THE SEARCH FOR CANADIAN CONTENT
(L'APPORT CANADIEN)

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ABSTRACT

Concern is frequently expressed about the extent of Canada's contribution to the world store of scientific and technological knowledge and innovation. Statements such as the following: "Canada contributes less than 3% of the total world generation of scientific and technological information" are frequently offered as proof of the weakness of Canada's scientific and industrial effort. Such statements are examined to learn what they mean and upon what they are based. The paper asks whether Canada produces 3% of the titles of some existing set of journals; whether Canadian technologists and scientists produce three one-hundreths as many reports, professional papers, letters to the editor, trade journal accounts, brochures and so forth as do all other world scientists and technologists; how these figures are obtained; and what is the definition of Canadian scientific and technical literature. Some of these questions are answered. A satisfactory analysis of Canadian content is not available at present. Techniques to carry out such an analysis are outlined and the results of preliminary studies are given. (On s'inquiète souvent de l'étendue de l'apport du Canada aux connaissances et aux innovations techniques et scientifiques mondiales. On dit souvent que le Canada contribue pour moins de 3% de toute l'information technique et scientifique recueillie sur le plan international. Une telle affirmation montre la faiblesse de l'effort scientifique et industriel canadien. Son examen peut nous apprendre ce qu'elle signifie et quel est son fondement. Les auteurs se demandent si le Canada produit 3% des titres de certains journaux déjà existants; si les techniciens et les scientifiques canadiens produisent trois centièmes des rapports, des communications professionnelles, des lettres aux rédacteurs, des articles de revues spécialisées, des brochures, etc. du monde scientifique; ils se demandent aussi comment on obtient ces données; et comment on définit la littérature scientifique et technique canadienne. Ils apportent des réponses à certaines de ces questions. A l'heure actuelle, on ne peut analyser l'apport canadien de façon satisfaisante. Le document mentionne les techniques nécessaires et donne les résultats des études préliminaires.)

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INTRODUCTION

A recent issue of a provincial engineering journal once more repeated the statement that Canada produces less than 3% of the world's scientific and technical literature (Moull, 1973) (1). Whenever this statement is made certain conclusions are either drawn or inferred. In general, these conclusions convey ideas or "notions" such as the following:

1. The amount of scientific and technical literature can be related directly to the scientific and technical productivity of a nation (Tyas, 1969, I, 1,2,4; Glassco, 1963, 63; Katz, 1969, 3; Lamontagne, 1972, II, 411).

2. Canada is not a very innovative nation. This idea is usually regarded as a corollary to no. 1, or vice versa (Tyas, 1969, I, 4; Lamontagne, 1970, I, 105,120,138,231).

3. Canadian innovation should be improved. This is to be accomplished partly by improving our scientific and technical communication system (Tyas, 1969, I, 4; Lamontagne, 1970, I, 229,230).

4. In Canada, we are not very innovative because much of our research is done in government laboratories and universities (Tyas, 1969, II, chpt. 3, 3; Lamontagne, 1970, I, 128,140,229). This conclusion, or theory from a conclusion, has spawned many other theories, conclusions, or recommendations; some of these follow. More research should be done in industry. Academics should spend time in industry. Industrialists should be appointed to research councils. Various contradictions concerning information dissemination policy have arisen from the assumptions in no. 4.

5. Since Canada does not produce much science and technology (see no. 1), we must rely on the world literature. Therefore, we need to devote our efforts to incorporating into our information system aspects of more prolific nations' systems. We must devote similar attention to linkages with these systems (Tyas, 1969, I, 3; Lamontagne, 1970, I, 233).

6. As a corollary of no. 5, the non-Canadian 97% is of greater intrinsic importance than the Canadian 3%. In fact, in certain instances, the implication almost seems to be that the 3% can be systematically ignored (Lamontagne, 1970, I, 231).

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(1)Page references for Lamontagne, Tyas, and Katz citations will be given in the body of the text to avoid cumbersome repetitions in the References.

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The truth or falsity of the above statements will not be discussed in detail here; but consideration of them and their implications, as a group, reveals some startling contradictions and surprising lapses in logic. Further, even a brief acquaintance with the literature covering Canada's scientific and technical information problems, found mainly in government reports and reviews and in the discussion of these in the trade journals, makes the incoherence and the contradictions more apparent. If such reports and such conclusions embody the results of a seemingly endless introspective investigation into the soul of Canadian scientific and technical information, then we need to explore the contradictions and to isolate some fundamental principles (Heaps, 1970; Cuadra, 1972).

