and have benefitted by their co-operative ventures. They are still in competition with one another, and with the Post Office operated National Giro. This is reflected in their individual investments in management systems, bank-card systems and so on. Ultimately, the Inter-Bank Research Organization (IBRO) foresees a merging of the separate bank networks with other functional networks (such as those of the airlines, Inland Revenue and large corporations) into a single national network.

2. SWEDEN

In Sweden, the transition to an integrated electronic payments system was made easier by the existence of a national registration number for each individual, and an operating GIRO payment system. In 1969, most of the Swedish banks formed a consortium to investigate a wholly integrated on-line real-time payments system. This project, called SIBOL, (System for Integrated Payments On-Line), is aimed at reducing the use of paper documents and cash for making payments based on the use of a machine readable bank-card. As a result, it is expected that many people will be released from unproductive work and become available to fill labour gaps in more productive areas.

Planning for the on-line system encompasses banks, department stores, shops, hotels, gas stations and cash-dispensers. Even home terminals are envisaged. The nucleus of this system is expected to be operational by 1975. The SIBOL project is predicated on the expectation that a combination of many independent, and slightly different, on-line systems can never be as effective and economical as one, fully-integrated and standardized nation-wide system. Still, the banks are keenly competitive and have co-operated only because of the pressures of their common problems.

It is interesting to note that although Sweden is a small country of only eight million people, the Saab-Scandia Company has been able to develop a total on-line real-time system for banks. This was developed under contract with a Swedish commercial bank. The system is owned by Saab-Scandia and is being actively marketed. To date it has been sold to several banks in Sweden, Denmark and Finland.

3. UNITED STATES

The banking industry in the United States consists of almost 14,000 separate banks, many of which are small, and serve only a single community or limited area. Due to the large number of banks, most of which are state-chartered, there is a compelling need for intermediaries to act as concentration points

for inter-bank transactions. The Federal Reserve Banks and their fellow-members help meet this need in the 12 Federal Reserve Districts.

The major banks in New York are currently transferring about $25 billion a week in large international payments, using a computerized communication network run by the N.Y. Clearing House Association. The system, called CHIPS, consists of a central B3500 computer and Burroughs TC500 terminals.

So far, it has eliminated 15,000 cheques per week, as well as the messenger service. The system is being expanded to a B6500 computer, to accommodate more banks and terminals.

A Federal Reserve System network serves the funds and transfer needs of the 12 Federal Reserve banks and their member-banks' branches The system is a star-shaped message switching system, using four M-100 communications processors at Culpepar, Virginia, connected via low-speed lines to terminals in the member banks. Activity has begun on a change-over to 2400 baud lines between selected districts, to effect high-speed transmission initially between magnetic tape terminals. This can ultimately be expanded to handle 50,000 baud circuits. Similar networks are, or will be, used to serve member commercial banks in each region. For example, the New York Fed uses two XDS Sigma 5 Computers to switch all intra-region traffic and to act as the local switching centre for all interregion traffic. Wire transfers sent by member-banks are credited or debited to their Fed accounts, thus taking the first step towards a completely paperless payments system.

Bank Wire is a fairly simple store-and-forward message-switching system, operated by 14 sponsoring banks and with about 220 members in 69 cities. It is not as sophisticated as the Federal Reserve System, but does provide an alternate, private service. The American Bankers' Association (ABA) has recommended that the commercial banks act to establish a nation-wide electronic funds-transfer network to compete with the Fed Wire for large dollar transfers.

SCOPE (Special Committee on Paperless Entries) is an experiment sponsored by the San Francisco Clearing House Association, several major California banks and the San Francisco Federal Reserve Bank. For 3 years this group has been developing uniform procedures and format standards which will allow California banks to exchange payment transfers electronically without creating paper at the entry point into the payments system. The Federal Reserve Bank of San Francisco will operate the automated clearing houses on an experimental basis. Start-up was scheduled for the spring of 1972. At least 18 other groups similar to SCOPE have been established in other U.S. centres, notably the Twin Cities Payments Mechanism Study Group in Minneapolis-St. Paul. All of these groups are awaiting the results of the California experiment before proceeding with their own plans. More detail on this project is given in Chapter III, Section 2.

The foregoing are only some examples of developments in the U.S. To provide a broader picture, the American Bankers' Association has conducted a series of studies on the technology and effects of electronic payment systems, many aspects of which are pertinent to the Canadian scene. The main ABA recommendations call for:

- The development of a comprehensive nationwide clearing and settlement system for electronic payments, capable of handling bank, corporate, government and consumer payments;
- development of a nation-wide authorization system based on the use of the bank-charge card;
- increase in use of descriptive billing by bank-card issuers and strong resistance to any legislative or regulatory moves that would inhibit the achievement of this objective;
- continuing research on standards for transaction content and formats, point-of-sale terminals, merchant identification numbers and sales drafts;
- continuous monitoring of the cheque payments, determining new customer needs;
- an extensive industry-wide educational/informational program, to increase the understanding of the need for change by all bankers.

These recommendations should be considered with caution, due to the differing structure of the Canadian banking industry and to differing economic factors. Nevertheless, many of the problems have much in common with those in Canada, and it is to be expected that fundamental techniques will tend to be adopted in both countries. For example, the standard machine-readable credit card and MICR technology was developed in the U.S. and these standards were adopted in Canada, as well as in the U.K. and many other countries. American developments in machine-readable credit cards and associated machinery will continue to have a considerable effect on the formation of international standards for machine-readable techniques for credit cards and identity cards.

4. JAPAN

All major banks are operating on-line systems for intra-bank transfers, but inter-bank dealings still require settlement through the use of older, paper-based methods. Personal payments are primarily made by "money transfers", similar to European GIRO systems. The payor instructs his bank to debit his account and to credit the payee's account. Cheque volume is low and mostly confined to commercial use.

Pre-authorized payments are widely used for all utility bills. Taxes and fixed charges, such as rent and insurance premiums, are planned for inclusion. Point-of-sale purchases are still mostly settled by means of cash.

By 1975, it is planned to have the majority of Japan's 10,000 bank branches connected by an on-line network. Cash for small purchases will be provided by cash dispensers and the growth in the use of credit cards will provide for other payment needs. A nation-wide Inter-Bank System is being developed and is scheduled to start operation in April 1973. This will be a message-switching system designed to handle 1,000,000 transactions per day and will interface flexibly with the already operating intra-bank systems.

5. INTERNATIONAL PAYMENTS-SYSTEMS DEVELOPMENTS

Interest in an automated payments system has crossed national boundaries. Several groups are involved in moving toward automating international payments. These groups are:

The Message-Switching Project (MSP) consists of representatives from 68 banks in 11 countries — 45 European banks and 23 U.S. banks. These banks are considering an international message-switching system, which will first link Western European and later, North American and Far Eastern banks. A feasibility study will be analyzed by participating banks and a decision will be made as to whether the proposed system should be implemented. Canadian banks will be invited to participate by mid-1972, when plans have been firmed up. MSP requires its members not to participate in a competitive system. It is interesting to note that Citibank is a member of MSP. (See MARTI, below)

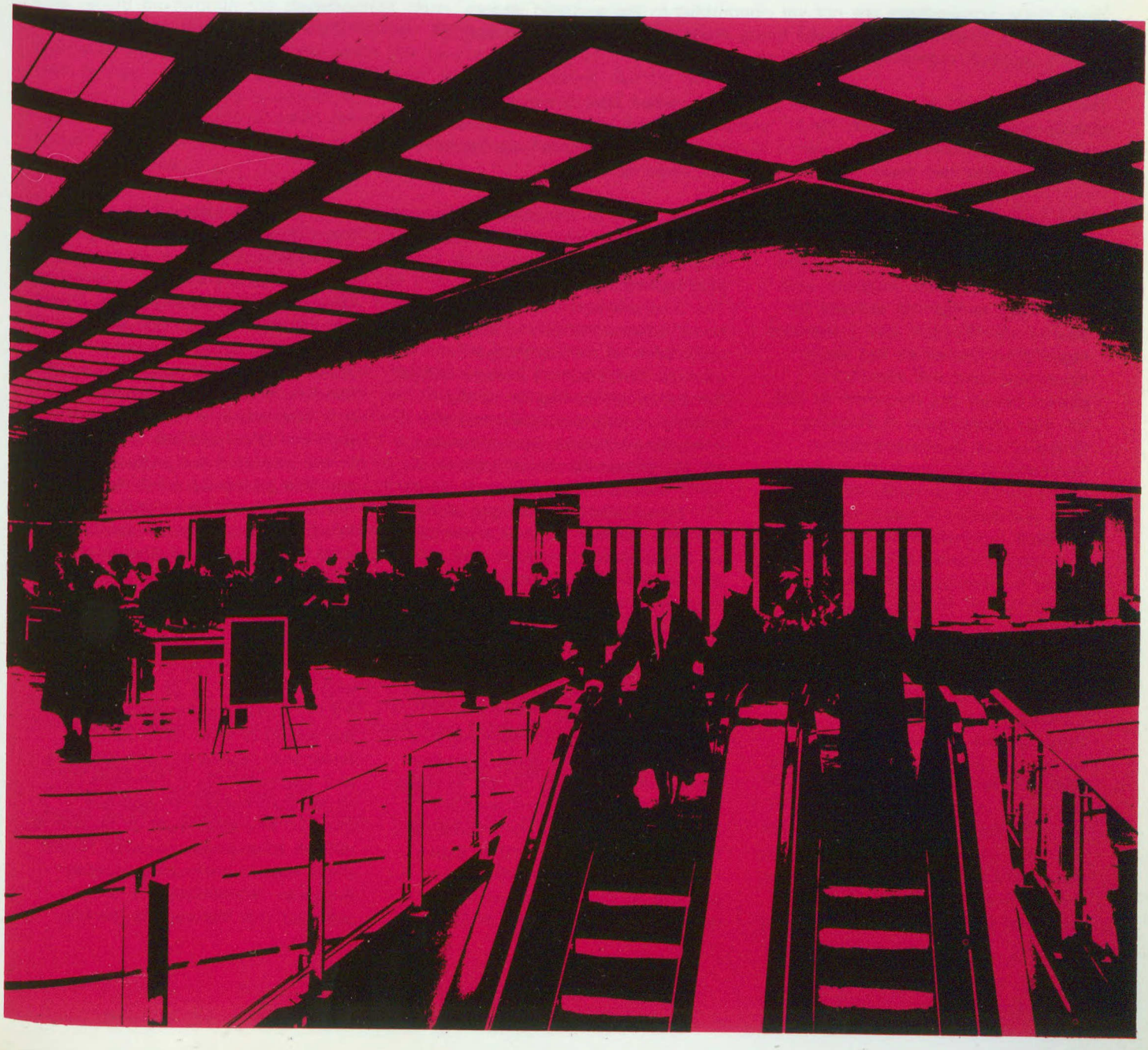
SIBOL's Swedish, Danish, and Norwegian bank representatives are investigating the possibility of establishing a unified automated payments-system.

Other groups participating are PO/Giro, certain business organizations, such as large department stores, the Statistical Agency, the Central Security Registration Office, the Central Risk Office and a real estate data centre. The central bank has not been involved in this effort.

MARTI is an international telecommunications system for transfer of funds, owned and operated by the First National City Bank of New York. After one year of trial with its own overseas branches, Citibank is now offering this service free of charge to any bank in the U.K. and Western Europe. Since Citibank is also a member of CHIPS in New York, a payment-transfer, remitted in the CHIPS-MARTI mode, can be received and executed in a matter of minutes by the receiving bank of New York. The system can be used for automatic transfer of payments by the following method: The European bank would prepare the standard MARTI transfer payment form and transmit it by Telex to the MARTI centre in London. The London Centre feeds the payment instruction into the Citibank payment processing centre in New York, which in turn feeds the information directly into the CHIPS System. Citibank has presently 28 subscribers to the system and expects that "several hundreds" will join eventually.

American Express International Banking Corporation announced its plans to set up an international communications network, largely through the use of satellites, to expedite control of its world-wide money operations. The objective is to link major foreign exchanges and money centres throughout the world on a "rolling account system". The system would be operational 24 hours a day, to switch the unbalanced portion of the European account to New York. As the day progressed, the unbalanced portion of the North American account would be switched to Asia, then to London and Europe and so on. The company hopes to virtually eliminate idle balances.

The Board of Governors of the *Bank for International Settlement* (BIS) has been requested to set guide-lines for central bank and BIS participation in developing a single, integrated international payments network. This request was made by a group of central-bank computer experts who had noted the activities of various organizations in the international payments field. They also took into consideration the fact that the existing multi-lateral telephone communication system between five EEC central banks could be developed into a message-switching and/or payment-order system. It was felt that several non-compatible international networks may develop, some of which might exclude central banks.



1. DEVELOPMENT OF AN ELECTRONIC PAYMENTS/CREDIT SYSTEM

A financial network for payments and credit in Canada will almost certainly be built around on-line banking systems. Key prerequisites of a fully-integrated system include:

- A machine-readable identification card with a built-in means of verification;
- a system of pre-authorization for repetitive payments;
- an on-line terminal at each place where payments might be made;
- an established line of credit for all customers.

Since these components are not yet operational to the required degree, it is necessary to examine the progress being made in each one in the light of today's situation regarding funds transfer systems.

The Chargex card, currently offered by four Canadian banks, might just possibly be the starting point for a "universal" payment card, by providing for electronic funds-transfer. However, a number of developments must occur before this card will meet the necessary requirements:

- The existing embossed card would have to be re-designed into a machine-readable form. A standard for embossed cards, together with a standard numbering scheme for issuing identification and a standard registration procedure has been developed, and will shortly be placed before the members of ISO for their acceptance. A Working Group of the Subcommittee on International Standardization of Credit Cards is currently developing draft standards for machine-readable techniques on credit cards and identity cards. Another Working Group is developing standards for identity cards. The Canadian Standards Association is deeply involved in the ISO Sub-committee, since its main representation consists of members of the Canadian banking industry.
- Although the standards being developed are not restricted to one particular technique of data recording, it is worth noting that the dual-density magnetic stripe (on the back of the card) appears to be the most common method in use at the present time. This technique has been endorsed by the ABA and several types of terminals are now being manufactured in the United States that will be capable of reading this type of card.
- The incorporation into any card of some feature that would allow verification of the card-holder's identity. While such a feature would not be strictly necessary to the making of payments electronically, it would be needed to cut down on the increasing use of stolen cards and other fraudulent activities. The most feasible technique at the moment appears to be the use of an embedded photograph and signature of the card-holder on microfilm, which is only visible when inserted in the proper terminal device. More remote possibilities include voice and finger-print analysis, performed on-line by a computer.
- The Chargex franchise will have to be extended to the other Canadian banks which are not at the moment offering the card. The Canadian franchise (from Bank Americard) is not exclusive and the other banks may join if they wish. While it is possible to conceive of another bank charge card in use in Canada, the probability seems slight, since there do not appear to be any significant competitive advantages. Extension of the Chargex system to other banks seems more likely, in view of the need of the non-participating banks to remain competitive in this new method of handling consumer-payments.

It is interesting to note that any technical developments in the card or the use of it are probably available to the Canadian franchise-holders, as well as to those in other countries such as Barclay's Bank in England and Sumitomo Bank in Japan. Thus the prospect of an international card is already beginning to take shape.

Increase in bank credit card coverage to a majority of individuals and merchants. As of the fall of 1971, there were somewhere in the region of over 52,000 merchants registered with Chargex, and approximately 2.2 million (or more) card-holders throughout Canada. The exact rate of growth is difficult to estimate because of the trend toward eliminating inactive accounts. Nonetheless, it is apparent that the card is gaining

acceptance, even though reasonably full penetration will require a number of years. At the moment, the credit-rating requirements of Chargex exclude many individuals — about 50% of the applicants are rejected. In time, it is expected that this problem will be solved by improved verification and authorization techniques, based on the use of enquiry terminals.

- As implied above, the acceptance of bank cards by the independent retailers, and petroleum companies, has already begun to take place. Recently, several major accounts have signed with Chargex, including Gulf Oil, Texaco, and several junior department-store chains. It is regarded as only a matter of time before most major retail organizations will accept banks' cards, either in parallel with their own, or exclusively.

A machine-readable payments card could evolve in either of two directions. One would be through the development of a "money" card, which would have a pre-recorded amount, systematically decreased with each successive purchase until exhausted. At this point the card would have to be recharged with money. This method could be efficient in some situations, but for the purchase of large items it would necessitate payment in full, and many customers would prefer a credit option. In addition, there would be more security problems with this type of card, inasmuch as the card itself would represent money.

The other technique would be a machine-readable card which would rely on access to a computer for credit authorization and the transfer of funds from buyer's account to seller's account. This type of card would be more flexible, in that it would serve only to identify the customer and activate the terminal device. An important feature of such a system would be the credit component. In fact, it would be preferable, from the customer's point of view, to make his payment by sending payment instructions to his bank. If such a method was implemented, the merchant would have no way of knowing whether or not his customer had the cash or was using bank-credit. It seems probable that the latter approach will gain wide acceptance because of its greater flexibility. Ultimately, such a payments card could be used for most large-item purchases as well as to obtain cash for small purchases, in many cases from automatic cash dispensers. Such frequent use would obviously place a heavy demand on bank processing facilities and would demand paperless technology to achieve reasonable costs. Ultimately, of course, a customer's bank-card activity would have to be integrated with his other banking operations to allow automatic transfers and single statements.

2. PRE-AUTHORIZATION

Pre-authorization refers to the automatic initiation and processing of debits and credits on behalf of customers by a bank. This technique, which is now commonly used for fixed-amount loan and mortgage installments, has a large potential for reducing cheque-flow through such arrangements as:

- Automatic payroll deposit;
- dividend and interest payments;
- social security, pension and welfare payments;
- automatic crediting of rental income;
- payment of repetitive charges such as telephone CATV, electricity, and other utilities;
- payment of credit card charges.

Pre-authorization is possible now in Canadian banks through use of the Pre-Authorized Payment Plan. Most users are large corporations, who obtain the right to draw on an individual's account by means of power of attorney. Substantial savings can be realized by this technique, compared with the normal method of making payment by a cheque drawn by the payor. However, the system is still paper-based, in that it is necessary to produce vouchers in support of each entry. When this paper can be eliminated, the reduction in handling costs will result in reduced charges for processing pre-authorized payment instructions and greatly increased usage. To reach this stage, three steps are necessary:

- The development of standards for the encoding of payment transfer instructions in electronic or magnetic form;
- the acceptance and use of these standards by all banks;
- customer and auditor acceptance of the entry without a supporting voucher.

To this end, the Canadian Bankers' Association, together with the chartered banks, has developed a set of standards which will enable payments information to be received on magnetic tape and exchanged between the banks by the same medium. These standards are close to finalization. It is interesting to note that some corporations now submit payroll instructions to their banks on magnetic tape. But the bank must then prepare documents in order to make use of the inter-bank clearings system. As a first stage in eliminating documents, payment instructions will be transferred on magnetic tape and eventually by direct transmission.

Once underway and given some promotion, use of pre-authorization for paying repetitive bills will grow quickly. Some of the advantages in addition to the reduction in cheque volume are:

- Ability of banks to "smooth" workloads;
- improved cash-flow projections;
- individual relief from cheque endorsement and deposit/cashing problems;
- less money tied up unproductively "in transit".

To gain some idea of the potential, with a Canadian labour force of 8.5 million which has an average pay frequency between 35 and 40 times/year, payroll deposit plans alone could eliminate about 400 million cheques. Using an average cost of $.50 per payroll cheque, the potential savings per item could reach $.35 due to elimination of cheques, postage, handling and reconciliation. This indicates a potential cost-savings of $140 million.

To establish the legal, procedural and acceptance requirements of a large-scale pre-authorization system, there are several experiments now underway in the United States. The most ambitious of these is the SCOPE Project. Participants include the Federal Reserve Bank of San Francisco and many private banks in California. The banks will send debit and credit entries to their automated clearing house by magnetic tape, punched cards or data transmission. There will be no accompanying paper documents. Initially, plans call for converting only 15% of the cheque transactions amenable to pre-authorization, mostly payroll cheques.

One of the conditions governing the SCOPE Project is that participation is to be offered to all California banks and at least 150 of them have indicated interest in the scheme. The programs and techniques are to be made available to other SCOPE groups.

3. LINE OF CREDIT FOR INDIVIDUALS

The basic need for a line of credit arises out of the convenience of granting credit automatically if the payor or buyer does not have enough funds in his account.

The beginnings of this can be seen today in the Chargex card and various cheque-guarantee plans. Each card-holder has a financial limit, which he is not supposed to exceed, for all purchases made with the card. However, the line of credit referred to here would apply to all the individual's financial transactions and would be based on such factors as personal assets, reliability and salary.

This could save a lot of unnecessary time and investigation on each occasion an individual wants credit. A limit is established for him, through an evaluation/rating procedure, and is stored on-line by a computer for reference when it is needed. This is just an extension of the familiar management-by-exception concept. In practice, it might also work as an automatic account overdraft facility.

4. ON-LINE RETAIL TERMINALS

If payment for goods and services is to be made electronically, then there must be a terminal device at the point of sale to generate the payment instructions to the computer and to record or transmit details of the transaction. Extension of the requirement leads to a nation-wide network of retail terminals. The technology is moving towards such a network, but development will be held back chiefly because of high costs and an immediate lack of urgency for the introduction of new methods. How, then, might such a Point-of-Sale (POS) network develop?

In the large department stores and retail chains POS systems through authorization terminals will come about as a result of the desire to reduce credit losses. This will lead to the use of the same terminals to capture sales data for management reporting, inventory control and accounting. Already, some major department stores in Toronto are making limited use of credit authorization terminals. Some large chains in the U.S., like Montgomery Ward, have placed orders for thousands of POS terminals. The fact that IBM now has a POS terminal will mean a major marketing push. After many false starts, point-of-sale systems appear on the verge of rapid growth.

For small and medium-sized retail outlets unable to afford their own systems, there are plenty of enterprising firms which will be willing to provide the service. Promising candidates are the banks, for the simple reason that they can provide many other terminal services as well. At present, the most

probable course of development appears to be the introduction of inexpensive retail terminals for the purpose of credit authorization. These terminals are likely to be credit card reader attachments to touch-tone telephones. Once installed, the terminal begins a natural chain of progression, starting with the entry of the amount of the sale by a clerk, followed by carrying out the payment transfer and ending with the input of stock codes, invoice receipts, and other items which would allow the production of sales and inventory reports. Such a service, when it becomes available, will place the small independent merchant in an improved competitive position in relation to the large merchandiser.

As we have seen, the key to this system is the machine-readable payments card. Up to this point, credit card plans have helped hold down the cheque flow by implementing one cheque service to settle a number of accounts. But credit card sales slips now cost more to process than cheques – about $.45 versus $.135. The real promise for the future lies in the great potential for savings which will be possible if the credit card can be made to generate electronic commands to a computer, and paper-processing is no longer required. It is estimated that with such a system the cost per item will fall to less than $.10.

