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public Knowledge': The Dissemination Of Scientific Literature In Victorian Canada As Illustrated From The Geological And Agricultural Sciences

Bertrum H. MacDonald

'PUBLIC KNOWLEDGE':

THE DISSEMINATION OF SCIENTIFIC LITERATURE IN VICTORIAN CANADA AS ILLUSTRATED FROM THE GEOLOGICAL AND AGRICULTURAL SCIENCES

by

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ABSTRACT

During the Victorian period when scientific work was established in Canada, Canadian researchers knew that access to the published literature was a crucial link to national and international scientific developments. This dissertation examines the effectiveness of the dissemination of scientific literature in Canada from the late 1830s to the end of the first decade of the twentieth century in two subject areas: geology and agriculture. It studies the careers of six scientists: Robert Bell, Elkanah Billings, Sir John William Dawson, James Fletcher, Sir William Edmond Logan, and William Saunders to learn what scientific literature was read and where it was or could have been obtained.

The dissertation explores four aspects of the dissemination of scientific literature: characteristics of the literature that the six scientists actually read; the nature of accessible scientific literature as ascertained from an examination of the personal libraries of the six scientists and the scientific literature acquired by six institutional libraries; and finally the role played by members of the publishing industry in the dissemination of scientific literature.

The research involved the creation of a database of citations for a study of reading patterns, the reconstruction

of the six scientists' personal libraries, completion of groundwork to establish the history of the six institutional libraries, and description of the activities of members of the publishing industry.

The findings of the study include the following: current periodicals and report literature formed the bulk of scientists' reading material; reprints in the thousands were circulated among scientists and libraries; exchanges formed a significant component of both personal and institutional collections of scientific literature; scientists played a leading role in disseminating scientific literature; Canadian researchers read widely, mostly scientific literature published in the United States and the United Kingdom, but European publications were consulted as well; and members of the publishing industry promoted the diffusion of scientific literature primarily through extensive advertising.

By mapping out a previously uncharted area this dissertation provides a detailed positive answer to the question: did Victorian Canadian scientists have access to the international scientific literature of the period?

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Chapter I - Introduction

For several centuries scientists have understood that the disclosure of the results of their research is of central importance for the promotion of further scientific discovery. John Ziman in his book, *The Force of Knowledge. The Scientific Dimension of Society*, states it clearly. Science, he claims, is "by its very nature a body of *public* knowledge, to which each research worker makes his personal contribution."[1]

During the Victorian period when foundations for scientific work were being established in Canada, researchers in this country were fully aware of the need both to be informed about scientific developments and also to have access to that information in the form of the published literature. If they recognized the need, the question is how well served were Canadian scientists in this regard?

Part way through the Victorian period, the New Brunswick palaeontologist, G.F. Matthew, wrote from his home in Saint John to J.W. Dawson, Principal of McGill University, in Montreal:

> Perhaps the work here would have been better, and the fruit more abundant, if this had been a collegiate centre and standard books more available.[2]

Matthew, in this brief statement, gave voice to a view shared by many in the world of science. The availability of scientific information, communicated both directly from other investigators and indirectly via relevant scientific literature, was recognized as essential to scientific work.[3] Throughout more than two centuries preceding Matthew's letter, scientists and others (such as publishers) had developed a variety of methods for making public the results of research. At the same time that they were contributing to the growing volume of international literature, scientists in Victorian Canada were also tapping into that body of information.

In this dissertation a number of questions concerning the dissemination of scientific information in Victorian Canada will be addressed. How accessible was scientific literature? Where was it coming from? How current was it? What types of literature were consulted? What agencies facilitated the dissemination of scientific literature? Were Canadian scientists isolated from the international scientific literature? In other words, how can the distribution of scientific literature in Canada in the last century be characterized?

During the careers of G.F. Matthew and J.W. Dawson dramatic developments took place both in the sciences and in the growth of scientific literature and related tools of access. A.J. Meadows, a historian of science and of librarianship, has noted that:

> In the early days of science, when it was a relatively small-scale enterprise, the dissemination and retrieval of research results could be carried out on a personal and often fairly haphazard basis. With the continuing growth of science in the nineteenth century, it became clear that a more systematic and organized approach to these activities was needed, if the expansion of research was not to be

> hindered by communication problems. At the same time, the increasing complexity of science made its methods and results less and less comprehensible to the general public. Hence, particularly in the latter part of the nineteenth century, it came to be recognized that there were problems in the dissemination of research both within the scientific community and outside it.[4]

The communication of scientific ideas or the findings of research can, as Meadows suggests, occur on two fronts -- among peers of the scientific community, and between the scientific community and the public at large. Some scientists saw the value of both. Writing about science and intellectual authority in nineteenth century Britain, Richard Yeo has said that "leaders of the scientific community believed that their interests would be served by the dissemination of scientific ideas and attitudes throughout society."[5] Yet, for most scientists primary interest in matters of communication rested with direct or indirect contact with their peers.

Popularity of Science

Turning back to the Canada that Matthew and Dawson knew, W.L. Morton claimed two decades ago that the "true intellectual achievement of Victorian Canada was neither in literature nor theology but in the sciences."[6] More recently, in a cogently argued essay, Suzanne Zeller has asserted that the sciences practised in Canada in the last century helped to create the very nation of Canada. She has written: "Victorian inventory science defined premises upon which a certain

Canadian nation could be built, and which gave rise to 'national' policies designed to safeguard that existence."[7] Taken together, the conclusions of Morton and Zeller attest to science as a significant aspect of Canadian society in the last century and, in recent years, discoveries of other historians of science in Canada give credence to this view.[8]

In Canada, as elsewhere, science was immensely popular during the Victorian period.[9] Evidence can be found in the large numbers of people who took out membership in natural history societies and who attended lectures, meetings, and outings of these organizations.[10] In the western world the dissemination of the new knowledge that the scientists were discovering was not restricted to scientists alone or even to "the scholarly world but soon spread first to the upper and middle classes and then...to all segments of society."[11] There was a "mania" for observing nature in the nineteenth century, and, as Martin Fichman has noted, the literary and scientific cultures had not diverged in the Victorian period, but "rather a profound and often provocative discourse, shared by both writers and scientists, developed which sought to interpret the broader cultural significance of science (and technology) and assess its impact upon traditional religious, philosophical, sociopolitical, economic, and educational values and institutions."[12] David Knight may in fact be right in stating that the nineteenth century was "The Age of Science."[13]

Some scientists in the last century and a number of scholars more recently have expressed the view that Canada was at the periphery of scientific endeavour during the Victorian era.[14] That Canada has produced no Darwins, Liebigs, Faradays, Lyells or Thomsons is advanced as evidence of this opinion.[15] In 1881 when the British Association for the Advancement of Science debated whether to take its peripatetic annual meeting outside of Britain with a visit to Canada (it did travel to Montreal in 1882), "Canada was indeed conceived as a provincial extension."[16] If Victorian Canada was on the fringe and if science played the significant role in Canadian society that the Morton/Zeller appraisal suggests, how good was the access of Victorian Canadian scientists to scientific literature? Bruce Manzer has written, that in the nineteenth century "burgeoning scholarship, particularly in the sciences and technology" produced such a growing body of literature that scholars even in established centres found difficulty in keeping abreast.[17] How possible was it for Canadian scientists of the period both to remain informed and to obtain access to the scientific literature?

Communication in the Sciences

Derek J. de Solla Price, a noted historian of science, has been credited with declaring that "science is papyrocentric" by which he meant that scientists feel "heavily motivated to publish" in the public domain.[18] Yet, not only do scientists feel obliged to publish the results of their research, they must also "interact" or relate their findings with the already existing literature.[19] This characteristic of scientific activity has existed for over three centuries and its importance has long been recognized by scientists. Historians of science, librarians, and information scientists, however, have only in the last few decades found reason to give closer scrutiny to this requirement that scientists communicate with other researchers via the formal literature.

In a 1983 paper, sociologists Augustine Brannigan and Richard A. Wanner raised the question of whether multiple discoveries of the same scientific phenomena, which have been reported over the centuries, could be accounted for by delays in communication. Then, using data from the sixteenth through twentieth centuries they set out to answer their own query. Their analysis led them to claim that over time there was a systematic decline "both in the average grade [rate] of multiple discoveries and inventions and the average interval between first and last instances of a multiple." They attributed this decline to improvements in communication brought about by "population growth and development of scientific infrastructures."[20] While it can be argued that multiple discoveries of the same phenomena entail factors other than communication alone, scholars who have investigated the properties of science generally stress that communication plays a fundamental role. Garvey, for example, epitomizes this view by titling his book on the topic, *Communication: The Essence of Science*.[21] More explicitly, he wrote that "the interactive flow and use of information is now viewed as an inseparable part of the research process."[22]

The significance of the formal literature in the scientific enterprise can be illuminated by examining disfunctions. Here, a classic case in scientific discovery in the last century illustrates the outcome of the dissemination of scientific information. In 1865, a Moravian monk, Gregor Mendel, in a study of the common garden pea (*Pisum*), discovered the basic laws of heredity and provided a foundation for what later became the modern theory of genetics. Mendel reported his research to a local scientific society (the Brünn Society for the Study of Natural History) and published his paper in their Proceedings (*Verhandlungen*) brought out in 1866. Then, for the remainder of the century, Mendel's "brilliant, rigorous and systematic" work lay dormant. Not until 1900 when other scientists "rediscovered" the same principles was Mendel's earlier work recognized. A number of explanations have been advanced to account for the initial neglect of Mendel's paper. Some have suggested that his work was known but ignored, others have argued that Mendel's paper was unknown, while still others, Gasking for example, have suggested a combination of the previous two views.[23] A recent paper by Michael H. MacRoberts has added to the debate by claiming that "communication among scientists is not good and never has been."[24] In the case of Mendel the data shows that about 120 copies of the Brünn Proceedings had been sent in exchange to institutions around the world and Mendel himself had circulated copies of his paper. MacRoberts argues that "an examination of [the] nineteenth-century data in terms of recent knowledge about scientific communication suggests that knowledge of Mendel's *Pisum* work (unlike his *Hieracium* [hawk-weed] work) never entered the informal communication network of nineteenth-century botany, and that very few individuals, either by chance or referral, located the Brünn *Verhandlungen* and read the paper. By this interpretation, Mendel's work was not neglected, it was not known."[25]

This brief sortie into the Mendel story provides reason to make more pointed our question about how well served nineteenth century Canadian scientists were by available scientific literature. If Canadian scientists were on the periphery or "in the provinces" where it might be expected that informal communication with peers would be more limited than that which could occur in the metropolitan centres of Europe or the United States, then formal communication via the published literature took on all the more important role for the development of science in this country. When informal levels of communication were restricted by matters such as geography and few local colleagues, as indeed was the case in Victorian Canada, access to the relevant literature was a notable advantage and, when it was not forthcoming, scientists of the day voiced their complaints.

In a 1981 study analyzing Charles Darwin's reading habits, Susan Sheets-Pyenson asked the incisive historical question, "How do scientists use scholarly journals?" Her query led to a number of others which probed the matter of "how scientists decided what to select from the sea of information that swells about them"; but she observed that "answers to these general questions cannot be formulated until we possess individual studies for particular countries, periods, and disciplines."[26] Framed in the historical context of the Victorian era, Sheets-Pyenson's questions remain largely unanswered even though a considerable body of literature dealing with the dissemination of scientific information among scientists has grown over the last few decades. Studies of the dissemination of scientific information have been peripheral to the mainstream of the history of science[27] and in library and information science a great deal more attention has been given to an analysis of late twentieth century activity rather than to the patterns that developed in the Victorian period on which foundation the later period rests.[28]

The Scientific Literature of the Victorian Period

Writing about publishing in the sciences in the nineteenth century, H.W. Paul said:

> Blessed with conflicting ideologies, numerous intellectual movements, prolific authors, and cheap printing, the nineteenth century unleashed an unprecedented flood of the printed word.[29]

This flood of literature is seen most clearly in the marked increase in the number of scientific periodicals that were launched in the last century. David Kronick maintains that these scientific periodicals "are not the residue but the rich soil from which our modern science developed and grew."[30]

It is generally acknowledged that 1665 is a key point in the history of the published scientific literature for in that year the first two readily recognized scientific journals were established, one in Paris (*Journal des Scavans*) and the other in London (*Philosophical Transactions* of the Royal Society). These two journals served as models for scientific periodicals that followed in the decades and centuries since.[31] While periodicals were not at first seen as the leading form for publishing in the sciences, by the Victorian period scientific journals had become the dominant mode for reporting research results simply because they provided a more rapid means of dissemination of new scientific information than was possible with monographs.[32] With a form lying "somewhere between the book and the newspaper,"[33] the scientific periodical has survived for over three centuries adjusting where necessary to meet the demands of formal scientific communication.

The book or monograph did not disappear with the increasing prominence of the scientific periodical. For the rapid dissemination of the results of research, books were less effective than periodicals, but for some purposes they continued to be published. H.W. Paul has noted, for example, that "the monograph clearly fulfilled an important function in establishing an area of scientific investigation as a discipline, or at least as a differentiated sub-discipline."[34] In the early 1860s, about one book in ten published by Macmillan was devoted to science, medicine or technology and by the end of the next decade this had risen to nearly one in four.[35] In a few of the Victorian sciences, such as geology, the monograph or report literature continued to be published in high numbers.[36]

Scientific books also appeared during the nineteenth century in the form of textbooks, series, and collections. The latter brought together a selection of articles from a number of sources and served to disseminate periodical literature even further.[37] Textbooks held a unique position because periodicals infrequently acted in a teaching capacity, a role left largely to books. Whenever there was an expansion in education, particularly post-secondary education, the demand for books swelled. So, as the Victorian period progressed the requirement for textbooks increased.[38] Finally, a number of well-known books "in series" were published acquiring a growing popularity in Europe and North America late in the last century.[39]

It was the increasing number of scientific periodicals that seemed to capture the lion's share of interest in the Victorian period, however. As Charles Darwin wrote to the botanist, J.D. Hooker: "I like all scientific periodicals," or as the ornithologist, Charles Lucien Bonapart, said about journals becoming "every day more indispensable to the naturalist," scientific periodicals were recognized for their importance by Victorian scientists for keeping abreast of developments locally or more widespread.[40]

Scientific periodicals were the offspring of scientific societies as well as the product of the initiative of single individuals and, in the 1830s and 1860s (at least in Britain), a significant number of commercial firms entered the ranks of publishers of scientific periodicals.[41] Given the precarious nature of periodical publishing it seems unusual that so many of the new scientific periodicals were brought out by commercial publishers.[42] One of the reasons advanced for the introduction of commercial journals was that their speed and frequency of publication was an improvement over lengthy delays in publication in quarterlies brought out by scientific societies.[43] Naturally, an overriding concern with commercial publishers was that the periodicals pay their way. The nineteenth century is replete with examples of journals that failed financially, which were either discontinued or merged with competitors.[44] Some of the commercial periodicals were eminently successful and highly regarded. *Nature*, for example, has continued to publish right up to the present day.[45]

The Victorian era witnessed a number of changes in the structure of scientific periodicals as they adjusted to meet the changing demands of scientific communication. For example, by the end of the Victorian period the modern standardized format had emerged. "Covert plagiarism" or the practice of publishing the same article in more than one periodical was a widely accepted custom throughout much of the Victorian period although by the twentieth century scientists began to frown on this habit. Multiple publication, of course, ensured wider circulation of scientific discoveries and ideas and many scientists encouraged it.[46] The "Tower of Babel" obstacle (or proliferation of journals in many languages) continued to plague scientific communication even though journal editors attempted to overcome the problem through publication of translated articles, reviews of foreign books and periodicals, and the maintenance of exchanges of material with foreign editors.

Almost from the time of the earliest scientific periodicals in the seventeenth-century, readers complained about there being too many of them.[47] With the increased numbers of journals in the Victorian period the concern intensified. The volume of literature becomes clearer when one considers that by 1850 the cumulative number of articles published in scientific journals must have surpassed 200,000[48] and by the end of the Victorian period far exceeded this number. The problem was seen not just as a matter of a rapidly increasing volume of literature but also as the two fold issue of identification and access. Access to some periodicals was limited.

Some, because of the cost of distribution, required subscribers to pick up their copies at the editorial office.[49] The dissemination of the published records of both large and small scientific associations was a "fairly leisurely process throughout much of the eighteenth and nineteenth centuries."[50] As late as 1879 C.A. Young writing from New England to the editor of *Nature* indicated it might be two or three years after the publication of the *Philosophical Transactions* of the Royal Society before he would receive copies.[51] In the United States the American Naturalist's Agency was established primarily to facilitate the distribution of papers and pamphlets on natural history.[52]

Because of the pending breakdown in bibliographic control of scientific literature in the latter half of the nineteenth century, a number of measures were taken to deal with the problem of identification. The principal means adopted was the publication of abstract journals and from the 1860s onwards a growing number of these periodicals were introduced.[53] Another publication which grew out of the concern about identification of scientific literature was the major Victorian scientific bibliography, the *Catalogue of Scientific Papers, 1800-1900* published by the Royal Society of London.[54]

A remaining matter concerning the scientific publications of the Victorian period (both periodicals and monographs) is the question of readership. This issue is probably the most difficult of all with which to deal, and although a number of scholars have investigated the matter none has been altogether successful in providing an answer. Alvar Ellegard was one of the earliest to study this question and he forthrightly stated that the readership of each periodical is "rather difficult to come by."[55] He elaborated

> Scarcely any direct information of the characteristics of the readers of each periodical exists. Those were not the days of market research and readership surveys. Some clues, indeed, can be obtained from descriptions and advertisements in the advertisers' handbooks and directories of the time. But in the main the readership has to be inferred from the periodical itself: its general appearance, its price, its style and tone, its opinions and contents.[56]

Writing about farming encyclopedias, G.E. Fussell suggested in a similar vein that "any attempt to assess the readership of these encyclopedias can be no more than a slightly informed speculation."[57]

Following Ellegard's lead those scholars who have attempted to assess readership of periodicals either have based their conclusions on the characteristics of the journals themselves or have looked at known press runs to arrive at a rough estimate of how widely read these journals were. Similarly, studies of the readership of monographs have concentrated on bibliographic evidence, e.g., the number of editions and press runs.[58] While some books and periodicals received wide circulation, many did not. Few journals saw the extraordinarily high number of 132,000 subscribers enjoyed by the Paris periodical, *Journal des connaissances utiles*,[59] and few books merited the six editions and 20,000 copies which Robert Chamber's *Vestiges* achieved in the mid-nineteenth century.[60] Even widely respected scientific periodicals were rarely produced in more than 1,000 copies. The number of personal subscriptions may by itself, however, be a misleading indicator of readership. Most copies of the *Philosophical Magazine*, for example, were sent to other publishers for distribution. In 1851 there were only eighteen personal subscriptions to this journal and by 1905 the number had only increased to 201.[61] It is also difficult to determine whether a single subscription meant a single reader. For some periodicals such a relationship was almost certainly not the case. Goddard, for example, studied the subject of agriculture and attempted to arrive at an approximate multiplier for establishing readership from subscription data.[62] In this example, Goddard was able to conclude that although the majority of English farmers never read the agricultural periodicals as many as half of the critical "opinion leaders" did read the journals of the time. While the majority of subscriptions or purchases in the Victorian period were probably personal, by the end of the period it may have been, as one commentator suggested, that private subscribers were fast declining and libraries were taking on a greater responsibility for building collections of this form of literature.[63]

Contributions Made by This Dissertation

"Science is organized knowledge, and no piece of work, however complete in itself, is valued until it can be fitted into the general corpus." claims Elizabeth Gasking.[64] There was, therefore, a need for access to scientific literature in nineteenth-century Canada. Canadian scientists were scattered geographically and much of the scientific activity of the period occurred outside the country.

This dissertation examines the dissemination or flow of published scientific literature among scientists in Victorian Canada, with particular attention given to a study of that process among geological and agricultural scientists. For this analysis I have selected six prominent, Canadian scientists of the period to determine what scientific literature they were reading and where in their communities they obtained or could have obtained access to scientific literature.[65] By giving close attention to the activity of these scientists it is possible to develop an understanding of the dissemination of scientific literature in Victorian Canada. Dissemination is taken to mean simply the distribution and receipt of a particular scientific publication, noting that only formally published works are considered. Formally published scientific information is public and potentially remains permanent.[66]

It is generally acknowledged that scientists are influenced by other scientists and their publications both in terms of the problems that are selected for investigation and in terms of the methods employed in research. The determination of influence forms an interesting and challenging study all of its own.[67] But influence or cause and effect become "fuzzy words," as Paul Rutherford has written, and to be truly demonstrated "always requires a long list of actors and events to explain why things happen when and how."[68] In this dissertation no attempt will be made to describe the influence of scientific literature or the absorption of scientific ideas, although it is assumed that influence and absorption did occur.[69] It is important to note that the flow of information was not the only factor that promoted scientific research in Victorian Canada or indeed elsewhere; others included the availability of research equipment, space, time to do the work, and financing.

This dissertation will extend our knowledge in library and information science and also in the history of science in Canada. First, it will fill a gap in our comprehension of the nature and pattern of the flow of scientific information as represented by the published literature.[70] Second the dissertation will demonstrate a means of ascertaining the flow of scientific information historically which may find application in other settings. Third, by examining the foundation years for science in this country, the findings may help to explain later developments. Fourth, this study will place Canada in the international arena of science and give evidence which may be used for comparison in other investigations of information dissemination. Finally, the dissertation queries G.F. Matthew's complaint and finds that his view falls short at least for Canadians in major centres. In these locations substantial collections of scientific literature had been accumulated where scientific research was undertaken.

For an analysis such as that undertaken for this dissertation, primary data suitable for directly answering the question is often lacking; therefore, it is necessary to build a picture using several methods. Darwin, in the example cited earlier, was atypical of scientists of the period (and even since) for very few researchers followed his pattern and kept meticulous records of what they had read and their thoughts and musings from such study.[71] Surviving detailed accounts of this nature do not exist for Canadian scientists.

To build a picture of the patterns of dissemination of scientific literature in Victorian Canada the following chapters will deal with different components of the portrait. Chapter II will set forth the methodology employed to compile and analyze data for this investigation. Chapter III will describe the Canadian setting and includes biographical sketches of the six scientists who form the core of this study. To characterize what was actually read Chapter IV will relate the results of a study of reading patterns based primarily on citations found in publications of the six scientists. To bring to light what scientific literature was available to read, Chapters V and VI will examine the nature and contents of libraries with Chapter V looking at personal collections of the selected scientists and Chapter VI inspecting institutional libraries. Rounding out the previous sections, Chapter VII will consider another factor that facilitated the dissemination of scientific literature in Victorian Canada, namely, the role of book dealers and publishers who made literature available. Finally, Chapter VIII will draw an overview and provide conclusions.

A number of features about scientific literature and its dissemination in Victorian Canada (at least as far as geological and agricultural literature is concerned) will be brought to light by this dissertation. First, this study will demonstrate a solidification of the prominence of periodicals in the transmission of scientific information, both in terms of the increased numbers of periodicals that were published by the end of the period and in actual use by scientists. Second, while the scientists were inclined to read widely, on a regular basis they tended to monitor a few major generalist and specialist journals, often giving particular attention to known authors who wrote on subjects of interest. Third, the literature perused by scientists was current, came from a variety of publishing centres in North America and Europe and was published in a range of languages. Fourth, the scientists had access to no shortage of scientific literature. Fifth, the researchers valued their personal libraries which often contained hundreds of reprints regularly received from authors or from publishing agencies. When personal collections of scientific literature were inadequate, as they frequently were, nearby institutional libraries provided a valuable resource, and in fact the scientists often helped to build the institutional collections.

By the end of the period geology had become sufficiently specialized that there was less opportunity for an amateur to read and understand the literature. In contrast, agricultural science had not yet reached such a specialized stage and, possibly because this science was more applied than geology tended to be, there was greater need for the literature to be understandable by the amateurs that mattered, i.e., the farmers or practitioners.

Notes to Chapter I

1. John Ziman, *The Force of Knowledge. The Scientific Dimension of Society* (Cambridge: Cambridge University Press, 1976), 90. Ziman extends this view in another volume entitled, *An Introduction to Science Studies: the Philosophical and Social Aspects of Science and Technology* (Cambridge: Cambridge University Press, 1984), 9f.

2. G.F. Matthew to J.W. Dawson in a letter dated Saint John, New Brunswick, 28th December 1886. Rare Book Collection, McGill University, Box 36 of J.W. Dawson's library. Tipped into a reprint which was part of Dawson's personal library.

3. For example, on the 19th February 1890, Robert Etheridge Jr., then Assistant Geologist to the Geological Survey of Victoria, wrote to Henry Woodward, editor of the *Geological Magazine* and Keeper of the Department of Geology at the British Museum (Natural History) for any "oddments of literature" that Woodward could spare. See Susan Sheets-Pyenson, "Geological Communication in the Nineteenth Century: The Ellen S. Woodward Autograph Collection at McGill University," *Bulletin of the British Museum of Natural History (Historical Series)* 10 (1982): 185. Sheets-Pyenson also states that "Working without the museums, libraries and learned societies of their fellow practitioners in Britain, colonists were acutely aware of their deprived circumstances." (p. 185).

4. A.J. Meadows, "Access to the Results of Scientific Research: Developments in Victorian Britain," in *Development of Science Publishing in Europe*, ed. A.J. Meadows, (Amsterdam: Elsevier Science Publishers, 1980), 43.

5. Richard Yeo, "Science and Intellectual Authority in Mid-Nineteenth-Century Britain: Robert Chambers and *Vestiges of the Natural History of Creation*," *Victorian Studies*, 28:1 (Autumn 1984), 14. Yeo admits some qualification on this point for he notes that not all scientists agreed that popularization was beneficial, not all scientists agreed that the diffusion of science was compatible with its advancement. Further discussion on popularization of science can be found in Charles Coulston Gillispie, *Genesis and Geology. A Study in the Relations of Scientific Thought, Natural Theology, and Social Opinion in Great Britain, 1790-1850* (New York: Harper & Row, Publishers, 1959), Chapter 7.

6. W.L. Morton, "Victorian Canada," in *The Shield of Achilles: Aspects of Victorian Canada*, ed. W.L. Morton, (Toronto: McClelland and Stewart Limited, 1968), 330. See also, Carl Berger, *Science, God, and Nature in Victorian Canada* (Toronto: University of Toronto Press, 1983), xiii.

7. Suzanne Zeller, *Inventing Canada: Early Victorian Science and the Idea of a Transcontinental Nation* (Toronto: University of Toronto Press, 1987), 269.

8. See, for example, papers which have been published in *Scientia Canadensis* (and its precursor, *HSTC Bulletin*) since 1981. A number of larger works, such as Suzanne Zeller's already referred to and an earlier volume by Morris Zaslow entitled, *Reading the Rocks. The Story of the Geological Survey of Canada 1841-1972* (Toronto: The Macmillan Company of Canada, 1975), demonstrate the major role that science played in Victorian Canadian society.

9. One English author writing in the early 1870s noted that:

> Ten or fifteen years ago, the staple subject here for reading and talk, outside study hours, was English poetry and fiction. Now it is English science. Herbert Spencer, John Stuart Mill, Huxley, Darwin, Tyndall have usurped the places of Tennyson and Browning, and Matthew Arnold and Dickens.

Whitelaw Reid in an address at Dartmouth, England published in *Scribner's Monthly* in 1873 and quoted in Roy M. MacLeod, "Evolutionism, Internationalism, and Commercial Enterprise in Science: The International Scientific Series, 1871-1910," in *Development of Science Publishing in Europe*, ed. A.J. Meadows. (Amsterdam: Elsevier Science Publishers, 1980), 66.

10. See, for example, Martin Hewitt's discussion in "Science as Spectacle: Popular Scientific Culture in Saint John, 1830-50," paper presented to the conference, Science and Society in the Maritimes, Mount Allison University, September 1988. Richard Jarrell has argued, not altogether convincingly, that the primary function of scientific societies in nineteenth-century Canada was as a cultural or social institution. Richard Jarrell, "The Social Functions of the Scientific Society in Nineteenth-Century Canada," in *Critical Issues in the History of Canadian Science, Technology and Medicine*, ed. Richard A. Jarrell and Arnold E. Roos. (Thornhill, ON: HSTC Publications, 1983), 31-44. Carl Berger has provided membership numbers for several Canadian societies -- in 1885 the Natural History Society of Montreal claimed 287 members (it had been higher earlier), the Nova Scotian Institute of Natural Science had 137 members in 1897, and the Ottawa Field-Naturalists' Club listed 300 in 1890. See, Carl Berger, *Science, God, and Nature in Victorian Canada*, 10.

11. Martin Fichman, "Science and Literature: A Bibliography," *Victorian Studies Association (Ontario) Newsletter* 42 (Fall 1988), 17.

12. Ibid.

13. David Knight, *The Age of Science. The Scientific World-View in the Nineteenth Century* (Oxford: Basil Blackwell, 1986). Knight states, in part, that the nineteenth century was the Age of Science because the scientific and literary cultures had not yet diverged. "Those working in the sciences and those engaged in literature, painting, politics and theology all shared much common ground. Education and reading was [sic] less specialized, though by the end of the century this was rapidly changing. The science taught to those who were being trained in [the] sciences was dogmatic and demanding, unlikely to provide metaphors or to excite the imagination....To those who had picked it up less formally, as everybody did down to the 1870s, science was a seductive pattern of reasoning, which might be extended into other fields: geology was a newcomer, and why should not political economy or even painting join it?" (p. 5). It was the Age of Science, too, "because those engaged in the sciences took pains to make the world aware of their work and its implications. They wrote about it in essays in the *Edinburgh Review* and the *Quarterly Review* and similar publications, and they spoke about it at public meetings; it was popular science which was disseminated, and was picked up." (p. 6).

14. This is, in essence, the view expressed by Matthew quoted above. Earlier, during the 1850s, British scientists attached to the Toronto Magnetic Observatory considered Canada to be on the fringe of scientific activity. Lt. J.H. Lefroy, the director of the Observatory in 1852, wrote to the American, A.D. Bache, on 12th October that "the state of physical science in this country is so low that it would be impossible to produce, or gain support for, anything less popular and miscellaneous in its nature, at present." Quoted in Gregory Good, "Between Two Empires: The Toronto Magnetic Observatory and American Science Before Confederation," *Scientia Canadensis* 10 (Spring 1986): 38. In a recent dissertation tracing the history of Canadian anthropology, Ivy Gale Avrith wrote that the two research committees established by the British Association for the Advancement of Science following meetings in Canada "were the conduits through which metropolitan anthropologists channelled their methods, theories and professional models of organization to Canadian amateurs at the periphery." Ivy Gale Avrith, "Science at the Margins: The British Association and the Foundations of Canadian Anthropology, 1884-1910," Ph.D. Thesis, University of Pennsylvania, 1986, abstract. Another scholar who has placed Canadian science on the periphery during the Victoria period is Vittorio De Vecchi who wrote that Canada was "at the periphery of the scientific world." Vittorio M.G. De Vecchi, "The Dawning of a National Scientific Community in Canada, 1878-1896," *Scientia Canadensis* 8 (June 1984): 37.

15. While not speaking directly about Canada, David Knight has written that for "most of the [nineteenth] century, as for preceding centuries, science has been the business essentially of European men. They were the stars, though there might be women and non-Europeans among the supporting cast," Knight, *The Age of Science*, 210. Similarly, Franklin L. Baumer asserts that the nineteenth century "was the European Century *par excellence*." Franklin L. Baumer, *Modern European Thought. Continuity and Change in Ideas, 1600-1950* (New York: Macmillan Publishing Co., 1977), 265-266.

16. Ann C. Hopper, "Was Canada in the Provinces?: The Reassessment of 1881," *Transactions of the Royal Society of Canada* 4th s., 20 (1982): 488.

17. Bruce M. Manzer, *The Abstract Journal, 1790-1920: Origin, Development and Diffusion* (Metuchen, NJ: Scarecrow Press, 1977), 6-7. Manzer's detailed study demonstrates that the growth of periodical literature in the nineteenth century led to a "concomitant crisis in its bibliographic control" which in turn led to the development of the abstract journal, the index journal, and later the major review journal.

18. Derek J. de Solla Price, "The Structures of Publication in Science and Technology," in *Factors in the Transfer of Technology*, ed. William H. Gruber and Donald G. Marquis. (Boston: M.I.T. Press, 1969), 94. See also, A.J. Meadows, *Communication in Science* (London: Butterworths, 1974), 226.

19. Garvey has written that if the results of a scientist's "new research are to be communicated effectively, they...must be embedded in the 'literature' of the subject." William D. Garvey, *Communication: the Essence of Science* (Oxford: Pergamon Press, 1979), 77.

20. Augustine Brannigan and Richard A. Wanner, "Multiple Discoveries in Science: A Test of the Communication Theory," *Canadian Journal of Sociology* 8 (Spring 1983): 148, 149.

21. Garvey chose his title from a phrase Francis Crick used when discussing how he and James D. Watson made their discovery of the molecular structure of DNA. Garvey, *Communication: the Essence of Science*, ix.

22. Ibid., 9.

23. See, for example, Elizabeth B. Gasking, "Why was Mendel's Work Ignored?" *Journal of the History of Ideas* 20 (1959): 60-84; T. Stomps, "On the Rediscovery of Mendel's Work by Hugo DeVries," *Journal of Heredity* 45 (1954): 293-294; A. Brannigan, "The Reification of Mendel," *Social Studies of Science* 9 (1979): 423-454; R. Olby, "Mendel No Mendelian?" *History of*

Science 17 (1979): 53-72; among others. Olby characterizes Mendel's research as "rigorous, brilliant and systematic" (p. 67).

24. Michael H. MacRoberts, "Was Mendel's Paper on *Pisum* Neglected or Unknown?" *Annals of Science* 42 (1985): 343.

25. Ibid., 339. Mendel's paper has been reprinted a number of times. An English translation (from the German by William Bateson) is reprinted in *Classic Papers in Genetics*, ed. James A. Peters, (Englewood Cliffs, NJ: Prentice-Hall, Inc, 1959), 2-20 where it is cited as "the cornerstone of the science of genetics."

26. Susan Sheets-Pyenson, "Darwin's Data: His Reading of Natural History Journals, 1837-1842," *Journal of the History of Biology* 14 (Fall 1981): 231.

27. R.G.A. Dolby has written that "although particular cases of transmission of ideas occur in virtually every historical study of science, they are normally subsidiary issues at the periphery of the historian's interest." R.G. Dolby, "The Transmission of Science," *History of Science* 15 (1977): 3.

28. See, for example, Meadows, *Communication in Science* and Garvey, *Communication: The Essence of Science*.

29. H.W. Paul, "The Role and Reception of the Monograph in Nineteenth-Century French Science," in *Development of Science Publishing in Europe*, ed. A.J. Meadows, (Amsterdam: Elsevier Science Publishers, 1980), 123.

30. David Kronick, *A History of Scientific & Technical Periodicals. The Origins and Development of the Scientific and Technical Press, 1665-1790*, 2nd ed. (Metuchen, NJ: The Scarecrow Press, 1976), x.

31. A number of authors have documented the history of these two early scientific journals. See, for example, Douglas McKie, "The Scientific Journal from 1665 to 1798," in *The Scientific Journal*, ed. A.J. Meadows, (London: Aslib, 1979), 7-17; A.A. Manten, "The Growth of European Scientific Journal Publishing before 1850," in *Development of Science Publishing in Europe*, ed. A.J. Meadows, (Amsterdam: Elsevier Science Publishers, 1980), 1-22; Marie Boas Hall, "Oldenburg and the Art of Scientific Communication," *British Journal for the History of Science* 2 (1964-65): 277-290; Raymond Birn, "Le Journal des Savants sous l'Ancien Regime," *Journal des Savants* (1965): 15-35; Roger P. McCutcheon, "The *Journal des scavans* and the *Philosophical Transactions* of the Royal Society," *Studies in Philology* 21 (October 1924): 626-628; Sherman B. Barnes, "The Scientific Journal, 1665-1730," *Scientific Monthly* 38 (1934):

257-260; R.J. Porter, "The Scientific Journal 30[illegible]h Anniversary," *Bacteriological Reviews* 27 (1964): 211-[illegible], Bernard Houghton, *Scientific Periodicals: Their Historical Development, Characteristics and Control* (Hamden, CT: Linnet Books, 1975); and Kronick, *A History of Scientific & Technical Periodicals*.

32. A.J. Meadows has observed that "the consistent trend in the development of scientific publications over the last three centuries has been the importance of the journal to be increasingly emphasized." Meadows, *Communication in Science*, 90.

33. May F. Katzen, "The Changing Appearance of Research Journals in Science and Technology: An Analysis and a Case Study," in *Development of Science Publishing in Europe*, ed. A.J. Meadows, (Amsterdam: Elsevier Science Publishers, 1980), 177.

34. Paul, "The Role and Reception of the Monograph," 138.

35. Meadows, *Communication in Science*, 55. Not only had the proportion of books devoted to the sciences increased but the total number of titles had escalated as well. Macmillan was only one publisher, of course, and not necessarily representative of other publishing houses.

36. Henry W. Menard, *Science, Growth, and Change* (Cambridge, MA: Harvard University Press, 1971), 42-45. In 1835 when nine U.S. state geological surveys were active there were 2,123 pages of geological literature and by 1879 when the U.S. Geological Survey was founded about 93,000 pages of geological literature had been produced by the U.S. states.

37. There were a variety of reasons for publishing "collections": (1) the high cost of the original publications, (2) the great volume and scatter of the published literature, (3) the poor availability of foreign books and journals, (4) problems of access to publications in foreign languages, and (5) the early obsolescence of important pieces of work. Manten, "The Growth of European Scientific Journal Publishing," 17.

38. Knight has written that "the nineteenth century was the age of the textbook" and cites such examples as successive editions of Charles Lyell's books on geology and Thomas Thomson's on chemistry. Knight, *The Age of Science*, 116. For further discussion on science books as textbooks see Paul, "The Role and Reception of the Monograph," 139; MacLeod, "Evolutionism, Internationalism and Commercial Enterprise," 63-64, 80-81, 91; and David M. Knight, *Natural Science Books in English: 1600-1900* (New York: Praeger, 1972).

39. Roy MacLeod has documented the history of one significant series, The International Scientific Series, published in English and other languages. MacLeod, "Evolutionism, Internationalism and Commercial Enterprise."

40. For the Darwin quote see Sheets-Pyenson, "Darwin's Data," 233. For the Bonapart quotation see Susan Sheets-Pyenson, "From the North to Red Lion Court: The Creation and Early Years of the *Annals of Natural History*," *Archives of Natural History* 10 (1981): 242.

41. For a discussion of the expansion of periodicals in mid-nineteenth century Britain see Alvar Ellegard, "The Readership of the Periodical Press in Mid-Victorian Britain," *Goteborgs Universitets Arsskrift* 63 (1957): 1-41 and W.H. Brock, "The Development of Commercial Science Journals in Victorian Britain," in *Development of Science Publishing in Europe*, ed. A.J. Meadows, (Amsterdam: Elsevier Science Publishers, 1980), 95-122.

42. Brock has noted that "the main growth factor in nineteenth-century periodicals was a commercial spirit *not* the proliferation of societies as is sometimes thought." Brock, "The Development of Commercial Science Journals," 95. A.J. Meadows, on the other hand, attributed the proliferation of scientific journals in late Victorian years to "the continually increasing number of societies and of other institutions which issued their own publications." Meadows, *Communication in Science*, 81.

43. Writing as late as 1896 one scientist complained in a letter to *Nature* about an extensive delay in the publication of one of his papers. The letter deserves to be quoted at some length:

> In the winter of 1894-95, I completed a piece of work.. and was advised to offer it to the Zoological Society for publication. The paper was received, in the first instance, on June 6, and I hoped it would have been taken as read at a meeting of the Society held in that month. It was, however, not read till November 19[th]....It was ordered for publication in the *Trans.*, and now (November 14, 1896) nearly twelve months from the date of reading, I have not yet received my proofs. Surely such an extraordinary delay as this ought not to be necessary. During such a long period I have found it necessary to keep pace with much more literature bearing upon the subject; but more than this, I have just suffered the chagrin of seeing a paper embodying a large slice of my results published in an Italian journal.

S. Vincent in *Nature* 55 (1896), 70 quoted in Meadows, *Communication in Scien* *e*, 81.)ther reasons advanced for the commercially published periodicals inc uded: "they provided intelligence of science in foreign journals for those who had no access to large libraries; they aired controversies and allowed the issues involved to be resolved promptly; they accepted for publication the minor, and sometimes trivial, research with which learned societies could not be bothered and therefore continued to cater to the popular and cultural images of science when it was undergoing the rigour of specialization; on the other hand, they accepted original findings and theoretical speculations not considered orthodox by societies." Brock, "The Development of Commercial Science Journals," 96.