Before we turn to specific examples, we need to ask ourselves some closely interrelated questions. 1) To what does the 3% figure really refer? 2) Assuming we can answer the preceding question, is the 3% figure correct? 3) If it is correct, what does it mean for Canadians? For example, is it a reasonable figure and what will an examination of the material that makes up the 3% tell us about our scientific and technical literature and about our science and technology? Can such an examination help us in defining science and industrial policy?

WHENCE 3%?

Examination reveals, first, that the important figure, which varies between 2% and 3% (2), is not very clearly specified and documented, even though so many conclusions spring from it. Secondly, because it is difficult to ascertain exactly what the figure means or to what it refers, it is not very easy to find out if it is correct. Consequently, we cannot immediately ask ouselves why we produce 3% and we cannot ask ourselves if it is good or bad or appropriate that we do.

The figure seems to appear first in the Tyas report. It is given without a documentary footnote or reference (Tyas, 1969, I, 3). Tyas also states that we "consume, process and apply" and, therefore, must access the "world literature" (Tyas, 1969, I, 3). Again no support figures are given. Katz infers that he agrees with the 3%, but he is aware that he is making an unsupported inference about the relation between scientific and technical work and scientific and technical information (Katz, 1969, 8). He also does not document his original source. Lamontagne uses the same figure and makes some attempt to justify it, by deriving it from funding, but here he is on rather insecure ground (Lamontagne, 1970, I,

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(2)For convenience in this paper we shall use the figure of 3%, although sources quoted use 2% or 3% or both. OECD (1971, 133) has 5% but this does not seem to appear elsewhere.

118,229; 1972, II, 378,410). There is insufficient evidence, in his report, from which to draw the conclusion that a certain amount of funding will produce a certain amount of publication (3).

Further investigation has revealed that a similar figure occurs in a recent National Science Library internal report on a planned STI (Scientific and Technical Information) system (4). The figure, again between 2% and 3%, is regarded by NSL workers as a composite figure, partially inferred from funding, via Lamontagne and the Science Council, partially drawn from Tyas, partially dependent upon some unpublished citation counting, and partially dependent upon inferences drawn from OECD reports (OECD, 1969; OECD, 1971). Unfortunately, this NSL report is not available, therefore, once more we do not have access in the open literature (5) to specific definitions of who is regarded as a Canadian author of scientific and technical literature, or to a description of the methods of identifying and counting Canadian journals. Finally, a survey by the authors of information science journals, both Canadian and non-Canadian, has not uncovered studies that would help answer any of the questions asked up to this point. We must conclude that the 3% figure, with all that it implies, is ill-defined and poorly supported in the open literature.

WHAT IS CANADIAN CONTENT?

Defining the Question

This paper will set forth some of the difficulties that arise in connection with determining precisely the Canadian content of scientific and technical literature; it will attempt to isolate some of the more troublesome contradictions and will offer suggestions for further

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(3)The relationship between funding and publication, especially in the Canadian context, could be discussed at some length. Lamontagne seems to be aware of the difficulties, but again he is handicapped by lack of rigorous studies, especially in regard to publications by Canadians.

(4)The authors are especially grateful to Dr. Jack Brown, the National Science Librarian, and Mr. Larry Coté, of NSL's STI planning group, for their helpful discussion regarding the figures quoted in the NSL internal report. It is unfortunate that the supporting citations for this report cannot be released at this time.

(5)A characteristic of information flow about information, in Canada, is the predominant position of government reports. "Open literature" in regard to British and American information literature presents a satisfactory mix. Open literature in Canada is of different composition.

studies and propose a theoretical framework for these. It will also contain the results of some tentative preliminary investigations. It is regarded as essential that the Canadian content in world scientific and technical writing be precisely defined, since so many conclusions, recommendations, and inferences stem from the ill-defined and undocumented figure that is quoted so frequently. Finally, the underlying theme of this paper is that a rewarding, necessary, and worthwhile area of study is open to Canadian information scientists if they wish to pursue it (6).