Many transactions today are handled by using cash – probably from 30 to 50 times as many as are made by cheque or credit card. Obviously, in the foreseeable future, the banks could not handle this volume. Cash will remain the primary method of payment for small-item purchases and in situations where terminals are not feasible. When payments are made by card, a delay in the actual debit to the customer's account will probably be inescapable. A standard time-delay might be incorporated to allow for enquiry or return of merchandise.

The procedures, problems, costs and effects of an electronic funds-transfer system for retail payments can be determined only by actually building such a system and testing it on a large scale. This is currently being done in a number of places in the U.S.

One of their major experiments is Omniswitch which began in the summer of 1971. The test involves the New York banks that offer Master Charge, including the First National City Bank of New York and Manufacturer's Hanover. Initially, terminals were installed on merchant premises for use in credit authorization. The system verifies that the card is not stolen and that the customer has not exceeded his credit limit. This experiment is particularly significant because of the stature of the banks involved.

Another U.S. experiment is being tested in Upper Arlington, Ohio, by the City National Bank and Trust Company of Columbus and National Bank Americard Inc. This six-month experiment started October 11, 1971, and is designed to test the procedures, the effect on participants, the convenience, and the economics of electronic payments using dial-up telephone terminals with a credit card reader terminal.

These experiments demonstrate the technical feasibility of electronic payments. The main problems to be investigated are the practical difficulties of implementation, the reaction of customers and merchants and the economics of the operation.

Of course, there are many other components to a complete payments/credit system — data files, programs, processing equipment, etc. and many technical problems to be solved before such a system can become operational. Among the major considerations are:

- Universal customer-identification and account numbering;
- data security;
- reliability;
- audit requirements;
- file organization;
- equipment selection;
- communications network configuration;
- system and application software;
- standards for system interfaces, transaction formats.

A comprehensive description of the above factors would require volumes. All are currently being studied by the banks in the course of designing and implementing their own on-line systems and will be resolved in due course. One of the advantages of the separate developments taking place is that a variety of possible solutions will be tried, eventually resulting in the discovery of the "best" approach, only obtainable through experimentation, trial and error.

5. ON-LINE BANKING NETWORKS

All of the Canadian commercial banks are actively planning for and developing on-line systems. According to a review of current plans of the national banks, there should be 3800 to 5000 bank branches on-line by 1977 (about 60 to 70% of the total branches) for at least one major function.

Plans are necessarily tentative, and are certain to change as a result of delays in equipment deliveries, cost changes, competitive forces and systems-design changes. Another variable is the number of banking applications that will initially be implemented as on-line applications. All on-line branches will have access to deposit accounting and enquiry services, which account for the greatest transaction volume. Loans and other applications can be added later. In any event, the systems to be installed are designed to support the full range of bank service applications, in the sense that these applications can be added without requiring fundamental re-design of the system.

Initially, the bank central processing systems and terminal networks will be developed and operated independently. The network growth pattern will originate in the major cities, particularly Montreal and Toronto, and will spread outward as economics and logistics allow.

On a coast-to-coast basis, major differences in network shape among banks can arise from different concentrations of branches, leading to different patterns of concentrator location and mainframe location. Various design

strategies are also sure to emerge. For example, some banks will perform all processing and will store all files in one central location to benefit from economies of scale. This is probably the least expensive approach from a computer hardware standpoint. Other banks may opt for two or more mainframes in different parts of the country. The latter approach saves data transmission costs, improves system reliability and allows some regional variations to occur in the operation, by virtue of the proximity of the processing centre to the area being served. Specific configurations are naturally based on minimization of communication cost, subject to meeting system objectives, in relation to the geographic dispersion of branches for each individual bank.

For real-time applications, the response time must be fast, because the customer is waiting across the counter. Most of the data to be transmitted are in the form of short transactions, averaging perhaps 20 characters in length, and the volume of these transactions is high.

A number of branch-banking terminals are on the market and include such components as alphanumeric keyboard input, special-function keys, error indicator lights, a journal recorder or printer, a voucher or passbook print mechanism and CRT display. IBM is currently dominating this market with variations of their 2970/2980 teller terminal system. However, NCR, Burroughs, GE-Honeywell and Olivetti have also introduced banking terminals, some of which are in limited use in Canada as on-line savings terminals.

It should be kept in mind that the banks will still be processing large numbers of cheques for many years to come. Up until the late 1970's, cheque-volume is expected to continue rising. After that, the number of cheques issued will probably level out and then decline. The significance of this is that cheque-handling — collecting, reading, sorting, cancelling, processing and returning or storage — will continue to be a major activity, largely independent of the operation of the real-time systems. In order to handle the over 2 billion cheques per annum which is expected in 1977, the banks will need pick up and delivery services, MICR reader-sorters and encoding and proof equipment. The capture of payment instructions from cheques, in a form suitable for data transmission must be performed locally to minimize the "in transit" time. Courier services have a limited practical range if cheques received during the day are to be processed that night. Hence, to handle the expected volumes of cheques, regional batch-data preparation and entry centres will be required throughout the seventies. In major centres, concentrators can also double as batch-entry computers. In smaller urban areas, small-scale computer installations may be used to input transactions of local origin, and to print high-volume branch reports.

The Royal Bank of Canada is already experimenting with this concept, using a small computer in south-western Ontario. Concurrently, the CBA, with the banks, is evaluating a shared network for use in medium-sized cities to improve the flow of payments data.

Authorization of a credit sale is initiated by a merchant and cannot be classified as a branch-banking application. Currently, merchants seek authorization for individually charged sales which exceed an established "floor limit". Chargex purchases over $50 are checked by telephoning a local authorization centre. Most of these are manual operations, although the Royal Bank in Montreal has used centralized remote CRT inquiry for over two years.

This retail application will probably develop in two stages:

- Growth of centralized remote CRT inquiry, using telephone operators in major centres;
- direct retailer inquiry, using Touch-Tone telephone with a credit-card reader attachment or separate terminal.

It should be noted that both Eaton's and Simpsons have already reached the second stage with the installation of credit authorization terminals in their main Toronto stores.

The second stage will set the scene for a number of other retail applications and will eventually contribute substantial transaction volume to local telecommunication facilities. Payment Systems Inc. of New York, estimates that about 6 million terminals would be required for the merchandising business in the U.S. This indicates considerable potential for retail terminals in Canada.

Development costs are extremely difficult to estimate. Inasmuch as the planning, development and implementation of on-line systems can take from 5 to 7 years from the start of work, many technical and production developments can significantly alter costs. Since many of the problems that must be overcome are new, estimates can be made only on a very approximate basis.

Total development, conversion and operating costs of an on-line banking system over the next 5 years will cost each bank approximately 100-200 million dollars. For the 5 largest commercial banks, this represents a total investment of $500 million to $1 billion.

As has been mentioned earlier, Canadian banks are strongly competitive and are convinced that computer technology is perhaps the most important tool with which to improve their market position. For this reason, plus the tendency of systems-managers to believe in the superiority of their particular approach, there is little likelihood of Canadian banks sharing programs or computer usage in the next few years. Thus, there may be some redundant programming and systems work (and costs) before a spirit of co-operation sets in. Co-operative efforts are appropriate in some areas, and the Canadian Banker's Association is working toward this end. However, the situation cannot be forced. The likelihood is that the competitive approach will stimulate the process and will lead ultimately to a complex electronic funds-transfer systems.

6. AUTOMATED CUSTOMER SERVICES

In the context of computer services, since much of the financial data of customers will flow through the financial computer centre, the bank will be in a position to maintain customer accounts, perform financial cash-flow analysis, help the customer plan the best means of meeting his financial needs, extend credit and plan his surplus funds investment program. These services may become bank services, for when a bank has a well-designed payment system, the bank's computer could provide these services at a lower cost than that which the customer could achieve by himself. There are several reasons to expect this bank efficiency:

- The existence of a large-scale, specialized bank computer processing system;
- the data used will be a by-product of the bank payment transfer system (leading to fewer intermediate processing steps and reduced document handling);
- banks will have specialized data and techniques (*e.g.*, economic research, econometric models);
- the existence of a country-wide network of branches.

It is apparent that not only the technology, but the nature of payment systems is changing. For some of today's customers, a payments service means a complete range of related activities — from point-of-sale data collection, to billing, to collection and to receivables accounting. To complete the picture, the payer's end of the transaction also requires payables and cost-accounting.

In recognition of these factors, the Federal Reserve Board in the U.S. recently changed their regulations in order to permit one-bank holding companies to offer data processing services to their clients, but to limit operations to processing of banking, financial or related economic data — such as payroll, accounts payable/receivable, or billing. It also allows excess computer time to be made available and the furnishing of any EDP service upon request, if not otherwise "reasonably available" in a market area.

In fact, the restrictions imposed are hardly necessary. Those U.S. banks which have ventured into other applications, such as classroom scheduling, have almost invariably lost money. Banks have lower marginal costs when processing financial data and their experience is relevant. But they do not have any such inherent market advantages in non-financially related applications. For this reason, plus the fact that the financial market offers plenty of scope, it is unlikely that banks will attack the non-financial computer services markets.

Market areas likely to be considered by the banks for ACS are as follows:

- Account reconciliation;
- payroll;
- pre-authorized payment plans;
- credit authorization;
- retailing package (accounts receivable accounts payable, inventory, sales-analysis, management reports);
- other industry specialized accounting/MIS packages;
- financial analysis (portfolio management cash-flow analysis, financial planning, modelling);
- OCR data preparation;
- billing and accounts receivable for doctors, dentists, etc.;
- credit evaluation.

Broadly speaking, a bank's market for ACS is primarily the small and medium-sized businesses, particularly retailing. Large companies usually have enough in-house expertise and computer capability, although they will also use services like account reconciliation. Retailing is a particularly good market for bank services, because of the short control cycle and the importance of tight financial control. Manufacturing has fewer sales and does not allow the same opportunities for financial integration.

The credit authorization market was generated from the need to verify that bank card purchases are within the customer's credit limit and that the card is not stolen. Again the retailing industry is the major user. Credit authorization leads the banks into the sale of retail services. It appears unlikely, however, that Canadian banks will be in a position to provide retail accounting/reporting services via a POS terminal network by 1975. In that year, to the extent that retail services are provided, they will probably be offered on an off-line basis.

The potential for OCR data preparation centres is uncertain. So far, only the Canadian Imperial Bank of Commerce is in the market, but their Commerce Optimations Services Ltd. in Toronto appears to be a success. Certainly, when the banks offer off-line services to merchandisers and small business, they must have a method of data preparation and OCR seems a reasonable solution because it has an application in reading sales drafts. In any case, OCR data preparation charges would probably be built into the overall fee schedule for a total bank service.

Individual credit is evaluated by banks when granting loans or issuing bank-cards and courtesy cards. To obtain the necessary information for other than the banks' own customers, credit bureaux are one of the sources of information. It is entirely possible that banks building Customer (or Centralized) Information Files (CIF's) will find it cheaper and more convenient to store their own accumulation of historical credit data on their customers. As more consumer credit is extended by banks, they may become the primary source of most credit/financial data. Thus, it is likely that alone, or in tandem with existing credit bureaux, banks will find themselves in the credit evaluation market. However, since there are no known plans at the present, it would be unrealistic to attempt a prediction of their penetration of this market.

Up to this point, much of the effect of bank automation has been dissipated by the necessity of keeping pace with the ever-increasing demands placed on the industry by an expanding economy. Most efforts of banks and programming people are still concentrated on building systems for internal use. As the internal development work peaks and starts to fall off in any bank, the experience of analysts and programmers will find its best application in the development of automated customer services. Already the banks are experiencing a growing demand from their customers for the provision of additional services.

It is therefore likely that the systems which will be first developed will be those which meet a known customer demand and will be initially designed for off-line processing. By 1976, the banks probably will have completed a

number of customer-service packages, in addition to those of payroll and account reconciliation. Among the ones most in line for early development are accounts receivable, accounts payable and billing. The packages will be industry-oriented and modularly constructed, to allow limited customization. Without exception, all the banks interviewed have a policy that all services must be self-paying. It follows, therefore, that any computer-services offered will be unit-priced and will be expected to make a profit. Naturally, there are difficult cost-allocation problems, but these are being pursued. Canadian bankers are aware that a major reason for the losses suffered by many U.S. banks on ACS was due to incomplete knowledge of the cost involved.

7. ESTIMATED SCHEDULE

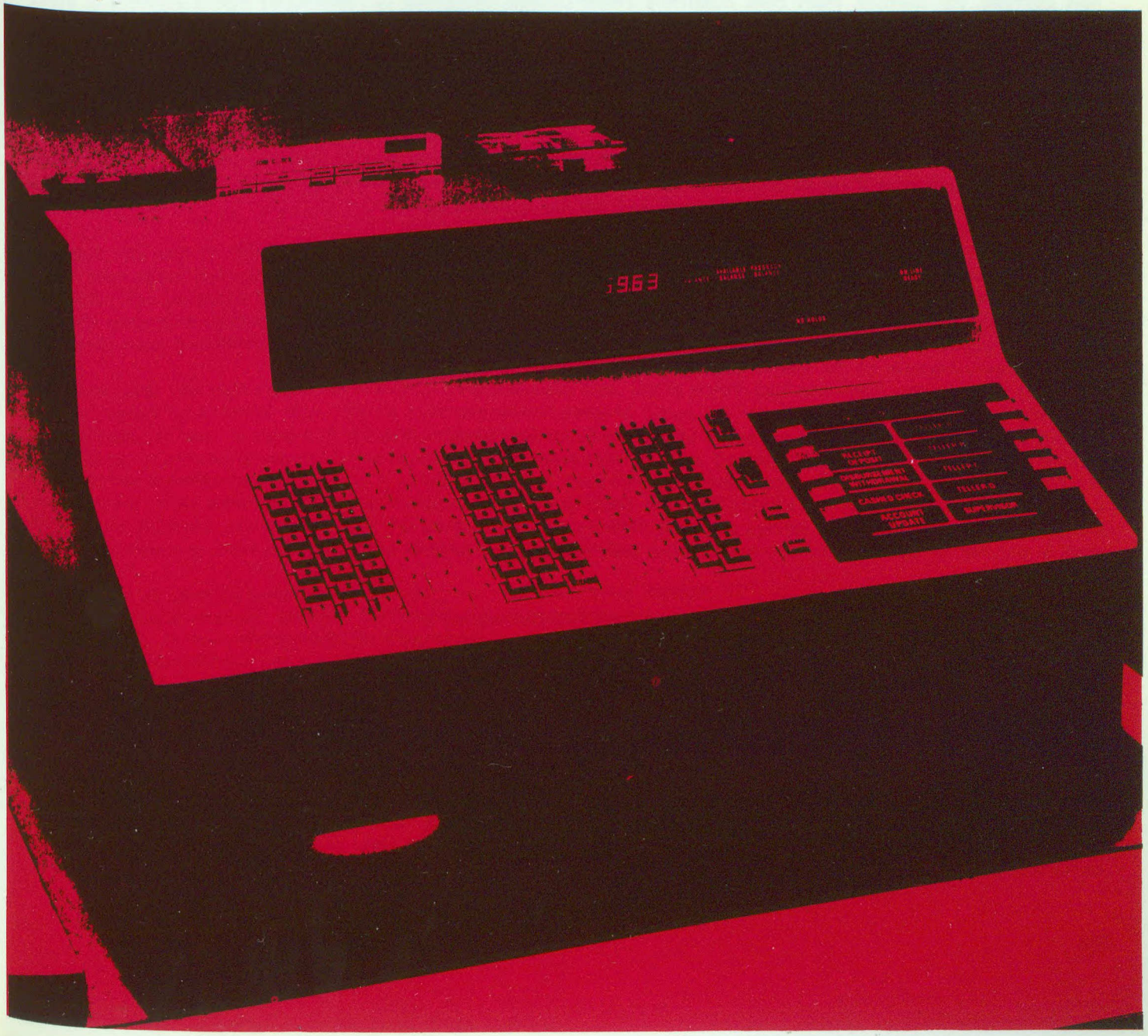
As a result of the overall survey, it appears that certain specific events and trends may occur within the following time-frame.

YEAR	EVENT AND TRENDS
1971-75	• Intensive period of on-line application development. • Internal bank operation of on-line savings systems in all major cities: development of parallel functional data transmission networks. • Limited implementation of on-line DDA, loans, securities and other internal applications. • Inter-bank exchange of payments data on magnetic tape. • Introduction of optional non-returnable DDA cheques. • Increased automation of regional bank credit authorization centres. • Experimental use of machine-readable bank-cards. • Increased use of direct credit for payroll, and dividend payments. • Expansion of bank services to include automated billing, accounts-receivable and accounts-payable. • Inter-bank settlements, handled primarily by direct data transmission.
1976-80	• Most domestic bank branches directly linked to a computer. • Co-operative bank arrangements to share data communications network facilities. • Direct data transmission between banks and the computers of large corporations. • Point-of-sale systems, operative in large department stores for credit authorization and capture of sales and order data which will be linked to banks. • Pre-authorization commonly used for fixed repetitive payments. • Widespread use of bank-cards for payments.

- Development of Centralized Information Files by banks to integrate customer financial status.
- Experimental direct links with foreign banks for international payments.
- Direct interconnections between banking systems and government networks for National Revenue-Taxation Customs & Excise, Department of Supply & Services, Bank of Canada. Some on-line services available to bank customers, particularly small retailers and wholesalers.

1981-85

- Rapid growth of financial network participation by retailers and other businesses using on-site terminals.
- Decline in use of cheques for personal and commercial payments, resulting in increased financial network transaction volume.
- Extensive use of international data links for financial and trade transactions.



This chapter attempts to outline some of the factors that inhibit the development of an electronic funds transfer and credit system in Canada.

Banking is by tradition and practice one of the most conservative of professions. Therefore the reluctance to alter established practice and habits constitutes the main restraining influence on the development of an electronic payments/credit system. This conservatism manifests itself in both the purveyors and users of financial services. Its effect is felt not so much in active resistance to new methods as in a feeling that existing methods are adequate and that new techniques will not attract a significant amount of new business. For example, many bank customers would strongly disapprove of a move to stop the return of their cancelled cheques. Aware of this public attitude, many banks might be wary of initiating such a step, for fear of losing their customers. Similar considerations apply to savings-account passbooks, direct crediting of pay, and automatic deduction of pre-authorized payments.

Rather than introducing new methods on an all-or-nothing basis, the banks will almost certainly offer them as options. Promotional campaigns will stress the convenience and speed of the new methods and the less conservative customers will accept the change. Ultimately, acceptance will grow, and will be encouraged by cost-incentives. If a telephone bill in 1980 can be paid on a pre-authorized basis for 7 cents, but the service charge on a cheque is 25 cents, there will be an incentive to reduce the number of cheques being written. Certainly the future holds many changes for the carrying out of commercial transactions. To some extent, the introduction of these changes will be delayed because of the lack of apparent customer interest. A marketing study by the Marketing Task Force of the ABA Monetary and Payments System (MAPS) indicated that the public is satisfied with the present use of cheques and most segments of the population see some disadvantages in any change to established systems. However, the changes are bound to come — pushed by cost considerations rather than pulled by customer demand. Once they are established, they could grow rapidly. The disruptive effects should not be serious since the changes will probably be gradual and will be opted for by customers rather than being forced upon them.

If, over the next ten to fifteen years, an electronic funds-transfer system is going to largely displace the bank cheque, it will be necessary to modify the existing laws. These are now predicated on the use of bills of exchange as payment instruments. In the future, a new legal framework for commercial transactions will eventually become necessary. A study has already been conceived and planned by the University of Toronto Faculty of Law. Some of the specific problems are discussed below.

Cancelled bank cheques now have legal documentary status as proof of payment. In order to eliminate the need for returned cheques, or indeed to have cheques at all, the courts must be able to accept bank statements or transaction print-outs as documentary proof.

In certain circumstances, certified cheques or official cheques are needed, to prove that the payor has the necessary funds. If the transfer of funds can be completed electronically, the need for such proof will be eliminated.

When funds are instantly transferred by electronic means, there is no longer any need for a stop-payment, except in the case of payments that are pre-authorized and are automatically initiated. To allow for the return of merchandise or refunds, due to inadequate service there will also be a need for a flexible transaction reversal mechanism.

There is currently a legal requirement to present a cheque before receiving payment. This would have to be changed to require *only* the presentation of the payment instructions — *i.e.,* in electronic form. Presumably, these instructions must be presented in a standardized format with unique and legally acceptable identifications of the payor and payee.

Current requirements pertaining to the examination and audit of financial records, which demand vouchers supporting accounting entries, must be updated. Again standards must presumably be established to ensure consistency.

Changes may also be needed in the law affecting the amounts and kinds of credit information that can be maintained or disclosed regarding a given customer. Too restrictive laws regarding access to personal data might severely encumber companies engaging in consumer credit. Nevertheless the consumer must be afforded protection.

Although entry into banking *per se* is subject to many conditions, there is no law to prevent quasi-banks from offering payment-transfer services. Theoretically, at least, a variety of different organizations could be active participants in an on-line payments/credit system. But, for a number of reasons, the commercial banks are in a strong position to lead the development of an electronic payments/credit system. They already form the hub of our payments system, and they have the money, the experience, the branch networks and the customer base necessary for expansion.

Competition in payment-transfers could arise from trust companies, finance companies, large retailers, common carriers, computer manufacturers, independents, or even government. In view of the profit potential of secondary markets for financial services (*i.e.,* financial services ancillary to payments), some firms are expected to attempt to break into this field. While it is true they would face strong, entrenched competition, these firms will be studying the progress of bank automation and market strategy. Significant delays by the banking industry would almost certainly lead to increased competition for payment-transfer services.

There will be a continuing need for credit evaluation services — a need which is now met by independent credit bureaux. If the bureaux act to mechanize their information files to meet the cost and speed of retrieval

requirements of the future, they will become active participants in the financial network. Otherwise, the banks will tend to build their own customer credit-rating files, thus reducing their dependence on credit bureau services.

Government will undoubtedly have a strong interest in an emerging electronic payment/credit system — as a user; as manager of monetary and fiscal policy; and as custodian of the public interest.

In brief, the electronic payment/credit system will likely develop by the merging and interconnection of separate networks, credit and retail sub-systems and service bureaux. While loosely referred to as a "network" or "system" the mechanism will, in fact, be a coalition of overlapping sub-systems.

Institutionally, the nucleus for this "network" will develop out of the independent on-line banking systems and will thus be assured of Canadian ownership, control and financial stability. This is the path already embarked upon, and the one that will create the least resistance. There may be strong contenders for this leadership from other economic sectors. And this, combined with competition among the commercial banks, should result in a stable, efficient network of services with a sufficient number of options for the customer.

There is no shortage of people with technical skills in conventional systems-design, programming and project management for batch computer applications, although many of these individuals generally seem to lack the necessary broad knowledge of business practice and communications skills. There is, however, some shortage of people with skill and experience in the design and implementation of commercial real-time systems and in the management of very large computer projects.

This shortage of experience with large real-time systems is simply due to the fact that few such commercial systems are yet in existence in Canada.

When the Bank of Montreal's plans for an on-line, real-time banking system were unveiled in 1969, the proposed system was the largest of its kind in the world. Clearly this meant a lot of ground-breaking activity. However, it is only by means of such projects that the necessary experience can be gained.