44. See Jean . Shaw, "Patterns of Journal Publication in Scientific Natural History from 1800 to 1939," in *Development of Science Publishing in Europe*, ed. A.J. Meadows, (Amsterdam: Elsevier Science Publishers, 1980), 149-176. Susan Sheets-Pyenson in "From North to Red Lion Court," cited earlier, gives evidence of failed periodicals. See also, two other papers by the same author, "A Measure of Success: the Publication of Natural History Journals in Early Victorian Britain," *Publishing History* 9 (1981): 21-36 and "Popular Science Periodicals in Paris and London: the Emergence of a Low Scientific Culture, 1820-1975," *Annals of Science* 42 (1985): 549-572.

45. On the centennial of *Nature* a series of articles by Roy MacLeod traced the history of the origin and development of this journal. All of the following articles were written by MacLeod and appeared in a special centennial issue of *Nature*: "Science in Grub Street," *Nature* 224 (1 November 1969): 423-427, "Macmillan and the Scientists," (pp. 428-430), "Seeds of Competition," (pp. 431-434), "Macmillan and the Young Guard," (pp. 435-436), "The New Journal," (pp. 437-439), "The First Issue," (p. 440), "Securing the Foundations," (pp. 441-444), "Private Army of Contributors," (pp. 445-449), "Faithful Mirror to a Profession," (pp. 450-452), "Lockyer: Editor, Civil Servant and Man of Science (pp. 453-456), "Into the Twentieth Century," (pp. 457-461). See also an earlier note, Roy M. MacLeod, "A Note on *Nature* and the Social Significance of Scientific Publishing, 1850-1914," *Victorian Periodicals Newsletter* no. 3 (November 1968): 16-17.

46. Meadows, *Communication in Science*, 68-69; Brock, "The Development of Commercial Science Journals," 97; Manten, "The Growth of European Scientific Journal Publishing," 8-9; A clear example of a scientist seeking the benefits of multiple publication of his paper can be seen in the following segment of a letter from Sir William Crooks to the editor of *Nature*, Norman Lockyer, in 1895:

> I have been working night and day to get in type a paper on the spectrum of helium before my holidays. I will send you an early proof tomorrow, and I should much like to see it in "Nature" if you can see your way to insert it. It will appear in the *Chemical News* on Friday, but my circulation is not to the same class of researchers as that of "Nature," and having taken a great deal of trouble about it I want the results to get to the right people.

Published in *Nature* 224 (1 November 1969): 475. Scientists also often endorsed the republication of their papers in translation in other countries. J.D. Forbes, for example, wrote in 1842 that he was pleased that "a most excellent French Translation of my article in the *Edinburgh Review* had appeared in the *Annales de Chimie*," Ian Campbell and David Hutchison, "J.D. Forbes' Scientific Correspondence with Switzerland," *Scotia* 8 (1984): 30.

47. As early as the seventeenth century readers were complaining about the volume of the literature. Barnaby Rich writing in 1613 commented that "one of the diseases of this age is the multiplicity of books, they doth so overcharge the world that it is not able to digest the abundance of idle matter that is every day hatched and brought forthe into the world." Quoted in Manten, "The Growth of European Scientific Journal Publishing," 16. See also, Kronick, *A History of Scientific & Technical Periodicals*, 171. Protests about the excessive volume of the information are repeated throughout the centuries since Rich's comment. Viewed from a slightly different perspective, the botanist, J.D. Hooker, wrote to Alexander Macmillan on 27th July 1869: "I cannot see how a really scientific man can find time to conduct a periodical scientifically or brains to go over the mass of trash that is communicated to it and requires expurgation." Letter published in *Nature* 224 (1 November 1969): 473.

48. Manten, "The Growth of European Scientific Journal Publishing," 12.

49. Meadows gives the example of the *Transactions of the Linnean Society of London* which Fellows were expected to pick up personally at the Linnean Society offices. A.J. Meadows, "Access to the Results of Scientific Research: Developments in Victorian Britain," in *Development of Science Publishing in Europe*, ed. A.J. Meadows, (Amsterdam: Elsevier Science Publishers, 1980), 14.

50. Meadows, *Communication in Science*, 70.

51. Ibid., 82.

52. Meadows, "Access to the Results of Research," 45.

53. The most detailed historical study of abstract journals is Bruce M. Manzer, *The Abstract Journal, 1790-1920*. For a discussion of the rise of the abstract journal in Britain see Meadows, "Access to the Results of Scientific Research," 48-53.

54. The first volume appeared in 1867 and the project continued into the twentieth century. For a discussion of the production of this bibliography see W. Boyd Rayward, "The Search for Subject Access to *The Catalogue of Scientific Papers 1800-1900*," in *The Variety of Librarianship. Essays in Honour of John Wallace Metcalfe*, ed. W. Boyd Rayward, (Sydney: Library Association of Australia, 1976), 146-170.

55. Ellegard, "The Readership of the Periodical Press," 3.

56. Ibid., 9.

57. G.E. Fussell, "Nineteenth-Century Farming Encyclopedias: A Note," *Agricultural History* 55 (January 1981): 19.

58. For example, Duveen and Klickstein used a bibliographical approach to provide an estimate of the dissemination and acceptance of Lavoisier's chemical ideas. Denis I. Duveen and Herbert S. Klickstein, "A Bibliographical Study of the Introduction of Lavoisier's *Traité élémentaire de chimie* into Great Britain and America," *Annals of Science* 10 (1954): 321-328.

59. Sheets-Pyenson, "Popular Science Periodicals," 560.

60. Richard Yeo, "Science and Intellectual Authority," 13.

61. Brock, "The Development of Commercial Science Journals," 107.

62. Nicholas Goddard, "The Development and Importance of Agricultural Newspapers and Periodicals, 1780-1880," *Agricultural History Review* 31 (1983): 122.

63. H.E. Armstrong, in 1914, wrote in the *Chemical World*: "Apparently the private subscriber to technical journals is a fast diminishing quantity: most of us who maintained a library of periodicals in our early days have ceased to do so." Quoted in Meadows,"Access to the Results of Scientific Research," 46.

64. Gasking, "Why Was Mendel's Work Ignored?" 77.

65. The six scientists will be identified and discussed in more detail beginning in Chapter III.

66. C.D. Hurt gives a succinct definition of the formal scientific literature. He states: "the best definition of scientific literature is just that: the tangible output of science," C.D. Hurt, *Information Sources in Science and Technology* (Englewood, CO: Libraries Unlimited, Inc., 1988), xi.

67. David Edge has written that "Formal 'communications' in science represent a process of *assimilation*: of 'separating scientific fact from conjecture', and of 'the transformation of research findings into scientific knowledge.'" David Edge, "Quantitative Measures of Communication in Science: A Critical Review," *History of Science* 17 (1979): 114. A number of authors have provided instances which illustrate influence of the literature. For example, W.H. Brock has noted that the journal, the *English Mechanic*, "certainly altered some readers' lives" and then cites one Jesse S. Nimkey who saw an advertisement for a telescope in the *Mechanic*, bought it, and was then launched on a career in astronomy. Brock also wrote that the "physicist, Oliver Lodge, became bent on a scientific career as a consequence of regular reading." W.H. Brock, "The Development of Commercial Science Journals," 114. As another example, Susan Sheets-Pyenson has observed that "a wealth of texts, particularly the writings of Sedgwick, Murchison, Buckland, Lyell, Forbes, Ramsay and Geikie, had convinced young men and women to take up geological pursuits. Meetings of scientific societies and their publications had been similarly persuasive," Sheets-Pyenson, "Geological Communication in the Nineteenth Century," 194.

68. Paul Rutherford, *A Victorian Authority. The Daily Press in Late Nineteenth-Century Canada* (Toronto: University of Toronto Press, 1982), 8.

69. It could be argued that there is a distinction between the diffusion of scientific literature and the diffusion of scientific ideas; but, in any case, studies of the influence and absorption of scientific ideas are more the purview of history of science than the history of library and information science.

70. Information can flow by informal means as well. However, this channel of information transfer is very difficult to follow historically, particularly when records such as personal diaries and correspondence are often not available. Informal communication is usually tracked by means of surveys (questionnaires or interviews), or ethnographic methodology (participant observer or case study) which often cannot be used in historical investigations.

71. Several interesting studies have taken advantage of the Darwin reading records. See, Sheets-Pyenson, "Darwin's Data," cited earlier. A description and transcription of Darwin's

reading records is provided in Peter J. Vorzimmer, "The Darwin Reading Notebooks (1838-1860)," *Journal of the History of Biology*, 10 (1977): 107-153. In a closely examined reading of the Darwin documents R. Alan Richardson has traced the concept of biogeography in the development of Darwin's thought. R. Alan Richardson, "Biogeography and the Genesis of Darwin's Ideas on Transmutation," *Journal of the History of Biology* 14 (Spring 1981): 1-41. Another study using Darwin's reading records is Sydney Smith, "The Origin of *The Origin* as Discerned from Charles Darwin's Notebooks and Annotations in Books Read Between 1837 and 1842," *Advances in Science* 16 (1960): 392-294.

Chapter II -- Methodology

The flow or dissemination of scientific literature is often difficult to chronicle historically. Consequently, in order to obtain as full a picture as possible, the subject needs to be considered from a variety of angles. In this dissertation the topic was examined from four viewpoints, and as the methodology varied, the procedures adopted will be described below. Much like any other historical treatise, this dissertation, of necessity, takes full advantage of surviving documentary records, i.e., extensive examination and analysis of primary and secondary sources has been carried out, but the use to which some of the those documents have been placed requires explanation.

First, the distribution of scientific literature in Victorian Canada can be investigated from the perspective of what was read. In this regard, the publications that the scientists cited were studied. The methodology of this study is set out below and the findings are discussed in Chapter IV. A second viewpoint on the dissemination of scientific literature concerns what was available to read. Both personal and institutional libraries enter the picture here. The methods of determining what was in each library are noted subsequently and the collections are described in Chapters V and VI. An additional viewpoint on the distribution of scientific literature entails the role of book sellers and publishers, and this aspect of the study is addressed in Chapter VII.

Sample of Six Scientists

As will be explained in Chapter III, six prominent Canadian scientists were selected and their scientific careers examined as a means of directing the analysis. Although additional scientists could have been chosen, increasing the number of individuals would have unnecessarily complicated the study. For reasons outlined in Chapter III, this group of six scientists had particular features relevant to this study beyond merely acting as a convenient vehicle for guiding the investigation.

Study of Reading Patterns

The determination of what scientific literature was actually read is not a simple task. No method of investigation can be totally comprehensive if only because a scientist may have read, and probably did read, more than any record will show. Without ignoring this limitation, the more thorough and systematic means of ascertaining what was read is to take advantage of a structural feature of the scientific literature and inspect the citations contained within the scientists' own publications. A citation is a commonly adopted means of indicating the publications that had been consulted and, therefore, an examination of the citations can reveal those works to which a scientist had access. In other words, a citation study can provide evidence of the dissemination of scientific literature.[1]

An assumption and a definition, which figured in the citation study, need to be made explicit. First, the study was based on the premise that the scientists actually consulted or had access to the literature that they cited. While there are some difficulties with this assumption, none are of a major nature that prevents conclusions from being drawn from the data.[2] Second, a citation was taken to mean any notation to another author found within one of the scientist's publications.[3]

Citation data for Victorian scientific literature can only be compiled by a lengthy process. The data for this citation study was obtained in the following manner:

1. The publications of the six scientists were selected with the aid of the Richardson and MacDonald bibliography of pre-1914 Canadian science and technology.[4]
2. Since each of the six scientists published extensively (J.W. Dawson, for example, has more than 500 publications to his credit), it was necessary to select a sample of their publications for examination. Sampling was done for all six scientists, selecting publications over the range of their careers. Approximately 40 publications per scien-

tist were examined which gave rise to 2,177 citations.

3. Each of the scientists' publications was closely scanned for a citation (in the traditional form of a footnote, or in some cases embedded directly in the text), or a reference to another author which implicitly cited a publication by that author.[5] Each citation/reference was extracted with "sufficient" textual context to aid in the identification of the cited publications.

4. The task of determining the identity of the cited publications was undertaken in a variety of ways depending on the completeness of the information in the citation.

    a. Where the information in a citation was unabridged and identification was obvious, it was accepted as is.

    b. Where the citations/references were incomplete, as indeed many were, it was necessary to use several techniques to solve the "puzzle." The first step usually involved clearly identifying the author of the cited work. A number of citations only provided the last name of an author and while most authors could be determined from this information alone, some provided considerable difficulty. For example, the surname Rogers in a geological context could refer to William Barton Rogers or Henry Darwin Rogers or conceivably both since they sometimes published jointly. A variety of bibliographic tools was used to guide the identification of authors and their works.[6]

c. In spite of extensive attempts at identification, some citations/references remain uncertain. Even for some citations for which the author can be clearly determined, the puzzle remains, simply because the citing scientist has not explicitly stated which work he was citing.[7]

5. Once the citation was clearly identified, bibliographic details were recorded for study. In some cases copies of the cited publications were consulted. For the geological citations most of this examination was completed using the collections of the Geological Survey of Canada Library in Ottawa which had the advantage that some of the works examined may have been the actual copies of the publications that the scientists themselves had consulted. At least some of the marginalia support this observation. Collections of the Canada Agriculture Main Library and its subdivisions were used to assist in identifying agricultural publications.

6. All of the data was entered into a machine readable database to assist with the analysis.[8]

With the citation data in hand an analysis was undertaken to characterize the literature that was cited and the results are discussed in Chapter IV.

Reconstruction of Libraries

The function of both personal and institutional libraries in the dissemination of scientific literature in Victorian Canada is detailed in Chapters V and VI. A catalogue of the holdings of each library is a document of primary interest for this sort of study, and, wherever possible, existing published or manuscript inventories of the libraries were examined. But, more often than not, the lack of such documents, either because they were never created or copies have not survived, thwarted the aim of inspecting catalogues. Since virtually all the libraries that warranted consideration for this dissertation underwent considerable change since the turn of the century (some collections have been widely dispersed), extensive detective work was required to reconstruct a picture of the libraries during the Victorian period. Historians of libraries and librarianship are well aware that while librarians are quite conscious of the necessity of preserving records of other disciplines they have been decidedly negligent concerning the retention of records of their own institutions. It therefore became necessary to either create catalogues or to extend earlier published catalogues. While this may seem to be a simple task, in fact, the scatter of collections called for historical sleuthing in the manner of Richard Altick's "Scholar Adventurers."[9]

A. **Personal Libraries**

Although many scientists maintained personal collections of scientific literature and indeed some gave their library considerable care, it was quite unusual for scientists ever to catalogue their collection entirely or even partially. When catalogues do exist they seem to have been created most frequently for two reasons. In the first instance, the preparation of a catalogue during the lifetime of a scientist seems to have been triggered by a pending physical move from one location to another.[10] More often catalogues of scientists' libraries were the product of executors or heirs of estates and were prepared prior to the sale of scientists' effects. In the latter situation, booksellers or auction houses which were handling the sale may have prepared the catalogues.[11]

Except for the well known scientist/book collector, Sir William Osler, printed catalogues of personal libraries of Canadian scientists do not exist.[12] As yet, very few manuscript catalogues have been located for any Victorian Canadian scientists that list personal collections even partially.[13] Further, since the heirs of scientists infrequently realized the historical value of personal libraries, very few libraries have been preserved as a unit.[14] J.L. Thornton and R.I.J. Tully have written that "it is sometimes impossible to prove that earlier scientists possessed even one volume, despite the fact that they may have owned very extensive libraries."[15] The dispersal of libraries and the absence of any indications of ownership both act as major hurdles in reconstructing a personal library. The task of determining what publications were in nineteenth century Canadian scientists' libraries is fraught with difficulty, and reconstructing their libraries can be "a complicated but often absorbing intellectual activity."[16]

Since inventories of the personal libraries of the six scientists do not exist it was necessary to create catalogues of each collection for this study. In compiling the catalogues reliance was placed largely on an examination of copies of actual publications that had once been in the scientists' collections. These items were located in a variety of depositories: university libraries, personal collections, archival holdings, and research institution libraries.[17] Within these libraries, systematic searches of particular subject areas or particular collections often located appropriate volumes.[18] A number of possible pieces of evidence were used to arrive at positive identification of publications:

1. The presence of the owning scientist's autograph written somewhere on the publication. Robert Bell,

for example, seemed to write his name on almost every document that came into his possession. Most scientists at one time or another wrote their name on at least some of the publications in their libraries.

2. Some scientists placed their bookplate on an inside cover or endpaper of volumes in their libraries. William Logan and J.W. Dawson, for example, followed this practice with some of their books.[19]

3. Numerous publications were sent to the six scientists' libraries compliments of the authors or publishers and often there was some indication that the publications had been sent to the scientists in question. Authors who had forwarded reprints of their work would, for instance, write on a covering page: "Sir William Dawson, compliments of the author."

4. Association evidence was sometimes used to assign a publication to a particular scientist's library. By way of illustration, two items bound together with only one having direct proof of having been part of a scientist's library were both credited to the library of the scientist in question. Other circumstantial evidence, such as both items written by the same author, both written on the same topic, both published during the same time period, was

often used to support these determinations.[20]

Besides examination of actual publications that had once been part of the scientists' libraries, two other methods of discovering the identity of appropriate items proved useful in some cases. The first technique applied principally to Robert Bell's library. At least part of his collection was dispersed by auction and through antiquarian bookshops, and some effort was made to trace his volumes by searching auction and book dealers' catalogues.[21] The second method applied to all scientists and involved the painstaking reading of correspondence files searching for reports of publications that had been sent to the scientists or had been ordered by them. On occasion researchers, other than the six selected for this study, wrote that they had consulted books obtained in the personal collections of the six scientists, and this information provided additional clues as to the content of the personal libraries.[22]

Sometimes, when all of the above procedures were exhausted, serendipity rescued appropriate volumes from obscurity.[23] However, the principal methods used were those outlined above and singly or in combination they provided the data for reconstructing the scientists' libraries discussed in more detail in Chapter V.

B. Institutional Libraries

Institutional libraries, more likely than was the case with personal libraries, prepared a catalogue in printed format. Thus, for example, there are published catalogues of the nineteenth century Library of Parliament and an early catalogue of the library of the Natural History Society of Montreal. But these catalogues were often inadequate for evaluating the holdings of these libraries. The only printed catalogue of the library of the Natural History Society of Montreal was brought out in 1846; yet most of the library holdings were acquired after that date. It was, therefore, necessary to supplement printed catalogues with information from other sources.

As with the reconstruction of personal libraries, a variety of procedures were used to augment data obtained from the printed catalogues. The existing records of the institutions were examined carefully and these provided details of purchases and other acquisitions. For example, information concerning the Library of Parliament and the McGill University Library was obtained in this fashion.

Another source of data was found in published annual reports of the library or its parent institution. In this instance reports of the Natural History Society of Montreal and the Mechanics' Institute of Montreal proved beneficial. In the case of the former, the annual reports usually contained lists of library acquisitions.

For one library, the Geological Survey of Canada Library, the current day machine readable catalogue was searched for all pre-1910 imprints and the list that was retrieved was selectively sampled against the holdings in search of a library stamp showing the date of acquisition.[24]

Finally, as with personal libraries, evidence of ownership, such as a bookplate or library stamp (perforated or ink), was also used to ascertain holdings for institutional libraries. This data, of course, can only be obtained by the time consuming task of removing books from the shelves and examining them one by one and was in fact done in several cases.

All the evidence taken together provided the data for institutional libraries and the results of the analysis are presented in Chapter VI.

Notes to Chapter II

1. The methodology of citation analysis has gained considerable respectability in the last several decades and is widely used for some types of information science research. The vast majority of cases in which citation analysis has been employed has dealt with late twentieth century data and has been concerned with measuring the success of particular publications, determining research fronts, and mapping the relationships between concepts or subjects, among other matters. For instance, the extensive work of the Institute for Scientific Information in Philadelphia, including the massive citation indexes that the Institute publishes, such as the *Science Citation Index*, is based on citation mapping. Little attention has been given to studying the Victorian scientific literature, primarily because citation data for the last century is not available in machine readable form in the large volume that is often required for the statistical manipulations of citation analysis. In addition, citations in Victorian scientific publications, as will be noted subsequently, were frequently listed in haphazard, incomplete form, requiring extensive effort to compile the data. The detailed methodology of citation analysis is not appropriate for this dissertation since no attempt is being made to trace relationships between documents. Rather the citation study was completed solely to identify and characterize the scientific literature that was read. For this reason, I have chosen to use the term "citation study" in this portion of the dissertation to distinguish the type of inquiry conducted here from citation analysis proper. A very helpful discussion of citations is found in Blaise Cronin, *The Citation Process. The Role and Significance of Citations in Scientific Communication* (London: Taylor Graham, 1984).

2. For example, it is possible that a scientist did not consult a publication that was cited but obtained the citation from another publication that was actually consulted. Since this dissertation is concerned with the distribution of scientific literature it is worth reiterating a point made in Chapter I, namely, this citation study is designed only to determine if scientist A consulted scientist B's publication, i.e., that this publication was accessible, and does not attempt to ascertain if scientist A was influenced by what scientist B wrote.

3. Standard methods of citing publications did not become firmly formalized until after the Victorian period. Therefore, it was necessary to adopt a somewhat "looser" definition of a

citation than is possible with late twentieth century documents.

4. R. Alan Richardson and Bertrum H. MacDonald, *Science and Technology in Canadian History: A Bibliography of Primary Sources to 1914* (Thornhill, ON: HSTC Publications, 1987). This bibliography, containing more than 58,000 records, is the major tool for identifying pre-1914 Canadian scientific and technical publications.

5. For monographic publications of the six scientists, the Canadian Institute for Historical Microreproductions, Ottawa, generously provided microfiche copies of some titles.

6. Some of the more helpful included: the *National Union Catalog Pre-1956 Imprints* (London: Mansell, 1968-1981), 723 vols.; Royal Society, *Catalogue of Scientific Papers (1800-1900)* (London, 1867-1925), 4th s. 19 vols.; British Library. *General Catalogue of Printed Books to 1974* (London: Clive Bingley, 1979-1987), 360 vols.; Robert Mortimer Gascoigne, *A Historical Catalogue of Scientists and Scientific Books from the Earliest Times to the Close of the Nineteenth Century* (New York: Garland Publishing, Inc., 1984); Richardson and MacDonald, *Science and Technology in Canadian History*, passim; for geological literature: John M. Nickles. *Geologic Literature on North America. 1785-1918. Part I. Bibliography* (Washington: Government Printing Office, 1922), Bulletin no. 746, U.S. Geological Survey; and for agricultural literature: Canada Department of Agriculture Headquarters Library, *Publications of the Canada Department of Agriculture 1867-1974*, 2nd ed. (Ottawa: Information Canada, 1975).

7. For example, when J.W. Dawson wrote that "the lower part of the valley of the St. Lawrence has been described by...Professor [Ebenezer] Emmons," to which of Emmons' thirty five or more publications prior to 1857 was he referring. J.W. Dawson, "On the Newer Pliocene and Post Pliocene Deposits of the Vicinity of Montreal, with Notices of Fossils Recently Discovered in Them," *Canadian Naturalist and Geologist* 2 (December 1857): 401. Nickles's, *Geologic Literature* lists thirty five publications by Emmons prior to 1857.

8. CDS Isis software was used to manipulate the data.

9. Richard D. Altick, *The Scholar Adventurers* (New York: The Free Press, 1950).

10. Two examples of such manuscript catalogues have been found, one in the George Lawson Papers, Dalhousie University Archives, Halifax, Nova Scotia, which on internal evidence seems to have been prepared in the late 1850s probably prior to Lawson's move from Edinburgh to Kingston, Ontario, and the

other is a very sketchy list in the Robert Bell Papers, National Archives of Canada, Ottawa prepared during a move between Kingston, Ontario and Montreal, Quebec.

11. For a number of auction catalogues of Canadian libraries see the catalogue for sale no. twelve of Christie's (Canada) with the Montreal Book Auctions, 20-21 May 1970. About 110 auction catalogues of personal libraries of Canadians spanning the years 1866 to 1941 were made available for purchase in this sale. Many of the libraries had been formerly owned by members of the legal profession, and some collections numbered as many as 5,000 volumes.

12. For Osler's library see: Sir William Osler. *Bibliotheca Osleriana: A Catalogue of Books Illustrating the History of Medicine and Science, Collected, Arranged, and Annotated* (Montreal: McGill-Queen's University Press, 1969, reissue with amendments of the 1929 edition); Edward C. Streeter, "Osler as a Bibliophile," *Boston Medical and Surgical Journal* 182 (1920): 335-338; and Ellen B. Wells, "Books for the Bibliotheca: a Study of Sir William Osler's Book Bills," *Osler Library Newsletter* no. 26 (1977): 1-4.

13. Two examples of manuscript catalogues which list parts of nineteenth century Canadian scientists' collections are the list of George Lawson's books noted earlier and an eight page manuscript in the McGill University Archives, Montreal, Quebec of volumes in Philip Carpenter's library prepared when Carpenter's widow sold the books to the McGill University Library. McGill University Libraries Papers. McGill University Archives, RG 40, C2, file "Donations to the Library 1861-1892."

14. One personal library that has survived intact in large segments is the collection of the nineteenth-century, French Canadian scientist, Léon Provancher. Raymond Duchesne has described this library in "La Bibliothèque scientifique de L'Abbé Léon Provancher," *Revue d'histoire de la Amérique française* 34 (mars 1981): 535-556.

15. John L. Thornton and R.I.J. Tully, *Scientific Books, Libraries, and Collectors. A Study of Bibliography and the Book Trade in Relation to Science*, 3rd ed. (London: Library Association, 1978), 339.

16. This is a phrase which Alan Gribben penned to describe his experiences in working with the libraries of American literary figures. See, Alan Gribben, "Private Libraries of American Authors: Dispersal, Custody, and Description," *Journal of Library History* 21 (1986): 306. Edwin Wolf II has recounted the problems in discovering the contents of Benjamin Franklin's library and wrote in a muted sense of exasperation that

"it is amazing how difficult it is to trace a book sold or seen fifty years ago, or even twenty five." Edwin Wolf II, "The Reconstruction of Benjamin Franklin's Library: An Unorthodox Jigsaw Puzzle," *Papers of the Bibliographical Society of America* 56 (1962): 13.

17. The decision to conduct searches for publications in particular libraries was usually based on knowledge of a scientist's prior affiliation with an institution, e.g., copies of some of William Logan's books were located at the Geological Survey of Canada library and items from J.W. Dawson's library were found in the libraries at McGill University. Serendipity and "talking with the right people" were sometimes the most fruitful methods of locating the elusive volumes. To give only one example, I spent a considerable time searching in the McGill University libraries and archives for publications from J.W. Dawson's library before a chance discussion with the "right person" brought forward a large group of uncatalogued items which were all known to have been part of Dawson's library.

18. For example, the collections of the plant sciences and entomological divisions of the Canada Agriculture Main Library were examined systematically for items from James Fletcher's and William Saunders's personal libraries. Librarians in a number of institutions were kind enough to allow direct access to special collections and then volumes were examined one by one for evidence of provenance. The rare book and special collections of the Canada Agriculture Main Library, the Geological Survey of Canada Library, and the Blacker-Wood Library at McGill University were so examined.

19. In the case of William Logan's library, some of his books are now held by the Geological Survey of Canada Library in Ottawa, Ontario. Once the characteristic shape and design of Logan's bookplates were identified (there was more than one design), potential books were examined for the telltale evidence. In a number of instances, the "evidence" had been covered over with new endpapers by some enterprising individual who had undertaken preservation work. The characteristic shape of the Logan bookplate, however, was still unmistakable even though it was masked by the new endpaper.

20. A case in point are publications by the American entomologist, William H. Ashmead, attributed to James Fletcher's library. Ashmead sent reprints of his papers to Fletcher and wrote on several of them "Mr. James Fletcher with Author's compliments." Ashmead's autograph is absent on a number of his papers that are now bound together in a volume held in the entomological division of the Canada Agriculture Main Library, but since they were published during the same time period of those that did, they were all assigned to Fletcher's library.

21. For example, the Montreal Book Auctions Ltd. held a series of sales of Bell material and produced a number of catalogues including: Sale no. 112, 12th October 1978, sale no. 115, 14th December 1978, sale no. 117, 18th January 1979, and sale no. 120, 23th ˙ :y 1979.

22. This was the case, for example, of Billings's personal library. In 1858, William Stewart M. D'Urban published a "List of Works to be Consulted by Students of Canadian Diurnal Lepidoptera," in the *Canadian Naturalist and Geologist* (pp. 416-419). D'Urban described books from several libraries: the Library of Parliament, the library of the Natural History Society of Montreal, the library of McGill University, as well as Billings's personal collection.

23. For example, a volume from Robert Bell's library was found by scanning the book shelves of a second-hand book shop in London, Ontario.

24. Annette Bourgeois, chief librarian at the Geological Survey of Canada Library, very kindly conducted a search of the machine-readable catalogue of the library and provided a printout of all the holdings of pre-1910 imprint. At the time the search was conducted many of the monographs had not yet been added to the catalogue. Selected manual searches were carried out in the monograph holdings. It should be noted, however, that because of space limitations the monograph collection has been weeded on a number of occasions since the turn of this century.

Chapter III -- The Canadian Context

The development of the Canadian nation and components of its society such as science neither began nor ended with the boundaries of the Victorian era for much happened both before the late 1830s and after the first decade of the twentieth century that has tempered the type of country that grew up in the northern part of North America.[1] By the first decade of the twentieth century Canada had become a growing, largely urban, society that spanned the continent. Technical advances in transportation and communication helped to tie former isolated colonies into a viable nation. Scientific endeavour in the form of associations, journals, research institutions, and educational opportunities had grown from fledgling roots in the 1820s and 30s to become a significant element of Canadian society in the first decade of the twentieth century. Between the beginning of the Victorian period and its conclusion the patterns of political, social, and scientific development in Canada were established, patterns that would prevail for many decades afterwards.

Science in Victorian Canada

In Victorian Canada, science, particularly natural history and its later specialized disciplines, found wide expression. Although early in the period some practitioners would claim that "public opinion was hardly capable of appreciating the importance of science" this was considered an understandable and temporary situation.[2] Indeed, by the turn of the twentieth century, science in Canada, reflecting developments at the international level with the rise of specialisms and firmly entrenched research institutions, had built a firm foundation, a base as a collective enterprise rather than the lone efforts of single scientists scattered across a wide geographical expanse. The numbers of scientists and research institutions were many fewer than that found in other nations, particularly the United States to the south, but all the same, by the decade leading up to the First World War, the position of science in Canadian society was assured.

Until recently historians have for the most part neglected the history of Canadian science. Within the last decade, however, a number of scholars have turned their attention to the place of science in Canadian history, making this "one of the more flourishing areas of Canadian studies."[3] This scholarship has identified a number of characteristics of the science practised in Victorian Canada, among which the most significant is the prominence of "inventory science."

"A common inventorial purpose linked early Victorian scientific pursuits in British North America," Suzanne Zeller recently wrote in her book, *Inventing Canada: Early Victorian Science and the Idea of a Transcontinental Nation*. She used the collective term 'inventory science' "to highlight the mapping and cataloguing of resources and other natural phenomena which preoccupied the colonists."[4] In several branches of natural history the primary work involved either collecting, describing, and classifying plants and animals, or identification and mapping of geological formations. Citizens with either amateur inclination or more professional interests could participate in such inventory endeavour throughout the Victorian period, and this accounts, at least partially, for the popularity of scientific activities in the last century. Inventory science, while it could be practised by almost anyone, did impose some conditions on those whose quest was professional. Not the least was the need for access to taxonomic and descriptive literature since identification and naming of the flora and fauna could not be completed successfully in isolation of the output of other workers, nor could identification and description of geological phenomena be carried out productively without consultation with previously published reports. Throughout the nineteenth and early twentieth centuries one of the concerns of individual workers and scientific associations was the creation of adequate local libraries of scientific literature.

Inventory or descriptive science was pursued in locations other than Canada during the Victorian period. Robert Bruce has noted that in the United States at mid-century science "was growing up outdoors." "To observe, to describe, to classify, perchance to name, then to observe again. That was the happy and simple round of most American scientists."[5] A similar pattern of scientific discovery and description was also occurring in Europe.[6] By the end of the Victorian era, however, much of the European and North American territories had been explored to some extent and a move from a study of "outdoor things" to a greater emphasis on laboratory-oriented investigation was well under way in Canada as elsewhere.

In Canada early illustrations of institutionalized inventory science are the geological surveys. The larger and more permanent Geological Survey of Canada begun in 1842 is the best example, but there were earlier surveys in New Brunswick and Newfoundland in the 1830s. The concept of science as fact gatherer had some hold on Canadian governments. Closely allied with this view was the idea that the facts once gathered had direct utilitarian applicability. Science was seen as offering economic solutions to problems of resource exploitation whether these were in mineral exploration or agricultural objectives. Public support of science, both in the formation of the Geological Survey of Canada and the Experimental Farms System in 1886, was forthcoming only when science was shown to be useful.

Victorian Canada witnessed a growth in the number of scientific societies, some with purely local focus, others with avowedly national intentions. While for some members (maybe even a majority of members), these societies served primarily a social need, for others intent on seriously pursuing scientific study through the facility of meetings, lectures, museums, outings, and libraries, the associations acted as a source of scientific information and a wellspring of encouragement.[7]

Concurrent with the rise in the number of scientific societies was a growing number of scientific periodicals published in Victorian Canada mirroring a phenomenon occurring during the same period at the international level.[8] For Canadians who might have had difficulty breaking into the international scientific press, these native journals provided increased opportunity for outlet of scientific investigation.[9] In addition, indigenous journals enhanced the diffusion of scientific information by reprinting scientific intelligence from foreign sources not readily available in Canada.

In Victorian Canada two fields of scientific endeavour - agriculture and geology - were prominently supported by governments and also actively pursued by scientists.[10] The evidence suggests that more publications on geological or agricultural subjects than on other topics were produced in Canada during this period.[11] As well, geological and agricultural work received more extensive and sustained financial support from various governments than that obtained by other scientific disciplines.[12] The pattern of support for the two areas of science differed throughout the Victorian period. On the one hand, agricultural ventures, from very early colonial days, secured government attention and obtained financial assistance. But until the last quarter of the nineteenth century, particularly with the formation of the Experimental Farms System, much of this assistance did not centre on scientific research. On the other hand, government funding of the geological sciences, the first of the sciences to obtain concerted and ongoing legislative support once the Geological Survey of Canada was established in 1842, was committed largely to the undertaking of field work, scientific investigation, and description. Throughout the Victorian period considerable economic importance was attached to both fields of activity, which brought pressure to bear on governments to continue financial backing of research in the two disciplines.

No doubt due to government munificence, some of the more outstanding Canadian scientists of the Victorian period found opportunity for employment in either geological or agricultural work. Because of the prominence of the research in geology and agriculture, science in general was promoted in Victorian Canada. Both the geological and agricultural sciences offered prospects for pure or applied research and both were pursued. But it was for the applied or utilitarian aspects that government funding was usually garnered and in the case of both geology and agriculture judicious highlighting of the practical side of investigations ensured that financial backing continued to be forthcoming.

For reasons of limiting the scope of this dissertation and considering that the transmission of literature in one scientific area might show characteristics that the other would not, the two sciences - geology and agriculture - were chosen for an analysis of the dissemination of scientific literature in Victorian Canada. A study of the patterns of the dissemination of literature in these two fields may also serve to illustrate the flow of scientific literature among Canadian scientists in general during this period.

The Six Canadian Scientists

To provide a means of tracking the flow of scientific literature in Victorian Canada six scientists were selected and aspects of their careers monitored. Chapter IV, for example, looks at the publications that they cited and chapters V and VI discuss libraries to which they had access or likely did use.

While full-time careers in science were available to only a very few in Canada at the beginning of the Victorian era, by the end of the first decade of the twentieth century opportunities had improved measurably. Collectively the six scientists chosen for this study were among the more outstanding in Canada during the Victorian period. Each found their life's work in scientific endeavour, and although the path leading up to their scientific careers often differed from the route adopted by the typical twentieth century scientist, all six were scientists in the modern sense of the word. C.D.

Hurt maintains that "the scientist who does not publish is not a scientist."[13] Menard applied a "more restrictive definition" when he stated that "a scientist is someone whose work is cited in the scientific literature."[14] By either definition, each of the six men in this study qualify as scientists.

For a variety of reasons the careers of Robert Bell, Elkanah Billings, John William Dawson, James Fletcher, William Edmond Logan, and William Saunders were selected for scrutiny.[15] First, and foremost, each of the scientists actively pursued research in either geology or agriculture, the two fields of scientific endeavour identified as the most prominent in Victorian Canada. Second, each of the six scientists published extensively, being major players in Canada's contribution to the published scientific literature of the Victorian period.[16] This being the case, it is likely they would require access to the available scientific literature more frequently and extensively than would be expected of a person who authored few publications. Third, each of the scientists was recognized as an expert in either geological or agricultural topics by the larger international community of scientists, recognition coming by way of citation by other scientists or by awards for achievement. Finally, each of the scientists exerted leadership in scientific endeavours by participation in scientific societies in Canada and abroad and in doing so they encouraged scientific work during the Victorian period when the very basis of science in this country was being laid down.

Although these six men were exemplars of Canadian science in the nineteenth century, they probably would not have thought of themselves in this fashion.[17] They were men with a mission, who by close attention to scientific work attempted to advance knowledge and promote the development of science in this country. By almost any measure they were successful in their aim. To provide further detail of the Canadian context the remaining paragraphs of this chapter are devoted to brief outlines of their careers.

A. Robert Bell (1841-1917)

"No man has accomplished so much pioneer exploration in territory where previously only Indians had been," is how one biographer summed up Robert Bell's career.[18] This brief commentary understates a fuller career, however. Born the son of the Rev. Andrew Bell, an amateur geologist, on 3rd June 1841 in Toronto, Robert Bell at a very early age developed an interest in natural history and as a teenager of only fifteen was engaged as a summer assistant with the Geological Survey of Canada. That placement was the beginning of an employment relationship that lasted until his retirement as Acting Director of the Survey more than fifty years later.

During his late teens when his summers were occupied with the Geologic. Survey (he headed his own survey party in

1859), he pursued post-secondary education at McGill University, graduating with a degree in civil engineering in 1861. While at McGill he studied natural history and geology with J.W. Dawson. The year following graduation from McGill was spent studying at the University of Edinburgh and then for five sessions from 1863 to 1868 he held the position of professor of chemistry and geology at Queen's University, Kingston, Ontario. Throughout the time he was teaching at Queen's he continued to work on a part-time basis with the Geological Survey, which he joined full-time in 1869 after resigning from his academic post.

The majority of Bell's geological contributions stem from the period of his full-time employment with the Geological Survey, but as early as 1857 he was publishing the results of his scientific investigation and in 1862 when he was only 21 he was elected Fellow of the renowned Geological Society of London. Morris Zaslow has written that "from the very first season [1857], his keen powers of observation and his broad interests were in evidence, as witness the outstanding botanical collection and extensive description of the fauna and flora of the Saguenay region he made during the summer of 1857."[19]

For more than thirty years Bell explored large tracts of land mostly in northern and western Canada. In 1902 he published a map that demonstrated the geographical accomplishments of the Geological Survey during its first sixty years.

Writing about this map Zaslow noted:

> A large number of those tracts were made by Bell himself, for his own work surpassed that of the several other very able explorers who worked for the Survey during this period in terms of the area covered, the districts mapped for the first time, and the reporting of local conditions and prospects of a wide part of Canada. In a 50-year period, Bell ranged as far afield as the prairies of Saskatchewan, the oil sands of the Athabasca, and north to Great Slave Lake and Baffin Island. But mainly his work was concentrated in what is now northern Ontario and Quebec, in an arc extending from the Saguenay to Lake Winnipeg and from these points north to the shores of Hudson and James Bays. It was no idle boast when he wrote in 1904 that almost single-handedly he had done the major part of the preliminary reconnaissance work for the third transcontinental railway that was being built in these years....His range was equally broad -- including not only geology and mineral resources, but soil, surface conditions, transportation facilities, forests, waterpower, crops, fish, wildlife, vegetation, climate, and as has been seen anthropology and ethnology.[20]

During the early years of his full-time employment with the Geological Survey, Bell judiciously used his time to complete a medical degree at McGill University obtaining the M.D., C.M. in 1878 and he later used this qualification to act as medical officer on the government exploration ships, *Neptune* and *Alert*, visiting the Hudson and James Bays during the mid 1880s. Bell's years of employment with the Geological Survey brought increasing responsibility. In 1877 he became one of four assistant directors, in 1890 chief geologist, and in 1901 he was appointed acting director. To his great disappointment he was never officially named Director of the Survey. He retired at 65 in 1906.