The major questions that we need to ask are the following: 1) What is meant by Canadian content in world scientific and technical literature? Is it material written by Canadians or is it material published by Canadians or both? 2) What is a Canadian in this context? 3) What is a "countable" Canadian publication? 4) Is there a direct relationship, in Canada, between the amount of scientific and technical research and development carried out and the amount of scientific and technical publication produced? This last is the question of output. If we believe there is, then how do we define the Canadian published scientific and technical information and how do we isolate other scientific and technical publications in which Canadians may publish? This leads us to the question of input. 5) Is industrial innovation, in Canada, related to the availability and use of scientific and technical information (Robertson, 1973; Economic Council, 1971). Lamontagne seems to imply that the relationship is weak, relying on American studies (Lamontagne, 1970, I, 4), but at the same time he recommends strengthening the Canadian STI network (7) and the implied purpose of this is to further Canadian innovation. What part does non-technical and non-scientific and non-documented information play in either input or output? If all these questions can be answered in some way, what then should be the relationship between information policy, science policy, and national policy? Many of these questions can be answered by specific studies, but up to this date

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(6)The pursuit of such study brings up questions concerning funding and competency in investigators. This paper will not discuss these, but recommendations in this area could well be made by CAIS/ACSI and implemented through MOSST grants or contracts.

(7)This ambivalence illuminates another set of assumptions that are frequently made. When the authors were investigating these problems, they were frequently asked if they were aware of studies such as those of Allen (1966). The accompanying statement always made was that we could assume these studies would apply to Canada (Dubas, 1973, 10). If so, however, then why does not a similar relationship have similar implications? For example, why is Canada not in control of its own industry as the United States obviously is?

these either do not exist or have not appeared in the open literature. To answer the first question, for the purpose of this paper, we shall say that Canadian content includes both material published in Canada and material published by Canadians. The other questions remain to be answered.

Canadian Scientific and Technical Literature

We must now define what constitutes "scientific and technical" literature, as it is published in Canada. At some point, we must also define what constitutes a Canadian who publishes scientific and technical literature. The first definition may seem like one on which everyone agrees. However, we may find two conflicting versions, one given by the scientific and technical librarian or editor and one given by the user. For this paper the better definition appears to be the one that defines Canadian scientific and technical literature as that which is both published and used for all aspects of scientific and technical input and output in Canada. This statement will lead us to conclude that the Canadian vehicles that convey scientific and technical information in Canada encompass the entire range from the scholarly scientific article to the news item. It is doubtful whether such a definition has been used to arrive at the figure of 3%.

Who uses what? However, the preceding general statement is not very satisfactory because we do not know much about Canadian use. We do not know, for example, to what extent the Canadian scientist uses non-Canadian (meaning published outside of Canada) sources for either input or output (8). Consequently, we do not know overall how significant are his contributions to the Canadian-based literature. The inference drawn by many of the government sponsored studies, that we must have access to 97% of the world's scientific and technical literature, leads us to believe that the report writers assume the Canadian scientist or technologist is a very heavy user of non-Canadian sources, although, as we have seen, the reports are not always adequately documented. The information science literature of other nations carries many documented citation counts and the interpretations of these (Lamontagne, 1972, II, 413). Where are our citation counts? Where is the Canadian information science literature in which we should find them?

If we move through the ranks of others concerned with scientific and technical information in Canada, we find that we do not know what applied scientists, engineers and industrialists use for input and output.

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(8)Katz quotes a 1969 study of the Canadian Journals of Research, which again he does not document. This study gives national origin of the articles (Katz, 1969, 18).

There is much inference but little data. What do they read and where to they publish (9)? We encounter the same problem when we consider the makers of scientific and technical policy, the minsters, deputy ministers, and their advisors. There has been very little analysis of Canadian administrators' periodical routing slips (10). We should probably find, and this is the inference also made by Tyas and Fortier (1969), that the policy makers do not use the formal scientific and technical literature. Again such inferences are generally supported by references to American and British studies (Dubas, 1973, 17,27). Once more we lack our own documentation (11) and, lacking this and its accompanying rigorous analysis, we cannot analyze adequately the corrective actions initiated or proposed (Dubas, 1973, 10). We cannot be sure that proper steps are being taken to bring Canadian scientific and technical content to the attention of Canadian policy makers. It is also unclear what communication links will develop between our scientists, our technologists and our policy makers if all are dependent upon a national network that emphasizes foreign scientific and technical information sources.

THE INFORMATION MANAGEMENT COMMUNITY: POLICY GATEKEEPERS?

There seems to be general agreement that information policy should serve public policy. The studies that we have been referencing, Tyas, Katz, Lamontagne, all agree that an information network is necessary, although its primary aim seems to be to make accessible the 97% of the world's scientific and technical literature that Canadians do not generate. Presumably, such a network will be of benefit to our pure scientists and

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(9)The study by Dubas and Martel (1973), currently being supported by MOSST should supply information about policy makers' use of science information in the general media.