The development of banking computer/communications systems will depend upon the availability of suitable hardware from the computer industry, and upon the development of data networks facilities by the common carriers. Costs for major hardware components, such as mainframes and memory, have reached acceptable levels, and further cost-reductions are probable. Terminals for banking networks are still evolving and their characteristics and quantity requirements have yet to be completely established. Plans for network developments by the carriers are discussed in Volume I. Software and systems-management concepts are as important as the hardware required for the systems, and are probably no further advanced. There is much to be done in both application systems-analysis, and hardware and software standardization.

For banking on-line systems, two general patterns are possible. These are:

- A separate functional network for each of the five major banks, or;
- a single functional network shared by all of the five major banks.

In either case, the carriers could provide the communications facilities. Supply and ownership of terminals will depend on the competitive situation.

At this point in time, the banks have opted for separate functional systems. A prime consideration for doing so is that each bank requires a freedom to develop its own system in its own way and at its own rate.

This freedom is important, because each bank has different priorities in automation — in terms of both degree and speed of implementation. Co-operation would require agreement on priorities and would imply roughly equal rates of development. Because automation may be a significant competitive factor, those banks which are ahead in the race are not inclined to mark time while waiting for the others to catch up.

On the other hand, and distinct from the on-line systems, the banking community recognizes the need for improved methods of cheque-handling. This will continue to be an off-line data collection and processing application for the next decade or so. Inter-bank co-operation in this area is commonly accepted, since roughly 80% of the cheques received by one bank are drawn on other banks. It seems more likely that agreement will be reached in the operation of an "automated clearings system", even if this only amounts to a standardized interface between bank computers, rather than the operation of a separate facility.

Through the CBA, transaction format standards have been developed for use by all banks, and a study of the feasibility of regional information collection and distribution centres has been initiated with representation from all the banks.

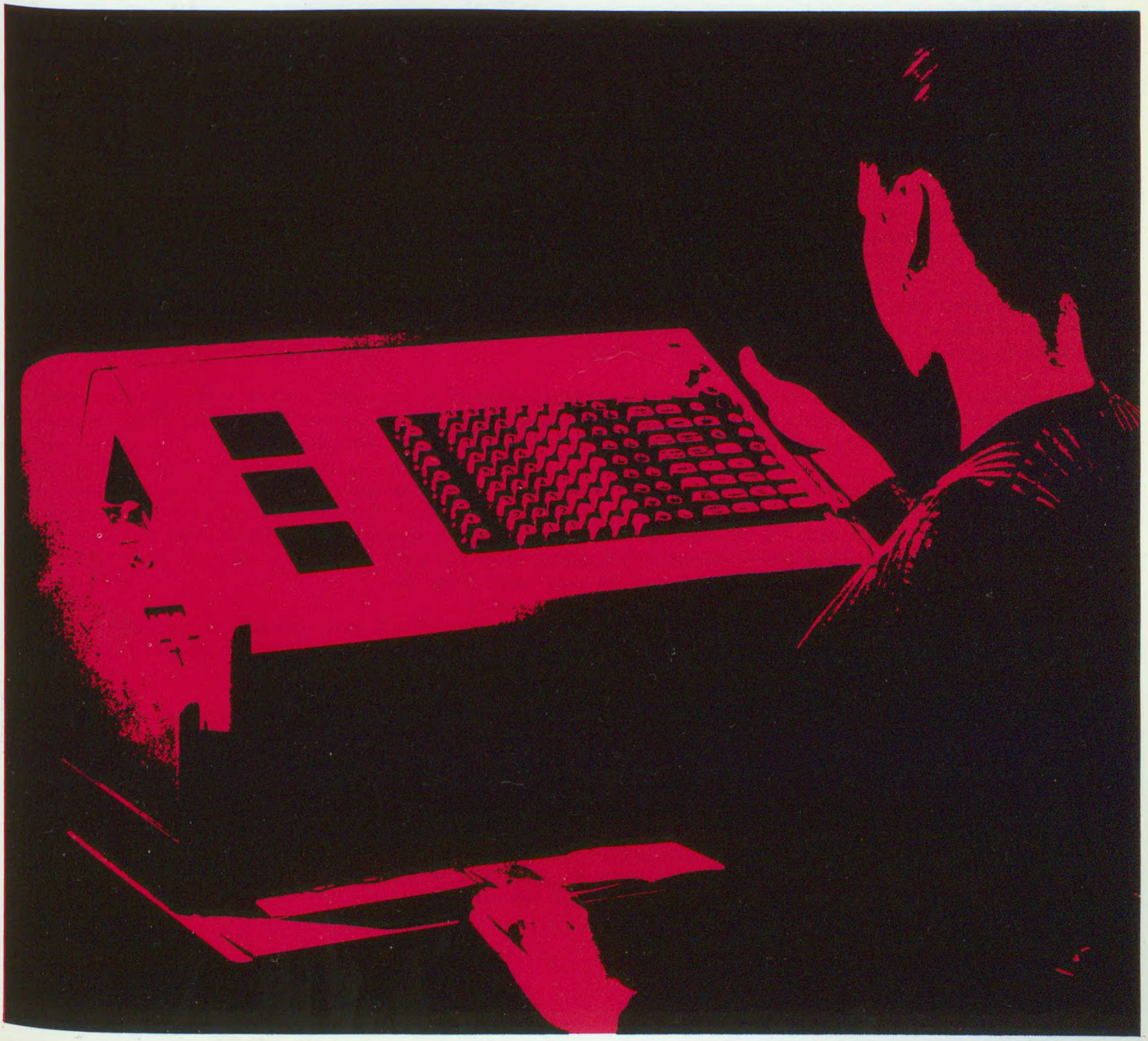
If transit times are to be reduced, the alternative to the above-mentioned regional information collection and distribution centres is parallel operation of many regional batch centres by the various banks. These batch centres would MICR encode cheques, sort them, translate them into magnetic storage media, and transmit the payment instructions for processing elsewhere. Again, current developments seem to indicate separate bank operation of these cheque-processing facilities with interchange of payment data between banks, first on magnetic tape, and then by direct transmission. However, it is conceivable that the economies of shared cheque-processing facilities will induce the banks to closer co-operation. There is precedent in their common adoption of MICR encoding standards.

In terms of regional development, it is evident that the major centres of population and financial activity offer the greatest returns on investment in automation. The cost of data communications to remote bank branches is high and still leaves the cheque-handling problem unsolved. For these reasons, it is to be expected that the remote bank branches will be the last to be connected to the on-line banking networks. Nevertheless, while the marginal cost of automating these remote branches is high, it may eventually turn out to be less than the cost of non-automation. And, as soon as the on-line systems grow to the stage where the remote branches must be treated as exceptions in cheque-handling, accounting and reporting, the pressure to "round out" the system will be great.

The remaining problem area in financial data communications is that of network services for customer applications. It has already been pointed out that there is a substantial future market for financial services that could be met by the banks, especially in the retailing industry.

The on-line systems being developed are designed for internal bank operation and are not intended to carry a significant volume of customer data. This would appear to indicate a lack of any specific plan to input customer data through branch terminal facilities.

In fact, the banks currently have not, or at any rate have not disclosed, any plans to offer general business services, *i.e.*, financially related services, such as accounts-receivable, on an on-line basis. To the extent that these services are made available in the next few years, it must be assumed they will be offered as batch-processing services. The need for complementary data preparation services, remote job entry (RJE) and report printing makes the case for individual bank regional RJE centres more attractive. Indeed, where OCR equipment can be used instead of MICR equipment, it can double up for use in reading cheques and customer data.



A study performed in the U.S. has shown that a doubling in the level of national economic activity requires an increase of from two to five times the current level of financial transactions. These increases cannot be supported by the present paper-based methods of payments.

In Canada, the situation is probably not as critical as in the U.S. Nonetheless, it is still true that the cost of the payments/credit mechanism would increase at a rate faster than the rate of economic growth, if changes were not being made. It is clearly in the national interest for Canadian banks to take the initiative in holding down these costs through better technology, thereby ensuring that Canadian financial mechanisms are as advanced as those developing in the rest of the world.

The reduction of the ''in transit'' time of money may have some effect on the day-to-day financial practices of business. Some firms today use ''float'' as a significant part of their working capital, by speeding the collection of receivables and slowing the disbursement of payables as much as possible. It has been estimated by the Canadian Bankers' Association that the average in-transit time has been halved over the last 10 years. Specific figures are not available, since debit float and credit float are jointly reported as a net figure. In any case, it is reasonably certain that electronic funds transfer will cut both the ''in-transit'' time and the float to zero for many transactions.

The banking community is well aware that faster and improved methods of cash-flow management would lead to acceleration in the rate of deployment of capital for expansion, and improved customer services.

As was stressed earlier, the increasing reluctance of corporations and individuals to maintain high deposit balances means a shift toward more direct costing and charging for unit banking services.

An automated financial system will eliminate many of the time-lags inherent in today's paper-based systems. In terms of economic analysis and forecasting, more accurate and complete data will be available more quickly. Changes to the bank rate, and other determinants of monetary and fiscal control, will have a more immediate effect on the system than is the case today. Thus, the potential for a better understanding and a finer tuning of the economy provides the possibility of yet another benefit as a result of automation.

Credit will continue to expand due to improved evaluation methods, lower costs of administration and more customization of services for specific customer groups or individuals. Better methods of controlling and recording credit transactions should also lead to a reduction in the costs of extending credit — e.g., the level of merchant discounts. For most of a consumer's needs, credit will eventually be extended automatically, based on an individual's record for credit reliability and ability to repay.

On the other hand, new types of enterprise may arise to take advantage of new markets created by the changing technology. Perhaps a forerunner in this regard is National Data Corp. (NDC) of Atlanta, Georgia. NDC has established

a computerized credit card authorization service for most of the major oil companies. It currently serves several of the Canadian oil companies. Recently, NDC began taking over the payments system (*i.e.*, billing through collection) of Atlantic-Richfield, one of its credit authorization customers. In so doing, NDC beat the banking community to the draw, which serves to illustrate the point that the market for payments services is not guaranteed to the banks. This is equally true in Canada.

In the computer services business, smaller companies now offering financial services such as payroll and accounts receivable will face heavy competition from the large financial institutions. In these generalized business applications, the small service bureaux will be hard-pressed to compete effectively. To survive, they will be forced to specialize in the particular applications of one or more industries.

Another effect will be the increase in skill and experience in Canada, which will result from the development of automated financial systems. This is even now being brought about by bank in-house training programs for hundreds of programmers and systems analysts. Research and development efforts by bank staffs and by contracted developers are, for the most part, taking place in Canada. The experience with large project management and real-time systems is transferable and will benefit the development of other on-line real-time systems in the future. The importance of this benefit should not be underestimated because of the huge potential for cost-savings in future systems-development. High-calibre and experienced systems analysts can often reduce system implementation time and effort.

There does not appear to be a major export potential for financial systems. However, some terminal and software developments for Canadian banking may be exportable by companies such as IBM and NCR. There may also be a market in the U.S. for some stand-alone banking computer services — *e.g.*, mortgage accounting and portfolio management. But, there are too many differences between Canadian and U.S. banking for a complete Canadian on-line system to meet American requirements. However, should Canada acquire a reputation for expertise in this area, there will be an export market for consultants.

In this connection, it is worth noting that National Cash Register plans to manufacture banking terminal equipment in Canada with federal government assistance.

While it is always difficult to predict social change, some trends are likely to emerge as a result of increased automation in payments and credit methods, if only because finances are such an integral and important part of everyday life.

One broad effect will be an increasing public awareness of the general importance of computers through more direct encounters with computer terminals in banks, offices and stores. In time, this will lead to acceptance of

the computer's role and its integration into the social fabric. But before this stage is reached, there are bound to be crises of confidence and widespread complaints regarding the whole area of personal privacy.

Changes in payment methods will entail changes in purchasing and payment habits of individuals. For example, due to the loss of "float", those individuals who now take advantage of time-delays in clearing cheques will probably have to pay for the privilege of delaying payment. However, to cushion the impact of this change, a standard delay might be a necessary part of an electronic system.

Due to reduction in free bank balances, banks will tend to collect more revenue from service-charges. Since these are more readily visible and understandable to the public, the average consumer will pay more attention to his banking costs, and advocates of consumer interests will attempt to bring pressure on the banks to keep charges down. There will also be the increased convenience of making deposits, obtaining loans without undergoing long personal interviews and not having to reconcile bank statements. There will be fewer trips to the bank. In actual purchasing, there could be the added convenience of not having to carry around large amounts of cash (less chance of loss or thef and of having a consolidated record of purchases provided by one's bank. As far as credit cards are concerned, the growth of multi-purpose bank-cards will mean a decrease in the number of cards an individual has to carry around in his wallet.

An electronic payments and credit system will have an effect on the operations of many government departments. Some of these effects have already been mentioned. The coverage in this section is by no means complete, but it does indicate the number of government departments and agencies that could be affected by an electronic payments and credit system.

Government responsibility for the monetary system has long been recognized. Since an electronic payments/credit system will have profound effects on the monetary system, government bodies must be prepared to modify their policies and their models to accommodate the changes as they evolve. Ultimately there will be a decrease in the supply of currency in circulation and in demand deposit levels, both significant components of the money supply. This will stem from a reduced need for currency and a greater velocity of money transfer. As a result, funds will shift into term deposits and long-term investments. This would seem to be a beneficial effect, but may necessitate a re-definition of the money supply and new ways of interpreting its significance.

Data on the performance of the economy will be available more quickly through computer-based systems that collect data at the point of transaction and are capable of rapidly integrating these data into a composite picture of what is happening. In conjunction with the data collection and analysis capabilities of computer-based financial systems, the speed of electronic transaction processing will reduce time-lags in the effect of changes in money

supply, and interest-rates. This means that the economy will be more responsive in a time sense to monetary and fiscal changes.

In its capacity as payor of federal government funds, the Department of Supply and Services will be able to make use of an electronic payments system to reduce costs. This Department is currently studying the feasibility of paying federal public servants by means of direct funds transfer. Current plans call for optional direct crediting of payroll by 1972 or 1973. In the future, this technique can be applied to a variety of government payments to individuals, such as pension, welfare, unemployment insurance and family benefits. Ultimately, it will also be extended to their accounts payable.

The Department of National Revenue (Taxation) already makes heavy use of computers and may someday form a component of a national electronic payments system for the collection of taxes without cash or cheques. This would certainly cut down on paperwork. Ultimately, taxes might be pre-calculated by computer and automatically deducted by banks for credit to the government. This approach would relieve employers of having to make income-tax deductions. If bank files contained a nationally-used individual identification, all necessary tax information could be forwarded electronically, eliminating the need for T4W, T5W forms and other documents, and also many redundant data preparation steps.

As business systems become more automated and linked through an on-line financial network, it is entirely feasible that many operating and financial statistics required by Statistics Canada could be acquired directly in electronic form. Again this has a great potential for paperwork reduction at both ends of the information flow.

The Post Office may be affected by a decrease in mail volume as the use of mail to send cheques, bills and statements declines. A study made by the Kappel Commission on postal services in the United States showed that 40% of all mail consisted of financial transactions. It is assumed that the same proportion holds true in Canada. The main development which may affect cheque-flow in the near future is pre-authorization. A recent Canadian Post Office study[1] predicts a 10% reduction in the volume of mail by 1985, as a result of the introduction of this system.

APPENDIX TO PART B1

APPENDIX 1

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Applications in Education

INTRODUCTION

The purpose of this study is to survey both the present state, and possible future impact, of computer/communications in the field of education in Canada. It does not attempt to either evaluate or recommend particular systems or methods either currently or potentially in use in this field.

Earlier studies and discussions with informed sources indicate that the main areas of computer application in the field of education are:

Administrative Systems
Computer-Aided Learning Systems
Information Retrieval Television
Systems (IRTV)

Examining the impact of technology on society today has been likened to assessing the impact of the automobile by judging reactions to the Model-T in the 1920's. One could say that computer applications in education have not even reached the Model-T stage. They are still in their infancy. They exist mainly as small, experimental systems and few people beyond those directly involved know of their existence or understand their potential. It is therefore difficult to obtain comments from anyone outside this group which, by virtue of its involvement, is both enthusiastic and optimistic.

No attempt has been made to derive a consensus via a large statistical survey. The Trans-Canada Telephone System has recently sponsored a study[1] on the future of educational technology using the Delphi technique. This study has been used for reference whenever aggregate opinion is necessary. Otherwise, all known experimental systems in Canada, falling within the frame of reference of this study, have been visited and informed opinion collected from individuals involved. These opinions, particularly when consistent, have been used in the preparation of the present study. Other statistical information has been obtained from Statistics Canada, the Economic Council of Canada and the Department of Manpower and Immigration.

The educational applications using computer/communications techniques characteristically have limited funds available for their development. Funding is being established by the Quebec Department of Education for the further expansion of computer-assisted applications in education. The Province of Ontario is presently developing administrative applications to be offered to its school boards. All other operational installations are funded either from private sources or school-board operating funds. At the post-secondary level, little co-operation exists between the institutions, beyond the sharing of ideas at conferences. However, at this level, with larger funds available and greater autonomy, a good deal of work has been done.

[1] Doyle, F. J. & Goodwin, D. Z. *An exploration of the future in educational technology* (Bell Canada, 1971)

The major applications which have emerged in the administrative area are student-record systems, including university admissions, career-guidance and time-tabling systems. At the elementary and secondary school level, little has been achieved, while at the post-secondary level, many "tailor-made" systems have been developed. A potential market of $34 million for 1975 is based on 5% of the current administration budgets.

In the area of computer-aided learning (CAL), projects in Canada are mostly experimental, using very limited funds. The potential market for 1975 is estimated to be $118 million. These new learning systems will require a short-term injection of substantial funds if any significant development and penetration is to result. Considerable effort would be required to adjust the educational system, if the potential benefits of CAL are to be realized. Few people beyond those closely associated with the experimental projects are aware of what CAL means, or how to use it. Particularily with the current surplus of teachers, together with unemployment and the initial concern with which automation is regarded, CAL systems face a somewhat difficult immediate future.

IRTV Systems seem to have an independent future in the short-term, but a much more integrated role with CAL systems in the long-term. There is, at present, only one known pilot-system, and it has been well used by the participants. Because of the integration possibilities, it is difficult to estimate the market for IRTV as a separate system.

The present application and future potential of both CAL and IRTV systems is discussed in greater detail in Chapter I, Sections 2 and 3. Further aspects of CAL's usage are examined in Chapter II, Section 2.

1. ADMINISTRATION

All universities and most community colleges in Canada have varying degrees of computerization. These cover applications from payroll and financial accounting to course scheduling, student record-keeping and space inventories. The degree and extent of implementation of such systems vary widely. They are generally developed by the institution in question and initially are using facilities installed for research, development and teaching. As the applications have grown, so have separate administrative computer departments. Administrators generally prefer to remain inviolate from the compliations posed by sharing facilities with inquisitive and inventive students.

At the elementary and secondary school levels, some urban school-boards mainly in Quebec and Ontario are using simple administrative systems. School-board budgets tend to keep individual participation at a low level, but these two provinces are now developing administrative computer systems services, which they are offering to their school-boards from central facilities.

(a) Student Information Systems

Information systems on students have been computerized at many of the larger post-secondary institutions. These systems have evolved over a period of time by the institutions concerned and now require integration with financial systems and space inventory systems. This integration process is already taking place at a number of universities. In Quebec, through the CESIGU (Comité d'élaboration du systeme d'informatique de gestion universitaire) group, the development of a student information system is being co-ordinated. At the elementary and secondary levels in Quebec, a large number of school-boards have, or will have, access to the facilities of the Department of Education. Among the remaining provinces, some have availed themselves of the services offered by Statistics Canada.

Arising out of an initiative in 1968, by the Council of Ministers of Education, Statistics Canada was requested to develop an educational data base, and the administrative procedures which would accompany it, as far as available funds would permit. Initial Student Information Systems have been developed at Statistics Canada for the prairie provinces, who have now taken over the system, and administer it themselves. Some Atlantic provinces have been introduced to the system during the past year. British Columbia is now in process of adopting it.

The Peel County Board of Education has been exploring the possibility of using computer/communications facilities for administrative functions. A joint project between the Peel County Board of Education, and private industry, partially funded by the Canadian Computer/Communications Task Force was established to assess the feasibility of this approach. The pilot-project provides for 2 transaction-type terminals and 2 teletype terminals, one of each located in Kennedy High School and the other two in the Board's administrative office. The applications covered are payroll, student record-keeping, including

attendance records, staff record-keeping, and marking of multiple-choice questions. Both types of input devices will be assessed by the school and by the administrative office. It is hoped that this approach will give the staff ready access to information which was previously difficult to extract from the files, thereby increasing their effectiveness in dealing with potential problems at an early stage.

In co-operation with the Department of Education in Quebec, the universities, through CESIGU, are developing a group of programs to cover such administrative functions as financial information and space inventory, as well as student and staff information-systems. Once the specifications have been outlined and agreed to by the group, each university will undertake a portion of the work, which they will develop and implement as a pilot-system. When each section is functioning satisfactorily, other co-operating universities will start to use it, either in their own installations or via a network. It is expected that this project will have all sub-sections ready for full implementation by the end of 1975. The cost will be borne in part by the universities and in part by the Department of Education.

(b) Time-table Systems

At post-secondary levels, time-tables are computer-prepared at a number of institutions. These systems vary in sophistication from full-scale simulations to seat-reservation systems; and even within a given university, the techniques vary from faculty to faculty. Computerized time-tabling services are available from MIT and Purdue on their systems, but the costs are considerably higher than can normally be afforded by either the school-boards or most post-secondary institutions ($20,000-$50,000 per year). Two provinces are known to be taking action to provide their school-boards with a form of computerized time-tabling services; and experiments with the Stanford System are being conducted in Alberta.

The Ontario Department of Education is offering a service to its school-boards to assist in the development of school time-tables. This system accepts a sample time-table prepared by the school, compares it against a previously entered set of student course requests, then evaluates and lists conflicts (student, room and teacher) and unsatisfied requests, as well as preparing teacher schedules, pupil schedules and room schedules. This output is then returned to the school for further refinement of the time-table. At present, one third of the Ontario school-boards are using this system on an IBM 360/50, some via remote batch-entry and others via the mail. The number of users is currently limited by the number of advisors available in the Department of Education to assist in the use of the system.

The University of Laval has developed an elaborate and sophisticated system, allowing many parameters as input, and producing in a single pass a fully optimized time-table. Inputs comprise student course requests, teacher capability and requests, classrooms available, including capacity and fixed equipment, course requirements (previous course completion, equipment, etc.), and a rating for the difficulty of the course. These inputs may be constrained by such items as limiting the number of difficult courses taken by one student on a particular day, or requiring a certain time interval between difficult

courses. The resultant time-table is produced in a single run on an IBM 360/50. Cost figures of $8,000 for a time-table for Laval itself, comprising 10,000 students and 1,200 members of staff are being quoted. The development has been funded by the Quebec Department of Education and, after a full-scale test at Laval, it will be made available to all the school boards in Quebec.