Bell's extensive geological work was recognized both nationally and internationally. He received honourary D.Sc. degrees from Queen's University, Kingston, Ontario and Cambridge University, England. He was a founding Fellow of the Royal Society of Canada in 1882 and he was elected a Fellow of the Royal Society of London in 1897. His geographical work was acknowledged with the King's Gold Medal from the Royal Geographic Society (its highest award) in 1906 and the Cullum Gold Medal from the American Geographic Society in the same year. Finally, "for faithful service" he received royal honour with Companionship of the Imperial Service Order in 1903. It is evident that from the middle of the Victorian period until the end of the first decade of the twentieth century Robert Bell played an important role in geological circles in Canada.

B. Elkanah Billings (1820-1876)

Unlike Bell, Elkanah Billings's early career was found in fields other than science, but for two decades in the middle of the Victorian period he was the first in Canada to be employed full-time as a palaeontologist.[21] Billings was born on 5th May 1820 at Billings Bridge, Bytown (now Ottawa) and he obtained his early education in a variety of schools in the area. For two years between 1837 and 1839 he studied at the St. Lawrence Academy in Potsdam, New York, and then returned to Upper Canada to enter the legal profession. In 1839 he enrolled in the Law Society of Upper Canada first articling with lawyers in Bytown for four years and then later with the legal firm of Baldwin and Wilson of Toronto for one year. For about a year following his admission to the bar, which occurred in the fall of 1844, he practised law in partnership with Judge Christopher Armstrong in Bytown, following which he returned to Toronto where he continued to practice law sometimes on his own and at other times in partnership. From Toronto he moved to Renfrew to carry on legal work and then in 1852 he returned to Bytown where he remained until he moved permanently to Montreal to take up the position of palaeontologist with the Geological Survey of Canada.

The legal profession did not hold Billings for his real interest was in science. Over a period of years he made a transition from law to science until the break was complete and he could write to William Logan on 29th February 1856: "I have abandoned my profession, and intend to devote the rest of my life to the study of Natural History."[22] The shift of career to science was gradual during which Billings acquired increasing expertise in palaeontology. His interest in science may have stemmed from family background. His grandfather (with the same name), a graduate of Harvard University, was a medical doctor and his older brother, Braddish, was a botanist and entomologist of some note.[23] Following his death in 1876, Billings's younger brother, Charles wrote:

> I think my brother's mind naturally turned toward the profession which he finally adopted...he never seemed to be fond of the legal profession. There seemed to be a void somewhere and it was not until about 1848 or 1849 that he seemed to get on the particular line that suited his inclinations. It was about that time that he seemed to find what he had been looking for and from that time forward he seemed to be contented and happy in the indulgence of his favorite study. The more his mind was bent upon it, the more he seemed to lose sight of his legal attainment until at last his thoughts were turned to it altogether.[24]

Events along the way to his becoming a full-time palaeontologist included being part of a committee in 1847 which organized the Bytown Mechanics' Institute and in 1852, when he had moved back to Bytown, Billings was engaged as an editor of the Bytown *Citizen*. Many of the articles which he wrote for the *Citizen* dealt with geological topics and, while employed with that newspaper during the early 1850s, he built an extensive collection of fossil remains found near Ottawa. As early as 1852 he was corresponding with William Logan, Director of the Geological Survey, building a respectable reputation with the latter such that Logan permitted Billings to accompany field expeditions of the Survey to Levis, Quebec and Lambton County, Ontario in 1854 and 1855.[25] Beginning in February 1856 Billings put his journalistic and scientific skills together to bring out the first volume of the *Canadian Naturalist and Geologist*. This was a notable undertaking because it launched a scientific periodical that for the remainder of the century published some of the most significant scientific research in Canada.[26]

By 1856 when Logan was financially in a position to hire long-desired and much needed additional staff for the Geological Survey, Billings's palaeontological expertise was sufficiently well advanced and known that he was engaged as the Survey's first palaeontologist. Billings left Ottawa for Montreal to begin the massive task of describing and classifying the large fossil collections that had accumulated at the Survey headquarters during the previous decade.

While he spent part of his career with the Geological Survey in field expeditions, Billings more often relied on other members of the Survey staff to procure the fossil specimens and he occupied most of his time at the Survey's headquarters in Montreal working with the ever growing collections. In 1856, at the beginning of his employment, there was reason for haste in putting the Survey collections in order because the American Association for the Advancement of Science (AAAS) had been invited to meet in Montreal in 1857[27] and Logan and others were judiciously using that meeting to advance not only the reputation of the Survey but science generally in Canada. For the remaining two decades of his life Billings devoted his time to the description of fossil forms, largely in the field of invertebrate palaeontology, for which he became a recognized authority. He has been described as "an able, observant paleontologist, and something of a genius at identifying and classifying fossils and recognizing their basic characteristics."[28] While initially he relied on published descriptions for his own descriptive work, he quickly discovered that many of the Canadian fossils were unique and he embarked on identifying many new species.[29]

The number of new forms that Billings identified for the first time was large. By 1863 "he had published descriptions of no fewer than 526 new species, mostly brought in by explorers for the survey, particularly when they examined new formations"[30] and it is estimated that by the end of his career that "in addition to routine descriptions of already known taxa, he erected sixty-one new genera and one thousand and sixty five new species."[31]

Recognition for Billings's palaeontological work was not long in coming. His descriptions were published in the reports of the Geological Survey and in international journals where they received favourable review. While in England in 1858 he was elected a Fellow of the Geological Society of London on the recommendation of some of the leading British geologists of the day. The Natural History Society of Montreal of which he as an active member acknowledged his contributions to science with its silver medal in 1867 and for his work with Canadian entries in the International Exhibition in London in 1862 and the Paris Exhibition in 1867 he received bronze medals.

Billings's contributions to Canadian science extended beyond his palaeontological work to other areas of geology, entomology and natural history. His continued involvement with the publication of the *Canadian Naturalist and Geologist* ensured that that journal became a prominent scientific periodical in Canada and elsewhere.

Billings was entirely self-taught in the sciences. One of his contemporaries wrote that the "success of his career as a palaeontologist...was largely due to the concentration of his mind on one object. To this must be added the possession of analytical powers of mind of a high order."[32] Still in the prime of his scientific career, Billings died in Montreal at the age of 56 on 14th June 1876.

C. **John William Dawson (1820-1899)**

A man of many abilities and prodigious output, John William Dawson (Sir John William Dawson after 1884) was a major scientific figure in the Victorian period by almost any standard of measure.[33]

Born of Scottish lineage in Pictou, Nova Scotia on 13th October 1820, Dawson spent most of his early years in this town which, at the dawn of the Victorian era, was a thriving community with more prospects than many other locales. The Dawson home was one in which education and a study of nature were encouraged. Following a business failure, due to the declining timber trade and shipbuilding industry, James Dawson, John William's father, opened a bookstore in Pictou and although family finances were scrupulously watched as the indebtedness of the previous business reversal was being retired, James Dawson ensured that his son had the best schooling available. Fortunately for young John William, Pictou Academy, a remarkable educational institution, had been established in the town by Thomas McCulloch, now largely remembered for his *Stepsure Letters*.[34] A man of acute and vigorous intellect, McCulloch was well read in philosophy and literature and also gave considerable attention to the physical and natural sciences. When Dawson attended the Academy it provided a liberal college education unavailable in most Canadian communities of the time. Here Dawson's nascent natural history interests were encouraged and promoted.[35]

A nearby area rich in fossils provided young Dawson with many collecting opportunities and occasional travel for his father's bookselling and publishing interests allowed him to consult with such authorities as Augustus Gould, an eminent conchologist, in Boston. Prompted by his growing interest in geology and palaeontology and with encouragement from both his parents and Dr. McCulloch, Dawson travelled in 1840 to Edinburgh to study at the University with some of the leading scientists in the United Kingdom.[36] The time of study in Edinburgh was short-lived since financial difficulties at home required Dawson to return to Nova Scotia in 1841. Except for another year of study at Edinburgh in 1846-7, Dawson had no further formal education. The University of Edinburgh conferred the M.A. degree on Dawson in 1856.

The return to Nova Scotia in 1841 was not without benefit, even though Dawson would have preferred to have continued his studies in Edinburgh, for during the summer of 1841 he met two of the outstanding geologists of the day who were visiting Nova Scotia examining the coal and fossil deposits. Charles Lyell, a distinguished British geologist, and William Logan, a native Canadian soon to be director of the Geological Survey of Canada, were surprised by Dawson's expertise and the quality of his observations when he accompanied them on geological explorations in the area. Lyell, in particular, encouraged Dawson to pursue his scientific research, and it was under Lyell's patronage that Dawson's early papers appeared in the *Quarterly Journal of the Geological Society of London*, a prominent scientific periodical of the period.

Encouraged by his study in Scotland and interaction with both Lyell and Logan, Dawson vigorously continued his examination of the geology of eastern Nova Scotia. His growing expertise gathered notice in the province and in 1850 he was invited to give a series of lectures on scientific topics at Dalhousie College in Halifax. In that same year, Joseph Howe, the Provincial Secretary, prevailed on Dawson to become the first Superintendent of Education for the colony. He undertook this position with characteristic vigour, travelling widely, visiting hundreds of schools, delivering lectures and organizing teachers' institutes.[37] Having been a major influence on improved education in Nova Scotia and instrumental in the founding of the Nova Scotia Teachers' College (or Normal School as it was called), Dawson resigned from the position of Superintendent of Education in 1853. His expertise and increasing confidence in educational matters led to his appointment to a Royal Commission on education in New Brunswick in 1854 and in the following year when the Board of Governors of McGill University sought a new principal who would revitalize a moribund institution they wisely "Resolved unanimously that J.W. Dawson Esq. of Pictou, in the Province of Nova Scotia be and is appointed Principal of McGill College for and during the pleasure of the Governors and no longer."[38] Dawson remained within the "pleasure of the Governors" for almost forty years, resigning in 1893.

Under Dawson's leadership during the latter half of the nineteenth century, McGill University was transformed from a small institution of little consequence to a leading centre for learning and research. Beginning with limited means, Dawson mobilized the financial magnates of Montreal to underwrite costs of new buildings, research equipment, library acquisitions, and other needs of a growing university. His commitment to a study of science ensured that the curriculum included a strong component of the natural and physical sciences. Initially Dawson was also concurrently Professor of Natural History and Chemistry teaching upwards of twenty hours a week, but as the university grew and his administrative responsibilities likewise increased he relinquished some of his teaching commitments to new faculty members. By the end of the Victorian period scientific research at McGill was receiving world-wide attention and the strength of this reputation rested largely on Dawson's efforts. Stanley Frost succinctly summed up Dawson's principalship by stating that "James McGill founded a college and John William Dawson made of it a university."[39]

Even though his employment in education was demanding (worthy of a career on its own), Dawson never abandoned his interest and work in scientific investigation. While he was Superintendent of Education for Nova Scotia he judiciously used all available free time while travelling to investigate local geological conditions culminating in 1855 with the publication of *Acadian Geology*, a work which went through several editions throughout the remainder of the century, and may justly be termed his *magnum opus*.[40] Dawson did not rest his scientific reputation on a single major volume. Throughout much of the last half of the nineteenth century, he produced an average of ten publications per year related to his scientific work.

Dawson's scientific publications were based on solid scientific observation and he gained wide respect for his study of fossil plants. Several decades of analysis were brought to bear in his book *The Geological History of Plants* brought out in the International Scientific Series in 1888 which for several decades "was a textbook practically without a competitor."[41] Not all of Dawson's views received universal acclaim, however. Among other matters, probably his position regarding Darwin's theory of evolution put him in the limelight of discussion in the mid- and late-Victorian period. Dawson has been termed the "leading anti-Darwinian in the English-speaking world" and if number of publications is any indication the description is probably true.[42]

Dawson's scientific energies extended beyond education and publication to active promotion of scientific associations. Among others he was a driving force that guaranteed a prominent role for the Natural History Society of Montreal and he was a major determinant in the establishment of the Royal Society of Canada initiated by the Governor General, the Marquis of Lorne.[43] Dawson's stature in the scientific community found recognition in his election to the presidency of both the American Association for the Advancement of Science (1882-83) and the British Association for the Advancement of Science (1886), the only person to have attained this double honour. Much earlier he had been elected a Fellow of the Geological Society of London (18‿4) and the Royal Society of London (1862). In 1884 Dawson was knighted by Queen Victoria.

T.H. Clark probably said it best when he wrote:

> In many respects J.W. Dawson was one of the most remarkable men in the roster of nineteenth-century North American scientists. Largely self-taught, with almost casual university attendance, he established himself as one of the foremost experts in several fields. Moreover, as a teacher or an

> administrator he had few equals, and as both none. His writing on divers subjects were voluminous. His impact upon the general field of education was profound. He did more by precept and by spoken and printed word to further the progress of geology and education in Canada during that period than did any other person.[44]

After his retirement as Principal of McGill University in 1893, Dawson continued an active pursuit of scientific interests but within a few short years he died on 19th November 1899 at the age of 79.

D. **James Fletcher (1852-1908)**

James Fletcher was the Dominion Entomologist and Botanist, or as he phrased it, the "Bug and Weed Man," during more than two decades of the formative period of the Dominion Experimental Farms System.[45] Stationed in Ottawa at the Central Experimental Farm, he was widely known in the agricultural and scientific communities in Canada and, in addition, was well-known among a extensive circle of scientists abroad, primarily in the United States and England.

Fletcher was born at Ashe, in Kent, England on 28th March 1852 and spent his youth there obtaining his early schooling at King's School in Rochester. In 1871, at the age of nineteen, he began several years employment with the Bank of British North America, being first located in London, England. Three years later the Bank transferred him to a branch in Montreal and a year afterwards he moved to the Bank's Ottawa office. In May of 1876 Fletcher left the Bank to take up a position as accountant with the Library of Parliament, a job which he found more to his suiting.[46]

It was while he was employed at the Library of Parliament that Fletcher's expertise in entomology and botany unfolded and he became widely acknowledged as an authority in these areas both in Ottawa and throughout the country. Even though he was already well-versed in natural history, the ample resources of the Library of Parliament in the way of scientific literature allowed him to pursue his studies of entomology and botany more vigorously, an activity which occupied much of his spare time.[47] Writing in 1909 shortly after Fletcher's death, W. Hague Harrington remarked that during the early years of Fletcher's employment at the Library of Parliament the "library was then more accessible to students than it has been of later years, as the hours were longer and less restrictions were imposed. Many pleasant and profitable hours did we spend there together, in the examination and study of valuable works of reference."[48]

Soon after his arrival in Ottawa, Fletcher became active in scientific and other social circles. Recognizing the difficulty of studying alone he carried through on a suggestion and in 1879 became one of the founders of the Ottawa Field-Naturalists' Club. For the next thirty years he actively supported this association, often taking a leadership position, and the published journal of the society became an outlet for some of his scientific investigation. Fletcher's involvement with scientific societies extended to other national and international organizations. At various times he held the positions of President of the Entomological Society of Ontario and the American Association of Economic Entomologists and he maintained membership in a variety of other societies including the Entomological Society of America and the American Association for the Advancement of Science. In recognition of his accomplishments as a scientist he was elected a Fellow of the Royal Society of Canada in 1885 in which organization he held the position of Honourary Treasurer (1893-1905) and Honourary Secretary from 1905 until his death. Outside of Canada his stature as a scientist was acknowledged in his election as Fellow of the Linnaean Society of London in June 1886. Queen's University in Kingston, Ontario in 1896 awarded him with an honourary LL.D. in recognition of his contributions to science and society in Canada.

In 1884, while the establishment of the Experimental Farms was still being considered by the federal government and debated in Parliament, Fletcher was appointed honourary Entomologist of the Department of Agriculture, an office he held concurrently with his position in the Library of Parliament.[49] Three years later, after the Dominion Experimental Farms System had been established, his employment at the Library of Parliament came to an end when he was transferred to the Central Experimental Farm in Ottawa to assume the combined position of Dominion Entomologist and Botanist. It was here, pursuing agricultural research or investigations in applied biology, that he found his life's work.

His research career at the Central Experimental Farm ranged over the disciplines of entomology, plant pathology, and economic botany. He travelled widely in Canada as a "fluent and popular lecturer" speaking to both agricultural and scientific audiences.[50] Well-informed about a range of agricultural topics, he pursued a role as gatekeeper of scientific information by maintaining an extensive correspondence with farmers and internationally known authorities. Until the time of his death in 1908 he "laboured assiduously, collecting, classifying, studying, writing, lecturing, conversing, strewing cheer and kindliness along the pathway of life."[51]

Although Fletcher was virtually self-taught in the sciences, he enjoyed the enviable and well-deserved reputation as an expert in agricultural applications of entomology and botany.

E. William Edmond Logan (1798-1875)

William Logan is the only scientist born in the eighteenth century that was selected for this study and it was his efforts as the first Director of the Geological Survey of Canada that helped establish a firm, independent scientific tradition in Victorian Canada.[52] Born on 20th April 1798 in Montreal, the son and grandson of prosperous Scottish businessmen, his early education was received in that city and in 1814 at the age of sixteen he was sent to Edinburgh to attend high school. Two years later he entered Edinburgh University registering as a medical student but he only stayed for one year. He left the university in 1817 to pursue a business career in London with his uncle, Hart Logan. During the year at Edinburgh, which completed his formal education, Logan attended classes in logic, chemistry, and mathematics (he took the first prize in this subject), but seems not to have registered in a course in geology, a subject in which he would later become an international authority.

For more than twenty years until the death of his uncle in 1838, Logan continued his business career. Within a decade after joining Hart Logan, he was in general charge of the business, his uncle having been elected a member of the British Parliament and having retired to a country home. While in London, Logan continued studies of the classics, languages, and mathematics in his spare time, but again nothing of a geological nature seems to have captured his attention. In 1831 he moved to Swansea in Wales to manage his uncle's investment in the Forest Copper Works, a copper smelting and coal mining enterprise, and it is from this period forward that geology became a central interest of Logan's.

While his initial assignment at Swansea was to sort out the financial management of the copper works, a task which he soon accomplished, the practical needs of ascertaining a continuous supply of coal led to his study of the geology of the area and a rapid acquisition of expertise in the subject. The geology of Wales was poorly known (the Geological Survey of Great Britain was not established until 1835) and Logan found it necessary to conduct field investigation and mapping of the coal seams. He ordered books on geology and mineralogy and surveying equipment from London and undertook intensive study and meticulous observation leading to a map of coal deposits of such detail and accuracy that it was adopted as the official geological map of the area by Sir Henry de la Beche, the first director of the Geological Survey of Great Britain.[53]

The map of south Wales established his reputation as a competent geologist (he presented the map to the Liverpool meeting of the British Association for the Advancement of Science in September 1837), but it was only one of several factors that demonstrated his ability in this field and that led eventually to his appointment as the first director of the Geological Survey of Canada in 1842. While in Swansea he helped to organize the Swansea Philosophical and Literary Institute in 1835 (later to be renamed the Royal Institute of South Wales) and from 1836 until his return to Canada in 1842 he was its honourary secretary and curator of geology. Fossil plant specimens acquired by the Institute may have prompted Logan to consider the origin of coal, a matter not clearly understood at that time. A paper describing his theory was presented to the Geological Society of London in 1840. By that time Logan had already been elected a Fellow of the latter Society which brought him into greater contact with the leading geologists in Britain of the period.

Logan's geological competence, taken together with his well-placed scientific connections plus the fact that he was a native Canadian led to his appointment as the first Director of the Geological Survey of Canada when it was finally established in 1842 after several years of debate by the colonial legislature of the united province of Canada. Although Logan had lived in Great Britain for a number of years he had not severed his ties with Canada and when the formation of a geological survey seemed imminent he actively sought the position of director. He was appointed in the spring of 1842 and for more than twenty-five years during the early decades of the Victorian period he brought immense skill to bear in shepherding a public institution through financial and political instability.

Logan's talents were not in management alon however. He had already established a reputation in geology and he immediately put his prodigious energies to work to give the Geological Survey an equally sound, scientific standing. When he retired in 1869 at the age of 71 the reputation of the Survey had spread widely and the honour which this brought to the new nation can be justly credited to Logan's efforts.

Logan's career with the Geological Survey has been divided into three periods by Zeller: "the initial reconnaissance of the 1840s and public reaction to Logan's preliminary geological findings; the flowering of Logan's reputation and authority during the 1850s, when he successfully showcased Canada's resources at several Universal Exhibitions; and the zenith of Logan's career during the politically unstable 1860s."[54]

Logan recognized the enormity of the task that the Geological Survey had before it. Shortly after his appointment he wrote to De la Beche: "You are aware that I have been appointed by the Provincial Government of Canada to make a Geological Survey of that Colony. The extent and the nature of the territory will render the task a most laborious one; but I am fully prepared to spare no exertion of which I am capable to render the work, when it is completed, satisfactory to those who have instituted the examination and creditable to myself."[55] The task, indeed, was laborious and during the reconnaissance period rapid and broad sweeping investigations of geological depositions and potential mineral resources were required. The initial funding provided by the government was inadequate to meet the needs of the survey[56] which meant that the number of staff members had to be kept to a minimum. Summer after summer found Logan in the field as he records, "living the life of a savage, sleeping on the beach in a blanket sack with my feet to the fire, seldom taking my clothes off, eating salt pork and ship's biscuit, occasionally tormented by mosquitoes."[57] The extensive work of long days and many late nights both during the summer field trips and winters sorting out the data back at the Survey headquarters in Montreal paid off. In annual report after report Logan demonstrated the value of geological investigation and by deft presentation of information was able to satisfy (or at least pacify) those individuals clamouring for the identification of economically exploitable mineral resources.[58]

During the 1850s, as Zeller has pointed out, Logan took the Survey on world tour by arranging for masterful entries in international exhibitions in London in 1851, Paris in 1855, and again in London in 1862. On each occasion Logan and his staff displayed extensive Canadian mineralogical and geological resources and at the same time demonstrated to the international scientific community the capable scientific work that was being conducted in Canada.

Evidence of proficiency in scientific endeavour was manifest not only in international exhibitions but also in the publications emanating from the Survey. With improved financial backing of the government Logan was able to add an increasing number of competent staff members and from their pen geological description and theoretical discussion was published in the reports of the Survey and the international scientific journals. After two decades of work, a major compilation, *The Geology of Canada*, was brought out by Logan in 1863 when he was 65. Two years later an atlas to accompany the 983 page *Geology of Canada* was published and in 1869 an even larger geological map of Canada was seen through the press. A classic text, the *Geology of Canada* even after more than a century, according to one commentator, "is still a reservoir of important information."[59]

From the early 1840s Logan's scientific reputation was secure and numerous personal honours received throughout the 1850s and 1860s only added to his status. In 1851 partly because of the outstanding display of mineralogical and other geological specimens at the London exhibition, he became the first native Canadian to be elected Fellow of the Royal Society of London. Five years later in 1856 he received the Wollaston Palladium Medal of the Royal Society and was knighted by Queen Victoria and a decade following this the Royal Society again conferred one of its honours on him, the Royal Gold Medal. The Canadian collection of minerals entered at the Paris Exhibition in 1855 prepared under Logan's supervision received the Grand Medal of Honour and the emperor of France, Napoleon III, awarded Logan with the Cross of the Legion of Honour. He received two honourary doctorates, one from the University of Bishop's College (1855) and the other from McGill University (1856). All of these accolades were well deserved but Logan deftly used them to promote the cause of science in Canada and garner political and financial support for the Survey.

For a number of years following his resignation as director in 1869 he continued geological research and involvement with the Survey but he was now reaching advanced age. He died in Wales at the home of his sister on 22nd June 1875.

Although Logan received tempting offers to direct geological investigations in other parts of the British empire, he declined, seeing responsibility in completing the task of the Canadian Survey.[60] In Victorian Canada, Logan was a remarkable Canadian and an outstanding scientist. In a summary statement of Logan's geological work Zeller recently wrote: "[a]lthough later investigations were able to improve some of his conclusions, as a whole his contribution to Canadian geology was enormous and stands the test of time remarkably well."[61]

F. **William Saunders (1836-1914)**

William Saunders, like James Fletcher, was largely self-taught in the agricultural sciences, and like William Logan with the Geological Survey of Canada, Saunders was a man well-fitted to take on the responsibility of being the first director of the newly formed Experimental Farms System. Endowed with the right combination of abilities to mediate between the farmer/practitioner and the scientific requirements of research, his tenure as director ensured a firm foundation for a major agricultural research establishment.

A native of England, William Saunders was born in Crediton, Devon on 16th June 1836. At the age of twelve he emigrated to Canada with his family and settled in London, Ontario.[62] While still a youth he was apprenticed to a local druggist and at the age of nineteen he opened his own drug store in London. By use of good business acumen and an interest in scientific investigation he soon succeeded in pharmacy. He "won an enviable reputation for his success in the manufacture of drugs" which he sold to wholesale drug companies.[63] Saunders early recognized the value of scientific association by joining the American Pharmaceutical Association when he was twenty-four, and he became actively involved in its operation leading in 1877 to his election as president.[64]

It was not for his pharmaceutical endeavours, however, that Saunders left his greatest mark in Canadian history. Rather, it was his work in agricultural research that persuaded the Canadian federal government to appoint him as the first director of the newly formed Experimental Farm System in 1886 and his work over the next two decades left an indelible imprint on Canadian agriculture.

Probably stemming from his preoccupation with the pharmaceutical value of plants and his teaching responsibilities at the Medical Faculty of what would become the University of Western Ontario, Saunders developed an interest in entomology and plant breeding. As early as 1860 he was submitting entomological papers to scientific journals of the period and

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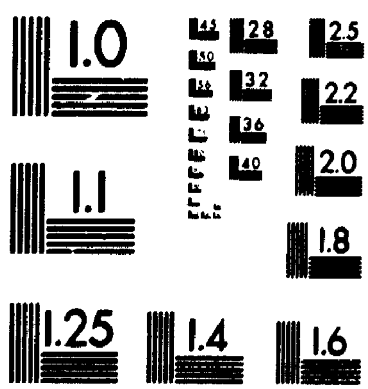

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in 1863 he was one of the founding members of the Entomological Society of Canada. Five years later that Society launched the *Canadian Entomologist* and Saunders became one of the major contributors. In 1873 he became the editor, a post he held until 1886. Saunders was a central figure in the Entomological Society serving as its president from 1875 to 1886 and for a number of years the headquarters of the Society were maintained in London.[65] Saunders's reputation as an entomologist spread beyond scientific circles largely because he maintained a strong interest in the economic aspects of the field. In the early 1870s, for example, when an outbreak of the Colorado Potato Beetle was causing havoc in Ontario, Saunders and Edmund Bayes Reed were engaged by the Ontario government to investigate the matter and to recommend measures for control.[66]

Saunders was an ardent gardener and orchidist. He maintained a garden at his London home and, in addition, in the late 1860s he purchased a seventy acre farm nearby at which he undertook extensive experiments in hybridization of fruit trees and a wide variety of other agricultural plants. In 1868 when the Fruit Growers' Association of Ontario was formed, Saunders was named a director and officials of the Association often made yearly treks to his farm to examine the results of his work with hundreds of trees and other plants.

Throughout the 1870s Saunders continued to conduct experiments in plant breeding and to study insects. In 1876, largely due to his efforts, the Fruit Growers' Association and the Entomological Society submitted entries to the Centennial Exhibition in Philadelphia to considerable acclaim. The culmination of about two decades study of economic entomology resulted in a major text on the topic, *Insects Injurious to Fruits*, which Saunders published in 1883.[67] A first such volume published in North America, it was described by one contemporary scientist as "one of the best manuals of the kind" that had been published up until that time.[68] The demand for the volume was sufficient to warrant a second edition in 1892 and he was working on a third edition at the time of his death.

Saunders sought active involvement in a variety of scientific societies other than those already mentioned. In 1868 he became a member of the American Association for the Advancement of Science and was elected a Fellow in 1874. In 1881 he became General Secretary for a one-year term. In the early 1870s Saunders joined the American Forestry Association and over a number of years he delivered several papers to its annual congresses. When the Royal Society of Canada was established in 1882, Saunders was among the founding Fellows and in 1906 he was elected president. Besides these scientific associations, Saunders supported his pharmaceutical profession by helping to organize the Canadian Pharmaceutical Society in 1867 and later taking a leading part in the establishment of the Ontario College of Pharmacy in 1871.

Although Saunders's early agricultural work was essentially a hobby, it became full-time endeavour from the mid-1880s until he retired. By the early 1880s he had become a well-established authority in agricultural research and when in his fiftieth year he took on the task of founding a new research institution in Canada, he carried the responsibility admirably. For some time the Canadian government had debated the practicality of creating a type of agricultural research bureau or experimental farm and when the matter seemed to be coming to a head in 1885, the minister of agriculture appointed Saunders to conduct further study into the feasibility of implementing an experimental farm system in Canada. Within a few short months following visits to numerous American research institutions and correspondence with others, Saunders submitted a report that guided the government in the text of the final legislation that brought the experimental farm system into being.[69]

Following his appointment as Director in 1886,[70] Saunders moved quickly to achieve the aims of the legislation. Within two years a 188 hectare farm near Ottawa had been laid out for research and brought under cultivation. In a similar manner branch farms were purchased and staffed in the Maritimes, Manitoba, the North West Territories, and British Columbia. The merits of the Experimental Farm System were quickly realized and over the next twenty-five years while Saunders was the Director numerous other branches and stations were opened throughout the nation. Farmers and others flooded the Central Farm with requests for information. In 1889, for example, only three years after the Farm was opened, nearly 7,000 letters were received; but a year later this number had jumped to over seventeen thousand. In this latter year the Central Farm staff sent out almost twenty thousand letters mostly to farmers across Canada.[71] As Anstey has written, Saunders "and his staff established a remarkable agricultural base" at the end of the Victorian period.[72]

Although Saunders carried a heavy load of administration of the Experimental Farms and had hired a number of competent staff (including James Fletcher as noted earlier), he retained responsibility for the cereal and agricultural divisions. The latter division, which Saunders assigned to a new staff member added in 1890, dealt with all field crops except cereals and with all types of livestock other than poultry. It was with work in the former section that the Saunders name is well-known in Canadian history.

While Saunders tested a variety of grains including oats, barley, flax, beans, corn and millet, his experiments in hybridizing wheat over a period of years eventually resulted during the first decade of the twentieth century with the development of Marquis wheat, a variety of wheat that quickly replaced others on prairie farms because of its high bread making quality and earlier maturing date.[73]

Saunders approached his responsibility of administering the Experimental Farms with energy uncharacteristic of his age. Over a twenty-five year period he lectured, conducted experiments, carried out an extensive correspondence, travelled throughout the nation, and participated in numerous meetings of agricultural and scientific organizations, all in an effort to promote the development of agriculture and science in Canada. William Saunders proved to be one of the outstanding agriculturalists of the late Victorian period and he was widely respected for his scientific achievements. He had been made a Fellow of the Royal Microscopical Society of London and a Fellow of the Entomological Society of London. In 1896 he was awarded an honourary LL.D. from Queen's University, Kingston and eight years later he received a second honourary LL.D. from the University of Toronto. He was made a Companion of the Order of St. Michael and St. George by King Edward VII in 1903. Reaching the age of 75 in 1911, Saunders submitted his resignation as Director of the Experimental Farms System. He died in London, Ontario three years later on 13th September 1914.

Having provided a brief description of salient features of the Canadian context and outlined the careers of the six scientists the dissertation now moves in the remaining chapters to a discussion of the dissemination of scientific literature in Victorian Canada in light of evidence found in the careers of the six researchers.

Notes to Chapter III

1. Throughout this dissertation Canada is taken to mean the country circumscribed by current national boundaries (less Newfoundland which did not join Canada until well after the Victorian period). Since the six Canadian scientists who form the core of the study lived principally in what is now Ontario and Quebec, chief concentration is given to those two provinces. In order to encompass the active careers of the six scientists, the term Victorian, which strictly speaking corresponds to the reign of Queen Victoria (1837-1901), is treated somewhat loosely to cover the period from the early 1840s to the end of the first decade of the twentieth century.

2. This was a view of the British scientist, J.H. Lefroy, director of the Toronto Magnetic Observatory, during the 1840s and early 1850s. See, Gregory Good, "Between Two Empires: The Toronto Magnetic Observatory and American Science Before Confederation," *Scientia Canadensis* 10 (1986): 43.

3. Trevor H. Levere, "The History of Science in Canada," *British Journal for the History of Science* 21 (1988): 422. For further discussion along this line see Bertrum H. MacDonald, "The History of Canadian Science and Technology: Some Resources for Mapping a Largely Uncharted Sea," *IATUL Quarterly* 1 (1987): 147-61.

4. Suzanne Zeller, *Inventing Canada: Early Victorian Science and the Idea of a Transcontinental Nation* (Toronto: University of Toronto Press, 1987), 4.

5. Robert V. Bruce, *The Launching of Modern American Science 1846-1876* (New York: Alfred A. Knopf, 1987), 64-65.

6. Writing about science generally, Ziman has stated: "Primary scientific knowledge is essentially *descriptive*. According to the conventional metaphor, scientists 'explore the natural world,' and endeavour to describe it 'as it is.' In such disciplines as geology, botany and zoology, there is a long tradition of simply recording what can be seen with one's own eyes, without interfering with natural processes." John Ziman, *An Introduction to Science Studies. The Philosophical and Social Aspects of Science and Technology* (Cambridge: Cambridge University Press, 1984), 14.

7. The formation and activities of Canadian scientific societies have been addressed by a number of authors including Peter J. Bowler, "The Early Development of Scientific Societies in

Canada," in *The Pursuit of Knowledge in the Early American Republic*, ed. Alexandra Oleson and Sanborn C. Brown, (Baltimore: The Johns Hopkins University Press, 1976), 326-339; Robert Daley and Paul Dufour, "Creating a 'Northern Minerva': John William Dawson and the Royal Society of Canada," *HSTC Bulletin* 6 (1981): 3-13; Stanley Brice Frost, "Science Education in the Nineteenth Century. The Natural History Society of Montreal, 1827-1925," *McGill Journal of Education* 17 (1982): 31-47; and J.T.H. Connor's two papers, "Of Butterfly Nets and Beetle Bottles: the Entomological Society of Canada, 1863-1960," *HSTC Bulletin* 6 (September 1982): 151-171, and "To Promote the Cause of Science: George Lawson and the Botanical Society of Canada, 1860-1863," *Scientia Canadensis* 10 (Spring-Summer 1986): 3-33. Richard Jarrell has argued that the primary function of scientific societies in nineteenth century Canada was "as a cultural or social institution." There is no doubt that for some members this function was paramount. But for how many is uncertain. For others the scientific societies served as "a channel for scientific information" and "a vehicle for molding and reinforcing the scientific ethos." Richard Jarrell, "The Social Functions of the Scientific Society in Nineteenth-Century Canada," In *Critical Issues in the History of Canadian Science, Technology and Medicine*, ed. Richard A. Jarrell and Arnold E. Roos, (Thornhill, ON: HSTC Publications, 1983). 31.

8. Scientific periodicals have only recently begun to receive historical analysis and as yet, nineteenth century Canadian scientific journals have been missed in such study. Evidence for the growing number of indigenous scientific and technical periodicals is found in R. Alan Richardson and Bertrum H. MacDonald, *Science and Technology in Canadian History: A Bibliography of Primary Sources to 1914* (Thornhill, ON: HSTC Publications, 1987).

9. Even scientists who had already established respectable international reputations and who had published abroad, saw the need for local journals in which to publish. J.W. Dawson was one of these. In his presidential address to the first meeting of the Royal Society of Canada he commented in several paragraphs on the lack of adequate means for publications of results of scientific investigation. He went on to say that "for anyt ing extensive or costly we have to seek means of publication abroad but this can be secured only under special circumstances; and while the public results of Canadian science become so widely scattered as to be accessible with difficulty, much that would be of scientific value fails of adequate publication, more especially in the matter of illustrations." J.W. Dawson, "[Address of the President,]" *Proceedings and Transactions of the Royal Society of Canada* 1 (1883): viii. More to the point, De Vecchi has written that "the publication of a journal -- a common corporate function

of learned and professional groups -- acquired a special importance in the case of an institution, such as the Canadian one, at the periphery of the scientific world." Vittorio de Vecchi, "The Dawning of a National Scientific Community in Canada, 1878-1896," *Scientia Canadensis* 8 (June 1984): 37.

10. Studies which have noted the importance of agriculture in Canadian history include: Vernon C. Fowke, *Canadian Agricultural Policy: the Historical Pattern* (Toronto: University of Toronto Press, 1946, reprt. 1978); Robert Leslie Jones, *History of Agriculture in Ontario 1613-1880* (Toronto: University of Toronto Press, 1946, reprt. 1977); John McCallum, *Unequal Beginnings: Agricultural and Economic Development in Quebec and Ontario until 1870* (Toronto: University of Toronto Press, 1980); and G. Elmore Reaman, *A History of Agriculture in Ontario* (Toronto: Saunders of Toronto, Ltd, 1970), two volumes. The prominence of geology in Victorian Canada is well covered in F.J. Alcock, *A Century in the History of the Geological Survey of Canada* (Ottawa: Edmond Cloutier, King's Printer, 1947) and Morris Zaslow, *Reading the Rocks. The Story of the Geological Survey of Canada 1842-1972* (Toronto: Macmillan Company of Canada, 1975).

11. Over 58,000 publications dealing with science and technology in Canada prior to the First World War have been identified in Richardson and MacDonald, *Science and Technology in Canadian History*. A large portion of these are of a geological or agricultural nature. Two papers which demonstrate the prominence of these two fields in the pantheon of other subjects are Bertrum H. MacDonald, "Clio's Blindspot? Science and Technology in Canadian History and the C.I.H.M. Collection," In *New Resources for Canadian Studies* (Ottawa: Canadian Institute for Historical Microreproductions, 1988), 44-82 and Bertrum H. MacDonald, "'Just a Little Better Than Other Sorts of Brains': Scientists and Engineers in the Maritimes Prior to 1914," Paper presented to the conference, Science and Society in the Maritimes, Mount Allison University, September 1988.

12. Trevor Levere has noted that "a salient characteristic of Canadian society has been, especially in the nineteenth century, the extent of government sponsored science." Levere, "The History of Science in Canada," 421. Expanding on this, De Vecchi wrote that "in Canada in the 1880s, the government was the largest single employer and trainer of men of science; furthermore, it was the main source of livelihood for most of the members of section IV (geological and biological science) and of quite a few of section III (mathematical and physical sciences) of the national Royal Society [of Canada]." Vittorio de Vecchi, "The Dawning of a National Scientific Community," 40. The geological and agricultural sciences did not have exclusive hold on government financial backing.

Another field which obtained some support was meteorology and terrestrial magnetism. See, Good, "Between Two Empires," and Zeller, *Inventing Canada*, part II, "Terrestrial Magnetism and Meteorology," 115-180.

13. C.D. Hurt, *Information Sources in Science and Technology* (Englewood, CO: Libraries Unlimited, 1988), xiii.

14. Henry W. Menard, *Science: Growth and Change* (Cambridge, MA: Harvard University Press, 1971), 11.

15. During the Victorian period there were very few French Canadian scientists. A classical education leading more often to careers in law or the church than to other options is the reason most often advanced for there being few scientists in French Canada during the last century. There were notable exceptions, however, such as Léon Provancher (1820-1892) who launched and almost single handedly edited *Le Naturaliste canadien* during the last three decades of the nineteenth century. Further information concerning science in French Canada can be found in Raymond Duchesne, "Science et société coloniale: les naturalistes du Canada Français et leurs correspondants scientifiques (1860-1900)," *HSTC Bulletin* 5 (May 1981): 99-139; Richard A. Jarrell, "Colonialism and the Truncation of Science in Ireland and French Canada during the Nineteenth Century," *HSTC Bulletin* 5 (May 1981): 140-57; Richard A. Jarrell, "The Rise and Decline of Science at Quebec, 1824-1844," *Histoire social* 9 (1977): 77-91; and Luc Chartrand, Raymond Duchesne, and Yves Gingras, *Histoire des sciences au Québec* (Montréal: Les Editions du Boréal, 1987).

16. As yet no thorough study of the publishing patterns of nineteenth century Canadian scientists has been competed. One investigation which looked at a sample of 3,212 monographs dealing with Canadian science and technology published prior to 1914 found that ninety six percent of the authors published only one monograph. While it is unlikely that this high percentage of authors with single publications would also be true of periodical articles (it is easier to bring out a short article in comparison to a full-length book), the percentage of prolific authors for journals articles is still probably low. See, MacDonald, "Clio's Blindspot?" 58-59.

17. The number of women scientists in Canada during the Victorian period was very low and much of their work has remained hidden. A recent book which discusses Canadian women scientists is Marianne Gosztonyi Ainley, *Despite the Odds. Essays on Canadian Women and Science* (Montreal: Véhicule Press, 1990).