(10)One of the authors carried out a very brief informal survey of such routing sheets with the collaboration of fellow information scientists. Canadian Research and Development and Canadian Data Systems were routinely preferred to Science Forum. Insufficient material has been collected to date to justify more than a general conclusion.

(11)Another brief, unpublished survey by Heaps and Cooke, circa 1970, found that editors of certain Canadian trade journals were not interested in receiving papers on scientific and technical information dissemination techniques even when the authors were willing to write them for the trade journal's specific audience. The remark was made that such information "did not tell the readership how to make a fast buck and that was what they were interested in" (Cooke, 1970; cf. Davy, 1970).

to some of our applied scientists, however, it will do little to disseminate information about our scientists' and engineers' work to Canadians in general, for whom and by whom policy is made in the long run. Yet, it is evident that the reports cited are concerned with this aspect of public or social policy; and they contain recommendations about the need for scientific and technical information to be more widely available; these recommendations include references to the employment of "information officers" to help in the dissemination. The skills required by such information officers are not defined (Lamontagne, 1970, I, 181).

Unfortunately the information officer may be primarily a journalist to whom the "form" and the "immediate impact" of the publication is of more importance than the content (Heaps, 1968). In certain instances such an information officer may be in charge of the scientific and technical publications of a task force or research group, yet be totally unaware of who the primary audience is or of the necessity for listing the publications in indexes (12). He may not realize that scientists are notoriously insensitive to "saleable" form in publications or that they may react against it. But "saleable" form is necessary to convey information to the general public. It is probably true that two types of information officer, the journalist/public relations/information officer and the information specialist/special librarian/engineer/ information officer, who manages an SDI information centre, for example, are necessary for the identification and dissemination of Canadian content, but their roles should be defined, their jobs specified, and their activities linked (Mercer, 1973).

The lack of definition and coherence in the information management community and a similar lack of widespread understanding of information tools is closely related to the difficulty of making Canadian content accessible to Canadians at all levels. Scientific and technical information may come from a press release incorporated in an article in the Financial Post or it may come in an SDI printout and it must "fit" the receiver. The advocates of the proposed information systems never seem to acknowledge the existence of varying levels of need (Heaps, 1971; OECD, 1971, 122). Indeed, the information management community has not come to grips with its most important question. Why do Canadian policy makers

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(12)The reports that we have been referencing display some peculiar bibliographic anomalies. While one may agree with criticism directed at the traditional bibliographer, overly concerned with describing the height of the book, one should admit that it is useful to have listed a clearly defined publisher, date of publication, and supporting references and footnotes (see Tyas, II, chpt 3, for conflicting standards. See also Beaulnes (1973) and Worth (1972).

managers, and innovators have so much trouble assimilating scientific and technical literature, so much difficulty in fact that there have been reiterated demands for a special class of intermediary (Heaps, 1970)? Even Lamontagne never seeks to uncover the basic reasons for the existence of his three solitudes, industry, government, and the universities.

DIFFICULTIES AND EXAMPLES

Let us now summarize. Let us acknowledge that scientific and technical publication in Canada covers the entire range of form and content level, but we must admit that there is no hard data on who uses what, for what, or how much, or on who is responsible for different forms of content transfer. That is to say, if we define a Canadian research scientist or development engineer or information manager, as a person born, naturalized or permanently resident in Canada, we do not know what he reads, where he publishes, or to what extent his work reaches the Canadian policy maker. If we use the Science Citation Index to trace the work of one of these Canadians we do not know what percentage of his work is cited there (Appendix A) (13). We do not know where else he publishes. Suppose he is a government scientist. Does he produce one research paper a year for a journal that might be cited (Lamontagne, 1970, I, 233) and four departmental reports, which may or may not be indexed or listed in Canadiana? Does some of his work appear in a Canadian trade journal as a result of his having a beer with a journalist at a conference? Is this trade journal item what the minister in the relevant department sees? Granted the concentration of Canadian trade journal editorial power in central Canada, does this mean that a study of Canadian trade journals will indicate more active Ontario and Quebec scientists than Alberta, Saskatchewan, and Manitoba ones?