(c) Career Guidance Systems

Career guidance systems have not been extensively developed in Canada. The systems-design phase for one of them is under way at the Department of Education in Ontario, and some work has been done in Alberta, by both the University of Calgary and the University of Alberta. At Calgary, sufficient work has been accomplished for the system to be considered operational, and courses for counsellors have now begun. These systems essentially provide an information retrieval service on career information, relieving the counsellor of the problem of having to obtain the necessary facts from a great number of sources. However, it is hoped in Calgary that this concept can be extended to actively help students make better career decisions.

2. COMPUTER-AIDED LEARNING SYSTEMS

As was mentioned in the Introduction, only a limited amount of experimentation with computer-aided learning (CAL) systems, has so far occurred in Canada. The testing that has taken place is already demonstrating the lack of inter-changeability which has characterized developments in the U.S. Even between the University of Alberta and Simon Fraser University, both of which use IBM's COURSEWRITER, exchange of course material is not easily achieved because of differences in machine configuration, operating system requirements, and different implementations of COURSEWRITER itself. Recognition of this problem has prompted NRC, through its Associate Committee on Instructional Technology, to prepare specifications for an authorship language, with the hope that it will be adopted as a standard for Canadian development of course material.

The NRC Information Sciences Division project, which was started in 1967, has acquired a PDP-10, as the basis for offering free computer time for development of CAL to various provincial organizations. Since there is increasing concern about incompatibilities in software, NRC (as mentioned above) is co-ordinating a national committee to specify an authorship language for CAL. The draft specifications of this language are being prepared now. NRC is also conducting some research into terminals suitable for educational use.

At the present time, participation in the project is limited. The greatest use is at the Ontario Institute for Studies in Education which is developing a remedial mathematics course. More remotely located participants are hampered by the present high cost of data communication services. However, arrangements have been established with the universities in the west and in Ontario and it is hoped to expand the number of participants during the coming year. For further details on the NRC project, see Appendix 2.

The Quebec Department of Education has been conducting a research and evaluation project into CAL, using an IBM 1500 series system. Even though the system is equipped with only a relatively small number of work stations, a carefully planned program of research is yielding encouraging results. The Department now feels that it has a good grasp of the scope and value of the medium, and will soon be ready to launch a second phase of development making more extensive use of it, as well as developing course material in appropriate areas.

The high degree of interest shown by members of the Department of Chemistry at Simon Fraser University has led to the development of CAL and its use in teaching, particularly at the first-year level. The course repertoire has been extended to permit experimental work with some schools in the area, and one or two more remotely located at Kelowna. (Plans for the future will include several community colleges.) Courses are prepared by the combined efforts of a lecturer and programmer who is familiar with the idiosyncrasies of the authorship language and with the techniques best suited to computer-assisted learning. The project is organized as a separate entity, under the budget of the Academic Vice-President, and run on an IBM 370/155 on a shared basis with other work. It is funded primarily from university funds, although grants have been made available by such organizations as B.C. Telephone Company, to cover specific experiments within the schools.

At the University of Alberta an IBM 1500 series educational system has been in operation for over two years. Considerable development in course material, particularly by the Medical Faculty, has resulted in this becoming one of the most advanced projects in Canada. In conjunction with the Medical Council, a project is being developed (based on experience gained with the Medical Faculty) to provide many level examinations in clinical competence, using such computer techniques as simulations. This particular project has initially been funded by the Medical Council, but application has been made to the Department of National Health and Welfare for further subsidy. The course material is usually developed by a combination of programmer and lecturer, although some lecturers have developed and designed their own complete courses. Financing for the extensive development of university and school course material, and initial provision of the system, has basically been from university funds, with some donations to the school experiments from the Alberta Human Resources Council.

The Computer Applications Division of the Ontario Institute of Studies in Education (OISE) has been experimenting with CAL for some time, using a PDP-9 acquired by a Department of Manpower grant. Considerable work has been done on language development, and the language currently used on the NRC project is the one developed by OISE. The University of Western Ontario also uses a derivative of the OISE language. Current projects under way are the production of a remedial mathematics course for entrants to manpower retraining programs, preparation of second language instruction and high-school physics. The evaluation phase for the remedial mathematics course has already been prepared, and this is now under test at two or three community colleges. The correctional phase is under development. Both phases are being implemented on the NRC PDP-10. The second language development project

is still in the design stage with a feasibility study being prepared. The high-school physics program is operational at two high-schools in North York on the PDP-9. OISE funds have been used for development of material, with outside funds now being sought for the second language instruction project.

The Computer Science Department at University of Western Ontario has been introducing different teaching methods for the computer science course over the past three years. This work has used both CAL and video tape. The video tapes have subsequently been released to be shown on cable television in Sarnia. The experiment is being repeated at a summer school in Owen Sound this summer. Within the university, CAL has been used primarily for first-year computer science and mathematics teaching, although some experiments have been conducted in local schools. The projects run on a shared basis on the university's PDP-10 and are primarily funded by the university.

Using a Digital Equipment Corp. TSS-8, the University of Calgary supports 16 terminals, of which 4 are located in a trailer, serving junior high schools. Some terminals are equipped with random-access slide projectors. Course material has been developed by academic staff and graduate students, with funding from the Alberta Human Resources Council, NRC and Canada Council, as well as the university.

3. INFORMATION RETRIEVAL TELEVISION SYSTEMS

Information Retrieval Television Systems are being examined as a means of resolving the difficulties presented to schools by the fixed schedule of Education Television on a single channel, and the problems involved in transporting film to the appropriate school in time for the class. Only one pilot-project has been implemented, with the concept being considered seriously in some metropolitan centres.

In conjunction with Bell Northern Research and OISE, the Ottawa Board of Education instituted a pilot-project to evaluate the use of IRTV. One hundred and fifty classrooms in five schools were outfitted with a twelve-channel cable outlet, a TV monitor and a telephone. Teachers telephoned in requests for particular films, to either a person or a computer, and these were shown on the first available channel, starting within 60 seconds, if so desired. The instantaneous access, while pleasant, was not found necessary, since most teachers plan classes at least a day ahead. But the availability of material at a time to suit the class resulted in the system being well used. The pilot stage is now complete, and the Ottawa Board of Education will extend the network to other schools over a period of time, but will reduce the number of telephone installations. Extra TV monitors will be added gradually, but existing monitors can be shared on a scheduled basis. The pilot-project costs were borne by the four participants: Bell Canada, who supplied the cable system and the projection equipment; Bell Northern Research, who provided the planning; OISE, who furnished programming support for the scheduling and performed an evaluation study; and the Ottawa Board of Education, which provided the monitors and the film library.

The rapid advances in technology in the last decade and research programs such as the PLATO project at the University of Illinois, have expanded the potential for computer applications in education and given early indications of a possible new form of education.

In the U.S., during the mid-sixties, a state of euphoria existed regarding the potential market in education and its rate of development. In 1968, it was forecast that sales in 1975 would be in excess of $100 million. However, in 1970 the forecast was reduced to less than $25 million, which indicates a far more cautious expectation today.

In Canada, while the potential for using such new techniques, particularly the computer/communications networks, is high, there are many factors inhibiting the growth of the instruction technology industry. In the Bell Canada Delphi "Study on the Future of Educational Technology", the total sample included U.S. as well as Canadian participants. The report repeatedly points out that the time-estimates for use between the U.S. portion of the sample and the Canadian portion differs in some instances by as much as 15 years.

1. ADMINISTRATION

For 1975, the operating budgets of the elementary and secondary schools in Canada are estimated to be $7.16 billion. In the past, an average of 6% of this amount has been devoted to administration, giving an administrative budget of $430 million for 1975. If 5% of the projected administrative figure is set aside for computer application, this will represent a potential market of $21.5 million.

On-line service capability is not paramount in most administrative applications, except possibly in the field of career guidance. However, the availability of on-line systems will tend to increase the effective use to which teachers put their administrative time. Though this has little direct bearing on the costs of education, it will tend to improve its efficiency.

In 1975, the post-secondary institutions are forecast to spend $4.15 billion, with an administrative budget of $249 million. Again, 5% of this budget would represent a $12.45 million computer communications market, giving a total potential market of approximately $34 million.

In the next ten years, the greatest potential for the computer in education is likely to be in administrative applications. The continuing awareness of the computer as a tool in this area makes use of the computer inevitable, particularly as costs of computing come down. Clearly, this market is open to the private sector of the economy, and some portion of it will be serviced by that sector, though competition from provincial cost recovery systems cannot be ignored. Moreover, if career guidance systems are developed, the economies of scale make centralization of these systems inevitable. Again, such services could be provided by the private sector. This, however, would result in a fairly long selling period before profits could be realized. The rate of development and use of systems will closely parallel the economic activity

of the province. School boards close to the provincial centre will be the first to avail themselves of such services, since their communication costs would be the lowest.

Apart from the direct budgetary expenditures on administration, there is also an indirect expenditure incurred by the amount of time teaching staff has to spend on administrative duties. One school-board, Peel County, estimates that the proportion of teacher time spent on administrative duties is as much as 20%. However, even with computerized administrative systems, it is not clear that this figure can be significantly reduced, since some form of supervised data gathering for attendance records will still be necessary, as well as some checks on attendance patterns. Computerized techniques generally permit a more comprehensive administrative function to be performed, giving staff easier access to the information they may require. The areas of multiple-choice test marking and time-table preparation have the greatest potential for saving time through the use of computerized techniques. Rapid development is likely to come in these areas since increased emphasis is being placed on a broader choice of subject matter at school, making time-table preparation an increasingly arduous task.

2. COMPUTER-AIDED LEARNING SYSTEMS

Computer-aided learning systems offer the greatest potential for savings, since teacher salaries form the largest portion of any educational institution's budget. CAL offers the possibility of increased efficiency in the education system, since there is already evidence[2] that, on the average, a student learns faster using CAL techniques. Teaching time, once freed by the introduction of CAL, could be used to meet other educational requirements. It could also provide these classes with all the educational benefits to be derived from CAL. In the initial stages, high cost areas of education, as in the medical field, could well be the proving grounds for CAL. The increasing emphasis on more individualized instruction also gives impetus to developments in this field. Informed opinion, such as that of Dr. Fred Whitworth of the Saskatchewan Education Research Center, indicates that 20% of the total current curriculum will lend itself to computer-aided, or computer-managed, learning, techniques. While it will probably not be feasible to reduce the teaching staff by an equivalent percentage, a reduction of 15% might be a reasonable assumption when the present number of pupils is taken into consideration.

At the elementary and secondary levels in 1975, the budgets are projected to be $7.16 billion. 75% of this is $5.37 billion. Thus, 15% of the salary budget in 1975 would be $860 million. It has been estimated by Dr. Bitzer at the PLATO IV project in Illinois, that his system, serving 4,000 terminals at 50 cents per student hour, has an operating cost of $4 million a year, based on current technology (see Appendix 3). If 20% of the course material requires computer-aided presentation, a ratio of 1 terminal to every 5 students is desirable. Thus, a system with operating costs of $4 million a

2 Hansen, D. N., "Current Research Development in Computer-Assisted Instruction", Tech Memo No. 17, Project NR 154-280, sponsored by Personnel and Training Research Programs, Psychological Sciences Division, Office of Naval Research, Washington, D.C. (Reproduced by the Clearinghouse for Federal Scientific & Technical Information, Springfield, Virginia), February 15, 1970.

year will serve 20,000 students. It is estimated that the enrolled students in elementary and secondary schools will be 5.7 million in 1975, requiring 285 centres to serve all children. The cost, based on current figures, would therefore be $1.14 billion. However, if the costs are reduced to 35 cents per student hour (as Dr. Bitzer hopes) by 1975, the cost of providing this service will be $798 million. While this represents a limited saving at the elementary and secondary school level, it does suggest the possibility of providing "better" education at a slightly lower projected cost.

At the post-secondary level, the student population is forecast to be 850,000 in 1975, requiring 43 centres of the PLATO type to deliver 20% of course material at a cost of $172 million based on the current 50 cents per student hour, or $120 million at 35 cents per student hour. 60% of the expected salary budget is $2.49 billion and 15% of this is $374 million. Thus, even basing expectations on current costs, a saving may be expected at post-secondary levels.

The eventual potential market is 15% of the teaching budgets. However, it is unlikely that a 20% utilization figure would be achieved by 1975, and even more unlikely that the teaching force could be reduced by 15%. If 10% of this eventual figure seems reasonable as the potential market, then this represents $118 million dollars.

A centralized configuration appears to be the one receiving most attention, although the recent advent of the mini-computers may radically change the physical configuration, and network requirements. While none of the individuals questioned had given much thought to the use of mini-computers, except possibly as multiplexing devices, the general feeling was that this method would cause two difficulties. First, there would be the problem of distributing computer hardware maintenance and operation over a much wider area; and second, that the processing and memory capacity of mini-computers may be insufficient to compete with economies of scale which would be made possible by the larger computers of the next generation, particularly if the communications rates are adjusted.

Because of the need for control by education authorities over the content of courses, and the relatively high costs of development of CAL systems, it is unlikely that the private sector will develop them. Clearly, they will provide hardware and some system software, such as language processors, communications software, and so on. However, the amount of money required for CAL's full development makes the use of public funding inevitable.

The primary technical delay in the implementation of computer-aided learning systems in the next ten years will be the preparation of adequate course material. Overcoming this problem will require a sizeable injection of funds, which will not be recoverable for a considerable period of time. There is also an inherent difficulty in changing the structure of the educational institution, so that all forms of educational technology are treated as an integral part of

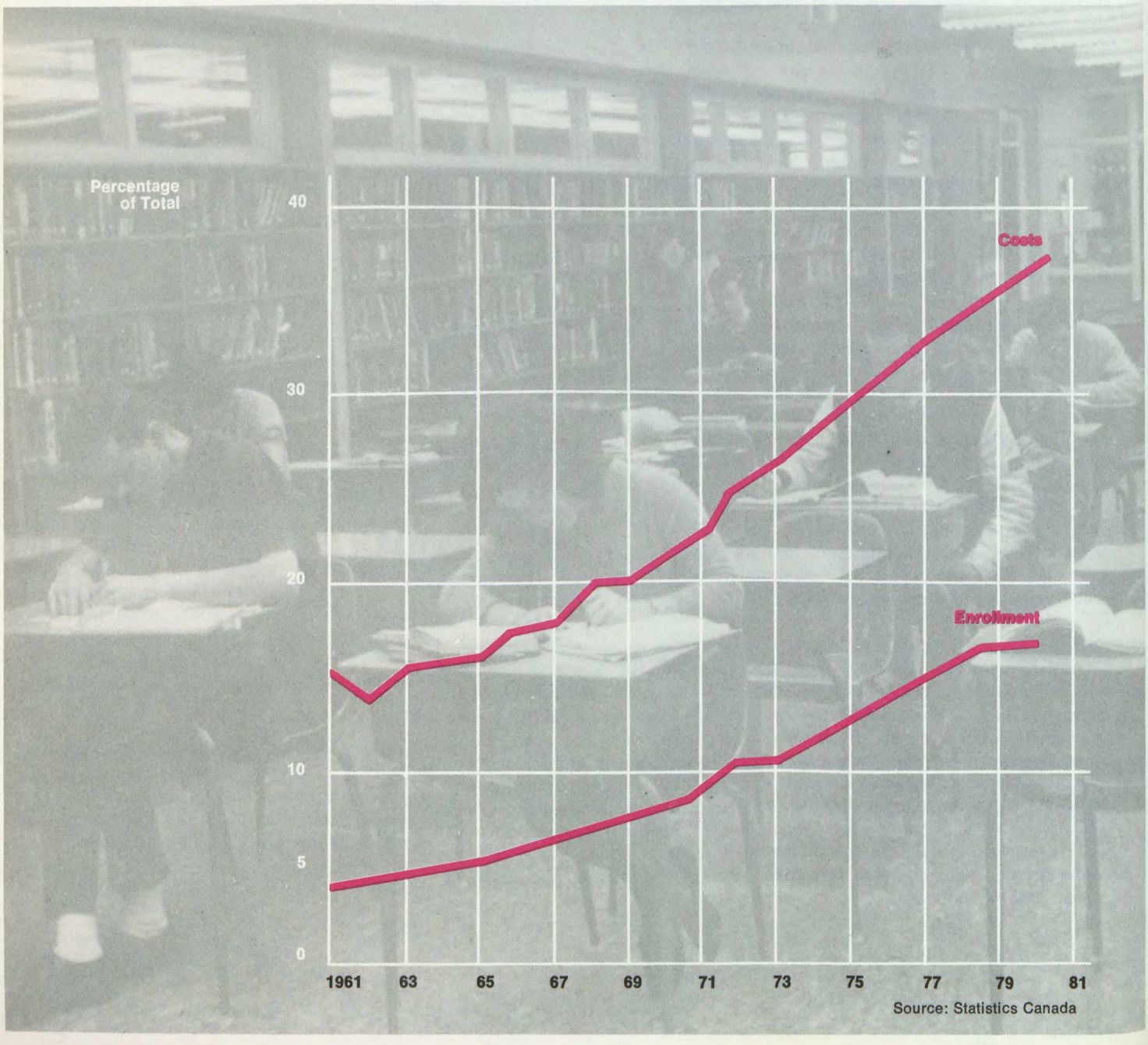
the teaching process, rather than as strictly incremental aids. This change of approach is essential to achieve the eventual cost-effectiveness of computer-aided learning systems.

The Bell Delphi "Study of the Future of Education" questioned a group of people knowledgeable in the field of CAL. The study asked the group to assess the time-span within which they expect CAL systems to have gained 20% utilization. They were also asked to assess the influence of cost on the rate of adoption of CAL, and, in the early sections of the study, society's rate of change of values. The study, however, does not directly address the problem of the rate of change of the current educational institutions. Within this framework of questions, a Canadian consensus emerged showing that CAL will be adopted at 20% utilization by 1978 in post-secondary institutions, and by 1983 in the primary institutions. Drill and practice systems will be the first to gain the widest use, rapidly followed by tutorial and simulation systems, then instructional game systems. However, the degree of complexity in programming socratic dialogue systems is such that it remains doubtful whether enough material of a sufficiently high standard will become available in the foreseeable future. A wide diversity of opinion existed in the study on the maximum acceptable costs of CAL, varying from $1-$10 per student hour, depending on the environment into which CAL is being introduced. The PLATO project, mentioned previously, has shown that much lower unit costs are possible.

Estimates provided by those involved in Canada in CAL work, consistently centre on 20% total utilization in the forseeable future. It can therefore be assumed that this could be taken to represent the potential market. The amount of work involved in preparing course materials (estimates vary from 25 – 150 hours for 1 hour of terminal time) is also very large, and the importance of producing high-calibre material cannot be overemphasized. It will require considerable, co-ordinated, dedicated effort at the post-secondary institutions to produce such a volume of material, establish hardware, and overcome some technical communications problems, if we are to have 20% utilization across the board by 1978, particularly with existing funding arrangements. It is also important to note that the number of people available in Canada with experience in the preparation of CAL courses at present does not number more than about fifty.

There is a further incentive for action to be taken in the area of post-secondary education, based on the rapidly rising costs in this sector of the education budget. Between 1961 and 1969 the costs of post-secondary education rose 5 times, while the enrollment increased by only 2.5 times. In the same period, the cost of elementary and secondary education rose 1.5 times with an enrollment increase of 0.25. As shown in Fig. 2, in 1961 it took 15% of the budget to educate 4.3% of the student population. In 1969, 20% of the budget was devoted to educating post-secondary students who formed 7% of the student population. In 1980, it is expected that it will require nearly 40% of the education budget to educate post-secondary students, who will represent less than 18% of the student population, if current trends continue.

Figure 1
Post-Secondary Enrollments and Costs as Percentages of Total: 1961-1980



3. INFORMATION RETRIEVAL TELEVISION SYSTEMS

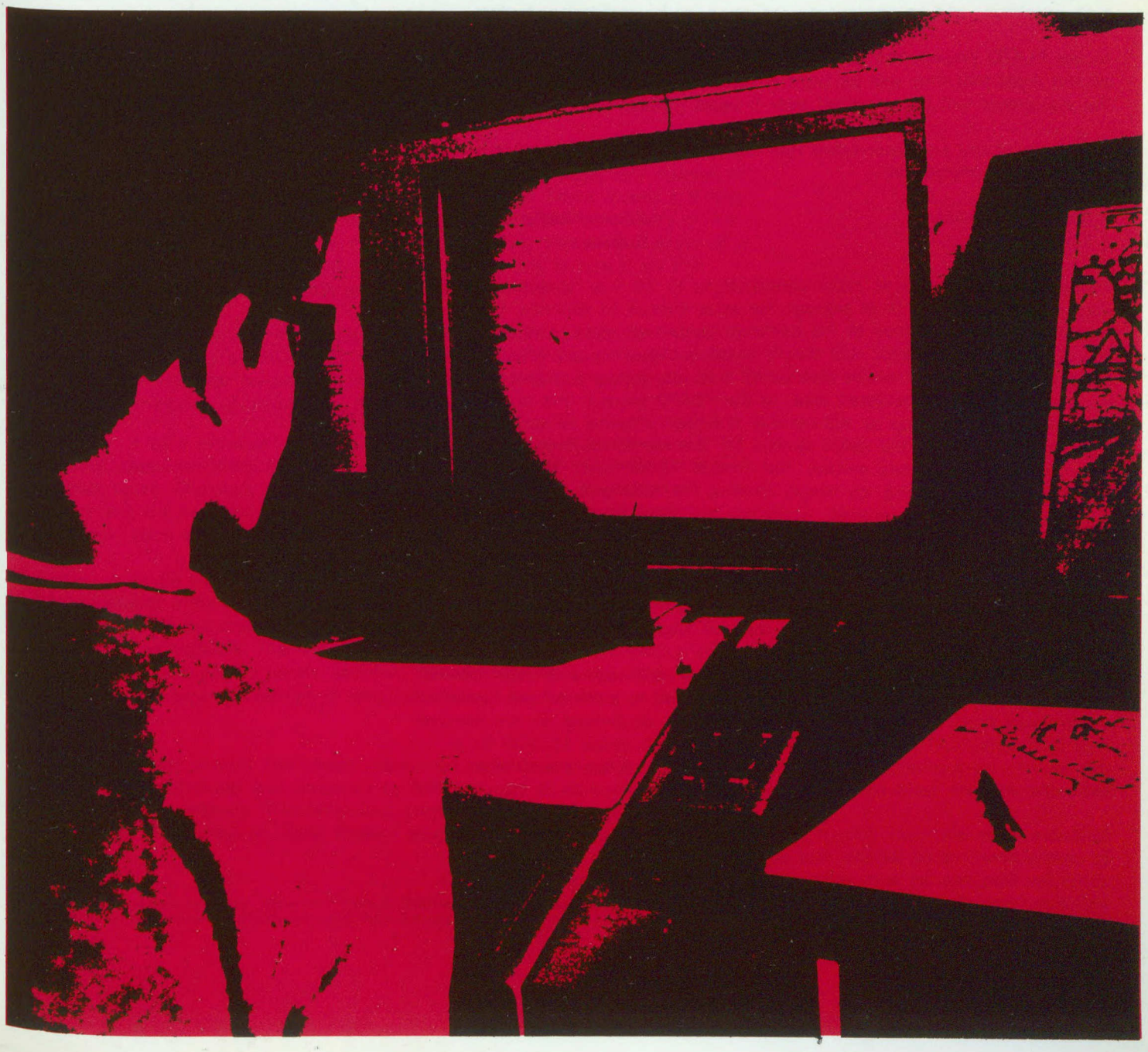
In the immediate future, the IRTV systems present a small market independent of the CAL market. In the long run, with the increase of computer-managed techniques, which will incorporate many aspects of educational technology, it is not clear that IRTV systems will survive on an independent basis. Professor Stephen Lower's words are representative of a growing body of opinion:

"Most important, we are beginning to see CAL as one component of an instructional system of which lectures, audiotapes, slides, etc. are other parts . . . . This might be considered a form of computer-managed instruction, in that the CAL system really paces the student through the material, albeit in an on-line fashion. It does seem to make more effective use of the various media, and most of our current new programming is taking advantage of this approach."[3]

The Bell Delphi study suggests that IRTV systems will be in use in all levels of education by 1985, at which time it is estimated that 55% utilization will have taken place. The study, however, does not examine the possibility of merging the IRTV functions with the computer-aided learning functions. Costs of $15 a year per student are quoted as acceptable, but it is not clear whether this is an incremental cost, or whether it partially replaces some existing expenditure.