18. T.H. Clark, "Bell, Robert," *Dictionary of Scientific Biography*, ed. Charles C. Gillispie (New York: Charles Scribner's Sons, 1970), vol. 1, p. 585. While there are extensive records of Bell's life, his career awaits the detailed scrutiny of a biographer. Brief sketches are found in "The Royal Society of London [Reporting the Election of Robert Bell as Fellow]," *Ottawa Naturalist* 11 (1897): 122-123; Charles Hallock, "One of Canada's Explorers," *Forest and Stream* 53 (1901): 9-15; "Robert Bell," *Proceedings and Transactions of the Royal Society of Canada*, 3rd s. 12 (1918): x-xiv; H.M. Ami, "Memorial of Robert Bell," *Bulletin of the Geological Society of America* 38 (1927): 18-34; "Men of the Day. The Official Career of Dr. Robert Bell, F.R.S., of the Geological Survey of Canada," Reprinted from *The Ottawa Free Press*, n.d.; Alcock, *A Century*, 48-54; Zaslow, *Reading the Rocks*, passim; and Suzanne Zeller, "Bell, Robert," *The Canadian Encyclopedia*, ed. James H. Marsh, 2nd ed. (Edmonton: Hurtig Publishers, 1988), vol. 1, p. 201.

19. Zaslow, *Reading the Rocks*, 65.

20. Ibid., 154-155.

21. Several authors have published brief descriptions of Billings's career including: J.F. Whiteaves, "Obituary Notice of Elkanah Billings, F.G.S." *The Canadian Naturalist and Quarterly Journal of Science* 8 (1877-78): 251-261; B.E. Walker, "List of the Published Writings of Elkanah Billings, F.G.S., Palaeontologist to the Geological Survey of Canada, 1856-1876," *Canadian Record of Science* 8 (July 1901): 366-388; Henry M. Ami, "Billings Memorial," *The Ottawa Naturalist* 14 (February 1901): 202-212; Henry M. A "Brief Biographical Sketch of Elkanah Billings," *American eologist* (May 1901): 265-281; T.H. Clark, "Billings, Elkanah," *Dictionary of Scientific Biography*, ed. Charles C. Gillispie (New York: Charles Scribner's Sons, 1970), vol. 2, pp. 128-129; T.H. Clark, "Elkanah Billings (1820-1876) -- Canada's First Paleontologist," *Proceedings of the Geological Association of Canada* 23 (1971): 11-14; Andrée Désilets and Yvon Pageau, "Billings, Elkanah," In *Dictionary of Canadian Biography*, ed. Francess G. Halpenny (Toronto: University of Toronto Press, 1972), vol. 10, pp. 64-66; and T.H. Clark, "Billings, Elkanah," *The Canadian Encyclopedia*, ed. James H. Marsh, 2nd ed. (Edmonton: Hurtig Publishers, 1988), vol. 1, p. 217. An unpublished report is Ann Lockwood, "Elkanah Billings, F.G.S. (1820-1876), Canada's First Paleontologist," Course Term Paper, Carleton University, Ottawa, December 1981.

22. Whiteaves, "Obituary Notice," 255.

23. Clark, "Elkanah Billings (1820-1876) -- Canada's First Paleontologist," 11. On Braddish Billings see: "Obituary [Braddish Billings]," *The Canadian Entomologist* 4 (April 1872): 70-73.

24. Charles Billings to J.F. Whiteaves, 20th November 1876 (draft letter). Billings Family Papers, Ottawa City Archives, MG2-1-123.

25. Clark, "Elkanah Billings (1820-1876) -- Canada's First Paleontologist," 11.

26. Billings was the sole proprietor and editor of the first volume of the *Canadian Naturalist and Geologist*. But beginning with the second volume the journal was taken over by the Natural History Society of Montreal and editea by a committee. The journal was discontinued after the First World War.

27. This meeting was the first annual conference of the AAAS that met outside of the U.S. and the first of two meetings held in Montreal before the century was over.

28. Zaslow, *Reading the Rocks*, 64.

29. While on a trip to England and the continent in 1858, partially to spend time studying type fossils in European museums, he wrote to Logan on the 19th April to say that "since I have been here I have examined, I may say, thousand[s] of specimens of Silurian and Devonian fossils in the different museums and am astonished to find so few that are identical with our own." Quoted in Whiteaves, "Obituary Notice," 258.

30. Zaslow, *Reading the Rocks*, 68.

31. Clark, "Elkanah Billings (1820-1876) -- Canada's First Palaeontologist," 13.

32. Whiteaves, "Obituary Notice," 259.

33. No doubt because he was such a prominent figure in Victorian Canadian science, Dawson has received more attention from scholars than has any of the other six in this study. Dawson, himself, prepared an autobiography edited by his son, and published shortly after his death. See, J.W. Dawson, *Fifty Years of Work in Canada, Scientific and Educational*, Edited by Rankine Dawson (London and Edinburgh: Ballantyne, Hanson & Co., 1901). Some of the early studies include Henry M. Ami, "Sir John William Dawson, A Brief Biographical Sketch," *The American Geologist* 26 (1900): 1-48; Frank Dawson Adams, "In Memoriam - Sir John William Dawson," *Proceedings and Transactions of the Royal Society of Canada* 7 (1901), section iv, 3-

44; J.C. Sutherland, "Sir William Dawson and Evolution," *Queen's Quarterly* 17 (1909-10): 212-217; and Edward Andrew Collard, "Lyell and Dawson: A Centenary," *The Dalhousie Review* 22 (1942): 133-144. More recent studies include T.H. Clark, "Sir William Dawson, 1820-1899," in *Pioneers of Canadian Science*, ed. G.F.G. Stanley, (Toronto: University of Toronto Press, 1966), 101-113; T.H. Clark, "Dawson, John William," *Dictionary of Scientific Biography*, ed. Charles C. Gillispie (New York: Charles Scribner's Sons, 1971), vol. 3, pp. 607-609; Edgar Andrew Collard, "William Dawson (1820-1899) and 'The Puritan Ethic of Work,'" in *Called to Witness, Profiles of Canadian Presbyterians*, ed. W. Stanford Reid, (Toronto: Presbyterian Publications, 1975), 24-43; Donald J.C. Phillipson, "Dawson, Sir John William," in *The Canadian Encyclopedia*, ed. James H. Marsh, 2nd ed. (Edmonton: Hurtig Publishers, 1988), vol. 1, p. 574; and Peter R. Eakins and Jean Sinnamon Eakins, "Dawson, Sir John William," in *Dictionary of Canadian Biography*, ed. Francess G. Halpenny (Toronto: University of Toronto Press, 1990), vol. 12, pp. 230-237. Dawson's multi-faceted career has received commentary in more specialized papers such as Bruce G. Trigger, "Sir John William Dawson: A Faithful Anthropologist," *Anthropologica* 8 (1966): 351-359; Ian F. MacKinnon, "Sir William Dawson: The Church and Science," *Dalhousie Review* 27 (1948): 246-256; James Angrave, "William Dawson, George Grant and the Legacy of Scottish Higher Education," *Queen's Quarterly* 82 (1975): 77-91; Clelia Pighetti, "William Dawson and Scientific Education," *Dalhousie Review* 60 (1980-81): 622-633; Daley and Dufour, "Creating a 'Northern Minerva;'" John P. Vaillancourt, "John William Dawson, Education Missionary in Nova Scotia," (M.Ed. thesis, Dalhousie University, 1973); and Bertrum H. MacDonald, "John William Dawson and Nineteenth Century Palaeobotany," (M.A. thesis, University of Western Ontario, 1982). A number of the positions that Dawson took were controversial. These views have been treated in a number of studies including Charles F. O'Brien, *Sir William Dawson: A Life in Science and Religion* (Philadelphia: American Philosophical Society, 1971); John F. Cornell, "From Creation to Evolution: Sir William Dawson and the Idea of Design in the Nineteenth Century," *Journal of the History of Biology* 16 (Spring 1983): 137-170; and William R. Shea," Introduction," in Sir J. William Dawson, *Modern Ideas of Evolution*, Facsimile reprint edited by William R. Shea and John F. Cornell (New York: Prodist, 1977), vii-xxv. Susan Sheets-Pyenson has begun work on the first, full-scale biography of Dawson. See, Susan Sheets Pyenson, "'Writing Lives' and Reconstructing the Past: Thoughts on Beginning a Biography of John William Dawson," Paper presented to the Fourth Kingston Conference on the History of Canadian Science and Technology, Kingston, Ontario, October 1985 and Susan Sheets-Pyenson, "The Nova Scotia Roots of Sir William Dawson's Scientific Worldview," Paper presented to the conference, Science and Society in the Maritimes, Mount Allison University, September 1988.

34. McCulloch's career has been discussed in Marjory Whitelaw, *Thomas McCulloch: His Life and Times* (Halifax: Nova Scotia Museum, 1985) and Anne Wood, "Thomas McCulloch's Use of Science in Promoting a Liberal Education," *Acadiensis* 17 (Autumn 1987): 56-73, among others. McCulloch concluded his career as president of Dalhousie University in Halifax.

35. In his autobiography Dawson wrote of his early natural history explorations encouraged by his father and McCulloch. Dawson, *Fifty Years of Work*, 21-22, 35.

36. Among the scientists with whom Dawson studied were Robert Jameson, Dawson's "principal geological teacher," Edward Forbes, John Hutton Balfour, Alexander Rose and Phillip Kelland. Dawson, *Fifty Years of Work*, 47; see also, Angrave "William Dawson, George Grant and the Legacy," 80; and Adams, "In Memoriam," 3.

37. Dawson drove himself to the point of exhaustion and illness which required several weeks recuperation away from the job. Dawson, *Fifty Years of Work*, 72-73.

38. Stanley Brice Frost, *McGill University for the Advancement of Learning. Volume I, 1801-1895* (Montreal: McGill-Queen's University Press, 1980), 172.

39. Ibid., 296.

40. John William Dawson, *Acadian Geology: An Account of the Geological Structure and Mineral Resources of Nova Scotia, and Portions of the Neighbouring Provinces of British America* (Edinburgh: Oliver and Boyd, 1855). There were three subsequent editions which entailed major additions: 2nd, 1868; 3rd, 1878; and 4th, 1891. The fourth edition carried the title, *The Geology of Nova Scotia, New Brunswick, and Prince Edward Island, or, Acadian Geology* and was published in London by Macmillan and Co.

41. John William Dawson, *The Geological History of Plants* (London: Kegan Paul, Trench & Co., 1888), reprinted 1905. T.H. Clark, "Dawson, John William," 608.

42. The characterization of Dawson as the leading anti-darwinian is found in Neville Thompson, "Foreword," in Carl Berger, *Science, God, and Nature in Victorian Canada* (Toronto: University of Toronto Press, 1983), x. See also, Carl Berger, *Science and Society in Victorian Canada* (Toronto: University of Toronto Press, 1983), 61; James R. Moore, *The Post Darwinian Controversies. A Study of the Protestant Struggle to Come*

to Terms with Darwin in Great Britain and America, 1870-1900 (Cambridge: Cambridge University Press, 1979), 92; and Robert John Taylor, "The Darwinian Revolution: The Responses of Four Canadian Scholars," (Ph.D. diss., McMaster University, 1976). Although no comprehensive bibliography of Dawson's publications has yet been produced a good source for most of his more than 500 works is found in Ami, "Sir John William Dawson," 14-48, reprinted in Adams, "In Memoriam," 15-44. For a discussion of Dawson's controversialist positions see O'Brien, *Sir William Dawson: A Life*, and for further treatment of his views on evolution see Cornell, "From Creation to Evolution."

43. For a discussion of the role Dawson played in the establishment of the Royal Society of Canada see Daley and Dufour, "Creating a 'Northern Minerva.'"

44. Clark, "Sir William Dawson, 1820-1899," 101.

45. One of Fletcher's characteristic instructions to correspondents seeking his assistance in identification of biological specimens was: "Just slip it in an envelope and address it to 'the Bug and Weed Man, Ottawa,' never mind the stamp." *Fifty Years of Progress on Dominion Experimental Farms, 1886-1936* (Ottawa: J.O. Patenaude, King's Printer, 1939), 34.

46. A detailed biography of Fletcher has not yet been published and much about his early years prior to his appointment to the Library of Parliament has not been documented. Several brief articles outline his career. See, "The Late Dr. James Fletcher, Honourary Secretary of the Society," *Proceedings and Transactions of the Royal Society of Canada*, 3rd ser. 3 (1910): xlv-xlviii; R.H. Estey, "James Fletcher (1852-1908) and the Genesis of Plant Pathology in Canada," *Canadian Journal of Plant Pathology* 5 (1983): 120-124; Herbert Groh, "'Let Us Now Praise Famous Men,'" *The Canadian Field-Naturalist* 69 (July-Sept. 1955): 75-78; B. Boivin and W.J. Cody, "Biographic Survey of James Fletcher's Flora Ottawaensis," *Canadian Field-Naturalist* 69 (1955): 79-82; "Fletcher, James," in *World Who's Who in Science. A Biographical Dictionary of Notable Scientists from Antiquity to the Present*, ed. Allen G. Debus, 1st ed., (Chicago: Marquis Who's Who Incorporated, 1968) 579; T.H. Anstey, *One Hundred Harvests. Research Branch Agriculture Canada, 1886-1986* (Ottawa: Minister of Supply and Services, 1986), 21; Arthur Gibson, "James Fletcher, LL.D," *The Ottawa Naturalist* 22 (January 1909): 189-191; W. Saunders, "Dr. Fletcher's Work, Its Influence on Canadian Agriculture," *The Ottawa Naturalist* 22 (January 1909): 192-196; W. Hague Harrington, "Reminiscences of Dr. Fletcher," *The Ottawa Naturalist* 22 (January 1909): 196-205; R.B. Whyte, "Dr. Fletcher as a Botanist," *The Ottawa Naturalist* 22 (January 1909): 206-207; Arthur Gibson, "Dr. Fletcher as an Entomologist," *The Ottawa Naturalist* 22 (January 1909): 207-211; John

Macoun, "Dr. Fletcher as a Naturalist," *The Ottawa Naturalist* 22 (January 1909): 212-214; H.M. Ami, "Dr. Fletcher as a Leader," *The Ottawa Naturalist* 22 (January 1909): 215-220; Arthur Gibson and Herbert Groh, "The Published Writings of Dr. Fletcher," *The Ottawa Naturalist* 22 (January 1909): 227-233; P.W. Riegert, "Fletcher, James," *The Canadian Encyclopedia*, ed. James H. Marsh, 2nd ed. (Edmonton: Hurtig Publishers, 1988), vol. 2, p. 791; and *Fifty Years of Progress*, 32-34. Other information is found in *Plant Pathology in Canada*, ed. I.L. Connors, (Winnipeg: Canadian Phytopathological Society, 1972), 5-7, and Paul W. Riegert, *From Arsenic to DDT: A History of Entomology in Western Canada* (Toronto: University of Toronto Press, 1980), especially, Chapter 4, "James Fletcher, Dominion Entomologist."

47. R.B. Whyte commenting at a special memorial meeting of the Ottawa Field-Naturalists' Club marking Fletcher's death noted that Fletcher was an example to other young men and "while a clerk in the Parliament Library he utilized every spare moment in studying or seeking information, and after office hours he did not waste his time in idling about the streets." Whyte, "Dr. Fletcher as a Botanist," 207.

48. Harrington, "Reminiscences of Dr. Fletcher," 198.

49. Fletcher was appointed Honourary Entomologist on 17th June 1884 by the Minister of Agriculture, the Hon. J.H. Pope. The term, "honourary" can be misleading since the appointment required active investigation of insect problems throughout the country and extensive correspondence with farmers and scientists concerning these matters. While Fletcher did not receive an extra stipend for his added responsibility as Entomologist, the term "honourary" should be thought of more in the sense of "temporary" or "short-term" since the appointment was made permanent in 1887. For reference to the unpaid position of Honourary Entomologist see, Estey, "James Fletcher (1852-1908)," 121.

50. Estey, "James Fletcher (1852-1908)," 121. See also Riegert, *From Arsenic to DDT*, 307-308.

51. *Fifty Years of Progress*, 32.

52. A number of articles and books about Logan have been published. B.J. Harrington, "Sir William Edmond Logan," *Canadian Naturalist and Quarterly Journal of Science* 8 (1876-78): 31-46 (Also published in *American Journal of Science and Arts*, 3rd s. 11 (1875): 81-93); B.J. Harrington, *Life of Sir William E. Logan* (Montreal: Dawson Brothers, 1883); Robert Bell, *Sir William E. Logan and the Geological Survey of Canada* (Ottawa: The Mortimer Co., Limited, [1907]); J.C. Sutherland, "Sir William Logan," *Educational Record of the Province of Quebec*

42 (Oct-Dec. 1922): 294-307; F.J. Alcock, "The Father of Canadian Geology," *Earth Science Digest* 2 (1948): 15-18; J.M. Harrison and E. Hall, "William Edmond Logan," *Proceedings of the Geological Association of Canada* 15 (1963): 33-42; C. Gordon Winder, "Logan and South Wales," *Proceedings of the Geological Association of Canada* 16 (1965): 103-124; C. Gordon Winder, "Where is Logan's Silver Fountain?" *Proceedings of the Geological Association of Canada* 18 (1967): 115-118; A.H. Lang, "Sir William Logan and the Economic Development of Canada," *Canadian Public Administration* 12 (Winter 1969): 551-565; A.H. Lang, "Contributions of W.E. Logan and G.M. Dawson to the Canadian Mineral Industry," *Proceedings of the Geological Association of Canada* 23 (1971): 19-23; C. Gordon Winder, "Logan, Sir William Edmond," *Dictionary of Canadian Biography*, ed. Frances G. Halpenny (Toronto: University of Toronto Press, 1971), vol. 10, pp. 444-449; C. Gordon Winder, "Sir William Edmond Logan (1798-1875) -- Founder of Canadian Geology," *Proceedings of the Geological Association of Canada* 24 (1972): 39-41; Zaslow, *Reading the Rocks*, passim; C. Gordon Winder, "Logan (Montreal) and Hall (Albany): Two Giants of Geology," *Geos* (Winter 1979): 10-12; Suzanne Zeller, "Logan, Sir William Edmond," *The Canadian Encyclopedia*, ed. James H. Marsh, 2nd ed. (Edmonton: Hurtig Publishers, 1988), vol. 3, pp. 1238-1239; William E. Eagan, "'I Would Have Sworn My Life on Your Interpretation:' James Hall, Sir William Logan and the 'Quebec Group,'" *Earth Sciences History* 6 (1987): 47-60; T.H. Clark, "Logan, William Edmond," *Dictionary of Scientific Biography*, ed. Charles C. Gillispie (New York: Charles Scribner's Sons, 1973), vol. 8, pp. 461-462; and Zeller, *Inventing Canada*, especially part I - Geology, pp. 13-112.

53. Details of Logan's geological work in Wales is set out in Winder, "Logan and South Wales."

54. Zeller, *Inventing Canada*, 52.

55. Quoted in B.J. Harrington, "Sir William Edmond Logan," *American Journal of Science and Arts*, 3rd s. 11 (February 1876): 84.

56. Logan was motivated by a deep sense of public duty and during the early years of the Survey he frequently covered expenses of the Survey out of his own pocket with no assurance of reimbursement.

57. Harrington, "Sir William Edmond Logan," 85.

58. J.C. Sutherland has written that "[a]lthough Logan's personal preference was for the purely scientific side of geology, he saw from the outset that practical results would be looked for as a justification for the existence of the Survey, and those were steadily forthcoming from time to time." Sutherland,

"Sir William Logan," 304. Zaslow's *Reading the Rocks* provides a wealth of detail about Logan's talents at managing the Geological Survey of Canada both internally and externally. Zaslow, *Reading the Rocks*, passim. For the economic benefits of the Survey see Lang, "Sir William Logan and the Economic Development of Canada."

59. Clark, "Logan, William Edmond," 461.

60. J.M. Harrison and E. Hall note that he was offered the financially more lucrative position of Director of the Geological Survey of India. Harrison and Hall, "William Edmond Logan," 36.

61. Zeller, *Inventing Canada*, 110. Similar views are expressed by other authors. See, for example, Winder, "Sir William E. Logan (1798-1875): Founder of Canadian Geology;" and Lang, "Sir William Logan and the Economic Development of Canada." Logan was equally competent in economic and theoretical geology and was not immune from some of the controversies that enveloped geological debate of the nineteenth century. See, for example, Eagan, "'I Would Have Sworn My Life,'" and Winder, "Logan (Montreal) and Hall (Albany): Two Giants of Geology."

62. Of the six scientists in this study William Saunders has received the least attention of biographers. The greatest detail is found in Elsie M. Pomeroy, *William Saunders and His Five Sons. The Story of the Marquis Wheat Family* (Toronto: Ryerson Press, 1956). Other briefer treatments include: "William Saunders," *Proceedings and Transactions of the Royal Society of Canada*, 3rd s. 9 (1915): viii-x; *Canada Agriculture. The First Hundred Years* (Ottawa: Canada Department of Agriculture, 1967), 9-10; William W. Judd, *Early Naturalists and Natural History Societies of London, Ontario* (London, ON: Phelps Publishing Company, 1979), especially pp. 22-25; T.H. Anstey, "Saunders, William," *The Canadian Encyclopedia*, ed. James H. Marsh, 2nd ed. (Edmonton: Hurtig Publishers, 1988), vol. 3, p. 1944; T.H. Anstey, *One Hundred Harvests. Research Branch, Agriculture Canada, 1886-1986* (Ottawa: Minister of Supply and Services, 1986), Research Branch, Agriculture Canada, Historical Series no. 27, passim; and Vittorio De Vecchi in "Science and Scientists in Government, 1878-1896 -- Part II," *Scientia Canadensis* 9 (December 1985): 97-113 provides some of the background regarding Saunders's appointment as first director of the Dominion Experimental Farms.

63. Pomeroy, *William Saunders and His Five Sons*, 5. His pharmaceutical products were exhibited at the World's Fair in Paris in 1886.

64. Ibid., 4-5.

65. The history of the Entomological Society of Canada has been recounted in Connor, "Of Butterfly Nets and Beetle Bottles." While the Society had a national intention as borne out in its title (there were chapters in more than one province), much of the activity of the Society centred in Canada West (later Ontario). In 1871 the Society was renamed the Entomological Society of Ontario and it was only in 1951 that a new Entomological Society of Canada was organized.

66. Pomeroy, *William Saunders and His Five Sons*, 9. A.G. Bogue has written that "to Saunders is given chief credit for checking the ravages of the Colorado Potato Beetle in 1874." A.G. Bogue, "The Agricultural Press in Ontario in the 1880s," *Ontario Historical Society Papers and Records* 38 (1946): 48.

67. William Saunders, *Insects Injurious to Fruits* (Philadelphia: J.B. Lippincott, & Co., 1883).

68. Charles J.S. Bethune, "The Rise and Progress of Entomology in Canada," *Proceedings and Transactions of the Royal Society of Canada*, 2nd s. 4 (1898), section iv, p. 163. Writing over a century later, T.H. Anstey commented that Saunders's book "remained the primary reference in that field for many years." T.H. Anstey, "The Formation of the Experimental Farms," *Prairie Forum* 11 (Fall 1986): 190.

69. De Vecchi has provided an engaging analysis of the political discussion leading to the formation of the Experimental Farm System. See, Vittorio De Vecchi, "Science and Scientists in Government, 1878-1896 -- Part I," *Scientia Canadensis* 8 (December 1984): 112-142, and De Vecchi, "Science and Scientists in Government, 1878-1896 -- Part II."

70. Saunders was appointed Director of the Experimental Farms through an order-in-council dated 16th October 1886. See letter dated Department of Agriculture, Ottawa, 29th October 1886 addressed to Prof. Wm. Saunders, London, Ontario which advised Saunders of his appointment as Director. Saunders Family Papers, Regional Collection, University of Western Ontario, Box 5434.

71. William Saunders, "Report of the Director," in *Experimental Farms. Reports...for 1890* (Ottawa: Printed by Brown Chamberlin, Queen's Printer & Controller of Stationery, 1891), 49. The actual correspondence figures are: letters received (1889) - 6,864; letters received (1890) - 17,539; letters sent (1890) - 19,806.

72. Anstey, "The Formation of the Experimental Farms," 193.

73. Saunders's son, Charles joined the staff of the Central Experimental Farm as Experimentalist of the Cereal Division in 1903 to relieve his father of the heavy responsibility of research in this division. Two years later he was appointed Chief of the division and it was under his supervision that the Marquis variety of wheat was developed from strains which had been crossed and tested by his father. See, T.H. Anstey, "Saunders, Sir Charles Edward," *The Canadian Encyclopedia*, ed. James H. Marsh, 2nd ed. (Edmonton: Hurtig Publishers, 1988), vol. 3, p. 1943.

Chapter IV - Reading Patterns

The six scientists in this study, who were all active researchers, published the results of their work both within Canada and outside the country. Each of them found it necessary to read pertinent scientific literature in order to place their work within the national and international contexts. This reading activity permits one means by which the diffusion of scientific literature in Victorian Canada can be determined and characterized. An examination of the literature read by the six scientists shows the type of publications that were consulted, where these documents were published, which authors were considered important, and the currency of the literature itself.

There is little doubt that researchers in Victorian Canada read scientific literature of the day.[1] A considerable portion of the literature that they studied can be identified, although not everything can be determined. Unlike Charles Darwin and few other scientists, none of the six scientists in this investigation kept a regular account of the reading that they did nor did they "mark up" copies of scientific publications in any extensive manner that would allow a latter day historian to tell if indeed they read a publication that they owned.[2] A sizeable body of evidence exists, however, in the publications of each of the six scientists, for here they frequently acknowledged the works of other authors. This evidence coupled with other data found in the individual scientists' personal papers forms the basis of the discussion of the first part of this chapter.

Following the examination of literature read by each scientist, presented in turn, the second part of the chapter will note how the scientific literature itself notified researchers about other relevant publications. A variety of alerting mechanisms, all aimed at facilitating the diffusion of scientific information, operated in the Victorian period. The scientific literature served as one of these mechanisms. There were others and these will be treated in subsequent chapters.[3]

This chapter about the scientists' reading is important for four reasons. First, it reveals the scientific literature that was actually available and consulted. Second, it identifies the scientific publications that the scientists considered important. Third, it discloses any changes in reading patterns over time and finally, it characterizes the literature that was read in order to answer the questions set out above. In short, scientists' reading patterns display an important dimension of the diffusion of scientific literature in Victorian Canada.

Robert Bell

Robert Bell, as noted in chapter III, was employed by the Geological Survey of Canada for half a century, beginning in the mid-1850s. Throughout this period the work he conducted for the survey resulted in geological and natural history descriptions for vast sections of the Canadian land mass. Early in his career he adopted a descriptive methodology, which served to guide his investigations, reconnaissance geology, for five decades. The type of scientific literature that Bell would find best suited for this type of work was reports of other similar undertakings. It is not surprising, therefore, that Bell's reading patterns, determined from a study of citations in his publications, demonstrates that he did indeed give prominence to report literature.[4] Table I categorizes the type of literature Bell cited in two periods: the first part of his career (1859-1885) and the last part (1886-1910).[5] Here it can be seen that over 60% of the literature Bell cited was research reports and this value re-

Table I - Bell Citation Study - Type of Literature

Type of Literature	Period	
	Early	Late
Periodicals	21.5%	15.9%
Monographs	15.1%	22.7%
Reports	63.4%	61.4%

mained virtually unchanged to the end of his publishing career. The proportions for periodicals and monographs interchanged between the two periods with articles in journals receiving less attention in the later period and monographs obtaining more. In the matter of type of literature, Bell was unlike any other scientist in this study. No other researcher consistently consulted research reports to the extent that he did. As will be seen subsequently William Logan and William Saunders gave prominence to reports but only in one period of their careers not both.

From another perspective, Bell's reading pattern was also unlike that of the other scientists in this study. The larger proportion of the literature Bell cited was published in Canada, as Table II illustrates. In the first part of his career, Canadian publications accounted for about 75% of Bell's citations. As his career progressed, this value declined and both American and British publications obtained increased recognition. No other scientist in this study gave such high prominence to Canadian publications, principally reports of the Geological Survey itself and to a lesser extent papers in Canadian scientific periodicals. All five of the other researchers looked outside of the country for more than half of the publications they read and cited. For Bell, however, reconnaissance geology meant building on previous descriptions, which required him to consult Canadian publications more widely than any others. In contrast to Logan, who

Table II - Bell Citation Study - Place of Publication

Place of Publication	Period	
	Early	Late
Canada	74.7%	63.2%
U.S.A.	5.5%	12.5%
U.K.	17.6%	23.5%
Europe	2.2%	.7%

also mapped geological structures of the country, Bell tended to overlook the work of American geologists even though their publications were available to him and even though there were similarities between the geological survey work in both countries. The difference between Bell and Logan in this respect may rest in the fact that Logan mapped territory that bordered American states whereas Bell, for the most part, dealt with more northern territories where the similarities between Canada and the United States were less pronounced. The British literature that Bell studied dealt largely with Canadian matters, e.g., Sir John Richardson's geological and zoological descriptions of northern Canada. European research went largely unnoticed.

Bell followed closely the work of other Canadians, among the authors that he read. He regularly consulted publications of his colleagues at the Geological Survey and other geological researchers, such as E.J. Chapman in Toronto, J.W. Spencer who worked both in Canada and the United States, and Henry Youle Hind, who had conducted geological explorations in a variety of locations in Canada. He also referred to American and British authors as their publications related to his descriptions of Canadian geology and natural history.

Further information about Bell's reading patterns can be found outside of the citation data. His personal library, discussed in Chapter V, and the wealth of information publishers and booksellers sent to him, reviewed in Chapter VII, reveals that he was well informed about scientific publications of the period. His personal papers, notably diaries from the early part of his career and other records of his reading, e.g., library borrowing records, point to his interest in keeping abreast of scientific developments.[6] Bell's interest in mining matters led him to scrutinize closely newspapers of the day and to subscribe to periodicals of the mining press.[7]

Bell recognized the importance of reading current literature while at the same time he consulted older documents for relevant information.[8] The age of the publications he cited ranged from less than a year to considerably older.[9] In his later publications he often referred to the earlier reports of officers of the Geological Survey of Canada, the age of which tended to overshadow the fact that he was also checking more current literature.

As the remaining discussion will show, Bell differed from the other scientists in the scientific literature that he consulted. He relied heavily on Canadian publications, whereas the others did not follow this pattern. In addition, Bell consistently counted on report literature more than any other scientist.

Elkanah Billings

The point in his earlier occupations as a lawyer and newspaper editor at which Billings began reading scientific publications is not clear. It is apparent, however, that his access to appropriate literature and his growing knowledge of palaeontology was sufficiently advanced by 1856 for him to obtain an appointment as the first palaeontologist to the Geological Survey of Canada.[10] It is also evident from publications that arose out of his subsequent work with the Geological Survey that Billings had a good command of palaeontological research occurring in the United States and Europe, the principal locations of such activity in the Victorian period. He was conversant with palaeontological discoveries and disputes and via the published literature he entered into discussion with other scientists on matters of geological debate, such as descriptions and relationships of fossil specimens, questions of priority of discovery and naming, and issues that related palaeontological findings with other geological phenomena.

As with Robert Bell, publications spanning Billings's career were examined and the citation data split so as to show a comparison between the early part (1855-1865) and the later portion (1866-1876). Several characteristics of the literature that Billings read stand out. First, in contrast to Bell, there was a marked increase in the citation of papers in scientific periodicals (see Table III below). This increase came about at the expense of reports of geological surveys as there was little change in the citation of monographs. Even though palaeontological research was frequently

Table III - Billings Citation Study - Type of Literature

Type of Literature	Period	
	Early	Late
Periodicals	34.2%	56.8%
Monographs	29.9%	28.8%
Reports	35.9%	14.4%

supported by geological surveys, more and more of the results of such research was published in the increasing number of scientific periodicals that were launched as the Victorian period progressed. Since research reports published by geological surveys appeared less frequently than the issues of scientific periodicals, researchers found periodicals more suitable for announcing new discoveries and establishing priorities in naming new fossil specimens. Billings's reading reflects an international trend in the diffusion of scientific literature in the Victorian period.

Not only did Billings cite more periodical articles, but he also made reference to a larger number of journals in the latter part of his career. This, too, reflected the increasing number of periodicals being published. Three periodicals were important in both periods, the *American Journal of Science and Arts*, the *Quarterly Journal of the Geological Society of London*, and the *Canadian Naturalist and Geologist*, which Billings had launched in 1856. In the later period Billings gave more attention to British and European periodicals including: the *Geological Magazine* and the *Geologist* published in England, and the *Bulletin de la Société géologique de France*, *Neues Jahrbuch für Mineralogie, Geognosie, Geologie und Petrefacten-Kunde*, and a variety of other European periodicals.[11]

Complementing the fact that over the course of his career Billings cited more and more British and European periodicals is the evidence found in the place of publication data. Table IV shows that as his career continued Billings gave less frequent attention to information available close at hand, namely Canadian and American publications, in comparison with the literature emanating from the U.K. and Europe. Publications from the United States dropped substantially (going from 46% to slightly less than 30%) and literature from Britain took on greater importance (almost doubling in frequency from

Table IV - Billings Citation Study - Place of Publication

Place of Publication	Period	
	Early	Late
Canada	18.6%	12.9%
U.S.A.	46.0%	29.9%
U.K.	17.7%	34.7%
Europe	17.7%	22.4%

about 18% to about 35%). While London and Paris were important centres of publication in both periods, other European cities, particularly those in Germany, gained in importance in the latter period.

As the century progressed, Billings read the publications of a larger number of authors. In the earlier period fewer than fifty were cited, while in the later period over sixty authors were read.[12] James Hall, an American palaeontologist, figured prominently in both periods. Billings's proximity to New York state, where Hall conducted his research, meant greater opportunity for communication with New York than with other parts of the United States and Europe. More importantly, a similarity in the fossil record in New York state and that in neighbouring Canada led Billings to pay close attention to Hall's work.[13]

Among European authors, Billings carefully noticed the work of Joachim Barrande in both periods. But as the century advanced other European or British scientists claimed his attention including: Thomas Davidson, Frederick McCoy, and Sir Roderick Murchison in England, and Karl Eichwald, Alexandre von Volborth, Ferdinand Roemer, Alcide D'Orbigny, and Johannes Mueller in Europe.

To pursue his palaeontological work effectively, Billings needed to be aware of current discoveries as well as descriptions of fossils that had been published in previous years, sometimes decades earlier. Citations in his publications demonstrate this requirement. He frequently made reference to literature that had been published within the previous year and he also cited literature that was brought out decades earlier.[14] The average age of publications ranged from as low as zero (that is making reference to works published within the same year as the citing document) to as high as twenty-one.[15] As the case required, therefore, Billings read and cited relevant literature.

The patterns of diffusion of scientific literature in Victorian Canada that emerge from Billings's reading first point to an increasing reliance on periodicals. Further, it can be seen that the prominence of North American publications, principally American geological survey reports, decreased as the century unfolded, while British and European literature took on greater significance. As far as Billings was concerned European languages did not seem to be an inhibiting factor in the dissemination of scientific research.[16]

John William Dawson

John William Dawson's interests in the sciences were wide sweeping. He wrote on agricultural, geological, palaeontological, and zoological topics, but it was in the subject of palaeobotany he excelled and completed much of his research. On account of his broad interests he read widely on a variety of topics and because of his work in palaeobotany extensive knowledge of international literature was necessary.

Right from the beginning of his career, Dawson placed a high value on reading the scientific periodicals of the day. During the last half of the nineteenth-century during which he brought out the results of his work, 62% of publications

Dawson gave reference to were papers from scientific periodicals. The pattern of the types of literature Dawson cited, as Table V shows, was identical in both the early (1845-1864) and late (1865-1890) periods. At approximately 18%, report literature obtained the least notice and monographs received only two to three percent more. In this consistent configuration of literature use, Dawson differed from the other scientists in this study. For each of the other researchers

Table V - Dawson Citation Study - Type of Literature

Type of Literature	Period	
	Early	Late
Periodicals	62.2%	62.4%
Monographs	21.7%	19.9%
Reports	18.1%	17.7%

the pattern changed over the course of their careers, including Robert Bell for whom report literature occupied the same place as periodical literature did for Dawson.

In both periods of his career the *American Journal of Science and Arts*, the *Quarterly Journal of the Geological Society of London*, and the *Canadian Naturalist and Geologist* were three journals that Dawson followed closely. As a very active member of the Natural History Society of Montreal he was a major contributor to the latter journal. But as the nineteenth century develcped, the number of citations to the *Canadian Naturalist* was surpassed by other periodicals including: the *Geological Magazine*, the *Bulletin of the United States Museum*, *Nature*, the *Philosophical Transactions of the Royal Society of London*, the *American Naturalist*, *Comptes rendus de l'Académie des sciences*, *Neues Jahrbuch für Mineralogie, Geologie, und Palaeontologie*, and an array of other American, British, and European journals.

Three-quarters of the scientific literature that Dawson read was published outside of Canada (see Table VI below). Approximately 50% originated in the British Isles, principally

Table VI - Dawson Citation Study - Place of Publication

Place of Publication	Period	
	Early	Late
Canada	27.0%	24.4%
U.S.A.	15.9%	17.0%
U.K.	52.9%	48.3%
Europe	4.2%	10.1%

in London and Edinburgh, and between 16% and 17% in the United States. European literature took on greater importance in the later period of Dawson's career, more than doubling from about four percent to about ten.

The increased attention to European publications can be accounted for in the growing volume of palaeobotanical research being conducted there, especially in Scandinavian countries. Discoveries of fossil plants along the western seaboard of Europe corresponded to Dawson's findings in eastern Canada and as a consequence he maintained a keen interest in the work of European palaeobotanists.

Dawson read the works of a large number of authors. In the earlier period the Canadian writers, Elkanah Billings, Richard Brown, Abraham Gesner, W.E. Logan, and two British authors, Charles Lyell, and Richard Owen, received the highest number of citations. Dawson knew the Canadian scientists well and, of the two British authors, he looked on Charles Lyell as his mentor, maintaining a steady correspondence with him from their first meeting in the early 1840s up until Lyell's death in 1875.[17] In the early period, too, American scientists figured prominently in Dawson's reading including: Louis Agassiz, James D. Dana, Ebenezer Emmons, Asa Gray, James Hall, and Charles T. Jackson.

As Dawson's palaeobotanical expertise developed throughout the latter half of the nineteenth century, he looked to more and more authors writing in this subject. The publications of Adolphe Brongniart, William Carruthers, J. Starkie Gardner, H.R. Goeppert, Oswald Heer, Joseph Hooker, A.G. Nathorst, A.E. Nordenskiold, Bernard Renault, Gaston De Saporta, Wilhelm Schimper, Franz Unger, and W.C. Williamson, all British or European scientists were read with interest. Leo Lesquereux and J.S. Newberry stood out among American researchers publishing on palaeobotany. In addition, many other writers numbered among those that Dawson read.[18]

Dawson was familiar with all the major developments in palaeontology and especially those dealing with fossil plants. In 1888, he brought several decades of research and reading to bear in his book, *Geological History of Plants*, published jointly in London and a number of European capitals in the International Scientific Series.[19] Like all the other scientists in this study except Bell, Dawson read publications of which the majority originated outside Canada. In a manner similar to the later part of Billings's career, well over 50% of the literature Dawson consulted came from Britain and Europe, and in parallel with Billings, Dawson was well informed about research in the United States and Canada. And very much like the other scientists in this study, Dawson cited very recent publications as well as literature that was much older.[20]

James Fletcher

James Fletcher, like Elkanah Billings, came to a career in the sciences following occupations in other fields. Like Billings, his reputation in the sciences was established on the basis of extensive reading and study of scientific literature as well as demonstrated ability, particularly in entomology.[21] Fletcher had his own collection of scientific literature, and for a time he worked in the Library of Parliament, which, with strong holdings of scientific publications, was undoubtedly the best library in Canada during the Victorian period.[22]

In some respects Fletcher's patterns of citations mirrored those of Billings. For example, Table VII, which identifies the type of literature that Fletcher read during his scientific career,[23] shows a substantially increased attention given to periodical literature in the later part of his career (almost 41% as compared to 10.5% in the earlier period). Further, the escalated reading of periodical literature complemented a decrease in citation of research reports, in a fashion also similar to Billings. References to monographs remained largely unchanged. Research reports emanating from agricultural experimental farms and stations, largely in the United States, were not uncommon. Fletcher issued such reports, too, often in press runs of many thousands. But, by the end of the Victorian period, journals frequently were the most common venue for the results of some types of scientific work. Not all scientists of the period gave primary attention to periodical literature, however, as the above discussion of Bell noted and as will be demonstrated with Saunders below.

Although Fletcher exhibited reading patterns that paralleled those of Billings, he also demonstrated trends that differed. First, it must be remembered that he worked in the last decades of the Victorian era, whereas Billings conducted his research in the middle of the period. By Fletcher's day periodicals were more common and his increased attention to

Table VII - Fletcher Citation Study - Type of Literature

Type of Literature	Period	
	Early	Late
Periodicals	10.5%	40.7%
Monographs	42.1%	40.7%
Reports	47.4%	18.6%

this form of literature could be expected. Probably the largest contrast between the two researchers lies in the place of publication of the literature they were reading. It will be recalled that Billings shifted his emphasis to British and European literature over the course of his career. Fletcher, in contrast, cited North American literature more often, particularly publications from the United States. As Table VIII reveals in the last decade of his career, over three quarters of Fletcher's citations were to American publications. He cited British literature only a little and European not at all. Given Fletcher's interest and work in agricultural entomology, this trend is not surprising. Since insects that attacked Canadian crops were more likely to be found in the United States than those encountered in Britain or Europe, the work of American entomologists was vitally important to him and it was their papers and reports that he scrutinized most closely.