Similar difficulties will be encountered when we look closely at the scientific and technical literature. What is meant by the entire range and should all within it be considered equally? Lamontagne states that sometimes scientific output is measured by publication in reputable journals (Lamontagne, 1970, I, 118). What are our reputable journals? For example, the Canadian Library Association does not consider the publication, Automation in Libraries, sponsored by one of its divisions, as reputable (Canadian Library Association, 1972/73). Therefore, the articles regarding library automation in that publication are not available to the information scientist who is not a member of CACUL. Would the articles be counted as Canadian content? If we are this rigorous in our definitions, should we then discount items such as the

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(13)American copyright law states that the publication is property of the journal in which it is published (Koch, 1974).

NTIS reports when we make our proportionate comparison between Canada and other countries? Although these reports are widely available and are listed and indexed we should not regard them as reputable publications if we are using the Canadian Library Association criteria (14). On the other hand, if Automation in Libraries becomes available through ERIC/CLIS is it then an American or Canadian publication? If a Canadian writes a Ph. D. thesis in an American school of information science and if the thesis is published in a report series and listed in ARIST, is it then Canadian or American (15)? If we relate the counting to funding, should it be Canadian if the Canadian university provides support during study leave? We know the chances of such a thesis being listed are fairly high, but what of Canadian work appearing in Canadian university report series? Individual universities frequently do not keep account of these or list them; they may or may not be indexed (CACUL, 1973; Boyer, 1973). How much Canadian content of this type is invisible? How is the invisible part related to the 3%? Could it throw light on the connection between funding and publication? The equation of funding and publication seems even more open to attack, when one takes into account the generally poor state of Canadian government and university bibliographic control and the weakness of Canadian publishing in general (Ernst & Ernst, 1970; Ontario, 1972; Pross, 1972).

The "publish or perish" theory, much attacked at present, at least permits some relationship to be established between research support, promotion, publication, and innovation; the identification of a degree of relationship would contribute to our knowledge of Canadian content. However, we do not know to what extent evidence of publication is a general criteria for awarding grants and contracts (Lamontagne, 1970, I, 413). Further, if we critize this criterion as unrealistic, we must be prepared to substitute another one, and we must cease to think that it is important for our scientists and engineers to have access to such published information or to contribute to it. In other words we must cease quoting the 3% figure.

SUGGESTIONS AND STUDIES

This paper has asked more questions than it has provided answers to or offered data on. We shall now attempt to fill one or two of these gaps. We recommend that studies should be done of the use of Canadian scientific and technical literature both for input and output; in these studies Canadian content should be strictly defined. These definitions

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(14)Cf. Pross' desire to have "processed" documents counted.

(15)Cf. the "uncountability" of Penner's work (1972) which has Canadian content.

should cover the author, the vehicles in which he publishes or which he uses to obtain Canadian scientific and technical information. Some of this could be accomplished, for example, by working from the list of federally supported university research (National Science Library, 1973), distribution of the inevitable questionnaire to an appropriate sample, followed by a check of university presidents' reports, where these list faculty publications.

In this context it would be very helpful for Canadian information scientists to have readily accessible for thorough analysis and study, with eventual publication of results in the open literature, the mass of material contained in the supporting documents for the Tyas study (Anderson, 1974; Heaps, 1968). These documents are held in the Documentation Centre of the National Library and are available by special permission. A somewhat similar situation exists in regard to certain of the Lamontagne briefs and other parts of the proceedings of committees and task forces. Critical summaries of this material should appear in Canadian library science or information science literature (16). These summaries should reach a cross section of those concerned with scientific and technical information. This proposal raises the question of where will such analysis be published in order to reach those interested.

Several tentative studies of the type suggested have been completed by the authors, the results of which are discussed briefly below. The studies include the following:

1) An examination of the publications of a small group of Canadian researchers. This group included people at all levels, publishing in various types of outlet.

2) An examination of a set of notification lists of current work. This set did not include the total publications of the people surveyed and it reflects some subjective judgements concerning "reputable" journals.

3) An examination of a collection of reprints.

4) An examination of the citations in a well-known and widely disseminated report.

5) An examination of the "visibility" of Canadian theses and their

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(16)The short-lived Information Science in Canada carried such reviews in its two initial issues (1970). The business press published a little known and difficult to obtain monograph summarizing the Lamontagne briefs.

contents.

6) An examination of general sources used by a cross section of Canadian academics.

Some general observations may be made on these preliminary studies; they follow in the order as given above.

1) Although no exhaustive checking of publication titles against titles indexed by various services was done, it seems that, in certain instances, at least fifty percent of the publications would not appear in cited sources (see Table I, Part I).