[3] Lower, S. K., "CAI at Simon Fraser University", Department of Chemistry, Simon Fraser University, Burnaby, B.C., 1971.

Chapter III
Computer-Aided Learning Systems



1. CONSIDERATIONS OF COSTS AND BENEFITS

As previously outlined in Chapter II, Section 2, the potential market for computer-aided learning systems is substantial. The PLATO project is the first large-scale attempt to prove the economic viability of this method. (See Appendix 3).

As shown in Chapter I, Section 2, it would be possible to consider a system such as the PLATO arrangement as representing some cost-savings in terms of the total education budget as early as 1975. This would, however, require high utilization, and an appropriate reduction in the staff salary budget.

In the PLATO project, the costs of the centre and the terminals are estimated on the basis that they will be used 8 hours a day, 250 days of the year and the equipment will be amortized over 5 years.

The costs of any computer-aided learning system may be broken down into four distinct components:

- Computer Hardware
- Terminals
- Communications
- Software

These four components all make contributions to the cost/student hour. The third, communications, is at present the most difficult to estimate. Using currently available facilities of the common carrier networks, and employing the current rate structures, will clearly penalize those centres which attempt to provide service to a widely-distributed area, as opposed to those providing service in a densely populated area. In the PLATO project, this problem has been overcome by using an educational television channel to service 1,000 terminals. The cost of the cable service for this method is higher than the common carrier telephone service, but divided 1000 ways, the unit costs are significantly reduced, and, by simply dividing the total cost of the channel equally among 1,000 terminals, users pay the same amount, irrespective of distance.

The central processor costs tend to be small in comparison with all others. With the advent of systems with a higher computing capacity, where the cost per instruction is drastically reduced, this will become a declining factor.

The terminal costs are very much dependent on the degree of sophistication of the terminal. Terminal prices now being quoted to some of the Canadian centres vary from $2,000 to $10,000 purchase, depending on the features they offer. The PLATO project terminal costs a little under $5,000 for a display unit, random-access slide selector unit and keyboard with one hardware and one software controlled character set.

Software costs are more difficult to determine. The ratio of preparation hours to usable hours varies widely, and appears to depend on the selected computer language for authorship as well as the experience of the author. However, one may assume that 100 hours of programming time are required

for each student hour, and that each student at elementary and secondary school has 8 hours of work, 250 days of the year and that 20% of this time (i.e. 400 terminal hours per student, per year) would be spent at a terminal. Then, if programming for all twelve grades is required, the work required is 400 x 12 x 100=480,000 hours, or 250 man years. Assuming an average salary of $15,000 per year for the production of these programs, this is a cost of $3.75 million for the personnel.

Operational costs for hardware availability for the development of this material will be in the order of $3 million a year. The full complement of terminals will not be required, although there would have to be enough terminals to serve the authors as needed, and about 5 years would be the minimum practical time to develop such material. This gives hardware costs of $15 million for the development period and a total cost of close to $19 million. In this instance, it would represent nationally less than 1 cent per student hour, amortized over 2 years.

Clearly this is a simplistic point of view. Development of equivalent courses in a second language is one problem Canada has to face. There is also a strong move towards offering a wide choice of subjects for study, particularly in the higher grades. It is also clear that not all schools study the same aspects of a given subject at the identical level, even within any one province, so that development costs are realistically going to be much higher.

To develop about twice the amount of material considered here, and to cover overheads, will require about $35 million spread over 5 years. There are also development costs for hardware and software support which will require funding to the level of about $50 million.

However, if each province develops its own course material on its own facilities, these simplistic development costs are multiplied 10 times for a national figure. Obviously, the provinces with a lower level of economic activity will not be able to afford them. Even in the more industrialized provinces, such a sum of money cannot be considered lightly.

If there is to be interprovincial co-operation, an authorship language should be adopted as a standard for course preparation, in order to make the portability of course material from one centre to another as easy and inexpensive as possible. The NRC work in this direction is a recognition of this problem, and with a timely decision, Canada may avoid the difficulties created by the incompatibilities in languages which have evolved in the United States.

Two cost-benefit studies have been conducted recently relating education to the GNP. One of these was prepared by NRC, as part of its justification for starting its CAL projects. The other was prepared by the National Council for Educational Technology of Great Britain.[4] In particular, the British study

[4] *Computer Based Learning Systems: Report of a feasibility study to outline an advanced program of research and development to apply computers to education and training* (National Council for Educational Technology, U.K., 1969).

emphasizes the difficulty of assessing whether introduction of different techniques in education produces a "better product". In the report's words: "in the field of education it is particularly difficult to specify this *better product*". The report continues:

"An exact calculation of the expected effect of CAL and CMI on 'National Benefit' or, to be more explicit, the quantification of the likely contribution which could be made to the GNP and towards 'Social Benefit', is, therefore, an insurmountable task at present; two cogent reasons, which in themselves are sufficient, are that:

- Estimates of potential educational efficiency of CAI/CMI will not be universally agreed unless more meaningful controlled experimentation gives a reliable measure of efficiency.
- the causal relationships, relating economic and social benefits to educational efficiency, are not yet understood."

Although the recent University of Illinois developments are promising, few of the previous attempts by manufacturers to produce an educational terminal have been successful. IBM, RCA and Westinghouse have made educational marketing efforts in the past. The IBM 1500 system supplies terminals that include CRT, light pen, keyboard, slide unit and audio unit. While these features are very desirable, they are also costly both in hardware and software. The software costs particularly, in terms of core requirements, limit the capacity of the central system, and this in turn affects the cost-effectiveness of the system. Both IBM and RCA have curtailed their marketing effort in education in the immediate past, IBM closing their experiments with the 1500 series. In Canada, AGT Data Systems Ltd. has conducted some marketing in the educational field, which has also met with limited success. Until the advent of the contracts for the terminal at the University of Illinois and the developments at NRC, there has been little advertised development in specialized educational terminals in recent years.

The potential Canadian market is substantial. Previous sections have shown a potential market for 285 centres, supporting 4,000 terminals each, at the elementary and secondary levels alone. The efforts of the NRC Associate Committee on Instructional Technology to define specifications for an educational terminal have already established a focus of interest in Canada.

2. SOME SOCIAL AND PEDAGOGIC ASPECTS

The introduction of computer-aided learning systems in the school room is one of the most effective ways of developing an awareness of this new pervasive technology.

It has been suggested[5] that children with a low level of achievement will respond well to computer-aided learning. It has been proposed that if

[5] McLean, L. D., "Computer Technology in the Education of Migrant Children and other Disadvantaged Groups". *AEDS Monitor*, January, 1968, p.8-14.

computer-aided learning systems were used in penitentiaries they could provide enhanced educational opportunities to inmates.

Few controlled experiments have been conducted for a sufficent length of time to adequately measure the effects of CAL, but two examples indicate that the learning experience at least equals, if not surpasses, other methods, and usually in a shorter time. There has also been an increasing pressure in the late 1960's to provide more individualized instruction to the average, as well as to the weaker student, to prevent him from falling behind. CAL offers the potential of allowing each student to work at his own pace; of providing additional detailed instruction for the slower learners, as well as more advanced material, beyond the required scope of the course, for those learners who are ready for it. CAL, however, cannot entirely replace the social interaction of group instruction, since this interaction is an integral part of the human factor in education.

One of the controlled experiments conducted at the University of Illinois was in the teaching of nursing. Two groups of students of matching abilities were established, one taught by the traditional method, the other through the use of CAL. The course material was in maternity nursing and covered a subject range from anatomy and physiology to normal delivery. The two groups had one course in common: a clinical discussion. The PLATO students completed the course using, on the average, about 1/3 of the time required to present the same material in the classroom. There are also early indications that the PLATO students retained the material for a longer period of time.

The Stanford Research Institute has conducted extensive studies into educational applications, particularly with young children. Professor Oettinger of Harvard reports[6] that both he and Professor Suppes of Stanford observed the amazingly long periods of time which young children are able to spend at a terminal while covering wide areas of study. They have shown that the brightest children learn at rates that vary up to as much as ten times the rate of the slowest learner, demonstrating the problems faced by a teacher instructing a class of 30.

One of the advantages believed in the past to be contained in computer-aided learning techniques was the ability of the computer to accept free-form and unpredictable answers to questions and to cope with them. This appears to be far from the case and is best summed up by Professor Oettinger, when he states:

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[6] Oettinger, A. G., *Run, Computer, Run. The Mythology of Educational Innovation* (Harvard University Press, 1969), p.183.

"Another advantage is seen in the computer's ability to handle responses constructed ad lib by the learner, rather than selected from pre-ordained alternatives. Some capability to recognize misspelled words and to pick out pre-selected key words does exist, but has not been used to the fullness of its limited advantages. Responses to requests like 'describe a relationship', 'define a concept', or 'explain how something works' are well beyond the realm of current computer capability. Recognizing arbitrary English sentences by computer is still beyond the frontier of either linguistic or computer science."[7]

On the same basis, computer-aided learning cannot readily take and use a child's own words to lead him on to the next subject or idea, nor can it adapt to the child's way of thinking, as can a teacher. It is clear that teachers will continue to play a vitally important role in the instruction of students. This role will shift in emphasis, allowing teachers more time to assist individual students. Yet another limitation of CAL is the problem of reliability. This is an area which has so far been given only passing thought. In experimental systems, reliability is not of paramount importance, but for an operational system it clearly is. A computer-aided learning system is composed of many components. In a centralized configuration, a single failure amongst a number of components can render the total system inoperable.

3. REQUIREMENTS FOR DEVELOPMENT

These are areas which must be considered and resolved before any successful development and implementation of computer-aided learning systems can be achieved.

Without exception, those interviewed in Canada were concerned with the price of communication services. Most people felt that average input was short with some 5 to 20 characters on an average, and no one envisaged more than 60 characters being supplied as input. There is also a requirement for fast response. Again, maximum acceptable response-times varied from 1 to 4 seconds, and most of the people interviewed felt that younger students would not tolerate delayed long response-times as readily as older students. Frequently, even adults showed a tendency to thump at the keyboard delimiter button if nothing happened within a short time.

Current common carrier network facilities over a short distance will probably serve densely populated areas satisfactorily, at least for the development phase, but the bandwidth requirements of the terminal, the use of which comes in bursts, separated by relatively long "think periods", makes poor use of the available facilities. The facilities must be paid for, whether fully utilized or not, and this could make the communication costs for implementation the highest single factor in the total system cost. This heavily penalizes systems serving widely-scattered populations, increasing the possibility of regional disparity.

[7] *Ibid.* p 181.

At present, extensive funds are not available in Canada for the development of computer-aided learning systems. Almost all the funds provided for the CAL projects are derived from university sources, with the exception of NRC Information Sciences Division. In the past, NRC granting policy has not permitted awarding of research grants for CAL, because it is not scientific research. Some of the universities have gone to other federal bodies such as the Canada Council, but these requests have met with little success.

While the technology involved in CAL has, to a certain extent, demonstrated its usefulness and applicability, it is doubtful that CAL could be implemented on a wide scale unless it is accompanied by changes in attitude towards this technique by many persons engaged in the educational process. An understanding of the aims and uses of CAL would be essential to school trustees and administrators, as well as the teaching profession.

The Department of Manpower and Immigration reported that, in the second quarter of 1971, it appears there will be a persistent teacher surplus during the '70's. In fact, the decline in the number of teachers required in the elementary schools has already started in the years 1971-72.

In the past, the introduction of audio-visual aids into the school system has usually been as an incremental cost. Teaching staff have been generally willing to use the new media, but only as a supplement to classroom presentation, rather than as an integral part of the teaching process. Educational television has also posed its problems. Arranging a class to watch something the teacher has not seen, at a time that is possibly inconvenient in the school time-table, has limited the use of ETV in schools. The incremental use of these media is not entirely the fault of the teacher. Apart from the scheduling difficulties experienced in the use of ETV, some of the material has been poor in quality and not geared to meet the particular requirements the individual teacher has decided upon for his course.

There will be a similar tendency to regard CAL as yet another incremental cost. Even more so if the material available is of doubtful quality. As has already been stressed, this medium is too expensive for such an approach to be practicable. Care would have to be exercised to ensure both the quality of the material developed and the training of the teachers in its proper use.

The costs of education in 1970 represented over 8% of the GNP, a higher proportion than in any other country. Costs have been rising at a rate in excess of the rise in the GNP. At the post-secondary levels, the portion of the GNP in 1961 was 0.72%; in 1969 it was 1.75%. An enrolment increase also took place in this period, and it is projected that post-secondary enrolment increases will continue until at least 1980. This could mean that Canada will devote 3.5% of the GNP in 1980 to post-secondary education, and this represents only 18% of the student population.

These rising cost figures give much incentive to an attempt to reduce the rate of increase. At the post-secondary level, it may well be justification for spending development money in the short-term. At the elementary and secondary levels, which more directly affect the rate-paying public, the short-term pressure to keep costs down may act as a deterrent to development of such systems.

4. USERS OF CAL

Two professional organizations, other than those directly concerned with education, are known to be actively interested in CAL, and to be pursuing studies in the area at present.

The high cost of examining the clinical competence of doctors, particularly specialists, has especially interested the Medical Council of Canada in developing computer simulation techniques to assist in this process. Examiners are usually practicing specialists, not teachers, who have contributed time to perform this function. The Medical Council has made an extensive study of this problem and presented to the Department of National Health and Welfare a request for funding to further this project.

The Society of Industrial Accountants of Canada organizes the training of industrial accountants. These activities comprise the preparation of curriculum content and course notes, and then contract with various post-secondary institutions to provide the courses. All are either evening or correspondence courses. Recently, a surprising rise in the percentage of students taking correspondence courses has taken place.

The Association is facing a shift of emphasis in activities which is away from the traditional accounting procedures. These are becoming increasingly computerized, and training is tending towards industrial accountants becoming interpreters and analysts of financial information. Recent changes have been defined for the curriculum and these are beginning to go into effect. However, some of the material does not lend itself at all to the correspondence course technique and only poorly to the traditional lecture technique. The Society is interested in computer-managed learning techniques, incorporating slides and video tape as part of the presentation, and is at present preparing a report on this subject for its membership.

APPENDICES TO PART B2

APPENDIX 1

INTERVIEW LIST

Institution	*Personnel*
National Research Council	Mr. W.C. Brown
	Mr. J.W. Brahan
University of Toronto	Mr. V.H. Mikkelsen
Ontario Institute for Studies in Education	Dr. L. McLean
	Dr. R. McLean
	Dr. S. Churchill
University of Western Ontario	Mr. P. Suttie
	Mrs. R. Newkirk
University of Alberta	Dr. S. Hunka
University of Calgary	Mrs. A. Brebner
Simon Fraser University	Dr. S. Lower
	Mr. N. Stroppa
Society of Industrial Accountants of Canada	Mr. N. Allan
Secretary of State's Office	Dr. D.C. Munroe
Statistics Canada	Dr. M. Wisenthal
Science Council of Canada	Mr. G. Miedzinski
Alberta Department of Education	Mr. R. Morton
Ontario Department of Education	Mr. B. Webber
	Mr. R. Wigdor
	Mr. B. Cook
University of Illinois	Dr. D. Bitzer
	Dr. B. Sherman
Quebec Department of Education	Mr. M.B. Croteau
Canadian School Trustees' Association	Mr. C.H. Witney
	Dr. F.E. Whitworth

APPENDIX 2

NRC COMPUTER-AIDED LEARNING PROJECT

Over the past five years, NRC has been evolving a research and development program in computer-aided learning systems. Undertaken by the Information Sciences Division of NRC, the project currently consists of a Digital Equipment Corporation PDP-10, providing centralized development facilities to all participants. The purpose in establishing this project was to avoid the enormous costs involved in fragmented development, by co-ordinating development across the country. The nationally distributed participants contribute to the project in two ways: The first is through membership on the Associate Committee on Instructional Technology. This committee provides a forum for co-ordination of projects, development of standardized technology and exchange of ideas. The second method of contribution is direct participation in development of either the technology or course content. Currently, the largest user of the PDP-10 facility is the Ontario Institute for Studies in Education.

The major thrust of the work underway on the PDP-10 at the present time is the development of a standard authorship language. The specifications for this language have been prepared and approved by the Associate Committee. When all the details are complete, NRC will undertake the preparation of suitable compilers, either directly or through contract. Parallel with this development, work is also being done on the definition of an educational terminal. NRC has conducted some research into suitable input and output devices for the education media, and in conjunction with Dr. Hallworth at the University of Calgary, is carrying out an evaluation program of prototype models.

Development of course material is being undertaken right across the country. Courses developed on the PDP-10 facilities are made available at no charge, but the communication costs must at the present time be borne by the participants. This places a large financial burden on remotely-located participants, severely limiting the extent of their involvement.

APPENDIX 3

PLATO PROJECT

Under the direction of Dr. Donald Bitzer, the Computer Based Education Research Program at the University of Illinois has been underway for about ten years. Starting with feasibility projects in the early sixties to demonstrate the potential role of the computer in education, the project has now grown to the stage where it may be possible to demonstrate economic viability. A Control Data 6400, with extended core memory, was installed in 1970. Four TV channels are attached to this machine, and are allocated to the use of educational television. Using interfacing and multiplexing techniques developed by the University staff, each channel is capable of servicing 1,000 terminals. The terminals are a product of the University, combining a plasma display panel with a keyboard and a random-access slide selector. The terminals are connected to their channel via a controller capable of servicing 32 terminals. Again, the controller was developed by the university.

Parallel with the development of the hardware, there has been development of both support software and course material. Currently available are about 1,000 hours of material, covering a wide range of subjects and educational levels. The emphasis on parallel development of support software hardware and course material has enabled the systems-designers to obtain rapid evaluation of these developments and their applicability.

The costs for the current system are based on a 250 day year, with 8 hours use per day. On this basis, the 4,000 terminal configuration, with an average of 20 people accessing the same course at the same time, the costs are estimated to be 50 cents per student hour with terminal response time less than two seconds.

The costs are broken down as follows:

• Central Processing	10 cents	• Communications	4 cents
• Terminals	33 cents	• Software (course material)	3 cents

The costing for the central processing includes the operation of the CDC 6400, provision of support software, and amortization of the equipment. The advent of computers with higher computing capacity, leading to a reduced cost per instruction, indicates that the central processing costs will be a declining factor.

The terminal costs are based on a delivery of 500, built to the Illinois design under contract. With increased competition in this field, it is anticipated that the cost per terminal, particularly in a more basic form, will decline.

Communication costs are based on the service being available in such communities as Springfield, Champaign-Urbana and Chicago, and that they are available at ETV rates. The costs are then divided by 1,000 per channel to equalize them regardless of location.

The course content costs are difficult to determine, since they are dependent to some extent on the ratio of preparation to terminal hours. The cost for 2,700 hours of course material, amortized over 2 years, prepared at an average salary of $15,000 per year, is 3 cents per student hour. This implies the use of the material developed on one system only. Clearly if the material is applicable on more than one machine, either the course costs can be reduced or more material can be prepared at an equivalent cost per student.

Computers, Communications and Canada's Health Care Delivery System

INTRODUCTION

Under the terms of the British North America Act the provinces have the prime responsibility for providing health care to Canadians. At the federal level, the Department of National Health and Welfare is the agency which co-ordinates and directs all federal involvement in the field. Nevertheless, communications has an important role to play in any area where health services can be improved through computer power, because its effectiveness and efficiency can often be improved through the marriage of large, general-purpose computers and communication networks.

Hospital administrators or physicians may not *per se* be interested in the breadth and depth of automation. What does concern them, however, is the extent to which they can effectively use automation to improve patient care and keep down operating costs. The same principle applies, on a broader scale, at the regional, provincial and national levels. It is only where this can clearly be proved that a case can be made for automation.

The purposes of this report, therefore are to outline some of the possible benefits to be derived from applying computers and computer/communications to problems facing the health care field with respect to patient care and rising costs; to survey the extent to which this potential is being realized today: and to indicate the possible future patterns of growth of automation in this particular field.

Since the largest concentration of medical service is in hospitals, they are given particular emphasis. Indeed, virtually all health care computing is associated with hospitals at the present time.

This is not to say that in the areas of medical research and education, there is less valuable activity or less potential for computer use. The importance of this activity is not underrated, but in terms of usage of computers and communication technology, the effect is not as large as it could eventually become in the actual practice of medicine.

In the preparation of this study, the method of approach was first to request all provincial hospital associations and commissions for information with respect to member hospitals using computers. Following this, visits were made to over fifty Canadian health care delivery centres across the country. These included federal and provincial departments of health, hospitals, universities and institutes. They are listed in Appendix 1. Reference material and special papers used in this study are listed in Appendix 2. Acknowledgments are given in Appendix 3. Appendix 4 is a description of the Université de Sherbrooke Hospital Network.

Branching Out

The health care delivery system in Canada has as its goal the provision of the best possible health care to the greatest number of people. The provision of these services involves many different medical and support functions. Chief among them are general hospitals, clinics and group practices, private practitioners, psychiatric hospitals, nursing homes, ambulance services and clinical laboratories. One could also include many of the manufacturers and service companies that cater to the health sector, but these are considered to be only indirectly connected with health care.

The British North America Act assigns the primary responsibility for the health of the population to the provinces. This responsibility is usually vested in a provincial Department of Public Health. Physicians are self-regulated through the College of Physicians and Surgeons, and through medical associations.

In recent years, governments in Canada have moved toward a guarantee of the right to health care, regardless of age, race, social status or place of residence. This has meant that health care services are being provided publicly, supported by mandatory insurance and tax systems. Provincial health programs now cover approximately 99% of the Canadian population. Under current legislation, the federal government pays approximately one-half the cost of necessary care for patients registered with a qualifying provincial health program. The remainder is funded by the provinces, from a combination of insurance premiums, sales tax and general revenue. Although provincial insuring commissions only exert budgetary control, the increasing governmental financial interest is leading to greater overall control.

Even though the increase in overall life-expectancy during the past 45 years has been marginal, there has been a significant reduction from one death in five, in the first years of life in the 19th century, to one in fifty today. Thus more people reach maturity with a resultant increase in middle- and old-age hospitalizations. As the average age of the population increases, there are longer average recuperation periods, and a correspondingly bigger claim on hospital services. This trend is expected to continue to grow.