Table VIII - Fletcher Citation Study - Place of Publication

Place of Publication	Period	
	Early	Late
Canada	13.3%	22.4%
U.S.A.	53.3%	76.5%
U.K.	26.7%	1.2%
Europe	6.7%	0%

Fletcher's concentration on American scientific literature is reflected in the periodicals he read and the authors he cited. All of the journals in both periods were published in North America. The *Proceedings of the Entomological Society of Philadelphia* and the *Canadian Entomologist* figured prominently in the early period. By the later period the *Bulletin of the United States National Museum*, the *Transactions of the American Entomological Society*, as well as a number of other American periodicals had joined the *Canadian Entomologist* in importance.

Over the course of his career Fletcher cited the works of an expanding group of authors.[24] Except for Eleanor Ormerod, an English entomologist with whom he carried on correspondence over a number of years,[25] and Ritzeman Bos, a European writer, Fletcher concentrated on the publications of American authors. Many of the latter he knew personally, either through ongoing correspondence or having met them at meetings of scientific societies. Researchers whose work he frequently cited, especially in the later period, included: J.B. Smith, H.G. Gray, W.H. Ashmead, William Beutenmueller, H.G. Dyar, and A.S. Packard.

As with all the scientists in this study, Fletcher frequently gave reference to literature that had been published within the year prior to his citation, but he also cited publications that had been brought out several decades earlier.[26] In the last decade of his career, Fletcher took on a task that clearly demonstrated his reading of current scientific literature. Beginning in 1901 he published, in the annual reports of the Entomological Society of Ontario, a summation of "important ent ,logical events." These reports listed and discussed briefly entomological publications brought out in the previous year.

Fletcher's reading patterns add to our understanding of the diffusion of scientific literature in late Victorian Canada. For the type of research work that he conducted, American publications were important and he cited these most often. British and European publications were largely ignored. He could read English and French, but language was quite possibly a barrier that accounts for his lack of citation of European publications.[27] Periodical literature along with appropriate monographs figured prominently in his reading whereas research reports received less attention, although they were not overlooked.

William Edmond Logan

The career of William Logan, the earliest writer in this study, was also divided into two periods -- early (1840-1855) and late (1856-1870) -- for purposes of examining of his reading patterns. Logan began reading geological literature while he was working in Wales in the 1830s and continued to consult publications in this subject for the remainder of his career.

During the first decade and more of the Geological Survey of Canada, Logan worked to discover the topographical and geological structures of the country. This work needed to be placed in the context of other geological explorations and, as Table IX points out, it was the reports of other geological surveys that Logan consulted most often.[28] Almost 65% of the citations in his earlier publications were to report literature. As Logan's career progressed, however, the emphasis on reading research reports dropped and the periodical literature became more significant. In the later period, 50% of the publications Logan cited were papers in scientific journals. The availability of more journals after mid-century provided Logan with further opportunities to read the geological research reported in periodicals. With the knowledge obtained from his earlier survey of the geology of Canada, Logan later

Table IX - Logan Citation Study - Type of Literature

Type of Literature	Period	
	Early	Late
Periodicals	27.8%	50.0%
Monographs	7.4%	15.4%
Reports	64.8%	34.6%

in his career entered into a number of the geological debates of the day that often were played out in the scientific periodicals. Literature of this latter type, therefore, took on greater importance in contrast to the research reports issued by geological surveys in bordering U.S. states as well as those of surveys in Britain. Two periodicals that figured prominently in Logan's reading in both periods were the *American Journal of Science and Arts* and the *Quarterly Journal of the Geological Society of London*. In the later period the *Geological Magazine* and the *Canadian Naturalist and Geologist* among others joined the previous two.

Throughout both periods of Logan's career, the pattern of the places of publication remained fairly stable. Table X

Table X - Logan Citation Study - Place of Publication

Place of Publication	Period	
	Early	Late
Canada	35.3%	27.4%
U.S.A.	37.2%	41.1%
U.K.	25.5%	26.0%
Europe	2.0%	5.5%

shows that American literature, at 37.2%, was the most prominent in the early period and this value persisted into the later decades. The percentage of British literature remained virtually unchanged, European literature increased moderately, and the percentage of Canadian publications dropped somewhat. Overall the data presents a picture of publication locations that changed little.

Data on the authors Logan frequently consulted complements the place of publication data. The works of a number of American authors, but principally those of Ebenezer Emmons, James Hall, Douglass Houghton, and the Rogers brothers, Henry and William, were studied in both periods.[29] These writers were cited more often than such British geologists as Charles Lyell, Sir Roderick Murchison, and J.W. Salter whose publications were referred to in the early period and William Carpenter, J. Beete Jukes, and Richard Owen whose works were cited in the later period.

Like all the other scientists in this study, Logan cited publications less than a year old, but he also examined older literature as the case required.[30] Like Billings, Logan turned greater attention to periodical literature in the latter part of his career, but, in contrast to Billings who sought out more and more British and European publications as his career progressed, the origin of the literature Logan read throughout his career remained unchanged.

William Saunders

As the emphasis of William Saunders's research pursuits changed over the years of his career, so did his reading of scientific literature. His early interests lay primarily in natural history, particularly entomology. Later when he devoted more of his time to agricultural matters, especially plant breeding, he wrote that "I may say that my time is so fully occupied with agricultural matters that...I have not the time to give any special attention to the study of this subject [natural history] at present.[31]

An examination of citations in Saunders's publications bears out his comments about his reading habits. The data in Table XI shows that in the early part of his career Saunders

Table XI - Saunders Citation Study - Type of Literature

Type of Literature	Period	
	Early	Late
Periodicals	68.2%	14.7%
Monographs	18.2%	26.5%
Reports	13.6%	58.8%

read mostly periodical literature whereas after his appointment as Director of the Experimental Farm system research reports, largely those of agricultural research institutions, garnered the larger portion of his attention. In the early period (1862-1883), periodicals accounted for 68.2% of Saunders citations, but in the later period (1884-1907) research reports secured the larger percentage. Periodical literature in the later period accounted for approximately the same percentage as research reports had earlier.

This change in emphasis in the type of literature, which was more frequently consulted, matches the type of work Saunders was doing in each period. His publications in the early part of his career dealt primarily with entomological topics leading up to the publication of a major volume entitled *Insects Injurious to Fruits* published in Philadelphia in 1883. The reading done in preparation for that volume spanned a number of years and close regard was given to entomological literature found primarily in American periodicals.[32] Later in the century, to support his plant breeding trials, Saunders followed developments found in reports of agricultural experimental stations in the United States. His interests in scientific subjects pursued south of the border is confirmed in the data presented in Table XII. Here it can be seen that American publications figured prominently in both periods, but more so in the latter part of his career. Canadian publications which accounted for almost 35% of the publications in the early period drop d later in the century to less than twenty percent. British and especially European publications, were referred to much less frequently.

Further evidence of the American preponderance in Saunders reading is detected in the journals he cited and the authors whose work he referred to. American scientists, such as William H. Edwards, Charles V. Riley, and A.S. Packard, and American journals including *The American Entomologist*, *Proceedings of the Entomological Society of Philadelphia*, and the *Transactions* of the New York Agricultural Society received the most frequent study.

Table XII - Saunders Citation Study - Place of Publication

Place of Publication	Period	
	Early	Late
Canada	34.6%	19.5%
U.S.A.	54.5%	72.4%
U.K.	4.5%	6.9%
Europe	4.5%	1.1%

In much the same manner as James Fletcher, his colleague in agricultural research, Saunders looked to American scientific literature to a greater extent than information from other countries. But, unlike Fletcher, research reports took on greater significance for Saunders in the latter part of his career. The relevance of agricultural research being conducted in the United States was recognized by both Saunders and Fletcher, and the greater ease of communication with that country than with most others led to close attention being paid to what was being done there. This was accomplished by reading the American reports and periodicals as well as attending meetings of American scientific societies and visiting border states.

In summary, the evidence provided by the reading patterns of these six scientists suggests that throughout the Victorian period Canadian researchers monitored scientific work occurring in other countries. Depending on the nature of their own research, Canadians looked either to the United States or to Britain and Europe for the larger portion of their information requirements. Agricultural researchers gave particular regard to American activities, while geological scientists, especially those pursuing palaeontological matters, considered British and European studies important. While European languages could have presented a barrier in the diffusion of scientific literature for nineteenth-century Canadian scientists, it did not pose a serious problem, at least for the geologists. Much of the literature Canadian scientists were citing was current, -- a practice made possible by the use of scientific periodicals.

Alerting Mechanisms

To read the scientific literature, Victorian Canadian scientists needed first of all to be aware of its existence.[33] One important means by which they could learn about new or previously published literature was by regularly reading current publications, particularly scientific journals.

The analysis of the reading patterns of all six scientists establishes that they consulted current issues of periodicals. In so doing, they encountered a feature commonly found in numerous scientific journals of the Victorian period, namely sections that identified recent publications. New publications were noted under the guise of reviews, scientific "intelligence," "new works", and, in the case of journals published by scientific societies, recent acquisitions by the society's library. Scientific societies had, in Sarah Gibson's terms, a "messianic attitude" with regard to communicating results of scientific research.[34] Editors, too, considered one important function of their scientific journals was to inform readers about recent publications issued by the world's scientific press. If only a few of the periodicals that Canadian scientists read are examined this alerting function can be amply illustrated.

In the early decades of the Victorian period, Canadian scientists had to look to foreign journals to fulfil the notifying function. For example, the *American Journal of Science and Arts* was a significant American scientific journal that began in 1818 and was regularly read by Canadian scientists throughout the nineteenth century. It typically featured accounts of research and discoveries reported in other journals and other countries. Brought out monthly in two volumes per year, this journal served its readers well by alerting them to a wealth of scientific publications on a wide variety of scientific topics. Another journal closely watched by Canadian researchers was the *Quarterly Journal of the Geological Society of London*, which began publication in 1845. It also informed readers about relevant scientific publications but focused, as might be expected, on matters of geological interest. As a society publication, the *Quarterly Journal* carried two sections that highlighted new publications. The annual presidential address was one, and each president customarily reviewed geological literature that had been published in the previous year. In 1863, A.C. Ramsay did just this, but he was following a pattern that had been established years earlier.[35] In his address Ramsay reviewed numerous European, British, and North American publications. The second section of the *Quarterly Journal* that served as an alerting function was the list of "Recent Acquisitions" of the

Society's library.[36] As the library of a major geological society, many publications from around the world were acquired by purchase and frequently by gift and exchange. These acquisition lists helped to advise readers about literature produced in many locations.

As the nineteenth century progressed and more and more scientific periodicals were launched, Canadian scientists could look to journals published within Canada for information about recent publications. Two mid-nineteenth century Canadian journals that followed the lead of foreign periodicals and adopted the notifying function were the *Canadian Naturalist and Geologist* and the *Canadian Entomologist*. The *Canadian Horticulturist* which began publication later in the century also embraced this model.

The *Canadian Naturalist and Geologist*, the earlier of the three journals, was launched in 1856 by Elkanah Billings and by the next year it had been adopted as the official journal of the Natural History Society of Montreal. Beginning in the first volume of this new journal, "Notices of Books" were featured. In June 1856, for example, Billings reviewed a monograph on Carboniferous and Devonian fossils by Joseph Leidy of Philadelphia, noted a paper on the New Red Sandstone of Pennsylvania by Isaac Lea, advised readers that the Montreal bookseller B. Dawson had a supply of Kirby and Spence's *Entomology* available in the "new and cheap English edition," and "strongly recommended that every Public Library in Canada should purchase a set of the Works of the Great Ornithologist and Naturalist, Audubon."[37]

The second volume of the *Canadian Naturalist* included a lengthy discussion of "microscopic literature"[38] and over the next decade many issues of the journal carried reviews and short notices of books and journals. Some of the reviews were extensive, such as J.W. Dawson's assessment of Louis Agassiz's *Contributions to the Natural History of the United States* published in the February 1861 issue, but the majority were shorter. Most of the publications selected for review were of American, British, and Canadian origin, and many of these were available for purchase from B. Dawson & Son of Montreal.[39] A variety of books, reports, and periodicals were noticed and, like the *Quarterly Journal of the Geological Society of London*, the *Canadian Naturalist* listed additions to the library of the Natural History Society.[40]

The *Canadian Entomologist* originated in 1868, a decade after the *Canadian Naturalist and Geologist*. Early in its publication history it, too, adopted the function of alerting readers to relevant scientific literature. "New Entomological Works" were listed, usually in each issue, and during the 1860s and 1870s mostly American publications were noticed with a smaller number of Canadian and British works receiving short reviews.

Further into the century, the *Canadian Horticulturist*, which began publication in 1878, also aided its readers by including sections entitled, "Literary Notices," "Books and Periodicals," and "Book Notices." An assortment of books, agricultural periodicals, and reports, the majority American in origin, were listed throughout the 1880s. Reviews were frequently very brief, except for the lengthier commentary on William Saunders's *Insects Injurious to Fruits*, which appeared in the June 1883 issue.

At the end of the Victorian period, as already noticed above, Fletcher took on the responsibility of scanning the year's output of entomological literature and reporting his findings in the *Annual Report of the Entomological Society of Ontario*. This serial, published with financial support of the Ontario government, was circulated among the members of the Society, exchanged with other scientific organizations, as well as being disseminated in the agricultural community, thereby bringing entomological literature to the attention of a wide audience. Fletcher's annual scrutiny of the entomological literature gave attention to numerous American and Canadian publications and few references to British literature.

Canadian scientific serials throughout the latter part of the Victorian period, as the above examples illustrate, included the alerting function among other roles in communicating scientific information. If Canadian scientists had relied on these journals alone to learn about new scientific literature, their awareness of the published scientific information would have been quite limited. None of the Canadian journals aimed to provide extensive coverage of the current scientific literature, nor did they endeavour to inform their readers about all the scientific publications available in Canada. The scientific literature found in both personal and institutional libraries, as will be noted in subsequent chapters, was more extensive than what was noticed in Canadian journals.

The reading habits of Canadian scientists throughout the Victorian period extended more widely than perusal of Canadian journals, however. Canadian scientists regularly checked American, British, and European periodicals from which they could have learned about many other publications that the Canadian journals did not notice. It was simply not necessary for Canadian editors to provide comprehensive duplication of what was being supplied elsewhere.

The picture assembled from the scientists' reading patterns demonstrates five features about the dissemination of scientific literature in Victorian Canada. First, we now know that Canadian scientists of the period read widely including publications in a variety of languages. Second, most of the scientific literature that they studied had been published abroad and it flowed steadily into the country so that Canadians could be and were aware of recent developments elsewhere. Third, for the palaeontologists, British and European literature was of considerable importance, whereas for the agricultural scientists, publications from the United States were the ones most closely followed. Fourth, as scientific periodicals multiplied throughout the nineteenth-century, Canadian scientists read this form of literature in growing numbers. Some scientists did not follow this trend, however, as the case of both Robert Bell and William Saunders reveals. For their line of work, report literature was important. Finally, reading the scientific literature increased Canadian scientists' awareness of other publications to which they could gain ready access and also some they could not.[41]

To understand more fully the dissemination of scientific literature in Victorian Canada, we must consider the matter of access. The next two chapters address this aspect from the point of view of personal and institutional libraries.

Notes to Chapter IV

1. Canadian scientists were, of course, selective in the literature that they read. For any one nineteenth century scientist, either in Canada or elsewhere, to have read all of the available scientific literature would have been very uncommon, if not impossible.

2. "Darwin's reading habits," according to Susan Sheets-Pyenson, "are better documented than those of any other nineteenth-century natural historian." His habit of both "marking up" copies of publications as well as recording what he had read has been studied by a number of scholars. Sheets-Pyenson's statement is taken from her study, "Darwin's Data: His Reading of Natural History Journals, 1837-1842," *Journal of the History of Biology* 14 (Fall 1981): 232. For reference to other scholars who have investigated the Darwin records see Chapter I, note no. 71.

3. For example, the acquisition of bibliographic reference works and personal correspondence between scientists will be noted in the discussion of personal libraries in Chapter V, and the role of publishers and booksellers will be examined in Chapter VII.

4. The details of how the citation study was conducted are outlined in Chapter II. It should be remembered here that a sample of each scientist's publications spanning their careers was considered. Scientific literature was classified according to three types: papers in scientific periodicals, monographs and books, and research reports issued by geological surveys or agricultural experimental institutions.

5. To facilitate an analysis of changes that might occur over the course of a scientist's working life, the career of each of the six scientists was split into an early and a late period. Citations in their publications in each period were then examined and comparisons between the two periods noted.

6. Borrowing records for many Victorian Canadian libraries have not survived. However, among the papers of individuals one occasionally finds records of volumes borrowed from libraries. Such is the case with Bell. Three documents (two relating to the library of the Geological Survey and one with the Library of Parliament) record Bell's use of institutional collections. Robert Bell Papers. National Archives of Canada. MG 29 B15.

7. With reference to periodicals that Bell subscribed to see the discussion of his personal library in Chapter V. Bell was an avid reader of contemporary newspapers. On various dates in the 1860s, for example, he recorded in his diaries spending time reading and clipping newspapers. For example, on the 17th February 1863 he wrote: "Cut scraps out of a lot of 'Globes' for scrapbook." The next day the entry ends: "In even[in]g finish cutting scraps out of my stock of newspapers." Some of the "scraps" that Bell collected have survived and are part of the Robert Bell papers at the National Archives of Canada. In addition to the diary entries, in the late 1880s through 1908 Bell kept a notebook which listed "subjects," an extensive inventory of topics that he had read about, mostly in newspapers but also in some scientific periodicals as well. Robert Bell Papers.

8. Among the tasks that Bell itemized in a "Memo of office work 1892-3" he listed "informing myself of what contemporary geologists are doing in reference to the geological problems we are now also engaged in working out." Robert Bell Papers.

9. For each of the scientists in this study the average age of citations in their publications was determined by subtracting the date of publication of a cited document from the date of publication of the citing work and then taking the average of all the date differences for each citing document. Once the average age of citations in each citing document was determined the overall average for each period was calculated. In Bell's case, for the earlier period, average age of citations ranged from .7 to 35.6 years with an overall average of 9.4 years and for the later period the average age of citations ranged from 0 to 61.5 years with an overall average of 18.2 years.

10. Evidence of Billings's broad reading and knowledge in the natural sciences is found in the first volume of the *Canadian Naturalist and Geologist* published during 1856-1857. The articles in this 480 page volume were largely the work of Billings alone.

11. For each scientist the scientific journals they referred to were determined. The frequency with which the periodicals were cited was calculated to ascertain reading patterns. The more frequently a journal was cited the more likely it was consulted more often than those that received fewer citations.

12. The actual figures are 47 authors for the earlier period and 63 for the later period.

13. On occasion Billings and Hall argued over priority in naming fossil specimens. See, for example, Elkanah Billings, "Remarks Upon Prof. Hall's Recent Publication Entitled: 'Contri-

butions to Palaeontology,'" *Canadian Naturalist and Geologist* 7 (October 1862): 389-393. Billings, therefore, carefully read Hall's publications and noted their dates of publication. Discussion on a related topic is found in Elkanah Billings, "On Prof. J. Hall's Claim of Priority in the Determination of the Age of the Red Sandrock Series of Vermont," *American Journal of Science and Arts* 33 (1862): 370-376 and Elkanah Billings, "On the Date of the Report on the Geology of Wisconsin, Noticed in This Journal, Vol. VI. p. 465," *Canadian Naturalist and Geologist* 7 (April 1862): 156-158.

14. Naming of fossil specimens required careful attention to the publication dates of reports in which names were first proposed. In 1870, for example, Billings noted, with reference to one type of fossil remains: "There is difficulty about the nomenclature of this Trilobite, owing, in part, to some uncertainty as to the true dates of publication. In the later reports of our survey we have adopted the name given to it by Stokes [who had described the species in 1822], while most American authors call it either *Asaphas gigas* or *Isotelus gigas*. Dr. Bigsby's paper was read February 21st, March 7th, & 21st, 1823. It is usually cited under the date 1822. In his article on the Minerals and Fossils of Canada, published in Silliman's Journal in 1824, vol. viii, p. 84, he alludes to it thus: - 'I beg to refer to three figures of large unknown trilobites, published last year in the Geological Transactions of London.' I infer from this that the portion of the Transactions containing his paper was issued in 1823. De Kay's paper, in which the species was first called *Isotelus gigas*, was read before the New York Lyceum of Natural History, October 27th, 1823. It is generally quoted with the date 1824. Elkanah Billings, "Notes on Some Specimens of Lower Silurian Trilobites," *Quarterly Journal of the Geological Society of London* 26 (1870): 479-486.

15. In the earlier period the overall average age was 6.1 years (ranging from 0 to 9) and for the later period it was 9 years (ranging from 0 to 21.2).

16. For example, Billings cited and quoted both German and French authors in "On the Classification of the Subdivisions of M'Coy's Genus Athyris, as Determined by the Laws of Zoological Nomenclature," *Annals and Magazine of Natural History* 3rd s., 20 (1867): 233-247.

17. Dawson dedicated his first major book, *Acadian Geology: An Account of the Geological Structure and Mineral Resources of Nova Scotia, and Portions of the Neighbouring Provinces of British America* (Edinburgh: Oliver and Boyd, 1855), to Lyell.

18. Well over one hundred authors were cited in both periods of Dawson's career: 145 in the earlier period and 172 in the later period.

19. For further discussion of the International Scientific Series of books see Roy M. MacLeod, "Evolutionism, Internationalism and Commercial Enterprise in Science: The International Scientific Series, 1871-1910," in *Development of Science Publishing in Europe*, ed. A.J. Meadows, 63-93. (Amsterdam: Elsevier Science Publishers, 1980).

20. For the early period the age of publications ranged from zero to 52 years (average 6.1) and in the later period the age of publications ranged from zero to 61 years (average 9.3).

21. Some evidence of Fletcher's reading of entomological literature is found in a notebook, captioned "James Fletcher./ Entomological Notes./ 1878," held at the Canada Agriculture Library, Entomological Division, Ottawa. In this notebook Fletcher recorded brief citations to entomological publications mostly of Canadian or American origin.

22. Both Fletcher's personal library and the Library of Parliament are discussed in subsequent chapters.

23. As with the other scientists, Fletcher's career has been divided into two periods - early (1884-1896) and late (1897-1908) to allow for comparison and determination of trends.

24. Almost three times as many authors were cited in the later period as in the earlier (48 as compared to 17).

25. Further information on this correspondence is found in the discussion of Fletcher's personal library in Chapter V.

26. The average age of cited publications for the early period ranged from .5 to 32 years and for the later period from 0 to 24 years. If the outliers (i.e., the ages of 32 and 24) are ignored, the average age for the early period is 2.6 years and for the later period 1.5 years.

27. Fletcher systematically consulted *Le Naturaliste canadien* published by Léon Provancher, which demonstrates his reading ability in French. Some of his correspondence was conducted in French and, in addition, two books in his personal library were published in Paris in French. Fletcher may have been able to read other European languages. He makes reference to a German geographical journal in a letter to George Vaux, Jr. of Philadelphia, dated 20th March 1908. Department of Agriculture Papers, National Archives of Canada RG 17, A II 7, Volume 2368. However, earlier in his career he arranged for a translation of a German article. In a letter addressed to

John Lowe, Deputy Minister of Agriculture, dated 11th August 1387, Fletcher requested that G.A. Tschirch's paper "Beitrage zur Kenntniss der Waourselknollchen der Leguminoisen" in *Berichte der Deutschen Botanischen Gesellschaft Jahrgang 1887*, pages 58 to 98, be translated for him. Fletcher noted that "It [the paper] has an important bearing upon my decision as to the nature of the disease which has attacked the pea-crop in Prince Edward County and concerning which the farmers are anxiously awaiting my final report." He had borrowed the issue of the *Berichte* from Prof. Farlow of Harvard University and asked that the journal be treated with care so that he could return it to Farlow. Department of Agriculture Papers, National Archives of Canada. RG 17, A II, vol. 545, Letter 60943.

28. This point is also corroborated in Robert Bell's comments about Logan's work habits. "To give an idea of the amount of work he accomplished," Bell wrote, "it may be mentioned that in addition to his daily round of visits of instruction or consultation with every member of the staff, he kept all the accounts with his own hand, carried on an extensive correspondence, without the aid of the type-writer, then unknown, plotted all his own surveys and constructed his own original maps, wrote his reports, edited the reports of his assistants, examined all the fossils, minerals and rock-specimens collected during the year, *studied the reports of the geological surveys of the different American States and of any other geological surveys which might be going on, in order to correlate the Canadian work with that of other countries so as to keep up with the times.*" Robert Bell, *Sir William E. Logan and the Geological Survey of Canada* (Ottawa: The Mortimer Co., Limited, [1907]). (Emphasis added).

29. In a journal covering some of his activities during 1846 Logan commented, in August of that year, on the careful and accurate observations of American geologists such as Douglass Houghton. Logan Papers, Metropolitan Toronto Reference Library, Journal for 1846.

30. The average age for the early period was 5.8 years (ranging from .7 to 22) and for the later period was 6.9 (ranging from 1 to 22.8).

31. William Saunders to Gerald M. Dunne, 18th February 1899. Saunders was responding to an offer from Dunne to sell a book on natural history to him. Department of Agriculture Papers, National Archives of Canada. RG 17, A II 1, Volume 2099.

32. A partial manuscript of *Insects Injurious to Fruits* is held in the Saunders Family Papers at the Regional Collection, D.B. Weldon Library, University of Western Ontario file 4303.

Saunders recorded the dates on which he had read particular entomological publications beginning in December 1871.

33. Actual access to the literature was, of course, necessary as well. This matter will be addressed in the discussion on personal and institutional libraries in Chapters V and VI.

34. Sarah Gibson, "Scientific Societies and Exchange: A Facet of the History of Scientific Communication," *Journal of Library History* 17 (1982): 152.

35. J.W. Dawson had a copy of this address (A.C. Ramsay, "Address Delivered at the Anniversary Meeting of the Geological Society of London, on the 20th of February, 1863. (London: Printed by Taylor and Francis, 1863)) in his personal library plus other such presidential addresses. Similar such presidential addresses are found in other personal libraries.

36. Published over more than half a century, the acquisition lists of this library provide a very good survey of the geological literature of the period.

37. "Miscellaneous -- Notices of Books, &c.," *Canadian Naturalist and Geologist*, 1 (June 1856): 239-240.

38. "Notes on Microscopic Literature," *Canadian Naturalist and Geologist* 2 (November 1859): 387-392.

39. There were a small number of reviews of European publications, such as comments in the June 1868 issue on Oswald Heer's research published in the *Archives des sciences physiques*. In addition, there were infrequent reviews of scientific publications from other locations as in the case of the review in the April 1861 issue of the Australian *Transactions of the Philosophical Institute of Victoria*.

40. As with the *Quarterly Journal of the Geological Society of London*, readers of the *Canadian Naturalist and Geologist* were alerted to new publications by the library acquisition lists. In addition, these lists are important sources of evidence for identifying the holdings of the library and will be discussed later in Chapter VI.

41. Billings, for example, acknowledged that he had not seen publications that his reading of the literature had brought to his attention. In 1867 in a discussion of taxonomy he wrote: "I have not seen his [Alcide D'Orbigny's] original description in the 'Annales des Sciences Naturelles,' referred to by Mr. Davidson in the extract given below; but in the 'Paléontologie Française,' vol. iv. p. 357, he says [and then Billings went on to quote D'Orbigny]." Elkanah Billings, "On the Classification of the Subdivisions of M'Coy's Genus

Athyris, as Determined by the Laws of Zoological Nomenclature," *The Annals and Magazine of Natural History*, 3rd s. 20 (1867): 237. Later in the same paper, Billings noted that "It appears also that it [a fossil species] was again noticed in Leonhard's 'Neues Jahrbuch,' 1854, p. 127. I have not at present access to that work, and do not know whether the genus is described there or not: at all events, at the time Mr. Davidson prepared the English edition of his 'General Introduction,' *Merista* was not understood." (p. 240).

Chapter V - Personal Libraries

Scientists in Victorian Canada could obtain access to scientific literature in a number of ways. They could visit a nearby library and consult the available holdings, they might borrow a publication from a colleague, or they could acquire their own copies of scientific publications. Motivated by the convenience of close and ready access, scientists assembled their own collections of scientific literature, and it is these collections that are discussed in this chapter.

Our understanding of the dissemination of scientific literature in Victorian Canada can be enhanced by answering a number of questions concerning the private libraries of scientists. The first and obvious question is: did the six scientists actually accumulate a personal collection of scientific literature? Since the answer to this question is yes, each of them did, the remaining questions can scrutinize each collection in turn to determine: how large were the private libraries of scientists? what types of literature did the scientists collect? what were the dates of publication, i.e., how current was the literature that they collected? where was the literature published? how selective were the scientists, e.g., did they acquire only the publications of a few particular authors? how did the scientists go about collecting the literature? how useful were the collections to each of the six scientists?

Because none of the groundwork had been done, it was necessary to reconstruct the libraries of the six scientists to answer these questions. Scholarly assessment of personal libraries, especially in English Canada, has so far been restricted to a few libraries. Even in French Canada, where the study of both personal and institutional libraries is more advanced, the library of only one scientist has been described.[1] Since so little is as yet known about nineteenth century personal collections, the role they played in scientific and scholarly endeavour is difficult to assess.

In Victorian Canada the value of a personal library varied from scientist to scientist. For a number of reasons, such as cost and proximity to other libraries, some scientists may have built only a modest personal collection of scientific books, reports, and periodicals. But others who pursued scientific work did assemble larger private libraries. While personal collections may have varied in size from a few volumes to many hundreds of items, their content or their significance is not well known.

Except for very large or unique collections, scientists' libraries are usually poorly documented and often remain uncatalogued. Even more common is the fact that many scientists' personal collections were destroyed or dispersed either at the end of their careers or following their deaths. This situation means that the reconstruction of scientists' private libraries usually requires enormous effort and in a large measure accounts for the few studies that have been published to date.

The collection of scientific and medical literature accumulated by William Osler, a bibliophile and medical researcher of international stature, is a Canadian example of a large private library. As was mentioned in Chapter II, collections of the calibre of Osler's are uncommon, however, and the scholarly attention that his library has received is an exception among Canadian collections.[2] More modest libraries, but not necessarily less useful, have been documented. Reference may be made here to the entomological library of Henry M. Lyman which forms the core of now a much larger collection housed at Macdonald College at McGill University,[3] and the palaeobotanical collection of Edwin D. Levittan now held at Dalhousie University.[4] A private library of agricultural literature, collected by the Hon. Jean-Charles Chapais (1811-1855) and his son, Jean-Charles Louis Thomas Chapais (1850-1926), is now part of the Canada Agriculture Main Library.[5] One other private library of scientific literature, that of Peter Fidler, a surveyor with the Hudson's Bay Company, has been described by Debra Lindsay.[6]

In this chapter further evidence of private libraries of scientific literature in Victorian Canada will be discussed in order to answer the questions set out above. Confirmation of these libraries will be drawn from a number of sources, principally the records of the six scientists whose careers were described in Chapter III. The wide dispersal of all six personal libraries, however, has made the accumulation of evidence difficult. Nonetheless, I have located and catalogued over 3,000 publications that had at one time belonged to the six scientists. Information about each personal library will be described in turn followed by a discussion which draws out observations about the dissemination of scientific literature in Victorian Canada based on these descriptions.

Robert Bell's Library

Robert Bell was a compulsive collector as illustrated by a variety of documents in his personal papers that are typically discarded either by their owners or later by archivists. For example, his papers contain numerous receipts from a wide array of purchases. Some of these give account of book and periodical purchases.

While the Bell papers are a rich source of documentation about his career, his personal library, unfortunately, is not intact and the identity of some items has been lost. Still, a sizeable collection was obtained by the National Archives of Canada. I have catalogued over 1100 printed items, largely from the holdings of the National Archives, but also supplemented by discoveries of Bell's books in other locations and together these form the basis for the following discussion.[7]

While Bell's library was larger than the number of publications that have been located so far, the range of items and evidence from his personal papers suggests that a good representation of his library has been obtained.

Characteristics of Bell's library which embrace the collection as a whole are set out in the next series of tables. In Table XIII dates of publication are enumerated and here it can be seen that most of the works were produced from 1890 onwards. Publications from the last decade of the nineteenth century and the first decade of the twentieth century account for 61.3% of the collection. These two decades correspond to the peak in Bell's career and since re-

Table XIII - Number of Volumes by Date of Publication in Robert Bell's Personal Library

Year	Number of Volumes
n.d.	31
1777-89	2
1800-49	23
1850-54	8
1855-59	10
1860-64	23
1865-69	32
1870-74	21
1875-79	82
1880-84	46
1885-89	78
1890-94	147
1895-99	147
1900-04	236
1905-09	160
1910-14	83
1915-17	14

prints account for a sizeable portion of the collection his scientific reputation at home and abroad during this period ensured that a large number of publications were forwarded to his attention.

The publications in Bell's collection came from a variety of sources, but as Table XIV illustrates half (50.7%) were produced in the United States. Canadian publications were the next most prominent group with 27.8%, followed by publications from Great Britain with 15.5%. A small number (4.6%) of scientific works came from Europe. Since Bell's geological research was generally of a reconnaissance nature, as noted in earlier chapters, it might be expected that his work would have closer affinity to similar geological exploration in the United States and less with either Britain or Europe. Bell's first university degree was engineering, and prompted partly by this he maintained a strong interest in mining matters. His membership in the American Institute of Mining Engineers ensured that he received a large number of reprints associated

Table XIV - Number of Volumes by Place of Publication in Robert Bell's Library

Place	Number of Volumes
Canada	319
Great Britain	175
Europe	52
United States	582
Other	15

with conferences of that association. Bell seems not to have established many ties with scientists in Europe and this is reflected in the few publications of European origin. In this regard he differed from J.W. Dawson whose library will be described below.

Bell's collection of scientific literature suggests that he did not have many favourite authors since fully 93% of the authors are represented in the collection by only one or two publications. In addition, as Table XV demonstrates, corporate authors figure prominently in the collection. The authors who produced ten, eleven, and twenty-five publications each were corporate including The American Institute of Mining

Table XV - Authors Represented in Robert Bell's Library

Number of Authors	Number of volumes/author
456	1
56	2
12	3
14	4
5	5
2	6
1	7
1	10
1	11
1	25

Total number of authors	-	549
corporate authors	-	128
individual authors	-	421

Engineers, the Royal Society of Canada, and Ward's Natural Science Establishment of Rochester, New York.

Personal authors with five or more of their publications in Bell's private library are: David T. Day with seven, Elfric Drew Ingall with five, A. McGill with six, J.W. Spencer with five, and J.F. Whiteaves with five. All of these writers were either Canadians or Americans and all published on scientific topics, primarily geological.

The data from the above tables delineate several attributes of the literature in Bell's private library and illustrate a number of features about the dissemination of scientific literature during the latter part of the Victorian period. The publications in his personal library were largely North American in origin. Fully 78% of the items in his collection were published in the United States and Canada. Bell placed heavy emphasis on North American literature, as the discussion in Chapter IV demonstrated, and now the evidence from his personal library shows that he collected more of this literature than any other.

The large number of authors represented in Bell's library points to a characteristic common to all six scientists in this study. Even though they might in fact consider the work of some authors of greater relevance to their own research than that of others, the literature to which they had access was not limited to a few selected authors.

Another aspect of the literature in Bell's library common to all six was the presence of reprints. This feature stands out in the case of Bell and Dawson (reprints number in the hundreds in both instances), but all six scientists collected this sort of publication. Reprints frequently were forwarded to Bell without any prompting on his part. But he also encouraged other researchers to send on complimentary copies of their publications by mailing out copies of his own works to an extensive group of scientists.

A further characteristic of Bell's library is that it contained contemporary literature, much of it acquired, as noted earlier, during the peak of his career. Bell, like the other five scientists in this study, was interested in current developments in scientific matters. A number of publications that he acquired would have alerted him to other authors and scientific literature. Directories, catalogues, indexes, and bibliographies can all be found in his library.[8]

Finally, it may be noted that the vast majority (about 95%) of the publications in Bell's personal library dealt with scientific and mining engineering subjects. Among the books are texts from his university days. His library also contains numerous periodicals including the *Geological Magazine* published in London, the New York *Engineering and Mining Journal*, the *Canadian Mining Journal*, and *American Forestry*.[9]

Elkanah Billings's Library

The fate of Elkanah Billings's library is difficult to determine. Since he had once been a journalist, it might be expected that personal papers displaying a variety of writing might have survived. Such is not the case. Instead, the selection of personal papers in any one location is small and the largest group consists of correspondence with his family.[10] Billings was a self-admitted infrequent letter writer, which may indicate that his personal papers were few and may also account for the small number of personal papers that found their way into public depositories.

Because Billings's personal records are limited in scope, the full extent of his personal library cannot be ascertained with certainty. The paucity of records means that in order to determine what was in his library it is necessary to look for evidence found in books that had once been in his personal collection. Some of these volumes have survived and are now held either at the Billings Museum in Ottawa or at the City of Ottawa Archives. A volume by volume examination of the hundreds of books in the Billings family library brought to light some which had formerly been part of Elkanah Billings's personal collection. A few volumes have also been found in the Geological Survey of Canada Library in Ottawa. In addition, William S. M. D'Urban, a contemporary of Billings, identified a number of books from Billings's personal collection in a paper in the *Canadian Naturalist and Geologist.*[11]

A total of 67 volumes have been identified as candidates for inclusion in a catalogue of Billings's collection, many of which provide clear marks of provenance confirming that they had once been part of his library.[12] Even though Billings's library undoubtedly contained more than 67 volumes, his financial situation did not allow him to acquire an extensive personal library. The collecti contains books on a variety of subjects, but most (40) are scientific. Legal texts and statutes make up the next largest group of volumes. Since Billings was a lawyer and had practised law for a number of years, it is not surprising that books on criminal law and other legal matters would be found in his library. Early in his legal career he had sought the financial assistance of his father in the purchase of law books, and one of the older volumes in the collection, published in 1778, is a legal text.[13]

The date of publication of the books is set out below in Table XVI. A sizeable portion of the volumes were published in the decade from 1845 to 1855 with a smaller number brought out from the latter date until Billings's death in 1876. As the next table (Table XVII) shows most of the books were published outside of Canada with the largest number being published in the United States. Books of American imprint included eleven volumes of reports of various state geological surveys.

The authors of the books in the collection are listed in Table XVIII. Most are represented by one volume, a few by several. Among the latter are such scientific writers as F.V.

Table XVI - Number of Volumes by Date of Publication in Elkanah Billings's Library

Year	Number of Volumes
n.d.	2
1775-78	2
1800-29	3
1830-39	6
1840-44	6
1845-49	10
1850-54	13
1855-59	6
1860-64	2
1865-69	7
1870-74	7
1875-76	3

Table XVII - Number of Volumes by Place of Publication in Elkanah Billings's Library

Place	Number of Volumes
Canada	10
Great Britain	24
United States	31
Europe	2

Hayden, Charles Lyell, and A.H. Worthen. Other authors represented by single scientific texts included the American writers: John L. Comstock, John William Draper, and Leo Lesquereux. British authors were Henry T. de la Beche, Oliver Goldsmith, and G.B. Sowerby, Jr. Alexander von Humboldt was a German scientist and the only Canadian author of a scientific book was Henry Taylor.[14] Of these authors, Lesquereux and Sowerby wrote on palaeontological topics, while the others

Table XVIII - Authors Represented in Billings's Library

Author	Number of volumes
Barrow, John, Sir	1
Boisduval, Jean Alphonse	1
Buckland, William	1
Cartee, Cornelius S.	1
Chitty, Joseph	2
Combe, Andrew	1
Comstock, John	1
Cross, John	1
De la Beche, Henry T.	1
Dick, Thomas	1
Draper, John William	1
Fabricius, J.C.	1
Goldsmith, Oliver	1
Hayden, F.C.	3
Humboldt, Alexander von	1
Hutchinson, F.D.	1
Jenkins, John S.	1
Johnson, George	1
Leconte, John	1
Leigh, T.H. (& R. Daizell)	1
Lesquereux, Leo	1
Longstroth, L.L.	1
Loudon, J.C.	1
Lyell, Charles	2
Mantell, Gideon Algernon	4
Maury, M.F.	1
Miller, Hugh	2
Milton, Viscount (& W.B. Cheadel)	1
Phillips, John	1
Rodgers, M.M.	1
Sergeant, Thomas	1
Sowerby, G.B., Jr.	1
Stephens, Henry	1
Taylor, Henry	1
White, Charles	1
Whittaker, Henry	1
Worthen, A.H.	5

treated more general geological or chemical matters.