2) There is a definite bias towards American and international journals and an avoidance of Canadian ones. Sometimes no reputable Canadian equivalent exists. What is the implication of this finding for the transfer of Canadian information to Canadian policy makers? We acknowledge that the information transfer process may be devious, but if there is no original Canadian source, it surely has less chance of taking place at all (see Table I, Part II).

3) One year's collection of reprints of a government research organization showed that about three quarters of the publications appeared in the journal or proceedings literature. One quarter were listed as monographs. About a quarter of the monographs were chapters in a book published in the United States, the remainder were government reports. The most popular vehicles for the periodical publications were proceedings of conferences and symposia, and a Canadian trade journal. Neither the proceedings nor the Canadian trade journal appear in the source journals of Science Citation Index, and it is doubtful whether they would appear in the citations. In total, of the journal publications, just under half appeared in journals not listed as source journals. The authors, and, therefore, the results of their research are not as visible as those who publish in SCI source journals or frequently cited journals. Little of this material would appear in citation counts of Canadian content and without doubt the chapters of the book, even though edited by a Canadian, would eventually be regarded as a contribution to the American scientific and technical literature.

4) In regard to the policy report, the citations were interesting (Table II). Canadian sources quoted were mainly governmental publications, news items, or trade journal items. The theoretical sources were British and American and were, in the main, published in the non-governmental open literature. Further, it was interesting to note that six of the references cited the same study, three of the six references were to unpublished seminars and three were to journal articles. These six references were in non-Canadian sources. Many Canadians, including

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TABLE I, PART I

Publications of Canadian Scientists and Engineers*

AUTHORS	ORIGINS OF PUBLICATIONS USED				
	American	International	Canadian Periodicals	Reports	Other
A (15 total)	4	5	1	4	
B (5 total	1	2	2		
C (7 total)	5	1	1		
D (59 total)	22	3	16		16
E (29 total)	13	6	4		

* A, B, C, and D were members of an applied research group. E was an engineer working in a related area. A, B, and C's publications appeared during a 6 year period and approximately 50% of these references would not be cited in Science Citation Index. The publications of D and E covered an entire publication history.

TABLE I, PART II

Current Notification Lists of Canadian Engineers' Publications*

ORIGINS OF PUBLICATIONS USED				
American	International	Canadian	French	British
18	3	0	1	2

* The publications covered here consisted of papers posted on notice boards for general information purposes.

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TABLE II

Citations in a Policy Report

American		Canadian		British		Other	
Open*	11	Open	0	Open	5	Government	1
Institution	3	Institution	4				
Government	2	Government (published)	14				
University	4						
Unpublished	3	Government (unpublished)	1				
		University	1				
		Unpublished seminar or symposium	4				
		Trade Journal	1				
		News Item	3				

* Open literature, as used here, means non-university, non-institution; in general, material issued by general commercial publishers. Well-known university presses, such as MIT Press, are counted with these, if the publication is not subsidized by granting agencies. Such a granting agency in Canada would be the Canada Council.

professional information workers, often state that we should not add to the paper pollution by starting new journals. Perhaps many Canadian scientists are overly scrupulous about publishing results once only and in not "rehashing" these. Such scruples are in accord with the best scientific ethic, but they disregard Canadian reality. Such an attitude assumes 1) that we have a well-constructed and well-refereed bibliographic structure like that of the British, where the results will be known and judged by an elite and transferred to a political elite (17) or 2) that bad money will not drive out good, that if the report of an American experience appears five times in various forms it will not reach the attention of the policy makers before the once published Canadian one.

What is the implication of such an attitude if we are self-denying and others are not? In the long run it has been harmful. We lack tools that we need. For example, only with the recent pressure for the introduction of Canadian studies has there been any attempt to look at the adequacy of Canadian bibliographic sources to support these studies (18); only over the past few years have we had available an adequate Canadian vehicle in which to publish articles on the Canadian content in scientific and technical information (19).

5) Information on Canadian theses is found mainly in two places: 1) the annual bibliography, Canadian Theses, a monograph publication. The latest issue available is for the 1969/70 year. How widely known is this publication and were the scientific and technical theses listed included in the 3% Canadian content? 2) The theses are also available through the Canadian theses on microfilm project. Support for this is on a voluntary

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(17)It is only too evident that many Canadians assume that the invisible college network that operated in the time of C.J. Mackenzie and C.D. Howe still works well. It has, in effect, broken down (Lamontagne, 1970, I 62).