Increases in the demands on and costs of medical care and hospitals, precipitated by social measures, such as universal health insurance, has further heightened the demand for health care, leading to increased claims for hospital admissions to Canadian public hospitals. This average annual increase of 3.0% is well in excess of the normal population growth rate of 1.8%.

Yet another contributing factor is the increasing public expectation of more and better health services, which manifests itself in a demand for readily-available medical service, 24 hours a day.

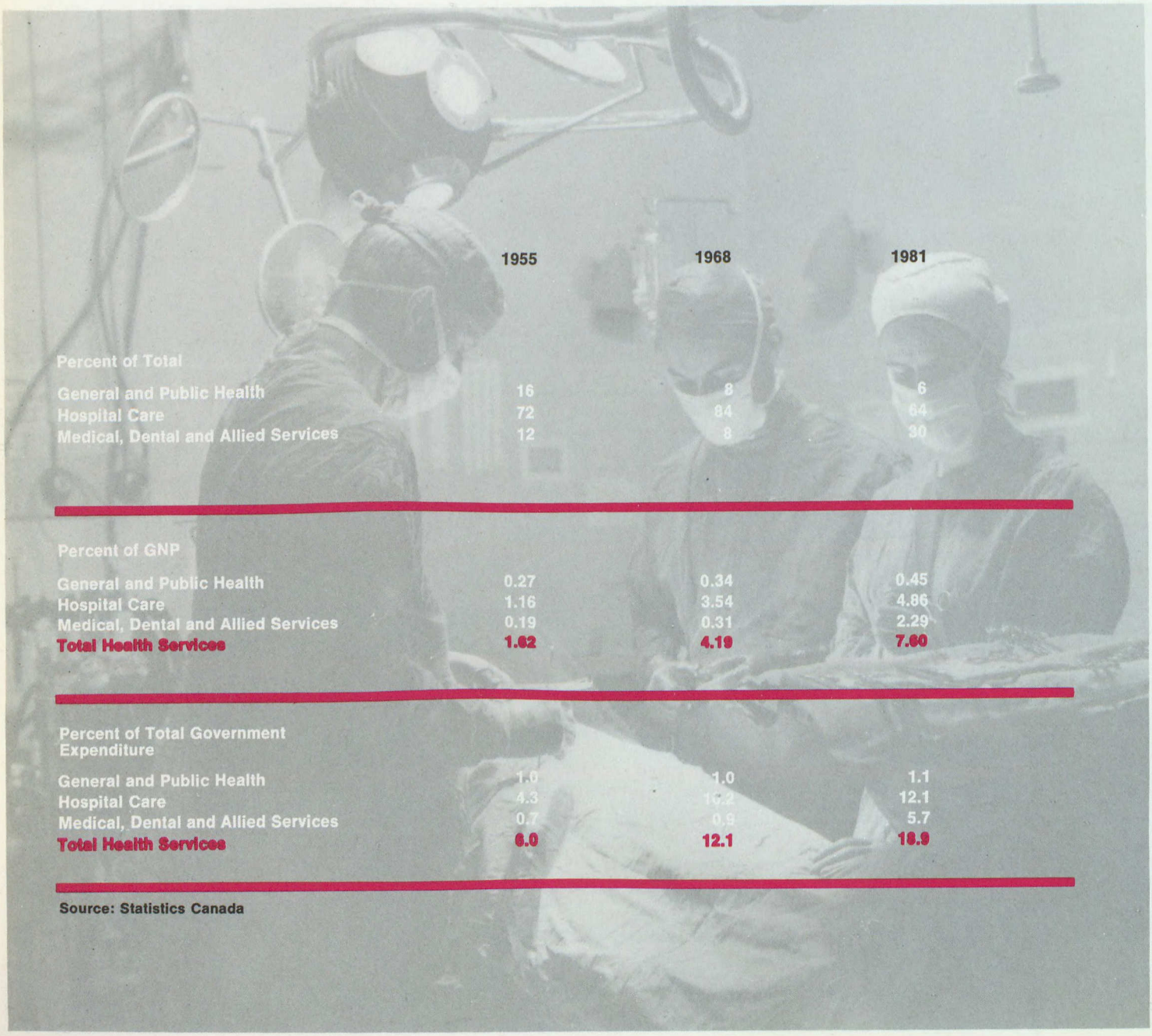
This ever-expanding demand presents a problem because of the growing inability to satisfy public needs without sacrificing the quality of care rendered. One of the main reasons is cost. By 1968, health care was already consuming over 4% of the GNP and constituted the second-largest service industry. In 1955, by contrast, health services accounted for less than 2% of the GNP. By 1981, the figure is expected to rise to over $13 billion. These figures are summarized in Tables 1 and 2.

Table 1
Estimates and Projections for Health Services
1955, 1968 and 1981 in Millions of Dollars

	1955	1968	1981	Annual Average Rate of Increase, 1955-68 %	Annual Average Rate of Increase, 1968-81 %
General and Public Health	72	227	785	9.2	10.0
Hospital Care	315	2,384	8,500	16.9	10.2
Medical, Dental and Allied Services	52	206	4,000	11.2	25.6
Total Health Services	**439**	**2,817**	**13,285**	**15.4**	**12.7**

Source: Statistics Canada

Table 2
Percentage Relationships
for Health Services: 1955, 1968 and 1981



	1955	1968	1981
Percent of Total			
General and Public Health	16	8	6
Hospital Care	72	84	64
Medical, Dental and Allied Services	12	8	30
Percent of GNP			
General and Public Health	0.27	0.34	0.45
Hospital Care	1.16	3.54	4.86
Medical, Dental and Allied Services	0.19	0.31	2.29
Total Health Services	**1.62**	**4.19**	**7.60**
Percent of Total Government Expenditure			
General and Public Health	1.0	1.0	1.1
Hospital Care	4.3	10.2	12.1
Medical, Dental and Allied Services	0.7	0.9	5.7
Total Health Services	**6.0**	**12.1**	**18.9**

Source: Statistics Canada

Hospitals will spend a major share of these large amounts. Between 1960 and 1969, hospital expenditures in Canada averaged an annual growth of 14.5% based on the figures in Table 3. In 1980, hospital costs are expected to rise to almost 8.5 billion (Table 1).

A further major trend is the increasing complexity of diagnosis and treatment. More and more, medical science finds itself forced to draw on an ever-developing number of disciplines — such as biology, chemistry, behavioural sciences and biomedical engineering. For practicing doctors, there is an increasing consciousness of the growing limitations of their knowledge because of their inability to keep up with newly-generated techniques and information. One of the consequences of the ever-changing complexity of medical science is the increase in medical specialization, leading to considerable changes in the traditional doctor-patient relationships.

With continuing increased specialization, highly-skilled practitioners in specific areas will tend to become less available in all localities. The same applies to the high-cost equipment (*e.g.*, radiology) which may be required for proper treatment. Such scarce and expensive resources must be fully utilized. Accordingly, this trend is forcing a new approach as to how health care resources should be distributed throughout a given area to provide adequate service at reasonable cost.

1. PROBLEMS, NEEDS AND OPPORTUNITIES

It should be pointed out that this report concentrates on weaknesses rather than strengths, in order to fit the technology into the picture. It is first necessary to establish the potential for computers and communications in this industry by demonstrating that it can have a valuable role. But one has to define the needs of a health system before one can say where computers and communications can help. It should also be noted that the phenomenon of rising health costs is not unique to Canada. It is being experienced in all highly-developed countries. At root, many of the technical problems at the operational level are the same, although Canadian solutions are uniquely tempered by considerations of geography, legislation and the variation in levels of prosperity between provinces.

Indeed, the effective geographical distribution of health care facilities is one of the main difficulties. The broad rule of thumb would be that costly, capital-intensive facilities should be centralized, and made available for use by all outlying agencies. Less expensive facilities can be spread more widely across the country, thus making them available to the individual patient. In practice, operations research studies and computer simulation models can be used to plan the location and physical design of future facilities. These methods can be based on such aspects as minimizing travel time and optimizing space allocation.

Another problem is the lack of an effective set of performance measures for the overall health care delivery system. As more source data are captured in

Table 3
Expenditures of Reporting General, Allied Special Hospitals:1960-1969

	1960		1969	
	Number of Hospitals	Expenditures	Number of Hospitals	Expenditures
Newfoundland	25	9,436,013	37	38,876,465
Prince Edward Island	8	2,575,235	9	6,817,499
Nova Scotia	46	21,857,618	47	65,535,586
New Brunswick	37	20,842,606	39	52,552,018
Quebec	114	131,603,992	186	568,492,152
Ontario	206	229,969,300	212	739,605,143
Manitoba	75	31,362,965	82	81,617,173
Saskatchewan	145	38,728,847	132	82,951,535
Alberta	110	47,002,397	145	152,105,178
British Columbia	99	59,463,280	101	170,673,339
Yukon			2	234,858
Northwest			5	1,563,927
Canada	**865**	**$592,842,153**	**997**	**$1,961,024,873**

Source: National Health & Welfare

machine-readable form from operating applications (*e.g.*, patient admission), a larger base of data will accumulate. In order to utilize this data base effectively for performance measures, it will be necessary to formulate an adequate conceptual framework and to develop valid models. Performance measures are needed, to enable a better control of the areas of manpower, services, costs and facilities.

The pronounced tendency toward specialization within the medical profession has made it more difficult for the average citizen to find a doctor familiar with the total family environment. This trend, combined with increasing personal mobility; means that few people can count on establishing a long-term, patient-doctor relationship. Today's health care is more fragmented and likely to involve a variety of consultations with several specialists. Thus, new methods and approaches are required to ensure continuity.

Certainly the computer, combined with modern communications techniques, can never supplant the personal and subtle doctor-patient relationship. However, in view of the inexorable trend toward still narrower specialization and the attendant fragmentation of service, these technological aids can serve as an integrating device, providing the necessary link between doctors, hospital, clinical staff and patient data which will help to ensure consistency of treatment. One means of achieving this could be the computerized patient history, which would be standardized to the extent that it could be used by all qualified medical personnel who attend a given patient.

Communications technology can also be used to advantage in another area — the dissemination of new knowledge and techniques. The time-lag between scientific discovery and its application in the health care industry will continue to increase unless new methods are adopted for bringing significant discoveries to the attention of busy physicians.

An application of this approach has already been experimented with in the U.S. It involves the use of new communication techniques (closed circuit TV, CRT displays etc.), to enable local doctors to consult on a long-distance basis with the most expert physicians available.

Another opportunity to reduce overall health costs, and improve the general health of the population, involves the greater use of preventive services. Here the contribution of the computer stems from its record-keeping capability. Any effective plan for preventive medicine demands accurate and timely records of patient characteristics, previous diagnosis and treatment. This would apply, for example, to vaccination and inoculation programs. Epidemiological studies, requiring large quantities of data, benefit greatly from the power and speed of the computer for data manipulation, retrieval and statistical calculations.

Finally, new computer-assisted techniques, such as multi-phasic screening, may have significant potential for reducing overall health care costs by "screening" out patients whose cases are relatively routine from those who require more detailed or complex specialist attention.

In general, computers can help the Health Services industry in a number of ways. The following are some of the methods:

- Lowering costs of an already-established service by reducing manpower requirements (*e.g.*, automated analysis, mechanized record-keeping);
- making available scarce, specialized medical capabilities throughout wider areas by means of communication technology (*e.g.*, remote ECG interpretation);
- providing more complex, integrated medical records for individuals and rapid access to crucial medical information (*e.g.*, poison-control data bank);
- providing better management-aids, through data collection and analysis, reporting and simulation techniques. This would assist in better planning of medical facilities and improved operating decisions as well as better ongoing utilization of facilities by the use of programmed aids to decision-making (*e.g.*, scheduling);
- improving the quality of existing services (*e.g.*, computer-assisted diagnosis, physiological monitoring);
- making it possible for new services to be implemented, or for available services to be performed by medical personnel with less training, thus reducing the load on physicians;
- combining hitherto separate services to improve efficiency;
- allowing for research involving large quantities of data;
- education and training of medical and para-medical staff.

2. HOSPITAL COMPUTER APPLICATIONS

As was mentioned earlier, hospitals are the present centre of health care in Canada. They account for approximately 84% of total health care costs. Thus, their intensive role and their correspondingly high volume of patients, make them the natural focus of any integrated plan for automation.

Hospital costs and charges have been growing at a rate of 10 to 15% yearly, well in excess of the 3.8% average growth rate for the Health and Personal Care component of the Cost of Living Index. As of the end of 1971, the average cost per patient-day was reported by Statistics Canada at $65. By far the greatest single component of hospital operating costs is the cost of salaries and wages — amounting to 71.1% in 1971. These costs can be expected to continue to rise.

Most estimates place the cost of handling medical data at 25-30% of total hospital operating costs. Since computers can be efficient information processors, there is clearly an opportunity to reduce costs in this area. To the extent that routine data handling chores can be lifted from the shoulders of scarce, highly-trained professionals, their could be more effectively used in patient care and contact.

Within the category of administrative applications are the accounting and reporting sub-systems common to most businesses. Included are:

- Accounts Receivable
- Accounts Payable
- Payroll
- Billing General Ledger
- Capital Inventory
- Stores Control
- Budgeting.

The main benefits from automating these activities would stem from cost-reduction in preparing the hospital's basic accounting records. Side-benefits would also be obtained in the form of more and better reports from the same data, increased speed of reporting, better management control and sometimes a savings on billings that tend to get lost in manual systems. Several reports on medical statistics, and for government reporting, can also be extracted from the accounting data. This latter area is of particular significance, as there has been an increased volume of statistical reporting for federal insuring and provincial government agencies, accreditation bodies, etc.

The applications in the category of patient care are directly related to medical, and medical support services. Some are hospital-wide in application, while others are sub-systems for the use of service centres within the hospital. Among the possible applications are:

- Automation of Food Services — dietary.
- Pharmacy — inventory control, purchasing, narcotics reports, etc.
- Radiology — scheduling and control.
- Clinical laboratories — calculations, and reporting.
- Staff/Patient Scheduling — *e.g.*, for out-patient clinics, operating rooms.
- Patient Records — including basic information, medical history, doctors' and nurses' notes, test results.
- Computer-assisted diagnosis.

Benefits to be obtained by using computers in these functions are harder to measure than in administrative activities. Partial savings can be expected in hospital space requirements, and in doctors', nurses' and laboratory technicians' time through computer scheduling. Such applications appear to have more immediate potential for reducing costs than any other single area. Scheduling of hospital in-patients, a complex job, lends itself admirably to computer assistance. Not only does it have to account for the order and rate of many different medical procedures, but it cannot be done deterministically, because each patient changes his characteristics over a given period of time. As ahother benefit, improved scheduling can reduce patient waiting-times and shorten average length of hospital stay. Centralized, automated patient records can mean increased time-saving by eliminating the re-recording of basic patient data, thus resulting in speedier, more accurate information. Furthermore, it could eliminate the duplication of costly laboratory tests for permanent readings (*e.g.*, blood type).

There are special applications of computers in hospitals which are extensions of the patient care applications, but are more-or-less "closed-loop" sub-systems and, as such, may best be performed using dedicated equipment. Examples are patient monitoring and automatic control of clinical laboratory equipment. Most benefits are not derived from direct cost savings, but through faster, more accurate patient care. While not cost-effective in the short-range, it may eventually prove that the increased speed and accuracy of patient treatment will help reduce the average length of stay and cut down on repeat visits.

From the total hospital viewpoint, it is desirable to bring together all data on a patient which have been generated in the various service centres. This, plus the need to manipulate these data, require the facilities of a large computer. On the other hand, within a given service centre (for example, a clinical lab),

the need for real-time control and data acquisition will probably always require a satellite mini-computer. This will be especially true in the foreseeable future, since the software for mini-lab applications has already been developed and field-tested over a period of years.

3. HEALTH CARE OUTSIDE HOSPITALS

There appears to be a trend toward more community centres and group practice, as opposed to single practitioners. If this trend continues, the group practitioners may be in a better position to make use of computer/communications technology, because of their higher volume of patients and large administrative workload. Just as in a hospital, computer services could be used to perform accounting and billing functions, assist in keeping patient records, scheduling patients and, perhaps, even assist in diagnosis through ECG analysis.

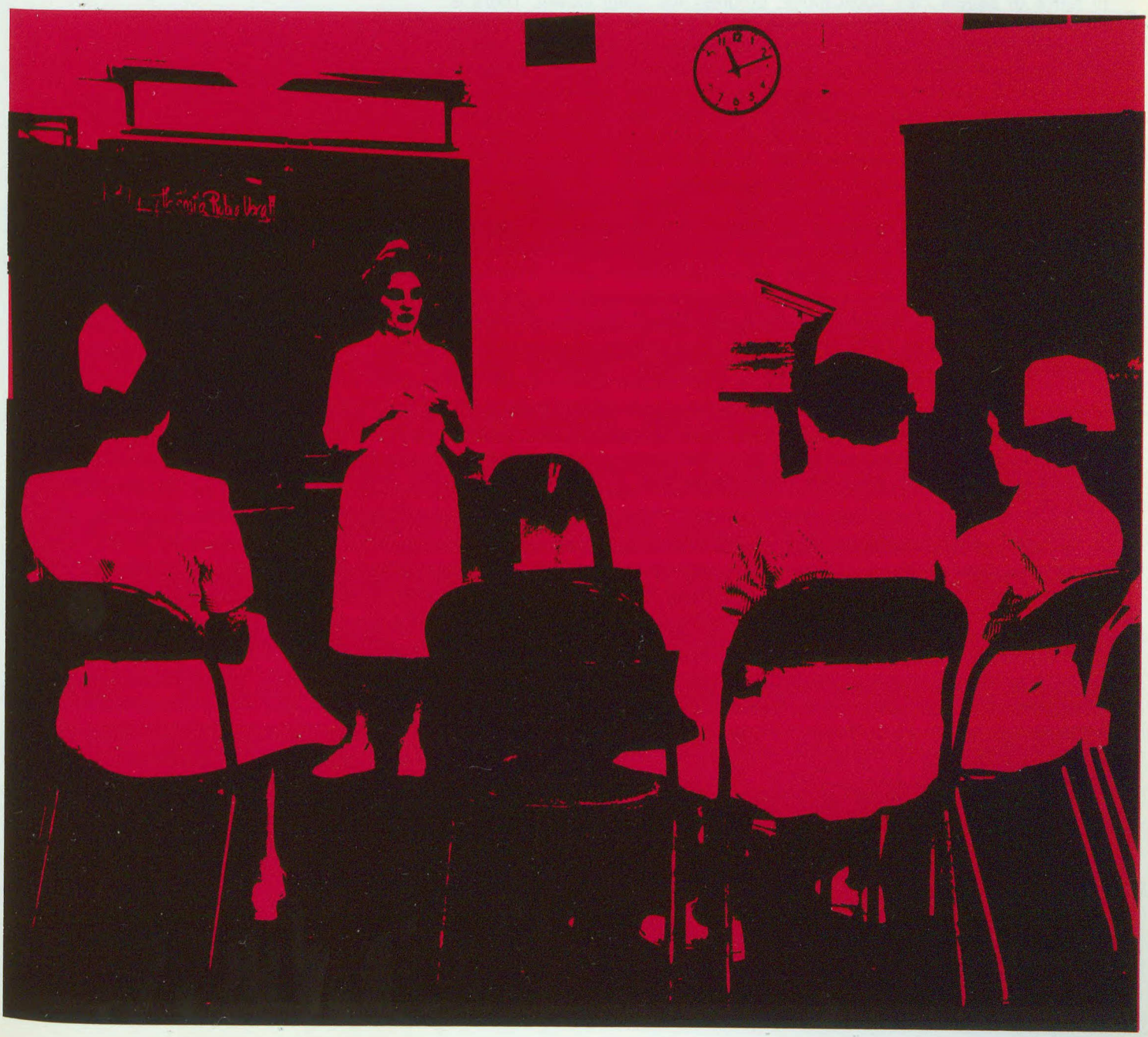
A further computer application could be related to the identification of medically fit patients who are abusing the system, or physicians who are needlessly over-utilizing resources.

An example of the above is shown by the recent findings of the Ontario Health Services Insurance Plan (OHSIP) *e.g.*, the utilization rate — the number of services a person receives annually — jumped 6% in 1971, compared to an expected rise of 2%. This came to the attention of OHSIP executives as a result of computer statistics compiled from bills it received.

Nursing homes and extended-care centres do not, as a rule, deal with the same variety and complexity of treatment as does a hospital designed to handle acute cases. Therefore, especially in terms of patient care, there is not the scope for computer application that exists in a general hospital. Still, as the cost of using computer-services declines, it is expected that administrative functions in medium and large-size nursing homes can be automated with a net reduction in costs.

Although organizations administering medical insurance plans are not directly involved in delivering health care, they are essential to the smooth operation of the health care system. They also account for significant costs, most of which are of a clerical or of a fixed-cost nature.

Since most of the payments to hospitals and physicians are made through the health insurance plans, the administrators of such plans are in a position to insist upon certain standards of performance, documentation of services performed, and adherence to established fee structures. This can have wide and important implications in relation to the development and use of those computer systems concerned with the accumulation of patient records or the preparation of statistical reports.



Mechanized data processing was first used in a Canadian hospital in the early 1950's, when the Royal Victoria Hospital in Montreal installed punch-card unit record equipment. Even so, by 1960, the computer was little known in the Canadian health community. Progress in automation since then has been sporadic, varying from region to region. The widest and most cost-effective usage, both at the hospital and at the provincial health plan level, has been in business or administrative applications. The use of computers for billing and accounting is now beginning to penetrate both the group practice and the individual practitioner's office.

In terms of patient care applications, progress has been slower. There is currently no system developed, and operating, which meets all the needs of a "general" hospital information system. A number of independent, special-purpose systems have been successfully implemented, but the goal of a large-scale system, which has the potential for significantly increasing efficiency and reducing costs, has so far remained elusive. The major medical centres, usually associated with universities, tend to be the most advanced in developing and using new techniques for patient care. Some examples of these projects are discussed later in this chapter.

As an indication of the extent of computer usage in hospitals, Table 4 shows the number of hospitals using computers and the associated application areas for each province. The emphasis on administrative applications is apparent (Payroll and Inventory). At first glance, there appears to be significant use of computers for patient records, but the great majority of these are restricted to the use of the medical audit services and are of limited value in daily hospital operations.

The total amount expended by Canadian hospitals on EDP services amounts to less that 0.2% of the total cost of health care. By contrast, labour costs are over 70%. For those hospitals which have their own in-house general-purpose computers, the costs are approximately 4% of overall operating budgets.

In absolute numbers, this amounted to about $7.4 million in 1971, according to Statistics Canada. This figure includes budgeted amounts for equipment rentals and purchases, depreciation and supplies, for in-house and contracted computer facilities plus unit record installations. These figures are summarized in Table 5.

Technically, the state of the art appears to have reached the point where it is now possible to automate a wide range of hospital and clinical services, both administrative and clinical. As we have seen, the present usage of computers indicates a gap between technical availability and practice. Some of the problems causing this gap are covered in Chapter III.