Scientific journals do not figure in Billings's collection. There is one volume of the *Journal and Transactions of the Board of Agriculture of Upper Canada*. This 1856 volume contains Billings prize winning essay, "Upon the Agriculture, Manufacture, Commerce, and General Condition of the County of Carleton, 1854." Reports of neighbouring United States state geological surveys are the more common type of publication in the collection. Most of these volumes had been sent as complimentary copies to Billings, either from the author of the report or from the head of the state survey. Examples of these included Charles White's *Report on the Geological Survey of the State of Iowa* and the multiple volumes of reports on the geology and palaeontology of Illinois forwarded by A.H. Worthen.[15] Besides the reports of geological surveys a number of books that related directly to Billings's work in palaeontology are found in the collection among which is G.B. Sowerby, Jr.'s *Conchological Manual.*[16]

In summary, the more than 65 volumes described above indicate that Billings's personal library contained mostly scientific publications. This literature was contemporary, mostly American in origin, and produced by a number of knowledgeable authors. When these characteristics of Billings's personal library are considered in light of the conclusions drawn from an analysis of his reading patterns, outlined in

Chapter IV, it is clear that his personal library did not meet all his information needs. Scientific periodicals, for example, were absent from his library, yet he frequently cited papers from a number of journals of the day. It was necessary, therefore, for him to look beyond his personal collection to books, reports, and periodicals held in institutional libraries. For the most part the literature that he needed could be located in Montreal libraries, a number of which will be described in Chapter VI.

John William Dawson's Library

At an early age Dawson began reading widely, and scientific literature soon numbered among the volumes of his library. In an autobiography written near the end of his life he noted that as a teenager he read a number of books on scientific subjects. While a student at Pictou Academy he had become "by a fortunate purchase at a sale of books, the possessor of a copy of Haidenger's translation of Mohs' Mineralogy."[17] His collection of books on science soon grew to include Charles Lyell's *Elements and Principles of Geolcgy*, Henry de la Beche's *Manual*, and Phillips's *Elementary Geology*.[18] Two local writers who provided Dawson with their scientific publications were Richard Brown, a Fellow of the Geological Society and manager of a coal mining company in Sydney, Nova Scotia, and Dr. Abraham Gesner, noted particularly for his invention of kerosene.[19] In addition to these publications Dawson wrote that "there came into my hands a series of popular articles, published in the *Penny magazine* of the Society for the Diffusion of Useful Knowledge, which gave a comprehensive summary of the facts of geology as then known."[20] Since his father was a bookseller and publisher, opportunities to acquire scientific publications came more frequently for Dawson than for many other Canadians at the dawning of the Victorian period.

While information about some of the early additions to Dawson's private collection is established, the outcome of his library from those Pictou days until the conclusion of his scientific career is not. There is ample evidence to show that he maintained a life-long interest in acquiring scientific literature both for himself and for institutions with which he was associated, especially McGill University.[21] Still, his private library did not remain intact following his death, and it is, therefore, necessary to reconstruct his library from evidence found in a variety of sources. As might be expected a sizeable portion of his personal library became part of the holdings of the McGill University Library. Guided by evidence of provenance found in these latter holdings, I have created a catalogue of over 1500 publications from Dawson's personal library, and the following discussion is based on these findings. Dawson's interests were broader than scientific subjects, which meant that his personal library contained publications on a range of topics. Only scientific publications were considered for this study, however. The catalogue of Dawson's library now itemizes a sizeable portion of his personal collection. Only by extensive searching of the McGill University collections will further publications be added.

Some overall characteristics of the collection can be established first. In summary form, Table XIX provides the dates of publication of each of the works. It is obvious from

Table XIX - Number of Volumes by Date of Publication in J.W. Dawson's Library

Year	Number of Volumes
1820-29	4
1830-34	2
1835-39	8
1840-44	14
1845-49	12
1850-54	44
1855-59	127
1860-64	187
1865-69	139
1870-74	180
1875-79	199
1880-84	268
1885-89	321
1890-94	59
1895-99	9

this data that most of the publications were acquired after 1855, a date which marks a significant point in Dawson's career. As noted earlier in Chapter III, he was appointed principal of McGill University in 1855 and he published the first edition of *Acadian Geology* in that year as well. His scientific work over the next few decades attracted the attention of researchers both at home and abroad, and the latter frequently forwarded copies of their works to him. A large majority of publications in Dawson's personal library consisted of reprints of scientific articles. Reprints were usually mailed out shortly after publication and in Dawson's case the number that he received peaked in the late 1880s. By that time his career was beginning to wind down.

Table XX - Number of Volumes by Place of Publication in J.W. Dawson's Library

Place	Number of Volumes
Canada	116
Great Britain	566
Europe	236
United States	632
Other	16

In the next table, data on the place of publication has been tabulated. Over 92% of the publications came from outside Canada, a not unexpected proportion. Among the foreign publications 43.6% were published in the United States, 39% in Great Britain, and 16.3% in Europe. Dawson's research on fossil plants located in Canada had some relationship to work being done in the United States, but equally

Table XXI - Authors Represented in Dawson's Library

Number of Authors	Number of publications/author
259	1
70	2
34	3
26	4
7	5
19	6
9	7
11	8
6	9
1	10
1	11
3	12
2	13
4	14
3	15
1	16
1	18
3	19
4	20
1	25
1	26
1	27
1	28
2	29
1	31
1	34
1	37
1	38

Total number of authors - 487

individual authors - 483
corporate authors - 4

important was research conducted in the British Isles (principally Scotland) and in Europe. This international perspective is reflected in the literature that flowed into his personal library.

Over 480 authors are represented in Dawson's collection of scientific literature (see Table XXI). This contrasts with Bell's library which had fewer publications but more authors. A further difference with Bell's personal library is seen in the higher number of authors (46%) in Bell's collection represented by multiple publications. Authors with five or more publications in Dawson's library numbered over sixteen percent.[22] Scientists with at least ten publications are listed in Table XXII. American scientists represented by twenty or more works each included: palaeontologists, E.D. Cope and O.C. Marsh, the geologists, James Dana, James Hall and J.S. Newberry, and entomologist, Samuel Scudder. British workers in this category were: the geologist T. Rupert Jones, the Scottish palaeobotanist, Robert Kidston, and the English microscopist, W.E. Williamson. Europeans included the palaeobotanist, Gaston de Saporta, the French researcher, Jules Marcou (who also worked in North America), the French palaeobotanist, B. Renault, and the German palaeontologist, M.R. Zeiller. Publications by Charles Lyell, who had a significant influence on Dawson, numbered fourteen. A number of other important scientific writers of the day are listed in Table XXII.

Table XXII - Authors of Multiple Publications in Dawson's Library

Note: The following authors are represented by ten or more works in Dawson's library. The number in parenthesis is the number of publications

Henry B. Brady (14)
William Carruthers (16)
E.D. Cope (29)
J.D. Dana (26)
Gaston de Saporta (20)
J. Starkie Gardner (12)
James Hall (29)
F.V. Hayden (15)
G. Jennings Hinde (12)
Henry How (12)
T. Sterry Hunt (19)
T. Rupert Jones (34)
Robert Kidston (20)
Leo Lesquereux (19)
Charles Lyell (14)
Jules Marcou (27)
O.C. Marsh (31)
G.F. Matthew (16)
F.B. Meek (19)
A.G. Nathorst (14)
J.S. Newberry (37)
H. Alleyne Nicholson (15)
A.S. Packard (14)
J. Prestwich (11)
A.C. Ramsay (15)
B. Renault (20)
S.H. Scudder (20)
J.W. Spencer (14)
John J. Stevenson (10)
R.H. Traquair (13)
C.D. Walcott (13)
W.C. Williamson (38)
M.R. Zeiller (28)

Characteristics of the literature in Dawson's personal library adds to our understanding of the dissemination of scientific literature in Victorian Canada. He accumulated publications that had a direct bearing on his palaeobotanical work and these were international in origin. Dawson could turn to his own library for many of the works that he read and cited. His reading patterns, summarized in Chapter IV, showed that he looked to British and European publications for over 50% of his citations. British and European publications comprise 51.2% of his personal collection.

As with Bell's library, reprints account for a large number of the publications in Dawson's collection. Scientists in numerous countries were aware of Dawson's work as illustrated by reprints by almost 500 authors in his collection. Scientists forwarded reprints of their publications to him and he reciprocated with copies of his own papers. The flow of these papers into his library ensured that Dawson had access to current literature.

All of the publications in Dawson's library dealt with scientific subjects and included books, periodicals, and reports of geological surveys as well as the many reprints mentioned above. Like Robert Bell, Dawson collected bibliographies and indexes that would have aided him in determining the existence of scientific literature relevant to his work. Among these bibliographic references are: John Belknap Marcou, *Bibliography of North American Paleontology in the Year 1886* (Washington: Smithsonian Institution, 1889), R. Zeiller, *Paléontologie végétale (Ouvrages publiés en 1888)* (Paris: Comptoir Géologique de Paris, 1889), and a number of indexes including: George W. Ormerod, *Classified Index to the Transactions, Proceedings, and Quarterly Journal of the Geological Society of London*, 2nd ed. (London: Printed by Taylor and Francis, 1870).

James Fletcher's Library

Evidence of James Fletcher's personal library comes principally from two sources: indirectly from his extensive correspondence and directly from actual copies of publications from his library. As Fletcher worked in the Library of Parliament, for a time, where he had direct access to one of the better collections of scientific literature in Canada, there was less need to accumulate his own copies of publications, at least in the early part of his career.

If we look first at the indirect evidence of Fletcher's personal library, a number of features stand out. Membership in scientific societies ensured that he was on the mailing list for a number of scientific periodicals. For example, as a member of the Entomological Society of Ontario, he regularly received the *Canadian Entomologist*, the most important Canadian periodical for Fletcher as Dominion Entomologist and a journal to which he contributed articles.[23] Another Canadian scientific periodical that he valued was *Le Naturaliste canadien,* published by Léon Provancher. In a letter to Provancher on 5th October 1885 Fletcher wrote that he intended to buy a complete run of the journal "as I can afford it."[24] In a subsequent letter he acknowledged receipt of the journal and advised Provancher: "I am pleased beyond measure that you are again able to carry on this important & useful work. Its cessation was a national loss for it was the only means we had of reaching the French Canadian farmers with advice and information concerning the countless insect enemies which prey upon and every year deprive them of a very large percentage of their crops."[25]

Copies of Fletcher's outgoing letters demonstrate that his correspondents, particularly fellow scientists, commonly forwarded their publications to him. Fletcher sought out the best scientific advice in North America and Europe for assistance with identification of biological specimens and publications describing insects, plants, and a variety of plant diseases and pests were sent on to him in return. For example, on the 14th November 1885 he wrote to Professor J.A. Lintner in the U.S. and thanked him for a paper on cutworms.[26]

Fletcher endeavoured to remain well-informed about the state of insect pests and plant diseases throughout the country and, while much of his correspondence records his requests for insect specimens and informed observation about agricultural problems, he also requested copies of published reports. On the 7th December 1885 he wrote to C.R.H. Starr, Secretary of the Nova Scotia Fruit Growers' Association officially acknowledging receipt of a copy of the Association's report at the Library of Parliament, and at the same time he requested that copies of all the reports be sent to him since he was now the Entomologist of the Department of Agriculture.[27] In a similar fashion Fletcher noted in a letter to A. Blue, Secretary of the Bureau of Industries, Toronto that he had "read with the greatest interest your valuable Agricultural Returns as they come to the Library of Parliament and as they are of great use to me in my work as Entomologist to the Department of Agriculture I shall be extremely obliged if you will give me a set for my own library and allow them to be sent to me in the future."[28]

Fletcher's endeavours to increase his knowledge of insects was not confined to Canadian literature, however. In mid-December 1885 he wrote to J.B. Smith of the Department of Agriculture in Washington: "My order for Entomologica Americana sent at the time I remitted for the set of the Brooklyn Bulletins has evidently been overlooked. Will you please send me the numbers of the past year and an a/c in duplicate for 1885 and 1886."[29] Later that month he wrote to Prof. W. Fream of the College of Agriculture, Salisbury, England and requested a "spare copy" of Fream's scientific papers.[30] Perhaps the nature of Fletcher's personal library is best described in a letter which he wrote not long after his appointment as Entomologist to C.V. Riley, State Entomologist with the U.S. Department of Agriculture:

> I am now collecting all the literature I can on the subject [of particular insect species] and hope next year to study the questions as fully as possible and hope also to visit the country (for part of the time at any rate) wherever I get the worst reports. Some time ago I purchased from you a few of your publications. I should like to get as complete a collection of your writing as possible. Will you at your leisure send me a list of all your papers and extras, with the prices, which you can supply me with -- and as I am writing on this subject I shall be much obliged if you will refer me to any of the U.S. Experiment publications which will be of use to me in my official capacity. My Minister has applied to your Commissioner of Agriculture for a set of the Ag. Dep[artment] Reports. I should like the Reports on the Entomological Commission and the Special Reports on the Rocky Mountain locust. I have in my own Library the Third Report and have lately received from Washington the 2nd Report with

> 8 volumes of the Ag. Reports. I should like to get the first Report and shall be obliged to you if you will inform me whether I should apply through my Minister to the Department of Agriculture or the Dep[artment] of the Interior. As I have no grant, as yet, for my work all books I procure have to be paid for by myself, because there are certain ones, such as these, which I must have.[31]

Fletcher was not prepared to rely on a few sources for scientific literature. In early 1886 he corresponded with Prof. Rivers of the University of California, Berkeley, particularly seeking information about insects in a different climate than that found in Canada and requesting "spare copies of any publications on these matters." If Rivers was unable to supply appropriate publications, Fletcher asked for a reference to someone from whom he could purchase the same.[32] Outside of North America, Fletcher cultivated a scientific friendship with Dr. Eleanor A. Ormerod (1828-1901) in England, a consulting entomologist to the Royal Agricultural Society.[33] He had met her while on a visit to England in the spring of 1886 and later that year his correspondence file indicates that she had sent on reports of her entomological work.[34] His contact with Ormerod alerted him to a French translation of reports on insects by Charles Whitehead and he wrote to the Minister of Agriculture in Brussels for a copy, later received.[35]

Fletcher took every opportunity to read available literature. During a visit to Nova Scotia to attend a meeting of the Fruit Grower's Association he had examined a journal in the home of one of the members and read a paper by T.J. Burrill of the University of Illinois. When he later could not locate a copy of the paper he wrote to Burrill requesting a duplicate.[36] In the same month he requested L.O. Howard, Acting State Entomologist in Washington, to forward a paper by C.V. Riley on a particular insect remedy which he planned on testing.[37] Howard's reply brought not only Riley's paper but the *Proceedings of the Society for the Promotion of Agricultural Sciences* and a number of other papers which Fletcher read "with keen interest."[38]

If Fletcher was unable to locate a copy of a desired publication in Ottawa, he borrowed the nearest available copy. An illustration of this action is seen in correspondence with D.W. Beadle, of St. Catherines, Ontario, Editor of the *Canadian Horticulturalist*. Fletcher had seen a reference to a New Zealand report on the codlin moth and believing that Beadle had a copy he wrote and requested the volume on loan.[39]

Over a number of years, indeed right up to the time of his death in 1908, Fletcher's correspondence file demonstrates that he had acquired a collection of scientific literature. Because of his modest means he often sought out complimentary copies of publications. He, in return, sent out hundreds of copies of the reports that he prepared for the Department of Agriculture. By judiciously obtaining publications directly related to his line of work he ensured that he could remain informed.

Books and periodicals that actually were in his library are characterized in Tables XXIII to XXV. A total of 86 volumes from his library were located. Fletcher's correspondence suggests that his library was larger, but not by any substantial number. More reprints than were discovered would likely account for any additional publications.

From Table XXIII, which summarizes the dates of publication of the 86 volumes, it is evident that Fletcher had access to contemporary literature. Almost 73% of the titles were published in the 1880s and 1890s and fully 84% of the publications were brought out during the three most productive decades of Fletcher's career.

Table XXIII - Number of Volumes by Date of Publication in James Fletcher's Library

Year	Number of Volumes
1832	1
1850-59	3
1860-69	2
1870-74	3
1875-79	4
1880-84	12
1885-89	20
1890-94	20
1895-99	10
1900-04	9
1905-08	2

The international perspective of the literature is apparent from the data set out in Table XXIV. Most of the publications came from the United States but there was a sizeable portion from Britain as well. The principal British author represented in the collection was Eleanor A. Ormerod (see Table XXV) with whom he maintained an extensive correspondence.

Table XXIV - Number of Volumes by Place of Publication in James Fletcher's Library

Place	Number of Volumes
Canada	5
Great Britain	17
Europe	2
United States	61
Other	1

Table XXV - Authors Represented by Multiple Titles in James Fletcher's Library

Author	Number of Volumes
W.H. Ashmead	16
W.S. Blatchley	3
S.A. Forbes	14
Asa Gray	2
William Le Baron	4
Eleanor A. Ormerod	8
Samuel H. Scudder	4
Thomas Shaw	2
John B. Smith	2
Cyrus Thomas	6
Clarence Weed	2

Fletcher's collection gives prominence to a number of American scientists, among whom were the entomologists, Samuel Scudder, W.H. Ashmead, S.A. Forbes, Cyrus Thomas, and William Le Baron. Canadian authors, conspicuous by their absence in Table XXV, were not unrepresented in Fletcher's library. Papers by numerous Canadian authors are found in such periodicals as the *Canadian Entomologist* and the *Ottawa Naturalist*, both of which he had in his library.

As with the previous three authors Fletcher's personal library illustrates the importance of reprints and complimentary copies of publications. He built a collection by deliberately requesting literature that he felt he needed. He was not at all reticent about contacting other scientists, particularly American researchers, for copies of their publications. Because he maintained contact with many of the leading entomologists of the period, he obtained scientific literature that was current. All of the publications in his library that have been located dealt with scientific topics. Fletcher's personal library was more modest than Dawson's or Bell's. But, as noted earlier, he had access to nearby institutional collections, which supplemented what he had obtained personally.

William Edmond Logan

Early in his scientific career, Logan saw a need for scientific publications and took steps to acquire appropriate publications. Shortly after being posted to Wales in 1831 to administer his uncle's mining interests there, he was in touch with his brother in London asking him to buy geology and mineralogy texts and a number of surveying instruments.[40] Among the volumes which he read in 1833 was the 1822 text, *Outlines of the Geology of England and Wales*, by W.D. Conybeare and W. Phillips and the following year there is evidence that he was familiar with Charles Lyell's *Principles of Geology* published in 1833.[41] Logan's years in Wales also brought him into active association with the Swansea Philosophical and Literary Institute (later the Royal Institute of South Wales). The Institute maintained a library and Logan was one of the contributors to the collection.[42]

Logan's personal library of scientific literature was built over a period of years, first while he was in Great Britain and then later in Canada. All the direct evidence of his library, however, comes from the latter period. The actual history of his library is sketchy. He frequently made his personal library available to the staff members of the Geological Survey of Canada and it is quite likely that a good number of his own volumes eventually ended up in the Survey library on a permanent basis. It is in this latter library that some of Logan's personal volumes have been discovered. A very few more have also been located in other collections, principally, the library of McGill University.

A total of twenty-three volumes by individual authors and multiple volumes of six scientific periodicals have been identified as Logan's. Almost certainly, Logan's personal library was larger than the collection so far identified indicates. However, this sample of his library has features worthy of notice. First reference should be made to the periodicals which are:

> *The American Journal of Science* (many of the volumes throughout the 1830s to 1850s have Logan's bookplate)[43]
> *Annales des mines* (many of the early volumes have Logan's bookplate)
> *Bulletin de la Société géologique de France* (volumes from 1830 through 1860 have Logan's bookplate)
> *Comptes rendus hebdomandaires des séances de l'académie des sciences* (many of the early volumes have Logan's bookplate)
> *Philosophical Magazine* (many of the early volumes have Logan's bookplate)
> *Proceedings of the Royal Society of London* (volume 7, 1854 has Logan's bookplate)

Only the last of the six periodicals is represented by a single volume. Logan was a Fellow of the Royal Society and as a matter of course should have regularly received the *Proceedings* and the *Philosophical Transactions*. He seems, however, to have had problems receiving his copies of this journal as a letter from W. Sharpey of the Royal Society on 6th April 1865 testifies. Logan had written to the Society requesting back issues and, since the lapsed time was greater than five years, the matter was referred to the Council of the Society for resolution.[44] Outside of the Royal Society's journal the periodicals to which Logan subscribed demonstrate an international perspective and the multi-year run of volumes suggest that he was regularly monitoring the current literature.

The books in the collection range over a variety of geographical and geological topics by such American authors as: Louis Agassiz, James D. Dana, John M. Duncan, Joseph C. Ives, and Richard Parkinson. British authors included J.B. Jukes, Charles Lyell, Sir John Richardson, and Patrick Fraser Tytler. Canadians were represented by the Governor General, the Earl of Elgin, William Kingsford, and A. Lillie. A book by the German author, Adolph Erman, in an English translation, is also found in the collection.[45]

As seen from Table XI the publication dates of most of the volumes centred in the early 1850s although the dates

Table XXVI - Number of Volumes by Date of Publication in William E. Logan's Library

Year	Number of Volumes
1805	2
1823	2
1833	2
1842	2
1845	1
1848	1
1850	4
1851	2
1855	4
1859	1
1861	1
1870	1

span more than half a century. Coming in the middle of Logan's career with the Geological Survey, volumes such as Louis Agassiz's *Lake Superior: Its Physical Character, Vegetation, and Animals* and two volumes on Arctic explorations would have proved useful for his work.[46]

A remaining feature of Logan's collection, common to the personal libraries of most of the other scientists, is the presence of complimentary volumes sent to Logan from the authors. J.S. Newberry forwarded a copy of Joseph C. Ives's *Report upon the Colorado River* published in 1861 and Lt. Colonel J.F. Graham sent Logan a copy of his *Report of the Secretary of War, Communicating the Report of Lieutenant Colonel J.F. Graham for the Year 1857*.[47]

Of all the characteristics of Logan's library outlined above the most notable is the presence of lengthy runs of scientific periodicals, represented by British, European, and North American journals.

William Saunders's Library

Direct evidence of William Saunders's library is confined to a number of volumes now held in the Regional Collection at the University of Western Ontario and others in the Canada Agriculture Main Library in Ottawa. While only eighteen titles have been found that bear confirmation of their provenance, his personal library was certainly larger than these volumes indicate. Information contained in book plates found in two of the volumes revealed a personal collection of at least 124 volumes and other evidence suggests there were several hundred more.[48] A determination of the full extent of Saunders's personal library from indirect evidence is not easily accomplished since his personal papers are scattered and there are gaps in correspondence files. Even though the reconstruction of Saunders's personal library has uncovered only a small portion, the publications that have been located show characteristics that help to understand the dissemination of scientific literature in Canada.

That Saunders did read widely is clear from the data discussed in Chapter IV. It seems, too, that reading was a common activity in the Saunders family. On 21st June 1874 he wrote to his son, Will: "here we are in the shop, that is, Henry and I, and we have to be here half an hour longer. We have been reading a good while so we thought it would be nice to stop reading and write you a little letter."[49] Writing from London, England, ten years later, Saunders advised his same son, Will, that he had obtained a number of volumes both for himself and Will and that he had also arranged future book purchases from a dealer at a 25% discount.[50]

Saunders's correspondence while he was the Director of the Experimental Farms also illustrates that he followed the pattern of the other six scientists in this study in requesting publications from researchers in a variety of countries. On the 18th January 1899 he wrote to A.R. Eastman, President of the New York State Dairyman's Association seeking copies of the reports of that association.[51] Later in that year he corresponded with Prof. L. Grandeau, Editor of the *Journal agriculture pratique* in Paris in an attempt to obtain Grandeau's *Annales de la science agronomique*.[52] In the summer of 1899 he wrote to Dr. N.L. Britton, Director of the New York Botanical Garden, for personal copies of the bulletins issued by the Botanical Garden.[53] Typically, among the packages arriving for Saunders at the Experimental Farm were reprints and other works sent as exchanges for Saunders's publications. For example, on 10th August 1899, in a response to one such package, he thanked Prof. C. Sasaki of Tokyo for a reprint which had been forwarded to Ottawa.[54]

If the reconstructed library is now considered, other characteristics can be observed and these are laid out in Tables XXVII and XXVIII. If the date of his appointment as Director of the Experimental Farms is used as a bench mark,

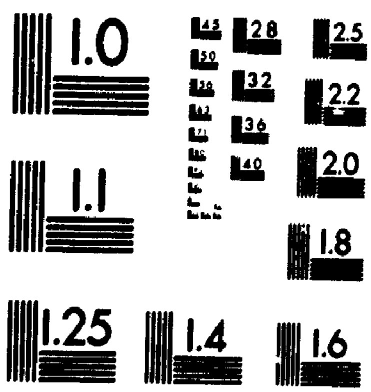
Table XXVII - Number of Volumes by Date of Publication in William Saunders's Library

Year	Number of Volumes
1845-59	2
1860-69	2
1870-79	3
1880-84	2
1885-89	4
1890-99	2
1900-07	3

experiments in plant breeding and to study insects. In 1876, largely due to his efforts, the Fruit Growers' Association and the Entomological Society submitted entries to the Centennial Exhibition in Philadelphia to considerable acclaim. The culmination of about two decades study of economic entomology resulted in a major text on the topic, *Insects Injurious to Fruits*, which Saunders published in 1883.[67] A first such volume published in North America, it was described by one contemporary scientist as "one of the best manuals of the kind" that had been published up until that time.[68] The demand for the volume was sufficient to warrant a second edition in 1892 and he was working on a third edition at the time of his death.

Saunders sought active involvement in a variety of scientific societies other than those already mentioned. In 1868 he became a member of the American Association for the Advancement of Science and was elected a Fellow in 1874. In 1881 he became General Secretary for a one-year term. In the early 1870s Saunders joined the American Forestry Association and over a number of years he delivered several papers to its annual congresses. When the Royal Society of Canada was established in 1882, Saunders was among the founding Fellows and in 1906 he was elected president. Besides these scientific associations, Saunders supported his pharmaceutical profession by helping to organize the Canadian Pharmaceutical Society in 1867 and later taking a leading part in the estab-

3



there is then an even split between those titles published prior to this appointment and those published after.

Regarding place of publication (see Table XXVIII), many of the volumes were produced in England with the next largest group coming from the United States. The evidence of Saunders's reading patterns presented in Chapter IV suggests that he probably had many more publications of American origin in his personal collection. He certainly received more reprints from American authors than have been positively identified, since his correspondence files bear this out.

There is no prominence of any one author is this modest collection, and the subjects of the books ranged over the spectrum of Saunders's interests. His early career as a

Table XXVIII - Number of Volumes by Place of Publication in William Saunders's Library

Place	Number of Volumes
Canada	3
United States	5
Great Britain	8
Europe	2

pharmacist is reflected in A.W. Blyth's *Foods: Their Composition and Analysis. A Manual for the Use of Analytical Chemists and Others* and Henry B. Brady's text, *On the Anatomy of Drugs*.[55] Natural history is represented by Thomas G. Gentry's *Life Histories of the Birds of Eastern Pennsylvania* and by

George Lawson's *The Fern Flora of Canada*.[56] Among the agricultural titles are: William H. Lynch's *Scientific Dairy Practice* and Andrew Murray's *Economic Entomology. Aptera*.[57]

Discussion

None of the libraries has been reconstructed in their entirety, but examined together the six scientists' libraries display several important characteristics about the dissemination of scientific literature in Victoria Canada.

First, each of the libraries of the six scientists may best be described as "working" collections. The books, reports, and reprints were acquired for use and were not intended as collectors items. Prior to the nineteenth century, as Ellen Wells points out, "men of prominence had collected books as a facet of their public lives, as patrons of learning and of the arts and sciences....These collections, often assembled over several generations, were encyclopaedic in nature and science books formed only one part of them."[58] In the six collections described above, however, there were few irrelevant publications; most of the literature was directly related to the areas of inquiry of the six scientists and could have been used in their research. None of the six scientists were bibliophiles in the sense that Sir William Osler was. Instead, they looked for publications that had a direct bearing on their work, and even those publications that were sent to them without their prompting were frequently relevant to their research.

Further evidence of the "working" description is found in marginalia scattered throughout publications. Annotations by the scientists were not extensive, but their frequency was sufficient to demonstrate that many of the publications had been examined. The scientists' valued their personal libraries. There appeared to be no difference between the geological and agricultural scientists in this regard. Personal bookplates were used and both reprints and issues of periodicals were organized and bound. Some scientists, such as Bell, wrote their name on almost all of their holdings to provide a clear indication of ownership.

A sizeable portion of the literature in these collections was distributed free of charge directly from other workers, and when particular publications were not received in this manner, the scientists wrote to the authors and asked for copies. Complimentary copies of publications is the second notable characteristic about the personal libraries. Books, reports, and reprints of scientific papers circulated with considerable regularity, although the latter figured much more prominently. The flow of reprints was not unidirectional, of course. Canadian scientists sent copies of their reports and papers to other researchers. As one example, Fletcher's correspondence bears this out, and Bell drew up lists of recipients for his publications.[59] Complimentary copies of publications were sent to institutional libraries as well as to individuals. The libraries of research institutions and scientific societies in Canada and abroad profited from the complimentary copies of publications forwarded by Canadian scientists.

As the number of scientific periodicals increased during the Victorian period reprints by the thousands were disseminated worldwide, and Canadian scientists were the beneficiaries of this trend. The high volume of reprints found in personal libraries is the third important characteristic about the six collections examined in this study. Dawson's personal library is the best example in this regard, but Bell, too, had a large number of reprints and the two agricultural researchers were also the recipient of numerous reprints. The value of these reprints cannot be overlooked. Few scientists in Canada or elsewhere could afford to subscribe to an ever growing number of periodicals. Largely for this reason alone an intensive world-wide system of reprint exchanges developed during the nineteenth century. Exchanges of reprints also improved the chances of the dissemination of scientific literature published in obscure journals or the transactions of little-known societies.[60] Not all of the reprinted articles came from obscure journals, of course.

The size of the personal libraries varied, and this is the fourth characteristic. Some had many more publications than others. Fletcher forthrightly stated that he had limited funding for library purchases. It also seems likely that Billings, too, had financial restrictions that would have prevented extensive book and periodical acquisitions.[61] The other four scientists had greater flexibility in this respect. Even so, none of the libraries matched the size of personal libraries of great collectors. Whether or not personal libraries were large or small, the scientific literature that was accumulated was both current and international in scope, the fifth and sixth characteristics. The inclusion of preprints in Bell's collection at the turn of the century indicates a new trend designed to increase the currency of scientific literature.

Books and periodicals from the United States were represented in the largest numbers, followed by British and European publications. Improved postal services in the last half of the nineteenth century ensured that publications sent through the mails were received in timely order. Publications sent from the United States arrived within a few days and those from England and Europe with two to four weeks.

Finally, to increase their knowledge about the existence of scientific publications Canadian scientists acquired bibliographic reference works. Both Bell and Dawson, for example, numbered bibliographies, library catalogues, directories, and indexes among the publications in their personal libraries.

At the beginning of the Victorian period, personal libraries of Canadian scientists were quite modest. As the years of the century unfolded, however, personal libraries as well as institutional libraries increased in size and depth. The role that the latter played in the dissemination of scientific literature in Victorian Canada is outlined in the next chapter.

Notes to Chapter V

1. Yvan Lamonde, for example, has written on public libraries in Montreal and has examined personal libraries in the province of Quebec. See, Yvan Lamonde, *Les Bibliothèques de collectivités à Montréal (17e-19e siècles): Sources et problèmes* (Montréal: Bibliothèque Nationale du Québec, 1979, and Yvan Lamonde and Daniel Olivier, *Les Bibliothèques personnelles au Québec: inventaire analytique et préliminaire des sources* (Montréal: Bibliothèque Nationale du Québec, 1983). For the description of a French Canadian scientist's library, see, Raymond Duchesne, "La Bibliothèque scientifique de l'Abbé Léon Provancher," *Revue d'histoire de l'Amérique française* 34 (mars 1981): 535-556.

2. See, for example, Paul Dumas, "William Osler et La Bibliotheca Osleriana," *L'Union médicale du Canada* 100 (mars 1971): 539-545 and Charles G. Roland, "The Osler Library," *Journal of the American Medical Association* 200 (June 1967): 865-870. A number of other papers are listed in Chapter II, note no. 12. For ongoing news about the Osler library, see *The Osler Library News*.

3. D. Keith McE. Kevan, "The Lyman Entomological Museum and Research Laboratory: A History to 1978," *Notes from the Lyman Entomological Museum and Research Laboratory* no. 4 (13 October 1978).

4. J.G. Ogden, III and B.D. Sharples, *The Palaeobotanical Collections of the Late Dr. Edwin D. Levittan* (Halifax: McCulloch Museum, Department of Biology, Dalhousie University, 1981).

5. Canada Department of Agriculture. Headquarters Library. *Chapais Collection* (Ottawa: Canada Department of Agriculture, 1976). Both father and son were actively involved in agricultural endeavours.

6. Debr Lindsay, "Peter Fidler's Library. Philosophy and Science in Rupert's Land," in *Readings in Canadian Library History*, ed. Peter F. McNally, (Ottawa: Canadian Library Association, 1986), 209-229.

7. All of that portion of Bell's library obtained by the National Archives of Canada was uncatalogued until I completed an inventory in preparation for this dissertation.

8. Among the directories are numerous membership lists of the Geological Society of London and Samuel E. Cassino, *The Scientists' International Directory Containing the Names, Addresses, Special Departments of Study, Etc., of Professional and Amateur Naturalists, Chemists, Physicists, Astronomers, etc.* (Boston: The Cassino Art Co., 1892). Numbering among the indexes is: *General Alphabetical and Analytical Index. Transactions of the American Institute of Mining Engineers* (New York: American Institute of Mining Engineers, 1910). Among library catalogues are: W.P. Cutter, *Library Publications Relating to Forestry in the [U.S.] Department [of Agriculture] Library* (Washington, DC: Government Printing Office, 1898) and *A Catalogue of Periodical Publications in the Library of the American Institute of Mining Engineers* (New York: [s.n.], 1904). Finally, bibliographies included S. Herbert Hamilton and James R. Withrow, *The Progress of Mineralogy in 1898. An Analytical Catalogue of the Contributions to that Science During the Year* (New York: Published by the American Institute of Mining Engineers, 1899).

9. *American Forestry*, published in Washington, DC, had previously been issued under two successive titles: *Forestry and Irrigation* and *Conservation*. Bell's collection contains copies of the journal under all three titles. Bell subscribed to a variety of technical journals as well as scientific periodicals. Further discussion of his periodical acquisitions is found in Chapter VII.

10. A collection of Billings's papers seems never to have been acquired by any archives. Some of his correspondence is found among the Billings Family Papers (MG 1 and MG 2) held at the City of Ottawa Archives.

11. William Stewart M. D'Urban, "List of Works to be Consulted by Students of Canadian Diurnal Lepidoptera," *Canadian Naturalist and Geologist* 3 (1858): 416-419.

12. Some volumes were included in the catalogue on the basis of association, that is, a volume by an author on a particular subject clearly part of Billings's library was used as evidence to suggest that another volume on the same subject by the same author was also part of his library even though provenance evidence is absent. For example, F.V. Hayden published the fifth annual report of the Geological Survey of Montana in 1872 and on the cover of this volume is found Billings's name. Two other reports by Hayden, published in 1873 and 1876, were found among the same lot of books but with no markings of provenance. Both volumes are believed to have been part of Billings's library, however. There is a very small possibility that some of the volumes included in the catalogue were not part of Billings's collection. His brother, Charles, was an avid book collector and many of the

books from the Billings estate had been acquired by him. Charles Billings also collected books of a scientific nature; however, he very often identified his books with his name and date of acquisition. The evidence on some of the volumes indicates that Charles acquired a number of Elkanah's books following the latter's death in 1876. This transaction may account for the survival of Elkanah Billings's personal books to the present day.

13. See, Elkanah Billings to his father, 11th September 1844. Billings Family Papers, City of Ottawa Archives, MG2-1-7. In this letter Billings listed the titles that he wished to acquire for a total purchase price of $91.00. He suggested that his father obtain the books from a dealer in New York. The eighteenth-century legal text is *The Spirit of Laws*. Translated from the French of M. De. Secondata, Baron de Montesqieu, 7th ed. (Edinburgh: Printed for Alexander Donaldson, 1778). Volume one of two volumes. On title page in ink: E. Billings.

14. Henry Taylor, *An Attempt to Form a System of the Creation of our Globe, or the Planets, and the Sun of Our System...as Evinced by the Discoveries of Lavoisier, and Others in Pneumatic Chemistry* (Quebec: Printed by W. Cowan & Son, 1840).

15. Charles White, *Report on the Geological Survey of the State of Iowa, to the Thirteenth General Assembly, January 1870, Containing Results of Examinations and Observations Made Within the Years 1866, 1867, 1868, and 1869* (Des Moines: Printed and Published by Mills & Co., 1870), two volumes. Inscribed on the front end paper of volume 1: "Mr. E. Billings, Palaeontologist of the Canada Geol. Survey. With regards of C.A. White. An example of one of the volumes sent by Worthen is A.H. Worthen, et al. *Geological Survey of Illinois. A.H. Worthen, Director, Volume I* ([Chicago]: Published by Authority of the Legislature of Illinois, 1866). On title page: E. Billirgs, Esq. with the regards of A.H. Worthen.

16. G.B. Sowerby, Jr., *A Conchological Manual*, 4th ed. (London: Henry G. Bohn, 1852).

17. John William Dawson, *Fifty Years of Work in Canada. Scientific and Educational*, Edited by Rankine Dawson (London and Edinburgh: Ballantyne, Hanson & Co., 1901), 29.

18. Ibid., 41. Although Dawson does not give details about any of the books he cited he probably was referring to the following: Friedrich Mohs, *Grund-Riss der Mineralogie* 2 vols. (Dresden, 1822-24), translated, revised and expanded by Wilhelm Haidinger as *Treatise on Mineralogy, or the Natural History of the Mineral Kingdom* 3 vols. (Edinburgh, 1825); Henry de la Beche, *Geological Manual* (1831); and Charles

Lyell, *Principles of Geology. Being an Attempt to Explain the Former Changes of the Earth's Surface by Reference to Causes Now in Operation* 3 vols. (London: John Murray, 1830-1833). Six editions of this work were published before 1840 and Dawson may have owned any one of them. Charles Lyell published his *Elements of Geology* in 1838. Dawson could have purchased this edition or the second edition which appeared in 1841.

19. Richard Brown's scientific work was published in the *Quarterly Journal of the Geological Society of London*. For a description of Gesner's inventive career see Elizabeth V. Haigh, "The Law and Abraham Gesner: Why the Developer of Kerosene Died a Poor Man," Paper presented to the conference, Science and Society in the Maritimes, Mount Allison University, September 1988. Gesner's book, *Remarks on the Geology and Mineralogy of Nova Scotia* (Halifax, NS: Gossip and Coade, 1836), was an early Canadian text treating geological matters.

20. Dawson, *Fifty Years of Work*, 36.

21. In this regard, see the discussion on the library of McGill University in Chapter VI.

22. The actual figures are: authors with multiple publications - 46.4% (483 less 259) and authors with five or more publications - 16.8% (81 authors out of 483).

23. In a letter to George Wade, Esquimalt, B.C. dated 8th October 1885, Fletcher noted that members of the Entomological Society of Ontario received the *Canadian tomologist* as a benefit of membership. Department of Agriculture Papers, National Archives of Canada. RG 17, A II 7, Volume 2330.

24. Fletcher to Provancher, 5th October 1885. In a subsequent letter Fletcher wrote that he could not afford to purchase the complete set of *Le Naturaliste* but would "take them one or two at a time as I find I can do so." Fletcher to Provancher, 31st October 1885, Department of Agriculture Papers.

25. Fletcher to Provancher, undated letter, Department of Agriculture Papers.

26. Fletcher to Professor Lintner, 14th November 1885. Fletcher wrote: "...[I] am sending you a line or two today to say how much obliged I am to you for your kind letter and cutworm paper." Department of Agriculture Papers.

27. Fletcher to C.R.H. Starr, 7th December 1885. In a letter later that month Fletcher acknowledged receipt of the reports. Fletcher to C.R.H. Starr, 21st December 1885, Department of Agriculture Papers.

28. Fletcher to A. Blue, 2nd January 1886, Department of Agriculture Papers.

29. Fletcher to J.B. Smith, 14th December 1885, Department of Agriculture Papers.

30. Fletcher to Prof. W. Fream, 21st December 1885, Department of Agriculture Papers. It is not clear which of Fream's papers Fletcher sought but earlier in the letter he made reference to Fream's description of Canadian agriculture and a notation to Fletcher's entomological work.