(18)The UBC School of Librarianship is sponsoring a National Conference on the State of Canadian Bibliography, May 22-24, 1974. It will look into the adequacy of Canadian bibliographic support for Canadian studies. Hopefully some suggestions will emerge that will be of use to Canadian information studies (UBC, 1974).

(19)The conferences of the Western Canada Chapter of ASIS and of the Canadian Association for Information Science have brought together people from many fields who must be involved if problems concerning Canadian content are to be solved (WesCan/ASIS, 1969-73; CAIS, 1973).

basis and is not uniform throughout Canadian universities. Some universities contribute their listings to U.S. Dissertation Abstracts. A listing of the theses on microform is Part II of Canadiana. Canadiana, Part II does not indicate what universities are contributing or whether the coverage is complete. In both instances, each theses is classified under a broad Dewey heading which provides the main access point. This access point is not always the most satisfactory for those seeking Canadian scientific and technical information. How "visible", "available" or "countable" is this Canadian content? For example, how would the user track down theses in computing science (Appendix B)?

6) Several interesting conclusions can be drawn from the survey of general sources used by a cross section of Canadian academics (Table III). When the academics consulted news-magazines or similar publications for general political, social, and scientific information, they used primarily American sources; when they read Canadian newspapers, they confined themselves to the local papers. Therefore, the quality of the information they obtained concerning Canadian science and technology, outside the specialized information in their own fields, would depend upon its coverage in local newspapers and in non-Canadian news-magazines. There was little reliance upon sources such as Science Forum.

The authors do not make any claim that the studies they have done or the rough data given in this paper are definitive. They suggest, however, that there is need for definitive studies.

CONCLUSIONS

The particular studies and the overall survey, covered in this paper, generate an impression of marked deficiencies in many areas. These deficiencies exist whether we consider ourselves a so-called advanced nation and compare ourselves with Europe and the United States, or whether we try to look at our needs from the standpoint of our own priorities without preconceived placement. The latter approach is more illuminating; it allows us to ask why we are as we are rather than why are we unlike the United States, or England, or France or the Ukraine.

Canada is a strange mixture of a developed and underdeveloped country (Doern, 1972) and recognition of this permits many anomalies to be explained, as, for example, the weakness of our bibliographic structure, illustrated by the very late development of our national library. We still lack adequate bibliographic structures to carry, disseminate, and encourage the production of our information (Alley, 1973; Heaps, 1972; Beaulnes, 1973). We have no significant applied science press; we have not developed the type of publication of which the Journal of Applied Chemistry is an example, combining as it does features of the scholarly

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TABLE III

Sources of General Information for University Personnel*

NEWSPAPERS		NEWS-MAGAZINES (and related sources)		CANADIAN PERIODICALS (named)
Local (city)	26	American	29	Saturday Night
Other Can.	2	Canadian	10	McLeans
American	8	British	1	Canadian Geographical Journal
British	5			Beaver
French	1			Canadian Historical Review
				Canadian Dimension
				Canadian Forum
				CAUT Bulletin

* A total of 17 people were interviewed; 7 were professors; 7 were university administrators; 3 were student administrators. They were asked to name sources of information. Their fields of study included political science, history, commerce, engineering, English, philosophy, sociology, humanities of science, economics, mass media.

scientific publication and the trade journal. We do not have other journals and various instruments necessary in certain specific Canadian areas. We do not have abstracting or review journals needed to link various groups together (Katz, 1969, 8; Lamontagne, 1970, I, 339). We have had excessive government publication, similar to what Lamontagne regards as excessive government research (Lapp, 1970). These conditions are characteristic of an underdeveloped country. Therefore, the problem is more complex than either the MOSST study or the surveys of Canadian publishing problems lead us to believe (Dubas, 1973; Ernst & Ernst, 1970; Pross, 1972).

At the same time, however, we use advanced technology as the foundation of services such as CAN/SDI and CAN/OLE; speakers at Bell Canada seminars tell us we are a country in the post-industrial age; Lamontagne recommends the establishment of a commission on the future; and this country produced McLuhan. In the long run, however, an exact study of the Canadian content of scientific and technical literature is needed. Such a study should provide much of the information necessary for Canadians to build adequate bibliographic and other information structures, to invent new mechanisms, and to incorporate new techniques in order to answer the needs of a country at the crossroads (Heyworth, 1973; Alley, 1973; Heaps, 1972).