Table 4
Computerization in Canadian General Hospitals by Province: 1970*

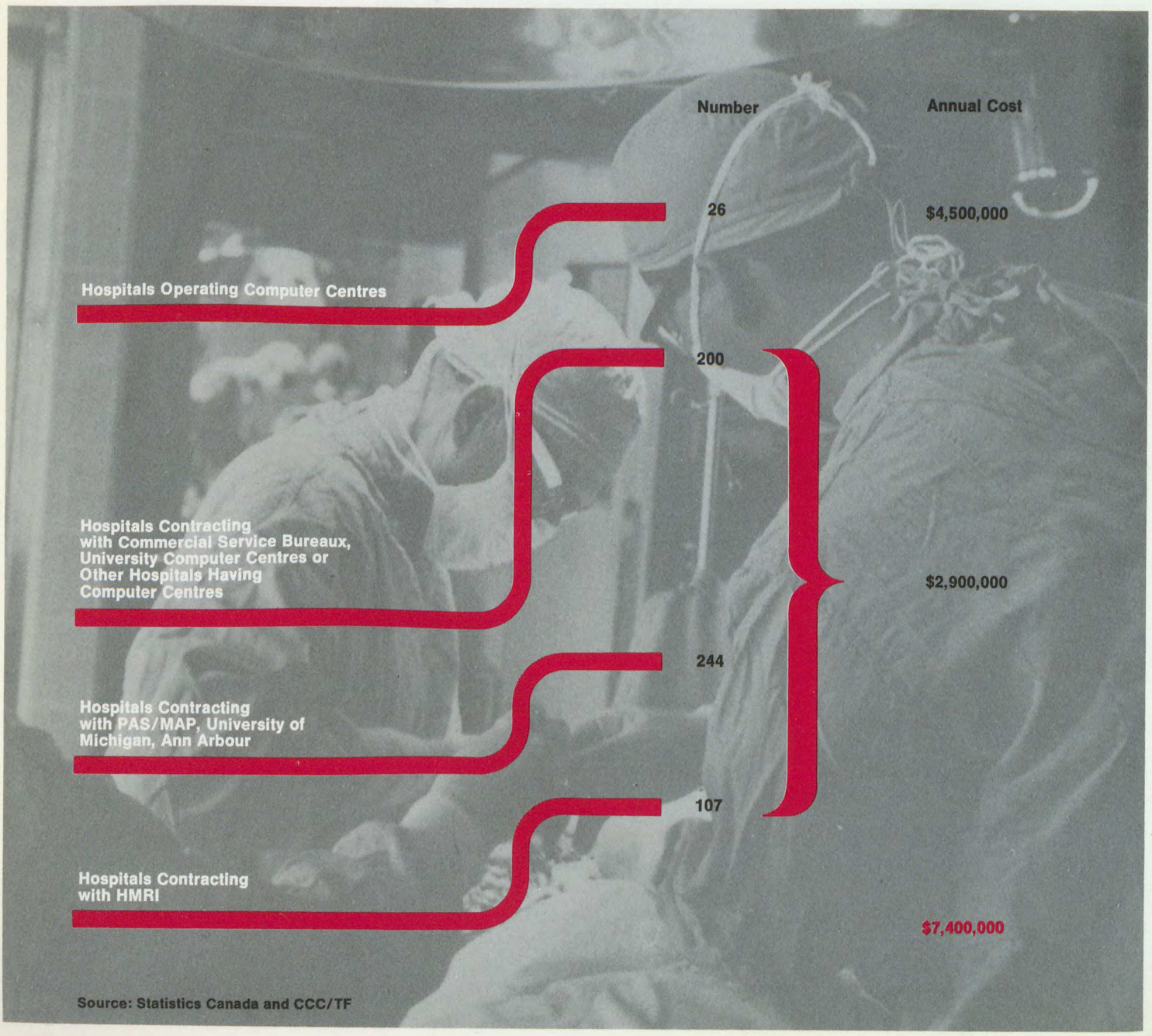
Province	No. of General Hospitals	No. of Hospitals using Computers	Application			
			Payroll	Medical Records	Inventory	Other**
Nova Scotia	45	9	9	8	1	
Quebec	152	89	89	23	35	1
New Brunswick	38	15	15			
Newfoundland	33	4	4			
Prince Edward Island	8		nil	nil	nil	
Ontario	201	78	78	27	27	
Manitoba	84	70	70	70		1
Saskatchewan	135	8	8	1	1	1
Alberta	121	21	21	21		
British Columbia	94	46	46	46	18	
Totals	**911**	**340**	**340**	**196**	**82**	**3**

* Includes both In-House Computers and Contracts with Outside Organizations

** Includes pharmaceutical distribution; ECG interpretation; multiphasic screening; medical information retrieval; operating room management

Source: Statistics Canada

Table 5
Total EDP Expenditures
by Canadian Hospitals: 1971



1. ADMINISTRATIVE APPLICATIONS

Of all computer services relevant to the health care field, those of a clerical, book-keeping or administrative nature are the most general or non-unique in their requirements. So it is not surprising that administrative applications are the most widely automated and effectively used. The situation parallels the introduction of computers into industrial firms, where the initial emphasis lay in the mechanization of repetitive, clerical tasks, possessing reasonably well-defined methods and procedures.

The degree of efficiency of administrative functions is primarily a function of volume. More specifically, the volume must be high enough to lower the unit costs of processing to the point where costs plus the initial investment can be recovered. Because of their largely non-unique nature, administrative applications can be shared. Therefore, the service bureau approach has some attraction for smaller hospitals, in that it can serve to reduce unit costs by increasing the volume base. A commonly-used figure for the minimum size a hospital should be to justify its own computer for administrative functions is in the range of 400 to 500 beds.

Since batch-processing is adequate for the requirements of most administrative data processing, the "shared" or service bureau solution satisfactorily meets present-day needs.

In Canada, it is estimated that a full complement of administrative computer services entails costs of about $1.00 to $1.50 per patient-day. For the most part, hospital business applications are run on medium-sized, general-purpose computers. A Canadian hospital can obtain data processing by one of three arrangements:

- *By using an in-house, general-purpose computer.* This option is normally available only to relatively large hospitals, usually associated with a university.
- *Voluntary grouping of area hospitals to share the use of a general-purpose computer* This is the way most hospitals in Canada obtain EDP services. Since these services are provided on a batch-processing basis, with physical pick-up and delivery of input and output, shared services have naturally grown within certain geographic regions. In British Columbia and Manitoba, for example, several hospitals use the computer operated by their provincial hospital associations. Alberta is planning this kind of arrangement, with its Alberta Regional computer committee just starting up. In Saskatchewan, 8 hospitals have co-operated through the Hospital Systems Study Group to provide a common service for Accounts Receivable, Accounts Payable, Payroll, Inventory and Medical Records. It is planned to extend the service to 144 hospitals. In Ontario, three groups of hospitals have organized the sharing of computer systems for some administrative applications. The IBM 360/40, of the Sick Children's Hospital, Toronto is now used for data processing by several Toronto hospitals. It is planned to move the computer to a separate location. In the Hamilton area, 8 hospitals and medical centres share the use of an IBM 360/25. Twenty-four hospitals in south-western Ontario have set up a shared computer facility in London, and have ordered a B2500 computer. Twelve Niagara Peninsula hospitals are attempting a similar type of arrangement. In the Montreal area, two groups of hospitals, English and French, each share a computer facility at the Royal Victoria Hospital and Notre Dame Hospital, respectively. There is a similar computer-sharing for administrative work in the Chicoutimi sub-region and in the Sherbrooke region.

- *Buying the services of a commercial service bureau.* The use of commercial services by hospitals is not widespread, about 35 Ontario hospitals, and about 15 hospitals in the Maritimes, use data centres for their payroll. The Ottawa Civic Hospital is a special case, in that it contracts all its administrative data processing (except laboratory reporting), to a local service bureau.

2. PATIENT CARE APPLICATIONS

Implementation of patient care applications has proceeded cautiously for two main reasons. First, since these applications directly affect a patient's health, medical staff must be totally convinced of their accuracy and reliability. Second, motivation has been slight, because up until now they have not been found to be cost-effective, although it is acknowledged that they can improve patient care.

Central to the system is the patient record. In the past, the data in these records did not have the range of precision needed for modern clinical decisions. As far as input and conversion are concerned, there is difficulty in establishing a suitable format. Much of the data needed is available today only in written form, and requires conversion to digital coding before it can be inserted in the patient's computer record. To complicate the problem, much of the data on the record become obsolete within 48 hours because of changes in the patient's condition (except for legal and research purposes). For economic reasons it must therefore be transferred into some form of secondary storage, leaving the basic and current information available for fast access.

There are also difficulties arising from social and environmental factors. For example, there is the question of personal privacy — ensuring limited, authorized access to private information.

The health care equivalent to the Management Information System is the Hospital Information System (HIS). The purpose of HIS was to "put it all together" and bring about a revolution in hospital operations and management. These visions may still come to pass, but at the moment the general HIS concept has not yet developed into a system which is genuinely workable or economically feasible. The present problems arise from the vast quantity of medical information that must be reduced to standard form and the inability of systems-designers to grasp the diverse and complex operations of a modern hospital or medical centre.

Despite the complex nature of the problem, several hospital information systems have been developed and are operative in the United States. Six of these systems are available for sale or lease. Best-known are the Medical System, operated by General Electric in the New England region for several users, the REACH system, the Lockheed Medical Information System, and a comprehensive hospital package developed by the McDonnell-Douglas

Automation Company. Experience with these systems has shown that a reasonably full range of business and patient care functions costs in the vicinity of $5 to $10 per patient-day.

Within the spectrum of patient care services, there are a number of self-contained applications. These include many of the "special systems" referred to in Chapter I — such as clinical lab systems, patient monitoring-systems and ECG analysis systems. Many of these isolated applications have been implemented on a stand-alone basis, often based on the use of a mini-computer. While these systems are operational, they have, as far as cost-savings are concerned, not lived up to expectations. In many cases, they have been individually programmed for relatively unique situations and hence are not easily adapted, either for linking to a larger system, or for use in another environment. In general, the patient care applications have been slow to develop, even with specially designed and manufactured EDP systems in existence.

3. PATIENT RECORDS

Some of the more general problems facing the automation of patient records have already been outlined. At the national level, it certainly seems desirable to have a system of health records, uniquely identified for each individual, that can be accessed throughout the country, to provide consistent health care and eliminate duplication. However, this goal still seems far away, and to the average hospital director and physician, there are more urgent problems to be solved that could bring faster and more evident benefits.

Mechanization of the patient record has limited value for the actual operation of the health care system unless it is made available to serve various purposes at the point of service. For this reason, it is necessary to distinguish between the mechanization of patient records for off-line record-keeping (medical audit, research) and the type that is organized for direct use in the on-going delivery of health care. Services such as those provided by PAS/MAP and HMRI belong in the former category. This section focuses on the action-oriented uses of the automated patient record, for it is from this area that major benefits from hospital automation will probably originate.

The record of a hospital in-patient is highly active, since it is the ultimate repository and source of data on the patient's condition and prognosis. For hospital use, the patient record should contain three classes of information: patient identification, administrative data, and medical data. Its content can originate from many centres within the hospital. In the reverse direction, data on the record may be required by many different medical personnel for the making of clinical decisions. Thus, rapid and accurate updating of, and retrieval from, the patient record are crucially important to efficient operation. Even if the record is not automated there is a need for location control (to avoid unnecessary delay), and rapid access to patient data.

There are several on-going projects in Canada on medical record automation:

- There is a group practice in Saskatchewan which is centralizing and computerizing its records. Each physician in the clinic will have access to a (desk top) terminal to retrieve information from a patient's file.
- McMaster University is developing a patient record system for its family practice unit.
- Department of National Health and Welfare is planning a computerized health record system for 35,000 people in the Northwest Territories. Data will be stored in an Ottawa-based computer, and made available to district health offices through telecommunication links. The data bank will carry information on individuals, doctors, facilities and social problems.
- The Centre hospitaliér universitaire (CHU) in Sherbrooke, is developing a centralized administrative system for all 14 hospitals in Quebec Administration Region #5, which contains nine counties and 600,000 people. The objective is to develop and test a pilot-system which can then be implemented in all hospitals in the Province of Quebec. The data bank associated with the system will contain on-line critical medical records, historical records, results of lab tests and administrative data. Currently the centre is processing the payroll for 10 hospitals, performing some real-time lab tests and analysis of medical records. The project was started in 1966, with the first major modules due for completion by the end of 1971. The schedule calls for the pilot-project to be completely operational by the end of 1972.

4. CLINICAL LABORATORIES

The primary motivation for laboratory automation is provided by the doubling of lab workloads every 3 to 5 years. To hold down the costs of wages and salaries, and to meet the demand for faster service in the face of the rapid volume increase, it is necessary to use staff and equipment more efficiently. Currently, it is estimated that up to 30% of a lab technologist's time is spent on clerical duties, many of which can be equally well performed by a computer. For although automatic test equipment has been installed, the recording and reporting methods are basically unchanged from a generation ago.

The basic laboratory work cycle is as follows:

- Requisition test;
- specimen collection;
- accessioning;
- data acquisition and calculation;
- reporting;
- workload recording;
- analysis of test and patient data.

Computers can, theoretically, be used in every step of this cycle, from the initial ordering of the test by a physician from a nursing station terminal, to the reporting of results back to the ward. However, in order to do this, the laboratory must be linked to the central system, at least for the purposes of requisitioning, reporting, updating the patient chart, and billing. For a stand-alone laboratory system these interfaces are document-based. This is the situation today in most hospitals with computers in their clinical labs.

There are many specially-designed laboratory systems available in the the market-place. These tend to be similar in price and capability, although none of them cover all possible functions. Most are based on the on-line use of a mini-computer to perform the basic functions of accessioning, data acquisition and calculations and printing of test results for distribution back to the originator. These systems are technically sophisticated, capable of reading digital values from peak detectors and digitizing analogue signals from

automated test equipment. Software techniques are also available to correct for instrument drift and noise. However, the largest problems still remain at the interface — sample identification and patient identification are still not perfected.

Owing to differences between installations, customized programming and the small size of the computers involved, laboratory systems today are normally dedicated. This is coming to be recognized as a problem, because it will, to some extent, hinder communications between dedicated lab computers and either central hospital information-systems or other laboratory computers.

Technically, however, this area is fairly well developed. Several laboratory systems in the U.S. are reportedly installed and operating satisfactorily. Among the commercially available systems, the MUMPS system, developed by the Massachussetts General Hospital, and the Berkley Laboratory System are considered to be well on the way to what is basically required. St. Paul's Hospital in Vancouver, is currently using the MUMPS system, and the Alberta University Medical Centre is using the Berkley System.

In Canada, success with automated laboratory systems has been mixed. Several hospitals, such as St. Paul's in Vancouver, Notre Dame in Montreal, the University Medical Centre in Edmonton, the University Hospital in Sherbrooke and the University Hospital in Saskatoon are using laboratory computers and evaluating their effectiveness. Others, such as Hamilton General, Ottawa Civic and Sick Children's Hospital in Toronto, have abandoned their attempts. Overall, it would seem that automated laboratory systems are not quite well enough developed to be cost-effective at this point, although it has been learned that very high-volume laboratories seem to be able to operate more efficiently with them. Some groups have concluded that this volume dependency points to the need for regional laboratories.

5. SCHEDULING

Out-patient scheduling aims to minimize patient waiting time and waiting space, as well as avoiding any waste of the doctor's time. Simulations of the types of queueing problems likely to arise would allow various strategies to be evaluated to cope with the problem. At least one such study has been conducted in a Toronto hospital with the result that some rules were developed. However, as far as can be determined, the recommendations have not been implemented.

Hospital in-patient scheduling is a complex problem. It is similar to job-shop scheduling, in that both the order and the rate of medical procedures can be varied within limits. Complicating it is the continually changing patient's condition making previous schedules inadequate or redundant. Due to this fact, and to the state of the system, an invariant schedule cannot be worked out for the patient at admission time. Accordingly, all schedules must be subject to change by medical staff (*i.e.*, interactive). A proper scheduling system should have as its goal the minimization of the total cost of caring for a patient during a hospital stay without lowering the quality of care. Studies

have demonstrated that it should be feasible in many cases to carry out patient examinations and routine tests (*e.g.*, radiology) as an integral part of the admissions procedure before the patient becomes hospitalized.

While computer-assisted scheduling appears to offer benefits, it is little used in Canada at the present time. Projects for operating room scheduling are known to exist at the Victoria General Hospital in Winnipeg, at the Notre Dame and St. Justin's Hospitals in Montreal and the Saskatchewan Hospital Systems Study Group.

6. COMPUTER-ASSISTED DIAGNOSIS

Several sub-systems for use in specific areas have been developed in various countries, but nothing approaching a general diagnostic capability has yet been achieved. Virtually all the limited diagnostic sub-systems are experimental at this stage.

In Canada, the only area of significant development is that of automated electrocardiogram (ECG) analysis. In 1970, over $300,000 was granted to researchers working on computer-aided ECG interpretation. A number of facilities exist for processing ECG's on a remote basis, using ordinary telephone lines for transmission. Most of these facilities utilize a small computer linked to a large computer for the heavy calculations. There are some 15 research teams in Canada using 5 different systems (4 U.S. and 1 Swedish). Among those institutions developing or using ECG analysis systems for remote use are:

- University of Montreal
- Laval Hospital (Quebec City)
- Quebec Institute of Cardiology
- Sherbrooke Regional Health Project
- Dalhousie University
- University Hospital, Saskatoon
- Queens University

A start is being made using mini-computers on EEG (electroencephalograph) interpretation. The Clarke Institute in Toronto, the Montreal Neurological Hospital and Notre Dame Hospital in Montreal, are known to be involved in this area. Special diagnostic aids continue to be developed in the United States. For example, spirometric examinations (for lung function) have been practically automated, with the computer even instructing the subject in breathing procedures. Of course, fitting curves to respiratory data is well-suited to the computer's capabilities and can save substantial technician time.

7. OTHER APPLICATIONS

There are a number of additional areas in which the use of computer techniques is not well developed or not widely beneficial at this point. These applications cover a broad span of functions, including multiphasic screening, physiological monitoring, radiology, food and dietary services, pharmacy, computer-assisted training and radiation treatment calculations.

Multiphasic screening is the identification of a previously unrecognized disease or defect by the application of tests, examinations, and other procedures that can be applied rapidly and with personnel less skilled than physicians. Using automated techniques, screening was started by the Kaiser Permanente Group in California about 10 years ago and has since spread to over 150 centres in the United States.

Multiphasic screening is being tried at St. Paul's Hospital in Vancouver, and by Medical Data Services, a private laboratory in Toronto. At this point, the service appears to be more costly than the traditional doctor's examination. The main reason is that a standard set of lab tests is performed involving substantial fixed cost, as compared to the selective testing approach of a physician. Nevertheless, the Toronto-based service is well utilized and, in general, operators are convinced that further refinements in the technique will make the service economically feasible.

In the area of physiological monitoring, there has been much development in the U.S., largely generated by the manned space mission programs. Lockheed Aircraft, Massachussetts General Hospital and the Mayo Clinic are the leaders in the field. In Canada, experimental work is going on at the Hospital for Sick Children and the Toronto General Hospital in their intensive care and coronary care units. Toronto General is also developing a blood-flow monitoring system based on the use of a small computer that forms part of an automated cerebro-vascular unit.

At the present stage of development, applications in the functional areas of radiology, food services and pharmacy have marginal cost effectiveness, and can be justified only on the basis of very high volume and shared use of a central computer. However, their feasibility has been established in the United States. By using automated menu planning, for example, one user claims a savings of 24% on food costs. Like lab data, radiology data lend themselves to computer processing, since both input and output are numeric and the calculations follow well-established procedures. The University of Saskatchewan has a project underway to develop a satellite pharmacy drug distribution system. This work should assist in the evaluation of the feasibility of this application.

While computer-aided learning (CAL) is not directly concerned with the delivery of health care, it has significant potential value for medical and para-medical personnel. At present, the University of Alberta uses CAL for training doctors in cardiology and patient monitoring. Radium dosage calculations for cancer patients are being performed on computer by the B.C. Cancer Institute and Princess Margaret Hospital in Toronto.

8. MEDICAL AUDIT SERVICES

Two specialized organizations use computers to provide medical audit services. The larger of these is Professional Activity Study/Medical Audit Program (PAS/MAP) which has its computing facilities in Ann Arbor, Michigan. As

shown in Table 5, PAS/MAP currently serves about 244 Canadian hospitals. The Hospital Medical Records Institute (HMRI), is a non-profit organization set up by the Ontario Hospital Association and based in Toronto. HMRI services about 107 hospitals in Canada — about 15%. On input forms, codes are used for patient and doctor identification, as well as for diagnosis and procedures.

Both organizations receive their input as mailed forms and employ batch-processing techniques to compile and report on the data.

The PAS/MAP system automatically compiles a hospital's routine statistics and provides cross-indexed printings of case abstracts which are useful as disease, operation and physician indices within the hospital. Special statistical compilations are available on a special request basis. The cost of the PAS/MAP service is 40 cents per admission. Hospitals using the service have found that their medical record department costs are decreased because of the resultant labour savings. In addition, medical records are better maintained and can be more reliably used for clinical research.

An added benefit of the PAS/MAP system is its resource data base of over 10 million hospitalizations, which has been built up on magnetic tapes.

HMRI uses the computer facilities of the Ontario Hospital Services Commission. Its services are essentially similar to those of PAS/MAP, differing somewhat in data requirements and flexibility. The cost is 42 cents per admission. This program does not restrict participating hospitals to any one system of coding. Consultation is provided to assist hospitals in determining their needs. As an indication of the data contents, the following items may be included in HMRI records:

- Dates of entry and release, with computed length-of-stay;
- Death Analysis (includes still-born);
- Accommodation — standard, private;
- Admission Status — elective, urgent, emergent;
- Age by hours, days, weeks, months, years;
- Sex;
- Intensive care;
- Identity by code number of:
  Attending physician (one or more)
  Consultant
  Anaesthetist;
- Identity of Hospital Service or Services involved in care of case:
  Procedural
  Consultant
  Resident;
- Investigations recorded in chart:
  Haemoglobin or haematocrit
  Chest x-ray (routine)
  Weight of patient
  Haematology
  E.C.G.
  Radioisotopes
  Blood-pressure
  Serology
  Biochemistry
  Ordered x-ray studies
  Microbiology
  Others elected by the hospitals;
- Complications of care:
  Medical
  Surgical
  Anaesthesia.

9. HEALTH INSURANCE PLANS

The bulk of the work of provincial health and hospital insurance commissions involves the data collection and processing of insurance policies, premiums

and claims for payment. Most provinces use computers for the processing of transactions on a batch basis, receive their input by mail, teletype or by hand.

In the course of this routine processing, the commissions build up magnetic tape files for each family or member belonging to the plan. Due to rising costs, and the necessity of raising premiums, the insurance commissions have started to use the computer to monitor the types of medical care delivered and the volume of practice. Analysis of the accumulated data will lead to calculation of the cost-benefit performance of the provincial health systems. To the extent that the records include data on diagnosis and treatment, they can be used for research into epidemiology and patterns of health care utilization.