31. Fletcher to C.V. Riley, 23rd December 1885, Department of Agriculture Papers.

32. Fletcher to Prof. Rivers, 2nd January 1886, Department of Agriculture Papers.

33. Ormerod was a entomologist of considerable international reputation. See, "Ormerod, Eleanor Anne," *Dictionary of National Biography* 2nd Supplement, 1901-1911 (Oxford: Oxford University Press, 1920), vol. 3, pp. 53-54.

34. Noted in a letter from Fletcher to Mr. [Isaac] Shaw, 11th June 1886, Department of Agriculture Papers. The fact that Ormerod sent scientific publications is also borne out in a number of her letters to Fletcher which have been brought together in the volume *Eleanor Ormerod, LL.D. Economic Entomologist, Autobiography and Correspondence*, ed. Robert Wallace (New York: E.P. Dutton and Company, 1904).

35. Fletcher to "Son Excellence Le ministre de l'Agriculture, Bruxelles," 6th September 1886. Acknowledgement of receipt of the report is found in Fletcher's letter to Monsieur Leydon, Directeur General Administrative de l'Agriculture, 18th October 1886. Department of Agriculture Papers.

36. Fletcher to T.J. Burrill, 2nd July 1886, Department of Agriculture Papers.

37. Fletcher to L.O. Howard, 10th July 1886. Department of Agriculture Papers. It is of interest to note that Fletcher anticipated a reply within a week since he was about to leave Ottawa for Western Canada where he planned on testing Riley's remedy. The next letter provides evidence that Howard had indeed replied within the week.

38. Fletcher to Howard, 21st July 1886. Department of Agriculture Papers.

39. Fletcher to D.W. Beadle, 2nd January 1886. Department of Agriculture Papers.

40. See, J.H. Harrison and E. Hall, "William Edmond Logan," *Proceedings of the Geological Association of Canada* 15 (1963): 34.

41. Winder records that in the spring of 1833 Logan's leisure reading included the Conybeare and Phillips text and Winder also makes reference to an entry in Logan's diary for 31st May 1834 which refers to Lyell's comments about Miocene formations that Lyell had described for the first time in his third volume of the *Principles of Geology* published in 1833. See, C. Gordon Winder, "Logan and South Wales," *Proceedings of the Geological Association of Canada* 16 (1965): 108-109.

42. Logan was an honourary secretary of the Institute and curator for geology. He contributed financially to the operation of the Institute and also donated a number of books on "'Walks Through Wales in 1798,' botanical tours of North Wales, a guide to the three counties of South Wales, and an English-Irish primer and dictionary, 1814-15." Ibid., 115.

43. Logan ha a number of bookplates, all of simple pattern. Some read "W.E. Logan" and others read "Sir W.E. Logan." Most of the bookplates are found on the inside front cover of his books. As noted in Chapter II, rudimentary restoration has been completed on a number of his volumes and new endpapers were pasted in covering over his bookplate. The characteristic shape of the bookplate is, however, visible underneath the new endpaper.

44. W. Sharpey to Sir W.E. Logan, 6th April 1865. Logan papers, Microfilm reel 7, Bundle E.10, Acc. 1207, McGill University Archives. There is no additional evidence to indicate whether Logan ever did receive his copies of the Royal Society's journal.

45. Adolph Erman, *Travels in Siberia: Including Excursions Northwards, down the Ogi, the Polar Circle, and, Southwards to the Chinese Frontier*. Translated from the German, by W.D. Cooley (Philadelphia: Lea & Blanchard, 1850). Volume two of two volumes.

46. Louis Agassiz and J. Elliot Cabot, *Lake Superior: Its Physical Character, Vegetation, and Animals, Compared with Those of Other and Similar Regions...with a Narrative of the Tour...and Contributions by Other Scientific Gentlemen* (Boston: Gould, Kendall and Lincoln, 1850). The two volumes on Arctic exploration were *The Last of the Arctic Voyages; Being a Narrative of the Expedition in HMS Assistance under the Command of Captain Sir Edward Belcher, C.B., in Search of Sir John Franklin, during the years 1852-53-54. With notes on the Natural History, by Sir John Richardson, Professor Owen, Thomas Bell, J.W. Salter and Lovell Reeve* (London: Lovell

Reeve, 1855), and Sir John Richardson, *Arctic Searching Expedition: A Journal of a Boat-Voyage Through Rupert's Land and the Arctic Sea, in Search of the Discovery Ships Under Command of Sir John Franklin. With an Appendix of the Physical Geography of North America* (London: Longman, Brown, Green, and Longmans, 1851).

47. Joseph C. Ives, *Report Upon the Colorado River of the West, Explored in 1857 and 1858...Under the Direction of the Office of Explorations and Surveys* (Washington: Government Printing Office, 1861). On cover in ink: Sir William Logan/ with the respects/ of/ J.S. Newberry. *Report of the Secretary of War, Communicating the Report of Lieutenant Colonel H.D. Graham for the Year 1857* 35th Congress, 1st Session, Senate Ex. Doc. no. 42. On front endpaper in ink: Sir William E. Logan/ &c. &c. &c./ Montreal/ with the respects of/ Lt. Colonel J.D. Graham/ U.S. Top. Engineers/ Chicago, March 19th, 1859.

48. William Saunders's bookplate in volume one of Thomas G. Gentry's *Life Histories of the Birds of Eastern Pennsylvania* (Philadelphia: Published by the Author, 1876) is numbered 124. This volume is now held in the Regional Collection at the University of Western Ontario, London, Ontario. In another volume, P Barry, *The Fruit Garden: A Treatise Intended to Explain and Illustrate the Physiology of Fruit Trees...* (Rochester, N.Y.: Published by the Author, 1863), the number 108 is recorded on the bookplate. This book is now held at the Canada Agriculture Main Library, Ottawa, Ontario Since these volumes date from the 1860s & 1870s and were probably acquired by Saunders by the late 1870s, it can be inferred from the bookplate accession numbers that his personal library was larger than 124 volumes. In a volume published in 1887, which does not have a bookplate, Saunders wrote the number 637 (see note no. 57 below). If this number is also an accession record, then his personal library contained several hundred volumes. This latter conjecture is probably a correct estimate of the size of Saunders's library. Among the Saunders Family Papers in the Regional Collection at the University of Western Ontario is a book headed "Books at 240 Central [Avenue]/ January 1931." It is conceivable that some of the titles listed in this book were once part of Saunders's personal library, but there is no easy way of confirming this. Much of the Saunders's family library was sold to a London book dealer a number of years ago and he informed me that virtually all of the books were on ornithological topics [conversation with Mr. Marvin Post, Proprietor of Attic Books, Parkhill, Ontario (formerly of London, Ontario), August 1989]. Since Saunders's son, W.E. Saunders, had a longstanding interest in ornithology (he published a number of works on the topic), it seems likely that most of the books in the library in London were not those of William Saunders.

49. William Saunders to W.E. Saunders, 21st January 1874. Saunders Family Papers, Regional Collection, University of Western Ontario, Box 5434 (punctuation added).

50. William Saunders to W.E. Saunders, 19th May 1886. Saunders Family Papers.

51. William Saunders to A.R. Eastman, 18th January 1899. Department of Agriculture Papers, National Archives of Canada, RG 17, A II 1, Volume 2099.

52. William Saunders to L. Grandeau. 10th March 1899. Department of Agriculture Papers.

53. William Saunders to N.R. Britton, 20th July 1899. In another letter on the 29th July 1899 Saunders acknowledged receipt of bulletins forwarded by Britton. Department of Agriculture Papers.

54. William Saunders to Prof. C. Sasaki, 10th August 1899. Department of Agriculture Papers.

55. Alexander Wynter Blyth, *Foods: Their Composition and Analysis. A Manual for the Use of Analytical Chemists and Others* (London: Charles Griffin and Company, 1882). On the half title in ink: Wm. Saunders/ Chemist/ London Ont/ June 1882. Henry B. Brady, *On the Anatomy of Drugs* (London: J.B. Taylor and Co., 1867?).

56. Thomas G. Gentry. *Life-Histories of the Birds of Eastern Pennsylvania* (Philadelphia: Published by the Author, 1876-77), two volumes. In volume one there is a bookplate with the notation: "Wm. Saunders./ No. 124." George Lawson, *The Fern Flora of Canada. Descriptions of all the Native Ferns of the Dominion, with Localities Where They Grow* (Halifax: A.& W. Mackinlay, 1889?). On the first text page in ink: Prof. Saunders/ With the Author's Kind Regards.

57. William H. Lynch, *Scientific Dairy Practice: or Profitable Dairy Agriculture for Canadian Farmers* (Ottawa: A.S. Woodburn, 1887). Inside the front cover in ink in Saunders's hand: Wm. Saunders/ Expt. Farms/ Ottawa/ 637. Andrew Murray, *Economic Entomology. Aptera* (London: Chapman and Hall, 187-?). A bookplate inside the front cover has the notation: "Wm. Saunders./ No. 66."

58. Ellen B. Wells, "Scientists' Libraries: A Handlist of Printed Sources," *Annals of Science* 40 (1983): 319.

59. Three of Bell's lists have survived. See, "Report on Report on Geol. of Manitoulin Island to be sent to, May 1867," "List of Addresses to Which Pamphlets are Sent, 1886," "List to Whom

were Sent 'The Nickel and Copper Depts. of Sudbury Dist.' - Also 'Glacial Phenomena' to Some of Same, Feby 1891" Robert Bell Papers, MG 29, B15, National Archives of Canada.

60. For further discussion of this point see, A.J. Meadows, *Communication in Science* (London: Butterworths, 1974), 81-82. As Meadows points out, letters to the editor of *Nature* in the 1890s voiced concern about inaccessible transactions of small scientific societies where biologists frequently published.

61. Various letters in his correspondence with his family support this conclusion. See, E. Billings to his father, 5th January 1857, 3rd June 1857 and E. Billings to his mother, 17th July 1863. Billings Family Papers, MG2-1-23, 27, and 86.

Chapter VI - Institutional Libraries

To supplement personal libraries, Victorian Canadian scientists turned to institutional collections to obtain access to scientific literature. During the Victorian period the largest collections of scientific literature were found in institutional libraries. Therefore, an examination of these collections, guided by the questions posed below, will augment our understanding of the dissemination of scientific literature. Here the relevant questions are: to which institutional libraries did scientists in Victorian Canada turn? what were scientific libraries of the period like, i.e., what were the holdings of scientific publications like? by what methods did the libraries procure the literature they contained? where was the literature coming from? was the literature current? In short, how helpful were those collections for reference to scientific literature?

In the middle of the last century institutional libraries in Canada were deficient, at least according to one reviewer. In an address to the Natural History Society of Montreal in 1859 Francis Fulford made a critical indictment of libraries in British North America. He lamented that:

> ...in the whole of Canada, with the exception of perhaps the Library of the Houses of Parliament, now just in the course of formation, there is not one Library, public or private that deserves notice, as supplying the wants of Literature or Science, or to which reference can be made, in case of need, with any reasonable hope of finding required information on any particular subject.[1]

Fulford's judgement of Canadian libraries was made in the context of some of the developments that he saw in the United States which, he noted, could boast of "50 Libraries containing upwards of 15,000 volumes each; and six of them with over 60,000." One of these was the library of Harvard University, which with 112,000 volumes had the largest collection, and most libraries afforded "immense advantages to students in every department."[2] Fulford's assessment, if it was correct, suggests that libraries were an inadequate means of disseminating scientific literature in Canada at that time.

In order to provide a response to the questions posed above, we need to examine the history of institutional libraries. There is a large number of Victorian Canadian libraries holding some scientific literature, albeit limited in scope or volume, particularly when mechanics' institutes are included in the survey. Therefore, the discussion in this chapter will be restricted to institutional libraries that the six scientists claimed they used.[3] Six libraries will be considered: the libraries of the Natural History Society of Montreal, McGill University, the Mechanics' Institute of Montreal, the Geological Survey of Canada, the Central Experimental Farm, and the Library of Parliament. With the exception of the library of the Central Experimental Farm, each of these libraries was established early in the Victorian period or shortly before. Each of the libraries was active during the nineteenth century and continued into the twentieth century, although the library of the Natural History Society was merged with the library of McGill University when the Society was disbanded in 1925. Three of the libraries were situated in Montreal and three in Ottawa. The library of the Geological Survey had two locations being first in Montreal and later in Ottawa when the Survey headquarters were moved in 1881.

Because brief descriptions have been published of only three of the libraries (the Library of Parliament and the libraries of McGill University and the Mechanics' Institute of Montreal), an examination of the records of all six libraries was required. From these records it is possible to trace the history of each library and determine the role each played in the diffusion of scientific literature in Canada prior to 1910.

The Library of the Natural History Society of Montreal

Scientific societies in North America and Europe tended to see libraries as a necessary part of their organization.[4] The Natural History Society of Montreal was typical in its establishment of a library.

In the nineteenth century the Natural History Society of Montreal was one of the leading (if not the foremost) scientific associations in Canada. Established in 1827 and incorporated in 1833, it functioned for almost a century until it was disbanded in 1925.[5] Although its history was marked by periods of slow growth, from the mid-1850s until the turn of the century the Society played a significant role in the development of science in Montreal, the province of Quebec and, indeed, in Canada as a whole. During this period, some of the Canada's more prominent scientists were active members of the Society. For over fifty years, beginning in 1857, the Society's journal, *The Canadian Naturalist and Geologist* (and its title variants), published some of the more important Canadian scientific research.[6] As a vehicle of exchange, copies of this periodical found their way around the world and, thereby, gave publicity to the Society and to Canada. As a measure of its success, the Society was able to attract the American Association for the Advancement of Science (AAAS) to meet in Montreal in 1857 for the first time outside the United States and twenty five years later, in 1882, the Society was once again the host for the AAAS. Two years following this latter meeting, the British Association for the Advancement of Science travelled to Montreal to hold its annual meeting for the first time outside of the British Isles. In addition, the Society supported other international congresses in Montreal, e.g., the American Institute of Mining Engineers in 1879 and the American Society of Civil Engineers in 1881. The Society maintained an active presence in the city of Montreal with its lectures, outings, museum, and library, and on a number of occasions the Society acted as a lobby for action by the colonial or provincial legislatures.[7]

The history of the library is not glamorous, yet from the founding of the Society in 1827 the library played an important role. The 1828 Constitution and Bye-Laws list a librarian as one of the officers of the Society and these governing documents also set out the administrative structure for the library and the rules under which it was to operate.[8] Fifty years later when the Constitution and Bye-laws were revised, the guidelines for the library remained largely unchanged.[9]

Surviving records of either the library or the Society as a whole are not extensive for the years prior to the 1840s when the first and only printed catalogue of the library was published.[10] However, the 1846 catalogue is an important document since it provides a means of disclosing the character of the contents of a scientific library in Canada during the first decade of the Victorian period. After almost twenty years accumulation, the library of the Society had acquired about 870 volumes plus about a dozen maps and the composition of the collection (using the classification of the catalogue) consisted of the following:

Botany	49 volumes
Chemistry	46 volumes
Geology and mineralogy	55 volumes
Natural history in general	206 volumes
Philosophy & general science	86 volumes

Voyages, travel, etc.	34 volumes
Biography and history	36 volumes
Periodicals, reports of scientific societies, etc.	252 volumes
Miscellaneous	106 volumes
TOTAL	870 volumes

A number of characteristics other than that indicated by the sum of volumes on each subject is revealed by the catalogue. First, over 80% of the collection dealt directly or indirectly with the published mandate of the library, i.e., books that "treat of some scientific subject or some branch of Natural History."[11] Second, the limited bibliographic information and inconsistency in classification found in the catalogue, although characteristic of the period, made it difficult to identify some volumes precisely. Yet, even given this difficulty, the evidence points to a collection of titles by prominent authors of scientific literature including: A. Michaux, William Hooker (1785-1865), John Torry, Benjamin Silliman (1779-1864), Robert Jamieson (1772-1854), Antoine Lavoisier (1743-1794), Charles Lyell (1795-1875), and Georges Cuvier (1769-1832).

The next relevant detail of the library's history comes from the late 1850s when the waning society had been resuscitated by the infusion of new members, such as Dawson and Billings, who saw the society as a significant means of developing and promoting scientific interests in Montreal and who worked unsparingly to rebuild the Society. Repeated statements throughout much of the 1850s as to the inadequacy of the library led to the recommendation in an 1858 report that if the Society was to take its place in the rapid progress of science, "large additions *must* be made to its museum and library."[12]

Additions to the library were acquired by several means: frequently by donation; less frequently by purchase as when the financial affairs of the Society permitted (with increased membership this was the case in the early 1860s), and by exchange. The latter method was the most significant and remained so during the remainder of the century. With the acquisition of *The Canadian Naturalist and Geologist* in 1857, a very useful publication for international exchange was gained and the Society quickly moved to profit from the venture. The first account of exchanges was reported in 1859 and, over several decades, this traffic in publications took on greater significance. In 1861, the colonial government allocated a grant of $1000.00 which was used, in part, to establish a better system of exchanges with the *Canadian Naturalist*. The grant provided the means to hire an Assistant Secretary and Curator who was expected, among other duties, to "take measure for the increase of the [museum] collection and the library."[13]

While the exchange programme was not without problems, principally financial because of binding costs, the incoming reports and issues of scientific periodicals added substantially to the library's holdings and increased its value as a reference source. Evidence of the increased size of the collection is found in a document associated with an abortive attempt to merge the Society with a new Montreal institution, the Fraser Institute.[14] In the 1875 Memorandum of Agreement, drawn up for the proposed merger, stock taking of the Society's assets including its library collection had been undertaken and from information in this document the holdings of the library can once again be assessed. The library was reported to contain the following:

Botany	96 volumes
Chemistry	37 volumes
Geology and mineralogy	64 volumes
Natural History in general	280 volumes
Philosophy and general science	91 volumes
Voyages and travel	50 volumes
Biography and history	44 volumes
Periodicals, reports of scientific societies, etc.	556 volumes
Miscellaneous	115 volumes
TOTAL	1,333 volumes

If comparison is made with the catalogue of thirty years earlier, the slow growth of the library is evident. Altogether only 460 volumes had been added representing an annual rate of accumulation of about sixteen volumes. The most important feature to note, however, is the large increase in the number of periodicals, a growth of about 120% or more than double the earlier figure which points to the dominance that this form of literature played in scientific communication, an observation made in previous chapters.[15] Another feature of the collection was the small increase in the number of geological and mineralogical texts (from 55 to 64 volumes). An explanation for the slow growth of volumes in this subject was the close proximity of the library of the Geological Survey of Canada and there is some evidence of cooperative efforts in collection building between the two institutions.[16] A final feature to note is that the collection contained scientific literature with very few exceptions. Since the primary purpose of the Natural History Society library was to facilitate the interests of members, the library was built for reference purposes and did not act as a source of leisure reading.

Throughout the remainder of the nineteenth century the library of the Society continued to grow but more rapidly than earlier. By the mid-1880s, when librarians were appointed who spent considerable time upgrading the collection, the library contained over 3,000 volumes with an additional 1,500 reprints. Even so, the library committee recognized weaknesses in the collection and recommended specific acquisitions, later arranging for their purchase in the early 1890s.[17] Better arrangement of the collection, a few judicious purchases which led to unique holdings of some scientific periodicals in the country, and the presence of librarians familiar with the collection all led to reports of increased use of the collection near the end of the century.[18]

Additions to the library, largely from exchanges, continued to accumulate until the end of the first decade of the twentieth century. The life of the Society, however, was drawing to an close. Much of the activity of the Society wound down during World War I. The museum and library were put into storage and, although attempts were made to revive the organization following the war, the efforts failed. When there seemed no value in maintaining the Society, it was disbanded in 1925 and the library holdings were merged into the collections at McGill University.

During the Victorian period, the library of the Natural History Society of Montreal served a useful function for scientists in that city. The library had holdings not found in other Montreal collections[19] and its periodicals formed an important component that served the needs of readers. With its scientific journals and transactions of scientific societies, the library of the Society facilitated the dissemination of scientific literature in Montreal. The library was, in the words of B.J. Harrington, "of very great value to the scientific man."[20]

McGill University Library

In Victorian Canada, McGill University became a leading educational institution noted for its scientific work. Largely because of J.W. Dawson, geological and allied sciences took a prominent place in McGill's teaching and research agenda. Dawson's appointment as principal in 1855 was also a turning point in the history of the library.[21] Prior to Dawson's arrival at McGill, the library was very modest. From the early 1840s students were assessed a library fee and there is a legend at McGill that suggests that the library of the disbanded Montreal Normal School was turned over to McGill in 1843.[22] Shortly before Dawson was appointed, the Governors had allocated £200 for the purchase of books and among the donations to the library at that time was Louis Agassiz's *Contributions to the Natural History of the United States*.[23] Among many other tasks of administration and teaching, Dawson also took on that of librarian. Even though in 1857 he transferred that responsibility to a professor of German, Charles F.A. Markgraf, his interest in the welfare of the library never dimmed. Throughout the century numerous additions to the library came by way of Dawson's efforts or from his personal collections.

Two decades into his duties as librarian, Markgraf wrote a brief report in which he described the development of the library. In late 1858, a year after he had begun his work, the McGill library held "1771 volumes, all told," and was then housed in a room which served both as the library and the Principal's Office,[24] Four years later when the library was moved into a room of its own, in a section of a new building on campus, the collection had grown to 3,000 volumes. Then for a period of years the number of volumes increased steadily so that Markgraf could report in late 1879 "with great pride and satisfaction" that there were 16,453 volumes in total.[25]

Markgraf resigned as librarian in 1882 and, although there had been some discussion about placing a professional librarian in the position, this was not done until Charles Henry Gould's appointment in 1892. After a year of travel studying libraries and librarianship, Gould returned to McGill in 1893 at an auspicious time. Through the benefaction of Peter Redpath, an affluent Montrealer, McGill had acquired a large, new library building and some valued additional endowment support. With these resources Gould built the collection from 39,000 in 1893 to 50,000 in 1896 and to 146,000 volumes by the end of his tenure of two and a half decades.[26] Thus, from very humble holdings in the middle of the nineteenth century, the McGill University library had matured into eastern Canada's major collection by the end of the Victorian period.[27]

Several factors in the operation of the McGill University library during the Victorian period had an impact on the dissemination of scientific literature. For example, a number of documents give a fair indication of the publications received at the library (these will be referred to later), but as with the library of the Natural History Society it is difficult to ascertain actual use.

To meet the teaching mandate of the university, the library naturally contained many volumes which dealt with subjects other than scientific ones.[28] Nonetheless, throughout the latter half of the last century, the library acquired a valuable collection of scientific literature. A steady receipt of donations from such local scientists as Billings, Dawson, and Logan increased the scientific holdings, and, as the reputation of the university improved, individuals and institutions abroad forwarded scientific books, reports, and periodicals.[29] Donations constituted a significant means by which scientific publications were added to the library. Even when the financial picture had improved near the end of the century, largely from endowment by Montreal citizens, Charles Gould was embarrassed to admit publicly the unimpressive amount of money he was able to spend on book and periodical purchases. He had an "adequate operating budget" but the amount of money at his disposal for acquisitions was not high.[30]

If donations were important for building the collection of scientific literature, what was received? To respond to this question reference will be made to two types of documents in which donations were recorded: a manuscript list of donations and the annual university calendars. The manuscript list of donations covers a seven year span from the university session of 1856-57 to 1862-63.[31] During this period approximately 750 volumes were donated to the library and of these about 362 volumes or almost half were on scientific topics.[32] Among the major donors was the British Museum which forwarded a large set of catalogues (about 134 volumes) of the zoological collections.[33] Other continuing contributors were the Smithsonian Institution, the United States Patent Office, the

Geological Survey of Canada, and the Agricultural Society of New York. Particular titles received during the period included: Louis Agassiz's paper "On the Origin of Species," James Hall's *Contributions to Palaeontology*, and Stephen Goodale's *Agriculture of Maine*. These three publications were all of American imprint but there were others from foreign locations including the *Proceedings of the Imperial Academy of Vienna*, in German, containing mathematical and physical papers, and several titles dealing with the Geological Survey of Australia. This early list of donations to the McGill University library shows a preponderance of geological literature and evidence of Dawson's hand in building the collection. A number of the donations had been channelled through his office.

Donations continued to flow into the library during the remainder of the Victorian period and some of the "principal donations" are listed in the annual University Calendars. In 1865-66, for example, the Royal Society of London forwarded its *Proceedings* and *Philosophical Transactions*, and the three volume crown folio *Viviparous Quadruped of North America* by John J. Audubon was received.[34] Journals of scientific associations regularly found their way into the donation lists including: the *Memoirs* of the Boston Society of Natural History, the *Proceedings* of the American Academy of Arts and Sciences, the *Scientific Transactions* of the Royal Dublin Society, *Reports* of the meetings of the British Association for the Advancement of Science, and the *Bulletin de l'Académie Impériale des Sciences de St. Petersbourg*, among others.[35] Among the scientific publications frequently noted in the list of donations are reports of geological surveys, particularly of neighbouring U.S. states. Less numerous are reports of an agricultural nature. In 1865 Dawson had sent on a number of "agricultural journals" to the library; in 1874-5 the *General Report* of the Commissioner of Agriculture for the Province of Quebec was received at the library; and in 1890 William Saunders's *Report of the Experimental Farm for 1888 90* and the *11th Annual Report of the North Carolina Agricultural Experiment Station for 1888* were acquired.[36]

Further evidence of incoming scientific literature is disclosed in another type of manuscript record. Several lists were prepared throughout the latter half of the nineteenth century that enumerated publications sent out for binding.[37] In each of the lists scientific periodicals were the principal type of publication. In 1874, a variety of scientific periodicals went to Dawson Brothers for binding, including American, British, and European titles. Later in the century, numerous other journals were added to the binding list showing the library's increased holdings of international scientific literature (see Appendix I).

An additional source of information concerning the acquisition of scientific literature is found in invoices and other documents relating to purchases. Late in the Victorian period scientific literature was obtained through a number of booksellers in Canada and abroad. In 1889, for example, a subscription list of over forty-five scientific and technical periodicals was placed with W. Foster Brown & Company of Montreal.[38] This list contains a variety of American, British, and European journals.[39] At the turn of the century an order, mostly of books, was obtained from William F. Clay, Technological and Scientific Book ller of Edinburgh.[40] Clay specialized in chemical literature and this is evident from the invoice. All of the publications in this order were in English. Finally, a number of lists of books and periodicals ordered from F.A. Brockhaus in Leipzig at the end of the Victorian period illustrate the international scope of the scientific literature obtained by the McGill University library. In 1897, for example, the library ordered Henri Moissan's *Le Four Électrique*, C. Poulenc's *Les Nouveautés Chimiques pour 1897*, and L. Grandeau's *Traité d'Analyse des Matières Agricoles* all published in Paris in 1897 and W. Ostwald's *Lehrbuch der Allgemeine Chemie*, and C. F. Nraumann's *Elemente der Mineralogie* (revised by F. Zirkel) 13th edition, both published in Germany also in 1897.[41] Five years later Sir William Macdonald provided $20,000 to be used for library acquisitions and additional orders were placed with the Leipzig firm. At this time the acquisitions ranged over several scientific subjects.[42]

Near the end of the Victorian period exchanges became more important for acquisition of scientific literature and related bibliographic tools. An exchange programme (using publications of faculty members) had been a long standing means of acquiring volumes for the library, but at the end of the nineteenth century the programme was pursued more vigorously. C.H. Gould, for example, wrote to the Director of the Bibliothèque nationale in Paris on 25th January 1898 requesting that a copy of the General Catalogue of the Bibliothèque nationale be forwarded in exchange for McGill University publications which Gould sent along.[43] A few years earlier the University of California, Berkeley, had opened an exchange arrangement with McGill by forwarding bulletins from its Department of Geology.[44]

Gould was fully aware of the need for good bibliographic control of scientific literature. Catalogues of other libraries, including the Mechanics' Institute of Montreal and the Library of Parliament, had been obtained and Gould sought out others such as that of the Bibliothèque nationale noted above. Acquisition of catalogues was not enough as Gould went beyond this to give considerable attention to Canadian participation in the Royal Society's *International Catalogue of Scientific Literature*. He lobbied for McGill to be designated the centre of Canadian participation. While he achieved this aim, it was not until near the end of the first decade of the twentieth century that any extensive work was done on this project.[45]

When the McGill Library did not have scientific publications requested by patrons, Gould obtained the volumes through special loan agreements from other Canadian or American libraries, such as the Library of Parliament, the Library of the Central Experimental Farm, and the Geological Survey Library all in Ottawa, the University of Toronto Library, and Harvard University Library.[46] These arrangements plus other activities demonstrate that the appointment of Gould, a professional librarian, towards the end of the Victorian period brought improved dissemination of scientific literature.

One remaining matter regarding the McGill University library concerns use of the collection, but there is little evidence that deals directly with this issue. The librarians' quarterly reports during the middle of the Victorian period give some indication of use. For example, of the 330 volumes "read" during the quarter ending 24th October 1887, five were on botany, forty-five on chemistry, twenty-six on geology, six on zoology, nineteen on mining and mineralogy, and four on natural science.[47] In the same period 359 volumes were on loan and of these eleven were on botany, four on chemistry, twenty-four on geology, four on mining and mineralogy, and eleven on natural science. In other words, about 15% of the books on loan and approximately 32% of the books "read" were on scientific subjects. The data from the quarterly report indicates that the scientific literature was used but does not reveal the particular titles. More indicative of the demand for individual titles is a librarian's annotations on a list of publications sent out for binding, dated 18th June 1883. The librarian specified those books and periodicals "constantly called for reference," and requested a speedy return from the binder. Among the periodicals so designated were: *Comptes rendus*, *Revue scientifique*, *Nature*, *American Naturalist*, *Magazine of Natural History*, *American Journal of Science*, *Journal of the Royal Microscopical Society*, *Canadian Naturalist*, *Philosophical Transactions* and *Proceedings* of the Royal Society of London, and the *Transactions of the Royal Astronomical Society*.

The above information on high demand for particular periodical titles and the data on general use of the collection is about as close as surviving records allow determination of "outflow" of scientific literature from the McGill Library. The difficulty in ascertaining use of the McGill collection resembles that encountered in analyzing many nineteenth century libraries.

Holdings of scientific literature in the McGill University library grew significantly during the latter part of the Victorian period. Concerted efforts by scientists on the McGill faculty were important in building the collection. They were motivated by the need for access to the relevant scientific literature. Donations, exchanges, and purchases all helped to build a collection which by the end of the period was the best in eastern Canada, and an important source of scientific literature in Montreal.

Mechanics' Institute of Montreal Library

Another Montreal institutional library that played a part in the dissemination of scientific literature was the library of the Mechanics' Institute of that city. Organized in the late 1820s with the stated aim of instructing "the members in the various branches of science and useful knowledge,"[48] the Institute had become by the end of the Victorian period an established "public" library in Montreal with a respectable collection, but less useful than other contemporary libraries for scientists or aspiring scientists who needed to read the latest literature in the field.

As an outgrowth of a movement for adult education, mechanics' institutes quickly grew in number after the founding of the Mechanics' Institute in London, England in 1823. Many of the institutes organized in South Africa, Australia, the United States and British North America were modelled after the London institute, and the Mechanics' Institute of Montreal was part of this pattern.[49]

Organized on 21st November 1828 with considerable optimism by a group of influential citizens, the Montreal Mechanics' Institution (as it was first known) foundered within a few years and "lapsed into suspended animation" after the spring of 1835.[50] By 1840 circumstances in Montreal had changed and the organization was re-established as the Montreal Mechanics' Institute. Of the hundreds of such institutes founded in Canada in the last century, the Montreal institute is the only one that continues today (under the current name of Atwater Library of Montreal). The reborn Institute quickly recruited members and by the end of 1840 had obtained more than 225. Membership was open to all men on payment of a subscription fee and election by the governing committee. No other qualification for membership was required. Several Montreal scientists were listed on the membership rolls of the Institute. Later in the century women were also admitted to the Institute but it seems that few joined. Throughout the Victorian period the number of members fluctuated, reaching a high of 1,245 in 1856 and dropping to 810 in 1878 and later to 586 at the turn of the century.[51]

As an organization designed to provide and promote adult education, the Institute was unsuccessful as were most similar institutes in many other locations.[52] But the library of the Institute filled a niche in Montreal society and this position accounts for the longevity of the Institute.

The library of the 1828 Institution had by the middle of the 1830s grown to 500 journals and books, some of which had been acquired in Montreal (largely by donation) and some by purchase outside the colony, such as the £44 *2s.4d.* spent on books and scientific apparatus in 1834.[53] When the new Institute was organized at the beginning of the Victorian period, the library and reading room was once again considered a principal asset and efforts were undertaken to build the collection.

During the first year of the new organization commendable results were obtained. The executive noted in the annual report for 1840 that 400 volumes had been acquired, "the whole representing a repository of literary and scientific knowledge of which amassed as it has been during a short period, the Institution may well be proud."[54] In that year over half the income of the Institute (£57 11*s*.8*d*.) was spent on purchases for the library and in the following year an additional £40 was allocated for library acquisitions. While there were few purchases over the next decade, the library continued to grow such that by 1850 1,200 volumes were said to have been in the collection. By the late 1850s, when the library had accumulated more than 3,000 volumes, a survey of the members gave evidence that the library and associated reading room were the most preferred divisions of the Institute.

Throughout the remainder of the century, the library continued to grow. In 1878 over 480 volumes had been added to give a total of 8,179 in the collection.[55] A few years later the number of volumes had surpassed 9,200 and, by the beginning of the 1890s, over 11,000 volumes had been accumulated. In 1890 over $700 was spent on purchasing publications for the library and reading room, a considerable sum not surpassed in many previous years. At the beginning of the twentieth century, the library contained 14,407 volumes, a respectable collection for an institution of its resources.

A more detailed examination of the records reveals the extent of the scientific literature within the total library holdings. While the desire to provide instruction "in the various branches of science" espoused early in the history of the Institute may have guided some of the decisions about acquisitions, emphasis was often placed on general applied or technical aspects of science rather than specific subjects in the physical or natural sciences. Some of the early acquisitions obtained in 1840 included Charles Lyell's *Principles of Geology*, T.R. Malthus's *Essay on the Principles of Population*, *Gardener's Arena of Science*, *Nicholson's Encyclopedia*, and *Nicholson's Five Orders of Architecture*.[56] These texts had a clear scientific emphasis. But the demands of readership a decade later led to the inclusion of larger numbers of volumes of fiction in the library. The governing committee of the Institute was never pleased with the high circulation of works of fiction in comparison to more "useful books," but after a period of years the committee seemed to have found a resolution to the matter in a speech by Prof. Justin Winsor of the Boston Public Library given at a conference of librarians in London in which he claimed that "the readers of useful books were recruited from the army of novel-readers, where the habit of reading was first learnt, and in that sense was not, perhaps, an unmixed evil."[57]

One type of publication that the Institute regularly maintained that would interest readers seeking scientific information was the newspaper and journal subscriptions. Beginning with twenty periodicals in the early 1840s the number soon grew and by 1878 had increased to almost 125. At the turn of the century periodicals numbered 135.[58] The periodicals were kept in the reading room and consisted of a mixture of dailies, weeklies, fortnightlies, monthlies, and quarterlies mostly of Canadian, American or British origin. Almost all of the periodicals were published in English. Beginning in the 1890s the French journal, *Revue des deux mondes*, published in Paris, was added to the subscriptions. Except for French Canadian newspapers, this fortnightly was the only foreign language periodical.

Nineteenth century newspapers often contained a considerable volume of scientific matter which would have been of interest to the amateur scientists among the Institute's readers. The more advanced readers, however, could have turned to *Scientific American* or *Popular Science Monthly*, two American periodicals that were early additions to the subscription lists, and the *Quarterly Journal of Science* and *Nature*, both English journals, the latter having been added in 1898. All four of these periodicals were generalist in nature and aimed at wide readership. *Nature*, which began publication in 1869, was almost thirty years old when it was finally included in the Institute's subscriptions. Other periodicals for which the Institute had subscriptions of many years run included: the Canadian *Patent Office Record*, the London *Journal of Chemical Industry*, the Canadian *Mining News*, the New York *American* *'ectrician*, the London *Engineer*, and the London *English Mechanic*. These and a variety of other similar periodicals indicate an emphasis on the applied science.[59] Among the assortment of other journals, including the London *Contemporary Review*, the *Atlantic* published in Boston, the New York *Harper's Monthly* and *Blackwood's Monthly* published in Edinburgh, articles of scientific topics were sometimes published, but these were usually science at the popular level and not particularly aimed at an audience of scientists.

Throughout the Victorian period, the Mechanics' Institute library held less specialized scientific literature than the other Montreal libraries considered in this study. The periodical subscriptions included none of the specialized scientific journals of the day and the book acquisitions, particularly in the latter part of the Victorian era, contained very few titles on scientific topics. Those books that did treat science were usually of a general nature.[60] In the dissemination of scientific literature the Mechanics' Institute library served to popularize science but was less important for the dissemination of the actual accounts of scientific research.

Geological Survey of Canada Library

The library of the Geological Survey of Canada stems from the appointment of William Logan as the first Director in 1842. Shortly after taking office Logan wrote to Sir Henry De La Beche, Director of the Geological Survey in Great Britain, describing the challenge that lay ahead. In particular, he noted the rudimentary state of geological investigation in Canada, the absence of an arranged collection of fossils and "no such thing as a geological library to refer to."[61] One of Logan's first steps as Director was to collect "such information as might already exist in the country, in public documents and reports, in contributions to the transactions of scientific Societies, and in the possession of such of the inhabitants as might have devoted observation to geological facts in districts immediately surrounding them."[62] From these modest beginnings the library of the Geological Survey was built, into "one of the great scientific libraries on the continent" by the end of the Victorian period.[63]

During the early years of the Survey it is quite likely that Logan's personal library fulfilled the role of library of the Survey as well.[64] In his first report Logan recounted how he had collected as many maps of the colony as were available and then he went on to say:

> ...among the documents which have come into my hands, I have especially to express my obligations to His Excellency the Governor General for the published reports he has been instrumental in procuring for me on the Geology of various States bordering on Canada. The value of these reports

> cannot be over-rated, and the study of them will tend to save a vast amount of labour and difficulty in the geological investigation of the colony. The final reports of the surveys accompanied by maps, geologically coloured, have not yet been placed before the world, and though the want of such maps often renders it tedious and perplexing to trace out with accuracy the range of formations described, enough is already given to teach a geologist what succession of rocks he has to search for in this portion of North America, and what subordinate mineral contents he may expect them to possess.[65]

Clearly Logan recognized the importance of assembling a library of scientific literature and for a number of years collecting books and periodicals for the library was one of numerous other tasks that he performed.

By the mid 1850s the Survey had moved into a permanent home in Montreal and Logan was in a position financially to hire additional staff. Among the new recruits was a young immigrant from England, T.C. Weston. Weston's primary duty at the Survey concerned the museum (he was an expert preparator of fossils), and he was also the Survey's first librarian.[66] The care of the library was not Weston's responsibility alone, however. Robert Bell, who had also joined the Survey in 1857, recorded in his diary for December of that year that he had spent the first five days of the month arranging books, journals, and "pamphlets" in the library.[67] "Pamphlets" was a nineteenth century term for a variety of paper bound reports and reprints, some of which could be many pages in length. While there is no indication of the size of the collection of the Survey library, the fact that Bell took several days to arrange the holdings suggests that the number of volumes had increased substantially from the early days when Logan had had to rely on the few available reports and journals. A few years later, in 1862, Elkanah Billings noted how he had placed an order for "a large number of books...from England for the library of the Survey," and had spent some time "making out the lists and endeavouring to find where they could be got in London."[68]

As the century progressed the library continued to grow, and when the Survey moved to Ottawa in 1881 the opportunity arose to recatalogue the collection, a necessary reorganization because of the increased holdings. John Thorburn was appointed librarian in 1882 and under his direction the recataloguing was completed and a more diligent programme of acquisitions was undertaken.[69]

The Survey library, like many others, used the medium of exchange to obtain important scientific literature. Distribution of the Survey's publications was for many years a task completed by library staff largely because the programme of exchanges was so important. Thorburn's reports at the end of the century illustrate how significant the exchanges were. In 1898 7,852 of the Survey publications were distributed, 2,049 of these were sent abroad as exchanges to other countries. In return the Survey library received 2,778 publications from scientific associations and research institutes around the world. In that year the library holdings numbered "about 12,500 volumes, in addition to a large number of pamphlets."[70] In the following year, 1899, 17,555 copies of various publications of the Survey (comprising annual reports, special reports and maps) were distributed, of which 5,800 were sent to other countries. In that year the library received 2,515 volumes in return.[71] The importance of the exchanges, at least in terms of numbers, is made clearer when it is noted that in 1898 161 volumes were purchased and thirty subscriptions to scientific periodicals were maintained and in 1899 111 volumes were bought and thirty four journals received. The exchange programme continued into the first decade of the twentieth century with an average of over 3,000 publications received each year in exchange for Survey documents. In 1910, for example, Jane Alexander, who had replaced Thorburn as librarian, reported that 3,152 publications had been received in exchange. That year the library subscribed to 88 periodicals and the next year that number had increased to 104.[72]

Scientific periodicals as has been emphasized earlier were a vital addition to the library. Subscriptions to scientific journals had been initiated by Logan and as the century progressed more and more titles were added to the collection. In the early 1890s when it is possible to identify some of the periodical subscriptions from reports of the Auditor General of Canada, a variety of American, British and European serials were purchased. At the turn of the century additional titles were recorded in the subscription lists (see Appendix I). These journals, some of the leading scientific periodicals of the period, were not the only subscriptions that the library maintained. The titles of numerous other subscriptions are hidden in the Auditor General's reports under the heading "subscriptions to journals and magazines" which does not itemize journal titles.