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APPENDIX A

Canadian Source Journals in Science Citation Index

Arctic
Can Aeronautics and Space J
Can Anaesthetists Society J
Can Entomologist
Can Farm Economics
Can Institute of Food and Technology J
Can J of Animal Science
Can J of Behavioural Science
Can J of Biochemistry
Can J of Botany
Can J of Chemical Engineering
Can J of Chemistry
Can J of Comparative Medicine
Can J of Earth Sciences
Can J of Genetics and Cytology
Can J of Mathematics
Can J of Medical Technology
Can J of Microbiology
Can J of Ophthalmology
Can J of Pharmaceutical Sciences
Can J of Physics
Can J of Physiology and Pharmacology
Can J of Plant Science
Can J of Psychology
Can J of Soil Science
Can J of Spectroscopy
Can J of Surgery
Can J of Zoology
Can Mathematical Bulletin
Can Medical Assoc J
Can Metallurgical Quarterly
Can Mining and Metallurgical Bulletin
Can Psychologist
Can Review of Sociology and Anthropology
Can Veterinary J
Can Aeronautics and Space Institute Trans
Clinical Biochemistry
Forest Chronicle
J of Can Petroleum Technology
J Fisheries Research Board of Canada
J Royal Astronomical Society of Canada
Memoirs Entomological Society of Canada
Naturaliste canadien
Proc Entomological Society of Canada
Proc Geological Assoc of Canada
Publications Dominion Astrophysical Observatory Victoria B.C.
Pulp and Paper Magazine of Canada
Revue canadienne de Biologie
Trans Royal Society of Canada
Union medicale du Canada

CANADIAN CONTENT

APPENDIX B (1)

Numbers in parentheses are Dewey classes.

APPENDIX B (2)

Theses in microform
including Canadian theses on microfilm

Microcopies de thèses
y compris les thèses canadiennes sur microfilm

Arranged under broad Dewey classes
Classées dans les grandes divisions de la classification décimale de Dewey

000 GENERALITIES – GENERALITES

Akiyama, Shigeko

Automatic document classification systems/ by Shigeko Akiyama. – 1972.

ix, 97 ℓ.

Thesis (M.Sc.)—University of Alberta, 1972.
Bibliography: leaves 78-80.
Microfilm of typescript. Ottawa: National Library of Canada, 1973. – 1 reel; 35 mm. – (Canadian theses on microfilm; no. 13277)
Positive copy: $2. Cataloguing Branch, National Library, Ottawa.

I. Title. II. Series: Canadian theses on microfilm; no. 13277.

CT73-1968

Enerson, Ronald Curtis

A data structure approach to interactive graphics software/ by Ronald Curtis Enerson. – 1972.

,12,, 206 ℓ.: ill.

Thesis (M.Sc.)—University of Alberta, 1972.
Bibliography: leaves 184-188.
Microfilm of typescript. Ottawa: National Library of Canada, 1973. – 1 reel; 35 mm. – (Canadian theses on microfilm; no. 13362)
Positive copy: $2. Cataloguing Branch, National Library, Canada.

I. Title. II. Series: Canadian theses on microfilm; no. 13362.

CT73-2051

Lo, Adrian K.

An automatic optimum iterative feedback document retrieval system/ by Adrian K. Lo. – 1972.

109 ℓ.: ill.

Thesis (M.Sc.)—University of Alberta, 1972.
Bibliography: leaves 84-85.
Microfilm of typescript. Ottawa: National Library of Canada, 1973. – 1 reel; 35 mm. – (Canadian theses on microfilm; no. 13455)
Positive copy: $2. Cataloguing Branch, National Library, Ottawa.

I. Title. II. Series: Canadian theses on microfilm; no. 13455.
Full name: Adrian Koo Lo.

CT73-2096

100 PHILOSOPHY & PSYCHOLOGY PHILOSOPHIE ET PSYCHOLOGIE

Andreotti, Larry Raymond

Temporal acuity of the visual system/ by Larry Raymond Andreotti. – 1972.

vii, 51 ℓ.: ill.

Thesis (M.Sc.)—University of Alberta, 1972.
Bibliography: leaves 33-34.
Microfilm of typescript. Ottawa: National Library of Canada, 1973. – 1 reel; 35 mm. – (Canadian theses on microfilm; no. 13283)
Positive copy: $2. Cataloguing Branch, National Library, Ottawa.

I. Title. II. Series: Canadian theses on microfilm; no. 13283.

CT73-1974