For example, in Manitoba, provincial health care records are used to ensure that applications for drivers' licenses do not misrepresent the state of health of the applicants. In theory, it is possible to envisage further linkages between medical records and other files for similar purposes. Files are kept on individual physicians to guard against malpractice and data are analyzed for billing and treatment procedures.

10. MEDICAL DATA BANKS

Provincial public health departments have the responsibility of monitoring infectious and communicable diseases and other conditions that could threaten the health and well-being of the people.

One automated data bank of medically-related information is maintained by the Medical Information Bureau in Boston, Massachusetts. This organization is used by all North American Insurance companies as a means of listing the names of rejected insurance applicants.

The provinces of B.C., Ontario and Quebec are participating in a project to develop a general registry for Pap smears and the incidence of certain forms of cancer. In Saskatchewan, the Cancer Commission has established a file of cancer patient records, including personal, diagnostic, treatment and follow-up data on 50,000 patients. Also in that province, the Federal Department of National Health and Welfare is supporing an automated immunization program by regional health services.

11. RESOURCE PLANNING AND MANAGEMENT

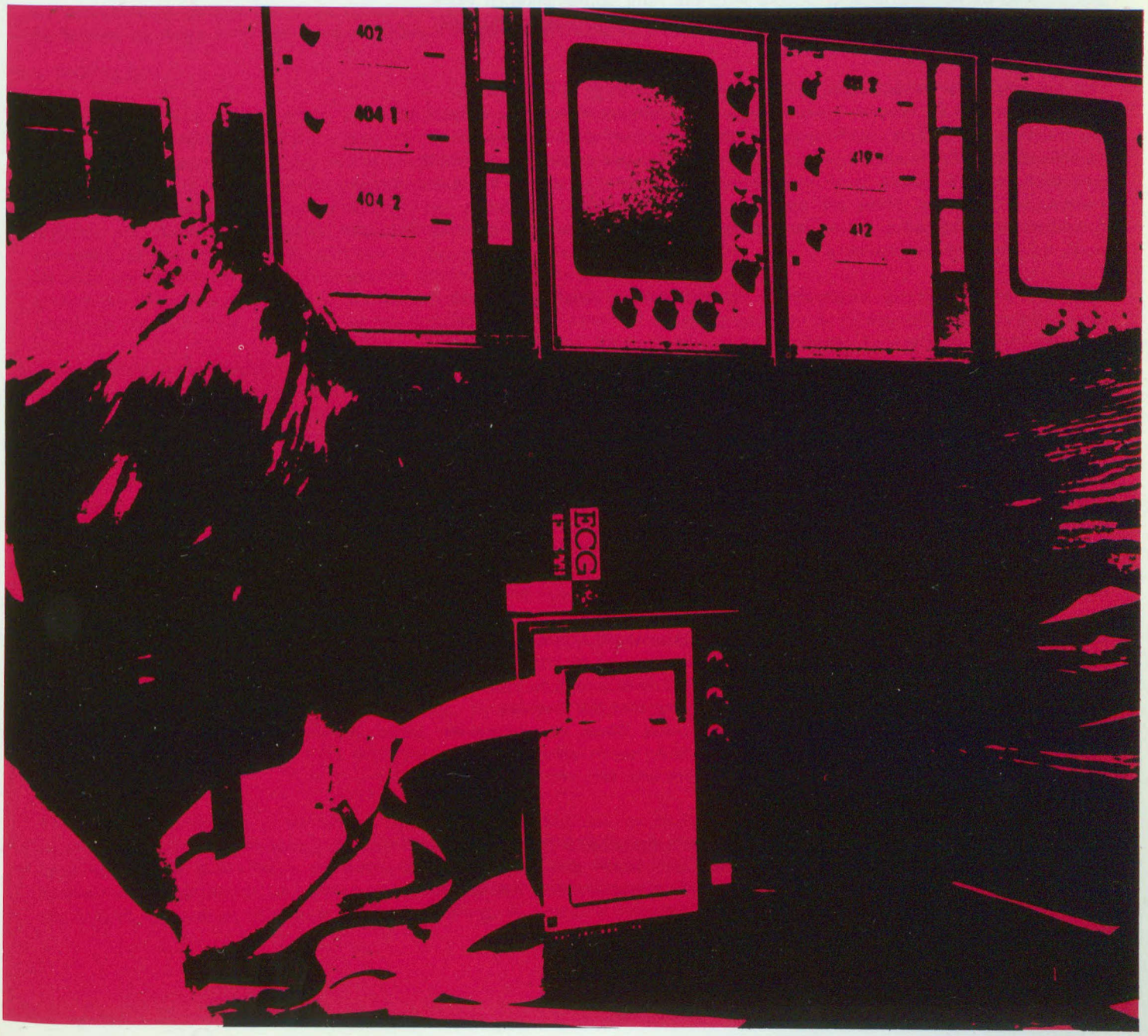
Use of the computer in operation research studies can assist in the planning and management of health care facilities. The techniques are not widespread, but there are some notable examples of work in the simulation of health care delivery in the Vancouver area for the purpose of making general policy and assigning resources. Making use of population and morbidity projections, the model forecasts the degree of health care available in the region if a given amount of resources were applied. The model is intended to help in policy-making and does not attempt to simulate the detailed operation of the health care system.

The Ontario Hospital Services Commission has an operations research team, that has developed models of ward care and ward monitoring as well as Ontario Ambulance Services Information Service (OASIS). The group also developed the "Relative Stay Index" for comparing the performance of various Ontario hospitals regarding the length of time required to treat various diseases.

12. PROBLEM AREAS AFFECTING AUTOMATION

It can be inferred from the current status of medical automation in Canada that the picture is highly fragmented. In some areas there is little work being done, in others, many similar types of experimental applications are taking place across the country (*e.g.*, ECG interpretation). Since the potential benefits to be obtained from the use of computers in medicine are far from being fully realized, it is worthwhile to mention some of the problems that appear to be retarding the rational development of automation in the medical field. These are listed in no particular sequence, and, as can be seen in many cases, problems overlap. Their inclusion is useful as a means of illuminating the types and extent of difficulties likely to arise when attempting to set forth any policies for the increased use of computers and communication technology in medicine. Indeed, the nature of these complexities is such that simple solutions are not apparent:

- High cost of medical system development (particularly software);
- dearth of R&D money for hospital management methods;
- lack of comprehensive understanding of the management process in health care organizations;
- lack of enthusiasm by physicians and hospital administrators for the use of computers, perhaps due to lack of understanding;
- lack of competitive pressure on hospitals to improve performance. Insufficient supplementary incentive for better performance;
- lack of informed customer demand for better methods;
- as hospitals are often run by committees, it is often difficult to obtain decisions;
- communication difficulties between physicians, administrators and technical people, due to differences in terminology goals, ways of thinking;
- shortage of persons trained in systems who are also familiar with medical/hospital conditions and problems;
- inherent complexities in mechanization of medical records;
- no "universal" system of patient identification;
- no effective spokesman/co-ordinator/planner for medical technology;
- high cost of ensuring reliability and continuity for health care computer applications.(i.e., need for duplication);
- difficulty of making computers as "transparent" as possible to users;
- high cost of large-volume, direct-access storage;
- difficulty in generalizing on continuous pattern of procedures for use by several hospitals, especially in regard to patient-care applications;
- lack of standardization in methods and procedures.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Health care applications of computer/communications technology have not yet been developed to the point where they can function in a demonstrably economical fashion. Cost-effectiveness can be influenced by many factors, such as volume of data processed, system acceptance and suitability of computer facilities or service. Yet, except for the routine business applications, which are not unique to the health field, computer uses in health care are not very attractive propositions at the present time.

The main underlying cause for this slow rate of progress is the inherent, complex nature of medical computer applications. The problem is further exacerbated by the shortage of people with the right combination of skills, and by the problems of communication between systems people, hospital administrators and medical personnel.

The gap between the potential for the use of technology in health care management and its present limited usage is becoming increasingly evident to the health care planners, administrators and policy-makers. This awareness, combined with the forecasts of market surveys and the consensus of health care professionals, points to an increased pace of development of medical systems in the future. Effort will probably concentrate more on the development of software, while also using the hardware technology which is now, or will become, available.

The rapid and continuing expansion of the technology, coupled with the increasing necessity to use it, is creating pressure for more fundamental changes in the structure of organizations providing health care. A tendency toward the voluntary co-operation of hospitals in geographical proximity has already been observed. This trend toward regionalization is expected to continue, where administrative, as well as some health care functions, are centralized, as a means of providing the required volume to justify computer use. Other influences which should lead to increased automation can also be observed. For example, the gradual influx of younger doctors and administrators, who are likely to be more receptive to changes in methodology, as well as the pressure on hospital managements to keep up with the progress of their counterparts in other regions and countries. A further positive force will be the role of the educational process in preparing medical and para-medical personnel to use medical technology and data.

Any comprehensive computer system must incorporate the policies, goals, objectives, structure, as well as the ways and means of its parent (or user) organization. The uniqueness and style of any given business or institution is so intimately a part of structuring the total system that the two are inseparable: to refer to one is to refer to the other. Thus, an information system shared by a number of hospitals and other health care facilities in a specific region will necessitate a common philosophy and working arrangements.

The objectives, application, day-to-day utilization and effects of an information system should be evaluated prior to its actual acquisition and implementation. For this reason, it would be futile for this study to recommend any specific

applications or actions involving the use of computer/communications technology for the health care field. Most of the urgent needs have already been identified by other studies and reports concerned with the quality, types and cost of health care services. It is up to the individual hospitals, commissions and regional associations to translate these general needs into specific requirements for their own operations.

Clearly, the computer is a sufficiently flexible tool to have considerable application in the field of medical services. The concrete questions of *what* applications, *when* they are needed and *how* to develop and use them cannot be answered in general terms. In substance, this is a job which can only be performed by those who are directly involved in the health care business.

1. TECHNOLOGY

The equipment required to enter, store, process, retrieve, communicate and display medical data is basically similar to that for any other area. Since much equipment is already developed and available, hardware capability is not a stumbling block to the increased penetration of the computer into the health care industry. Hardware costs are certainly not small, but they are declining steadily, and therefore cannot be regarded as a major source of delay. The exception to this statement is, perhaps, in the storage of high-volume patient records and history on directly-accessible media. Again, the problems of coding, structuring and filtering this data will probably present more pertinent problems than the cost per "bit" of the storage used.

An important problem still lies in the application of the computer to the management of everyday operational procedures in health care centres. Their solution depends upon the design of equipment configurations and operational programs which can perform functions that are more efficiently handled by machines than by health care personnel and can also interact smoothly with the staff. Reliability and continuity of service are of paramount importance in medical systems, where failure or loss of service could lead to injury or death. This requirement usually implies fully-duplexed computer facilities and fully debugged and recoverable programs. Since user-acceptance will depend on reliability, long testing and shake-down periods will be required before any system can be made operative.

Health services cover a wide range of computer applications, from real-time control of lab instruments, to numerical computing for statistical analysis, to large data base management, to high-volume transaction processing. Under these conditions, it is impossible at this stage, to define a single configuration of computers or set of telecommunications linkages which would simultaneously and efficiently fulfil the variety of needs of all parts of the health services sector.

The important problems to be solved, and the gains which can be made, are in the application of technology to health care at the individual institution at local or regional level. These are many and diverse, ranging from administrative transaction processing within a hospital, to local computer sharing, to regional or provincial facilities planning. A "national network" may

ultimately coalesce due to the merging of many independent systems and networks by means of telecommunication links.

Considering our highly-mobile society, there will be an increasing need for the linkage of patient records between provinces or regions. A fully-operational Medical Information Retrieval System would undoubtedly be the answer. However, the return on such an investment would be highly questionable at present, compared to other projects.

Statistics are already being collected by Statistics Canada and National Health and Welfare from patient discharge reports and annual hospital returns. In any event, statistics can be adequately collected and summarized at intervals and do not require instantaneous transmission.

Computer-assisted diagnosis may someday be of great benefit, but that day is still far in the future. Most experts do not envisage any kind of generalized computer diagnostic capability before 1985. Specialized diagnostic aids, such as ECG interpretation, can now be satisfactorily distributed (*i.e.* made available) through the use of dial-up telephone lines.

Finally there is the issue of patient-record linkages and portability. This leads to the requirement for standardization of content and format of patient medical data and for compatability of data interconnections. This is an important matter, since it concerns the extent to which patients are treated both intra- and interregionally. No data of sufficient significance have been found to make it possible to evaluate the present extent of this kind of activity. Its impact is therefore difficult to assess.

2. HOSPITAL INFORMATION SYSTEMS

With the exception of administrative applications, the experience of the past few years has shown that piecemeal patient care applications of computers are seldom cost-effective. Since a hospital operates as a system, albeit with many separate clinical units, there is a great deal of intercommunication between the various departments and an over-lapping of functions. From the point of view of efficiency, the interactions between service centres make it difficult to design viable stand-alone or independent sub-systems.

In the midst of all this activity is the patient — the centre of a wide range of differing procedures. If a hospital information system is regarded as a "model" or "image" of the on-going hospital procedure, then the patient record is, similarly, the centre of the computer-based system.

Continuing with this analogy, just as the physician forms the main link between the patient and the hospital services, so the medical order in an information system forms the link between the patient record and the various sub-systems associated with hospital service centres. This concept of the central role of the physician's order is the key principle of the Lockheed Hospital Information System and the REACH system, two of the first "general" medical systems now commercially available in the United States.

To be capable of handling most medical orders, a computer system must accept the orders from nursing stations, for example, and be able to transmit them to the complete group of service centres which can then act upon them. However, in so doing, the system should go much further than simply communicating the orders. The information, plus additional data on available resources, should enable the computer to schedule laboratory tests, x-rays and operations. The results of actions initiated by such orders can be fed back into the system and used to update the patients' charts. Forgotten orders can be reported on an exception basis for follow-up action. The particular service performed can be itemized and posted to the patient's account. Thus it can be seen that one of the major roles of the hospital information system is to tie together all the sub-systems, whether they are automated or not.

The necessary computer power could be obtained in several ways:

- In-house main computer
- Large-scale computer shared by several hospitals
- Commercial computer service

In general, service bureaux may not be acceptable to most hospital managements because of fear of loss of control and possible loss of service. However, a commercial computer service, dedicated to the offering of hospital applications, may be able to overcome these objections. In essence, it is the equivalent of the computer shared by a collective group of hospitals, except that the economic risks and ownership belong to an entrepreneur.

Large-scale in-house computers will probably be restricted to very large hospitals, especially those connected with medical schools and those doing research and development into computer applications. Small computers will continue to be used in a number of specialized functions, such as control of laboratory instruments and patient monitoring. These may require communication with the main or central computer in order to be integrated into the overall system.

Customization of programs and procedures to suit the requirements of different hospitals will be possible. First, a number of different "packaged" systems are likely to be available. Choosing among these will allow the prospective user to exercise basic options. The available system will undoubtedly be modularly constructed to allow modifications to portions of the system without destroying its operational integrity. As the information systems will support the hospital in carrying out its functions, they will have to be adapted to existed practices to minimize disruptions of personnel and to ensure acceptance.

3. COMPUTER-ASSISTED DIAGNOSIS

Some experts in the field of medical systems believe that the possibility of assisting physicians in diagnosing disease and abnormal conditions is potentially the most rewarding of computer applications in health care. Others question the goals and viability of the whole concept, concluding that there is little scope for the computer in general diagnosis. However, there is one point

on which general agreement seems to have been reached, and that is that there is little chance of any computerized diagnostic system of any sizeable dimensions before 1985-2000. Too little is understood about the mental processes of a doctor as he analyzes symptoms and tests results, in order to reach a diagnostic conclusion. There is art as well as science involved in the diagnostic process and much work remains to be done in understanding and documenting the detailed methodology of the current practice of clinical diagnosis. Current computer-aided diagnostic techniques are based on the use of Bayesian statistical inference and are probably inadequate, considering the complexity of the problems involved.

In special cases, where the main nature of a given condition has been isolated, computer systems have established a measure of success. For example, an experimental programme at the University of Missouri for the diagnosis of rheumatic heart disease using chest x-rays achieved overall test accuracy of 73% compared to 62% for a control group of radiologists.

There is no doubt that specialized diagnostic systems can, theoretically, obtain better definition and greater precision of measurement and analysis of quantitative data for diagnostic processes. By augmenting the pattern recognition and inferential capability of the physician, such systems can be most useful. Benefits will arise out of improved accuracy and speed of diagnosis, which, in turn, will lead to more satisfactory methods of treatment.

APPENDICES TO PART B3

APPENDIX 1

CANADIAN HEALTH CARE DELIVERY CENTRES VISITED

Royal Jubilee Hospital	Victoria
St. Joseph's Hospital	Vancouver
Vancouver General Hospital	Vancouver
British Columbia Cancer Institute	Vancouver
Department of Pathology, UBC	Vancouver
St. Paul's Hospital	Vancouver
C U & C Health Service	Vancouver
University Medical Center Hospital	Edmonton
Glenrose Hospital	Edmonton
Foothills Provincial Hospital	Calgary
Regina General Hospital	Regina
Regina Grey Nuns' Hospital	Regina
Medical Arts Clinic	Regina
Manitoba Rehabilitation Centre	Winnipeg
Victoria General Hospital	Winnipeg
Manitoba Hospital Commission	Winnipeg
Hotel Dieu de St. Josephs	Windsor
St. Joseph's Hospital	Chatham
Public General Hospital	Chatham
Victoria Hospital	London
Southwestern Ontario Computer Center	London
St. Thomas-Elgin Hospital	St. Thomas
Greater Niagara Falls General Hospital	Niagara Falls
Hamilton Civic Hospital	Hamilton
McMaster Medical Centre	Hamilton
Toronto Western Hospital	Toronto
Clarke Institute of Psychiatry	Toronto
Sunnybrook Hospital	Toronto
Ontario Hospital Association	Toronto
Hospital Medical Records Institute	Toronto
Hospital for Sick Children	Toronto
The University Teaching Hospitals Association	Toronto
Princess Margaret Hospital	Toronto
The Ottawa Civic Hospital	Ottawa
Information Sciences Institute	Ottawa
The Royal Victoria Hospital	Montreal
Notre Dame Hospital	Montreal
Joint Hospital Computing Centre	Montreal
Sous-comité d'informatique medicals	Montreal
Laval University Medical Centre	Quebec City
St. Michel Archange Hospital	Quebec City
Victoria Public Hospital	Fredericton
Department of Health (Provincial)	Fredericton
Chaleur General Hospital	Bathurst
Moncton General Hospital	Moncton
The Riverside Hospital of Ottawa	Ottawa
Canadian Hospital Association National Assembly	Montreal
Fifth Annual Hospital Systems Research Symposium	Toronto
Third Annual Hospital Systems Institute	Saskatoon

Ontario Hospital Services Commission	Toronto
Department of National Health and Welfare	Ottawa
Statistics Canada	Ottawa
Centre hospitalier universitaire de l'université de Sherbrooke	Sherbrooke

APPENDIX 2

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APPENDIX 3

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Mr. J. Wall

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APPENDIX 4

DESCRIPTION OF UNIVERSITY OF SHERBROOKE HOSPITAL NETWORK

1. The Centre hospitalier universitaire (CHU) de l'université de Sherbrooke is developing a medical complex using all of the existing hospitals (14) in Quebec Administrative Region #5, grouping 9 counties and 600,000 people.

The aim is an operational and functional merger of the services through common computer-based data banks and management systems. The 14 hospitals will keep their autonomy, but service to clients will be ''transparent'' from any hospital. Unnecessary duplication of specializations will be avoided.

This operation is a pilot project by the Department of Social Affairs which funds the CHU through a non-profit organization: CISE (Centre d'informatique de la santé pour l'Estrie).

The merger was made possible by the common set of standards for management set by government in all the hospitals.

The organization for services will be three levels of care:

- Primary: Small hospitals as point of entry, and local health centres.
- Secondary:Medium-sized hospitals as specialization centres.
- Tertiary: CHU — Highly-specialized centre and research institute.

Data bank will include:

- Socio-economic data on citizens.
- Critical medical records (on-line).
- Historical medical records.
- Lab tests.
- Administrative data.

Present state of system:

- Payroll of 10 hospitals.
- Same real-time lab tests (no electro-cardiography yet).
- Functional analysis of medical records.

Work is being done on:

- Specifications of common set of programmes and standards on medical records.
- Data Bank creation and interface software.

Staff (CISE) — 30 people: Administration
Doctors
EDP specialists

Research Group on Medical Records: 40 people

Hardware – Administration: Univac 1106 Labo. DNA 2703 linked to Raytheon 703

Software – Common coding language: SNOP
ID SIN + alphanumeric codes.

2.
- Project under way since beginning of 1966, when staff consisted of six people.

3.
- Budget of $1.5 million.
- At present, most of the 70 members of staff are working on development.
- Development is done at the CHU.
- Processing will be done at Hôtel-Dieu de Sherbrooke.
- Co-operation underway with McMaster University;
- National Institute of Health, U.S.
- System is based on computer/communications. Volume of traffic will not be very large for pilot-project.

4. Application will contribute to making more medical services available to more people without disproportionate rise in costs.

Cost benefit has not yet been established but cost/effectiveness is already showing positive results.

5. Funding by Department of Social Affairs (Quebec) now. *Centre d'informatique* is expected to be financially autonomous in 16 months.

6. Public awareness is still limited but improved services should increase acceptance.

7. System is designed to be adapted to all Quebec hospitals. Access methods include protection of personal data.

8. First modules will be operational by the end of 1971. Pilot-project will be completed by the end of 1972. After evaluation, it will be extended throughout Quebec.

9. Management of project is under doctors' control. Co-operation of the hospital management keeps system close to reality.

APPENDIX 5

THE CASTONGUAY — NEPVEU COMMISSION

RECOMMENDATIONS ON COMPUTERS AND HEALTH

That an integrated electronic data processing system be established in Quebec, based on the following principles:

- The establishment by the Quebec government of a long term development programme;
- An exact definition of the role electronic data processing should play in the entire medicare distribution system;
- Recognition of the importance of the Regional Health Boards[1] in collaboration with the University Hospital Centres[2] and universities in the creation of regional data processing centres;
- The participation of those responsible for the organization and distribution of medicare in the setting-up of the system.
- The establishment of individual medical files for the identification of individuals and families.
- The exact definition in precise and rigorous terminology of the problems submitted to the Medicare Programme.

[1] ORS – Office régionale de la santé

[2] CHU – Centres hospitaliers universitaires

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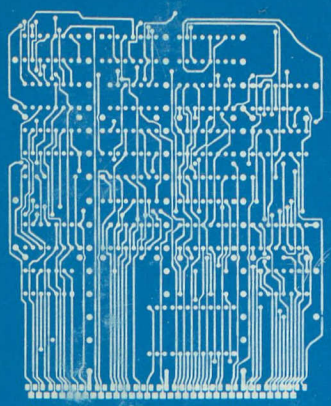

Machines and computers should become a functional part in a life-oriented social system and not a cancer which begins to play havoc and eventually kills the system.

Eric Fromm
The Revolution of Hope