The periodical subscriptions ordered each year imply that the Geological Survey library was receiving up-to-date scientific literature. More direct evidence of currency is found in the actual volumes of the periodicals. Beginning in 1872 and continuing until the turn of the century the library date stamped issues of journals as they were received. The practice was not followed consistently, however, and some journals have fewer date stamps than others. Even so, it is possible to track receipt of journal issues to greater or lesser detail. Issues of four journals were examined and the dates of receipt recorded. Two of the journals were American, one British, and one German. The *American Journal of Science* was issued monthly from the period 1872 to 1900 for a total of 348 issues. The majority of issues were dated stamped by the library and only twenty issues were late, that is, these latter issues were received more than a week after the month printed on the issue.[73] While a few of the late issues were received several weeks after the month of the issue most were received within the first two weeks of each month. For about thirty years there was remarkable consistency in the time of the month when issues of this journal were received.

Another American journal which exhibits similar consistency in receipt at the Survey library was the *Journal of Geology* which began publication in 1893. During the last decade of the nineteenth century when eight numbers per year were issued, fifty-six issues were examined.[74] Only three issues brought out in the first year of publication were received more than three weeks after the printed month of the issue.

Turning to the British periodical, the *Quarterly Journal of the Geological Society of London*, the data for receipt of issues at the Survey library is less complete than that found in the two American journals. Numerous issues were not date stamped by the library. However, of those that were stamped, the evidence shows that issues were received at the Survey library within a few weeks after publication. Over a thirty year period, fewer than five issues arrived at the library several months later than the pattern of receipt suggests they should.

Near the end of the Victorian period the library subscribed to *Zeitschrift für praktische Geologie* published in Berlin by Springer Verlag. The volumes for 1893 and 1894 were received in May 1896 (the volume for 1895 has no date stamp) and then beginning with the 1896 volume most of the monthly issues were date stamped. For the remainder of the decade the majority of the monthly issues of this journal arrived at the library either within the month printed on each issue or within a week following the month.[75]

One remaining example, which shows the dates that publications were received at the Survey library, comes from the twelve year period 1882 to 1894. In mid-February of each of these years the president of the Geological Society of London delivered a lengthy "anniversary" address to the Society, and these addresses were printed separately from other of the Society's publications. Copies received at the Survey library usually arrived in May or June but never later than mid July during the total period.

The collection of books, periodicals, reports, and reprints at the Survey had grown substantially by the end of the Victorian period and the quarters assigned to the library became seriously inadequate. In a memo at the turn of the century Mrs. Jane Alexander, then assistant librarian, noted that

> for years, books have just had to be put down wherever a vacant space presented itself, and constant moving of the books in the endeavour to crowd a few more into shelves already too full, has made any proper arrangement quite impossible....The higher shelves are beyond reach except with a step ladder, and the lower shelves are completely blocked by books piled up on the ledges, and the assistant librarian is not strong enough for the constant lifting about of heavy books which this entails, to say nothing of the amount of time wasted.[76]

At that time Robert Bell was Acting Director of the Survey and one of his accomplishments was both provision of a larger space for the crowded library and the procurement of additional funding for library acquisitions.[77] Bell fully recognized the need for a good library and through his efforts a special grant of $2,700 a year was obtained for augmenting the book and periodical holdings.[78]

From 1842 until the year that Bell stepped down from the directorship of the Survey, a large body of scientific literature had accumulated in the library. As a specialized collection it provided an invaluable source of information for the staff of the Survey.[79]

Library of the Central Experimental Farm

The library of the Central Experimental Farm, the youngest of the six institutional libraries under scrutiny, was established in the mid-1880s. The formal history of the "Main Library" of Agriculture Canada (currently located at the Central Experimental Farm) is traced to a beginning in 1910.[80] At that time it was part of the Publications Branch of the Department of Agriculture and only became the "Main Library" in 1925. In the twentieth century this library has become "one of the foremost collections in the world on the literature relating to agriculture and the allied sciences."[81] But the roots of the library lie in the Victorian period. Shortly after the establishment of the Experimental Farms system in 1886, steps were taken to assemble agricultural literature for the use of the research staff. The annual reports issued by the Central Experimental Farm give very little information about building a library collection, however. During the whole period of his directorship, William Saunders only recorded library expenditures in the 1890 report where he noted that the expenditures for the operation of the Central Experimental Farm included $161.96 for "books, periodicals and newspapers." In the same year almost $3,000 was spent on printing reports and bulletins which points to the considerable emphasis that was placed on distributing agricultural information, particularly to the farming community in Canada.[82]

Besides placing orders for library acquisitions, Saunders also quickly arranged an exchange programme with experimental farms and agricultural research institutions around the world. In his report at the end of the second year of operation of the Experimental Farms, he announced that "exchanges of publications have been made with nearly all the Experimental Stations of the United States, and with some of those in Europe."[83] In his next annual report he repeated this statement and added that arrangements for exchanges had also been made with the Royal Agricultural College at Tokyo.[84] This important step, taken early in the operation of the Central Experimental Farm, guaranteed an inflow of some of the most significant literature relevant to the research programme at the Farm. On an annual basis hundreds of reports and volumes of research findings arrived at the Central Experimental Farm in exchange for the Annual Reports and Bulletins published at the Farm.

The exchange programme was not sufficient to stock the library of an active research institution, however, and purchases were made each year to supplement the reports and documents received free-of-charge. Since a catalogue of the library was never published, it is necessary to seek information about acquisitions from a number of sources and, as with the Geological Survey, the reports of the Auditor General of Canada provide some of the more detailed data.

Each year after the establishment of the Experimental Farms, the Auditor General reported expenditures for the library. In 1888, for example, subscriptions to scientific periodicals and newspapers cost $104.33 and books costing a total of $127.57 were purchased from Canadian and American firms, principally J.B. Lippincott & Co. of Philadelphia.[85] Over the next seven years an average of $175.00 was spent each year on library acquisitions with periodicals taking the larger portion of the funds.

Throughout the 1890s and early years of the twentieth century, a variety of North American and British agricultural and scientific periodicals were included in the subscriptions received at the library (see Appendix I). Besides these periodicals a variety of newspapers were acquired and a number of unnamed German periodicals.[86] In total, the subscriptions covered a spectrum of agricultural and scientific periodicals.

At the end of the nineteenth century, the library acquired an index that made the myriad of publications of agricultural research institutes in the United States more accessible. On 18th January 1899 Saunders wrote to Dr. A.C. True, Director of the Experiment Station of the U.S. Department of Agriculture in Washington, requesting that the Central Experimental Farm library be placed on the mailing list for a card index which classified the subjects of the hundreds of publications of American agricultural experimental stations. This index, Saunders noted, "would be invaluable to us as a means of reference to the vast amount of useful material which is scattered throughout the bulletins issued in connection with various experiment stations."[87] Subsequent correspondence throughout the ensuing months confirm that the index was received and by August of that year the number of cards in the file numbered 18,000. Saunders wrote to Dr. True commenting on the "great convenience" of the index, which served its purpose "admirably."[88]

The combination of exchanges, periodical and newspaper subscriptions, as well as books purchased each year, ensured that an extensive collection of scientific literature relevant to agricultural research had been assembled at the Central Experimental Farm by the end of the Victorian period. When the library of the Department of Agriculture was formally established in 1910, a core of scientific literature was ready to become an important component of the "new" library.

The Library of Parliament

For many decades the Library of Parliament acted as the *de facto* national library in Canada and the size of its collections may explain why Robert Fulford was less critical of this library than others in his 1859 indictment. In addition, until well into the twentieth century the Library of Parliament acted much like a public library for the citizens of Ottawa. Earlier it was noted that James Fletcher had once been employed at the Library of Parliament, but he was not the only scientist who took advantage of the collection.[89] Researchers used the Library of Parliament simply because it contained a large number of scientific texts. Throughout the Victorian period the collection policies of Librarians of Parliament were more broadly sweeping than one might expect for a library that had as its primary mandate to meet the needs of elected and appointed parliamentarians.

The history of the Library of Parliament can be traced back into the late eighteenth century, although most of the books were obtained much later, particularly since disastrous fires in the nineteenth century necessitated major restocking of the shelves on a number of occasions. Two branches of the library existed prior to 1841, one in Lower Canada (Quebec) and the other in Upper Canada (Ontario). The legislative assembly of Lower Canada decided in 1791 to create a library for "the use of the deputies of the Canadian people."[90] By

1817, this collection had grown to 1,000 volumes and by the early 1830s it numbered about 5,000.[91] In Upper Canada a small collection of publications was destroyed during the War of 1812 and in 1816, after the war was over, the legislature voted £800 to recreate a legislative library.[92] The Upper Canada library grew slowly. By the mid-1830s it contained only about 600 volumes and a report at that time stated that the collection was "singularly deficient in works relating to science and the mechanical arts, agriculture, roads, bridges, canals, banking, statutes, etc."[93] In 1836, Alpheus Todd, who later became Librarian of Parliament and a major figure in the development of the library during the nineteenth century, was appointed an assistant in this library.

At the time of the union of the two provinces in 1841, the libraries of the two legislatures were amalgamated and for the next two decades, until Ottawa was designated the permanent home in the 1860s, the library followed the legislature in its peripatetic placement about the colony. The library did not move into its final location in Ottawa until 1876 when the library wing of the parliamentary buildings was completed.

In 1841, when the two legislative libraries were combined, a total of 6,000 volumes were said to have been in the collection. By 1849, this number had grown to 25,000 but a fire set during a riot in Montreal in April of that year destroyed all but 200 volumes. An agent was sent to Europe to purchase a new collection for the library, but once again fire destroyed a large portion of the holdings, this time in Quebec City in 1854.[94] In 1855, Alpheus Todd succeeded Dr. William Winder as librarian and he was given the task of rebuilding the library. A large grant of over £9,600 was placed at his disposal and during a buying trip to England and Europe Todd began the process of assembling a new collection.[95]

Both G.B.Faribault, who had completed purchases for the library in Europe in 1851, and Todd realized that the scientific component of the library was weak and both sought out publications to add to this department. Surviving records from Todd's trip abroad give some indication of the extent of the scientific acquisitions.[96] He was often successful in obtaining outright donations of books and periodicals from libraries and institutions in Britain and France, as a list of volumes received from the British Museum and the Geological Survey of Great Britain demonstrates.[97] Beyond donations Todd visited numerous book dealers and purchased hundreds of volumes for the library. In Paris, Todd was assisted by T. Sterry Hunt, Chemist with the Geological Survey of Canada, and he seemed to have worked primarily through the firm of Hector Bossange. He had written to the latter on 9th August 1855 that a library "of a more *thorough* and *practical* kind than we have had heretofore - more *systematic* in its proportions of works in the various classes of literature & science, and more complete in its various departments" was being assembled.[98] In Britain, Todd arranged to acquire a variety of scientific books and periodicals as an order placed with the firm of Piper, Stephenson, and Spence of London illustrates.[99]

In 1858, a catalogue of the library was published and here the results of Todd's work in Europe can be seen.[100] Scientific writers such as Louis Agassiz, Charles Darwin, Alphonse de Candolle, Henry T. de la Beche, John Gould, Asa Gray, W. Kirby, Justus Liebig, John Lindley, Charles Lyell, Thomas Nuttall, Alexander Von Humboldt, John Torrey, and a large number of others are represented in the collection. Scientific periodicals numbered among the titles in the catalogue, some of which Todd had placed on subscription while in Europe. A variety of reports (principally reports of geological surveys), pamphlets and reference works complemented the collection of scientific literature.

Major purchases, such as Todd had completed in 1855, were not the normal pattern, of course. The library had an annual grant from Parliament for acquisitions and in addition to purchases, the Library of Parliament, much like other institutional libraries in this study, maintained an exchange programme with a variety of libraries around the world. However, in contrast to the other libraries, the Library of Parliament often had to purchase multiple copies of the books and reports that were used for exchange purposes. In this way, the library encouraged the dissemination of scientific information since a number of the volumes purchased for the exchange programme were scientific texts authored by Canadians.[101]

An aggressive acquisition programme throughout the latter half of the nineteenth century ensured that the collection grew substantially. At the time of confederation in 1867, the library held about 60,000 volumes and this increased to about 121,000 in 1887.[102] By the turn of the century the library had built a collection that attracted readers and scholars from not only the city of Ottawa, but also from around the country and abroad.

Supplements to the Catalogue published throughout the latter part of the Victorian period give additional evidence of acquisitions of scientific literature.[103] Two of the supplements are sufficient to illustrate annual acquisitions. In 1889 the library subscribed to 456 serials of which eighty-five were newspapers.[104] Of the remaining 371, seventy were scientific or technical, or about 19% of the periodicals on the regular subscription list in that year. About two decades later when the total number of subscriptions had increased to 538, slightly more than 26% (119) were scientific or technical in nature.[105] While the number of periodicals had increased, some of the journals had been discontinued including: the *Canadian Bee Journal*, the *Journal of Morphology*, the *Journal of the Royal Agricultural Society*, and the *Quarterly Journal of the Geological Society of London*. Most of the periodicals that had been added were aimed largely at an engineering or technical readership but there were a number of new scientific journals including: *Annales de la science agronomique*, *Forestry and Irrigation*, *Journal of the Royal Horticultural Society*, and the *Proceedings of the United States National Museum*. Besides periodicals, both Annual Supplements record that books on scientific topics continued to be added to the collection. Several subject categories, covering "agriculture and horticulture," "anthropology and zoology," botany and forestry," "electricity," "encyclopedias, transactions of societies," "geology and mineralogy," "natural history," and "natural philosophy and chemistry," figure prominently in both supplements.

For more than half a century, the Library of Parliament served parliamentarians and a variety of other researchers. It is not surprising that scientists in the Victorian period viewed this library as an important source of scientific literature. Even though the librarians at times believed that the scientific section of the library needed up-grading, the Library of Parliament maintained a valuable collection of periodicals and reference works useful to nearby scientists.[106] Later in the twentieth century a large portion of the scientific holdings of the library were transferred to the National Research Council of Canada and are now part of the collection on the Canada Institute for Scientific and Technical Information.

Discussion

As seen from the six libraries described above, most institutional libraries were small and one did not even exist at the beginning of the Victorian period in Canada. At mid-century scientists may have had difficulty in locating scientific literature in institutional libraries but at the end of the Victorian period this had changed substantially. Respectable collections of specialized, scientific publications had been assembled.

No doubt the six scientists considered in this study consulted institutional libraries other than those described. But the variety of types of libraries that figured in the above discussion (academic, legislative, research institute, scientific society, and mechanic's institute) are representative. Each served somewhat different mandates and this factor is reflected in the collection of scientific literature held by each library.

Six features about the dissemination of scientific literature in Victorian Canada as illustrated by these libraries stand out. First, all of the libraries contained scientific literature which arrived on a regular basis. If the collections of such literature were incomplete, they were certainly not out-of-date. The evidence of annual reports makes clear that the current literature was being acquired, and the data from the Geological Survey Library demonstrates that the literature was received on a timely basis.

Limited funding was a second feature common to all the libraries. The libraries of McGill University, the Natural History Society of Montreal, and the Mechanics Institute all operated under this limitation, particularly in the 1840s and 50s. Even the three libraries which regularly had government funds at their disposal functioned with less than ideal resources. Low acquisition budgets were the standard of many scientific libraries not only in Canada but in other countries as well. According to A.J. Meadows, even as late as 1925 a typical university observatory only had about $50 per year to spend on books and periodicals.[107]

Even with restricted financing, each of the libraries built collections that contained a selection of publications from the world-wide body of scientific literature, and this constitutes the third feature of these libraries. In comparison with the more specialized libraries, the Mechanics' Institute collection was quite limited but even this library acquired a number of periodicals which gave an international perspective. Aimed at a more general readership the Mechanics' Institute library had less need to actively collect the specialized literature that is evident in the libraries of the Geological Survey and the Central Experimental Farm. By the end of the Victorian period these latter libraries had become rich resources of specialized scientific literature.

Scientific periodicals, the fourth feature, made up a large portion of holdings of scientific literature, becoming more and more prominent in libraries as the nineteenth century progressed. By the end of the Victorian period they constituted the largest portion of all the scientific collections and also took up the largest segment of annual budgets allocated for library purchases. Scientific reports constituted another sizeable component of the scientific literature and both geological surveys and agricultural research stations produced large numbers.

Many of these reports formed the backbone of exchange programmes and all six libraries made extensive use of the latter. Exchanges ensured that scientific literature, often difficult to obtain except by exchange, arrived at the libraries on a frequent basis. The exchange programmes were never operated cost-free, but the costs could be kept to a minimum by eliminating any need for commercial profits. The importance of exchange programmes is the fifth aspect common to the institutional libraries.

A final feature characteristic of most of the libraries was the role that scientists themselves played in helping to build the collections. Scientists readily recognized the need for adequate libraries and men such as Bell, Billings, Dawson, Fletcher, Logan, and Saunders, actively contributed to the development of scientific collections. They donated books and periodicals and provided their own publications for exchange purposes. Wherever possible, they also lobbied for improved financial resources. At McGill University, faculty members regularly made decisions about actual purchases and even late in the nineteenth century were involved in the classification of the holdings.[108] All of these efforts were important and necessary for the formation of adequate collections of scientific literature.

Libraries in close proximity competed for limited resources. This was particularly true of the libraries in Montreal and some steps were taken early in the Victorian period to prevent duplication between the libraries of the Natural History Society, the Geological Survey, and McGill University. If the collections had been combined, a more substantial library might have been formed. However, the nature of the collections and their users prevented such a move.

In 1985, two Canadian historians wrote that the study of the "circulation and consumption [of library holdings] can reveal patterns of movement of books through a society."[109] The paucity of records, however, makes the "consumption" of books or the actual reading of texts very difficult and often impossible to determine. The circulation of library holdings can stubbornly elude historical assessment since borrowing records have often not survived. For all six libraries in this study actual circulation data is not available and indirect evidence is spotty.[110] There is no question that all six libraries were used. In a number of cases, such as with the library of the Mechanics' Institute, and McGill University, the number of volumes that circulated in broad subject areas during particular periods is available. But even this data is incomplete. Use of the libraries can, therefore, only be ascertained from indirect evidence. Accounts of volumes borrowed and not returned, reports that inadequate quarters hampered access, and that the presence of knowledgeable librarians increased circulation, all testify to use of the collections. It is clear that the six scientists in this study did make use of one or more of the institutional libraries that have been described, but the extent of use by other scientists is not as obvious.

At the beginning of the Victorian era, libraries were haphazardly managed by untrained, usually part-time staff, but by 1900 the addition of full-time librarians ensured that collections were much better maintained and patrons better served. The individuals charged with administrative responsibility of institutional libraries were very conscious of the need to acquire and disseminate scientific literature. They often did not have extensive financial resources at their disposal but within the means available to them they pursued their obligation with vigour such that by the first decade of the twentieth century a number of respectable collections of scientific literature had been accumulated. Still some collections continued to be small and the scientific component inadequate for any extensive research purposes.

In the middle of the nineteenth century, Francis Fulford could, with some justification, remark on the weaknesses of collections of scientific literature in institutional libraries in Canada. He had overlooked the sizeable collection at the Geological Survey of Canada, however. If Fulford were to return at the end of the century, he would have found a different picture. Libraries at McGill University, the Geological Survey, and the Library of Parliament had extensive holdings of scientific literature and the library at the Central Experimental Farm had made a good beginning. Fulford would have also discovered that the library of the Natural History Society was soon to close and the library of the Mechanics' Institute did not contain a large collection of scientific literature. He may have given a mixed review of libraries at this time, but he surely could not have been as critical as he had been a half century earlier. By the end of the Victorian period the combined holdings of scientific literature in institutional libraries was considerable, even if ease of access was hindered by institutional and geographic restraints.

Notes to Chapter VI

1. Francis Fulford, *Five Occasional Lectures, Delivered in Montreal* (Montreal: Printed and Published by John Lovell, 1859), 103. This quotation is taken from "Lecture V. On the State and Prospects of Science and Literature in Montreal. Delivered in the Lecture Room of the Montreal Natural History Society, as the Concluding Lecture of the Winter Course, on Tuesday, April 5, 1859."

2. Ibid.

3. With reference to mechanics' institutes, James Bain, chief librarian of the Toronto Public Library, reported 264 institute libraries in 1893 a number which had grown from 26 in 1869. James Bain, "The Libraries of Canada," *The Library* 7 (1895): 247. A useful guide to the secondary literature on mechanics' institutes is found in Jim Blanchard, "A Bibliography of Mechanics' Institutes with Particular Reference to Ontario," in *Readings in Canadian Library History*, ed. Peter F. McNally, (Ottawa: Canadian Library Association, 1986), 3-18. The selection of the six institutional libraries was based on an examination of the records of the six scientists. While it is probable that these were not the only institutional libraries that they consulted, the evidence points to each of the six libraries as having been used by one or more of the six scientists.

4. Writing about nineteenth century Canadian scientific societies, Carl Berger noted that they shared a consensus on purposes and procedures which meant holding regular meetings for discussion, maintaining libraries of useful books and periodicals as well as museums, and sponsoring public lectures. Carl Berger, *Science, God, and Nature in Victorian Canada* (Toronto: University of Toronto Press, 1983), 10. A similar statement can be made about scientific societies in the United States, Britain, and Europe. Jean Shaw has noted one European example, that of the Société Géologique du Nord in France, which published a periodical entitled, *Annales de la Société Géologique du Nord*. Through a programme of exchanges of this journal the society's library "became one of the best specialized geological libraries in Europe." Jean G. Shaw, "Patterns of Journal Publication in Scientific Natural History from 1800 to 1939," in *Development of Science Publishing in Europe*, ed. A.J. Meadows, (Amsterdam: Elsevier Science Publishers, 1980), 170-171.

5. Yvan Lamonde gives 1825 as the beginning year of the Natural History Society of Montreal and 1827 as the date of incorporation. These dates are incorrect, however, since the reports and publications of the Society give 1827 and 1833 respectively. See, Yvan Lamonde, *Les Bibliothèques de collectives à Montréal (17e-19e siècle)* (Montréal: Bibliothèque nationale du Québec, 1979), 41. Henry T. Bovey in *A Lecture on the Progress of Science in Canada* (Montreal: [Montreal Herald?], 1886?) gives the founding date as 1832. Likewise, this date is also incorrect. Stanley B. Frost supplies the correct founding date of 18th May 1827. See, Stanley Brice Frost, "Science Education in the Nineteenth Century. The Natural History Society of Montreal, 1827-1925," *McGill Journal of Education* 17 (Winter 1982): 32.

6. As noted in Chapter III, Elkanah Billings published the first volume of *The Canadian Naturalist and Geologist* on his own but with the second and subsequent volumes the Natural History Society of Montreal took over responsibility for its publication and editorial matters fell to a committee appointed by the Society. Billings continued to take a leading editorial responsibility, however.

7. In the early 1840s the Society was an effective lobby for the establishment of the Geological Survey of Canada. Two decades later, in 1862, the Society petitioned the Legislature for protection of smaller birds. See, *Annual Report of the Natural History Society of Montreal for the Year Ending May, 1862, with the Amending Act Recently Passed: Also, a List of the Officers, Life, Corresponding, Honorary, and Ordinary Members of the Society* (Montreal: Printed by John Lovell, 1862), 12.

8. *Constitution and Bye-laws of the Natural History Society of Montreal with Directions for Preserving and Forwarding Objects of Natural History* (Montreal: Printed at the Montreal Gazette Office, 1828), passim.

9. See, *Constitution and Bye-Laws of the Natural History Society of Montreal, with the Amending Act, 20th Vict. Ch. 118* (Montreal: Mitchell & Wilson, Printers, 1886), passim.

10. Not long after its formation some of the initial records of the Society were lost. Major R. Lachlan, in an address in 1852, noted that a committee of the Society had conducted a search for the early documents and reported that "many of the records of the Society appear to have gone astray." See, R. Lachlan. *A Retrospective Glance at the Progressive State of the Natural History Society of Montreal, with a View to Ascertaining How Far It Has Advanced the Important Object Contemplated by Its Founders: Being a Lecture Delivered Before the Natural History Society, on the 31st March, 1852, and*

Published by Desire of the Society (Montreal: Printed by J.C. Becket, 1852), 18. Frost, who has written about the Society, also implicitly recognized the gap in the records since he refers mostly to the period up to the early 1830s and the period after the early 1850s. See, Frost, "Science Education in the Nineteenth Century."

11. The collection management policy of the library is recorded in the Bye-Laws. See, *Constitution and Bye-Laws [1828]*, 10.

12. *Annual Report of the Council of the Natural History Society of Montreal, For the Year Ending May 18th, 1858* ([Montreal]: s.n., 1858?), 3. Emphasis in the original.

13. *Annual Report of the Natural History Society of Montreal for the Year Ending May, 1861: With a List of the Officers, Life Members, and Ordinary Members of the Society* (Montreal: Printed by John Lovell, 1861), 11.

14. In the mid-1870s the Fraser Institute was just being established as a free public library from the estate of Hugh Fraser, a wealthy Montrealer, and it was proposed that the Natural History Society join the undertaking. The Institute was to provide the Society with a free building and the Society was to supply the library and museum. The plan, however, failed with the two organizations going their separate ways. The Fraser Institute (now Fraser-Hickson Institute) continues to operate as a public library in Montreal. See Edgar C. Moodey, *The Fraser-Hickson Library. An Informal History* (London: Clive Bingley, 1977). Records of the discussion about the merger with the Fraser Institute are found in a number of the proceedings of the Natural History Society but principally in *Proceedings at the Annual Meeting of the Natural History Society of Montreal, for the Year Ending May 18th, 1875, With a List of the Officers, Resident Members and Associates of the Society* (Montreal: Mitchell & Wilson, Printers, 1875).

15. Focusing on the increase in the number of periodicals is not to downplay the situation that because of financial constraints books were infrequently purchased for the library. But, with the growing number of periodicals published in the nineteenth century, the importance of this form of literature for the diffusion of scientific information is emphasized in the Natural History Society collection.

16. In the early 1860s a call was made for collaboration between a number of Montreal libraries including those of the Geological Survey of Canada, the Natural History Society, and McGill University so that purchases of books for one institution would, as far as possible, "supplement the deficiencies of

others." See, "Report of the Natural History Society," *Canadian Naturalist and Geologist* 5 (1860), 235.

17. E.T. Chambers, in his 1890-91 report as librarian, noted that the library was "still somewhat deficient in modern works of reference, such as are continually asked for, particularly works on Entomology, Palaeontology, Ornithology, Mineralogy and Botany. The Committee would therefore respectfully suggest that such works as Dana's "Mineralogy," Nicholson's Palaeontology, new edition of Gray's works on Botany, Carpenter on the Microscope, etc., be added." E.T. Chambers, "Report of the Librarian," *Canadian Record of Science* 4 (1890-91): 386. In a subsequent report Chambers noted that the Council of the Society appropriated the sum of "$100 for the purchase of Standard works on the different departments of Natural History, books which are so often enquired for by the members." He then proceeded to list the fifteen or more volumes that had been purchased, including some of the titles mentioned in the 1890-91 report. E.T. Chambers, "Report of the Library Committee," *Canadian Record of Science* 5 (1892-93): 200-201.

18. See, for example, the comment made on the death of F.B. Caulfield, librarian for some time, who it was said: "...always took great interest in examining new books as they were added, was so well acquainted with the contents of the cases, that his knowledge and advice were at all times of great assistance." E.T. Chambers, "Report of the Library Committee," *Canadian Record of Science* 5 (1892-3): 201. It must be noted, however, that the concept of "reference service," common in late twentieth century libraries, was a new idea in the latter part of the Victorian period. It was well into the twentieth century before librarians were trained and/or assigned to the dedicated task of assisting patrons with information requests. See, Samuel Rothstein, "The Development of Reference Services Through Academic Traditions, Public Library Practice, and Special Librarianship." in *Rothstein on Reference...with Some Help From Friends*, ed. Bill Katz and Charles A. Bunge, (New York: The Haworth Press, 1989), 33-155.

19. In the same report by Chambers cited above, he stated that the "Society has been enabled by the purchase of twelve of the earlier volumes of the German Geological Survey to make up what is believed to be the only complete set in Canada of that useful geological work." Chambers, "Report of the Library Committee," 201. Other evidence of unique holdings of the library of the Natural History Society is found in William Stewart M. D'Urban, "List of Works to be Consulted by Students of Canadian Diurnal Lepidoptera," *Canadian Naturalist and Geologist* 3 (1858): 416-419. D'Urban noted publications found in a number of libraries including that of the Natural History Society.

20. B.J. Harrington, "Annual Presidential Address," *Canadian Record of Science* 4 (1890-91): 373.

21. Peter McNally in a brief history of the McGill University Libraries noted that there is some question about whether the university library was begun in the 1840s or later since Dawson "claimed that on his arrival at McGill in 1855 there was no library other than Medicine's and that he established the first one in 1855-1856." Peter F. McNally, "McGill University Libraries," in *Encyclopedia of Library and Information Science* (New York: Marcel Dekker, 1976), vol. 17, p. 313. Frost, however, has demonstrated that there was a library prior to Dawson's appointment. See Stanley Brice Frost, *McGill University for the Advancement of Learning. Volume I, 1801-1895* (Montreal: McGill-Queen's University Press, 1980), 244-247.

22. Frost, *McGill University*, 247; McNally, "McGill University Libraries," 313.

23. The actual amount designated for library purchases may have been higher since Frost and McNally give different amounts for the allocation by the Governors. Frost states it was £200 while McNally claims it was £250. Frost, *McGill University*, 247. McNally "McGill University Libraries," 313.

24. Charles Markgraf to J.W. Dawson dated 9th January 1879. A transcription of the letter is printed in "Charles F.A. Markgraf on McGill Library Developments, 1857-1879, Archives Fact Sheet No. 4," (Montreal: McGill University, 1st February 1974).

25. Ibid.

26. For the 1893 and 1919 figures see McNally, "McGill University Libraries," 315. The 1896 data is found in a letter from Gould to H.H. Langton, Librarian of the University of Toronto, 12th December 1896. McGill University Libraries Papers, McGill University Archives, RG 40, C56, Letter book no. 2, p. 511. Gould was an outstanding librarian who did much to advance the profession as well as strengthen the McGill University libraries.

27. The McGill University library was not a centralized organization even in the nineteenth century. For example, the Medical Library was completely autonomous and the medical faculty resisted any attempt to place its library under the control of the university librarian. At the end of the Victorian period the Medical Library held over 23,000 volumes.

28. Some very rich collections of non-scientific literature were acquired by the McGill library during the Victorian period. For example, Peter Redpath donated a large collection of works on British history and initiated the Redpath Tract Collection of seventeenth to nineteenth century pamphlets dealing with British religious, political, and social history. Evidence for the diversity of subjects of library acquisitions can be seen in two surviving daily journals, one for 1885 and the other for 1889, which document book and periodical receipts and some other limited library activities. Both journals are found in the McGill University Libraries Papers.

29. Dawson regularly donated publications to the library and records of these are scattered through a variety of documents in the main collection of historical records relating to the McGill University libraries held at the McGill University Archives, RG 40, Accession 654. Records of donations from Billings and Logan are contained in a number of documents one of which is the manuscript "List of the Principal Donations to the Library and Museum of the Faculty of Arts, McGill University, Session 1856-7 to Session 1862-3 Inclusive," McGill University Library Papers, RG 40, C2, file "Donations to the Library, 1861-1892."

30. McNally, "McGill University Libraries," 315 terms Gould's operating budget as "adequate." In a letter to a G.W. Prothero of Edinburgh on 2nd April 1898 Gould recorded that his total operating budget was about $10,650 of which $3,200 was spent on book and periodical purchases. In a letter of the same date addressed to a McGill alumnus, Andrew Ross McMaster, also resident in Edinburgh, Gould wrote: "Unfortunately, the fund at the disposal of the library for the purchase of books is so very small that I was and am quite ashamed to let any outsider know what it is. I do not hesitate, however, to mention the fact to you as a graduate. This is the true reason why I delayed answering your letter. Of course, this is entre nous." Gould had written to Prothero at the request of McMaster. Copies of both letters are held in the McGill University Libraries Papers, RG 40, C56, letter book # 3, pp. 457-59.

31. "List of Donations to the Library of the Faculty of Arts, McGill University, Session 1856-7 to Session 1862-3 inclusive," McGill University Library Papers. The manuscript list runs to eleven foolscap pages, but internal evidence suggests that there may have been one additional page. The manuscript was written largely in one hand with some modifications in another. The latter looks like J.W. Dawson's.

32. Volume counts are approximate and are based on the information provided in the manuscript list. A few of the entries on the list simply indicate that an individual donated a volume or

several volumes of publications but do not specify the title(s).

33. The donation from the British Museum is listed in more detail in another manuscript list headed: "The Corporation of McGill College have pleasure in acknowledging the following donations during the Quarter ending July 29th, 1861." McGill University Library Papers.

34. *Annual Calendar of the McGill College and University, Montreal... Session of 1866-7* (Montreal: Printed for the University by J.S. Becket, 1866), 35.

35. Records of these donations are found in *Annual Calendar of McGill College and University, Montreal...Session 1881-82* (Montreal: Printed for the University by John Lovell & Son, 1881), 177-180; *Annual Calendar of McGill College and University, Montreal...Session 1885-86* (Montreal: Printed for the University by John Lovell & Son, 1885), 187-196; and *Annual Calendar of McGill College and University, Montreal...Session 1891-92* (Montreal: Printed for the University by John Lovell & Son, 1891), 201-210.

36. Reports of these donations are found in *Annual Calendar of the McGill College...1866-7*, 35; *Annual Calendar of the McGill College and University, Montreal...Session of 1875-6* (Montreal: Printed for the University by J.C. Becket, 1875), 105; and *Annual Calendar of the McGill College...1891-92*, 207.

37. The manuscript lists include: "List of Books & Pamphlets sent to be bound by Messrs. Dawson Bros., June 26, 1874;" "Delivered to McGill College, September 1874;" "List of Books & Pamphlets to be bound, April 27, 1876;" an unnamed, undated list which on internal evidence suggests a 1878 date; "Books and Pamphlets which require to be bound, December 1878;" "List of Books & Pamphlets to be bound, January, 1879;""List of Books for Binding, 18th June 1883," and "Memo of Periodicals &c for Binding," 11th March 1884." All of these documents are held in the McGill University Libraries Papers, RG 40, C2 file: Binding 1867-1884. In addition, the Daily Journal for 1889 lists publications to be bound.

38. The list is contained in the "Daily Journal 1889," McGill University Libraries Papers.

39. Among the journals ordered at that time were:

American Geologist
American Journal of Mathematics
American Journal of Science
American Machinist
Annales des sciences géologiques

Annales des sciences naturelles botaniques
Annalen der Physik
Annals of Natural History
Annuaire géologique
Botanisches Centralblatt
Botanisches Zeitung
Chemical News
Comptes rendus
Curtis's Botanical Magazine
Engineer
Engineering
Engineering & Mining Journal
Engineering News
Geological Magazine
Iron
Jahrbücher für wissenschaftliche Botanik
Journal de Physique
Journal des mathématiques
Journal of the Chemical Society
Journal of the Linnaean Society (Botany)
Journal of the Linnaean Society (Zoology)
Journal of the Microscopical Society
Meteorological Journal
Mind
Monthly Notices of the Royal Astronomical Society
The Naturalist
Nature
Nouvelles annales mathématiques
Observatory
Philosophical Magazine
Popular Science Monthly
Proceedings of the Royal Geographical Society
Quarterly Journal of the Microscopical Science
Revue Scientifique
Science
Telegraphic Journal

40. Three page invoice dated 7th May 1898 listing almost seventy publications for a total purchase price of £38 15*s*. 9*d*. McGill University Libraries Papers.

41. Taken from two lists of books dated 23rd December 1897 and 30th December 1897 and ordered from F.A. Brockhaus, Leipzig. McGill University Library Papers.

42. Several documents record the transactions leading to the dispensing of the Macdonald fund and are held in a number of files in the McGill University Libraries Papers, RG 40, C15, including: "Requisitions for books from Professors, 1900, 1902," and "Macdonald, Sir William, Gift for books, 1903."

43. Gould to Dr. Leopold Delisle, Director, Bibliothèque nationale, Paris, 25th January 1898. McGill University Libraries Papers, RG 40, C56, Letterbook no. 3, p. 208.

44. J.C. Rowell, Library at the University of California to the librarian at McGill, 19th December 1893. McGill University Libraries Papers, RG 40, C3, file: "1893." Dawson wrote on the letter "I shall be glad to send museum publications and my own papers. Possibly Pr . Bovey or Prof. McLeod might obtain the Trans. Soc. Civil Engineers. JWD."

45. McNally, "McGill University Libraries," 315. See also, Keith Crouch "Gould, Charles Henry," typescript, n.d., 3-4. A copy of this typescript is held at the McLennan Library, McGill University, reference vertical file.

46. Letters documenting the interlibrary loan arrangements are scattered through the McGill Library letterbooks. See, for example, Gould to Martin J. Griffin, Library of Parliament, 7th May 1896. McGill University Libraries Papers, RG 40, C56, Letterbook no. 2, p. 49 and Gould to Thomas J. Kiernan, Superintendent of Circulation, Harvard College Library, 12th November 1897. McGill University Libraries Papers, RG 40, C56 Letterbook no. 3, p. 18.

47. "Librarian's Report for the Quarter Ending 24th October 1887," McGill University Libraries Papers, RG 40, C2, File: Librarians' Quarterly Reports. It is not clear what was intended by the heading "read." Since the library was a closed stack operation it may have meant books retrieved for patrons and used only in the library.

48. Montreal Mechanics' Institution, *Minutes*, 21st November 1828. Quoted in Nora Robbins, "The Montreal Mechanics' Institute: 1828-1870," *Canadian Library Journal* 36 (1981): 374.

49. Two papers which discuss the early history of the Montreal Mechanics' Institute are Robbins, "The Montreal Mechanics' Institute," and Patrick Keane, "Priorities and Resources in Adult Education: The Montreal Mechanics' Institute (1828-1843)," *McGill Journal of Education* 23 (Spring 1988): 171-187.

50. Keane, "Priorities and Resources," 178. See also, Robbins, "The Montreal Mechanics' Institute," 375.

51. For membership figures for 1856 see Robbins, "The Montreal Mechanics' Institute," 376; for 1878 see *Thirty-Ninth Annual Report of the Mechanics' Institute of Montreal, with An Abstract of Proceedings of the Annual Meeting, 2nd December, 1878* (Montreal: J. Starke & Co., 1878), 5; and for 1900, see *Sixty-first Annual Report of the Mechanics' Institute of Montreal, with an Abstract of Proceedings of the Annual*

Meeting Held on the 3rd Dec., 1900 (Montreal: D. Bentley & Co., Printers, 1900), 5.

52. The lack of achievement of the original objectives in adult education is discussed in both Robbins and Keane. See, Robbins, "The Montreal Mechanics' Institute," 376-378 and Keane, "Priorities and Resources," 184-185. The activities of mechanics' institutes in other locations have been treated in a number of publications. In the Victorian period, Ontario had a large number of mechanics institutes. For a discussion of mechanics' institutes in that province see, Jim Blanchard, "Anatomy of Failure: Ontario Mechanics' Institutes, 1835-1895," *Canadian Library Journal* 38 (1981): 393-398, and John A. Wiseman, "Phoenix in Flight: Ontario Mechanics' Institutes, 1880-1920," *Canadian Library Journal* 38 (December 1981): 401-405.

53. Keane,"Priorities and Resources," 176. Robbins, "The Montreal Mechanics' Institute," 375.

54. *Annual Report of the Montreal Mechanics' Institute*, 2nd February, 1841 quoted in Robbins, "The Montreal Mechanics' Institute," 377.

55. The actual figures for that year are:

Books added to the library	
By purchase	316
Magazines bound	41
Donations (principally pamphlets)	124
Total	481

See, *Thirty-ninth Annual Report*, 6.

56. Keane, "Priorities and Resources," 182.

57. *Thirty-Ninth Annual Report of the Mechanics' Institute*, 6. Popularity of fiction was also apparent in many other mechanics' institute libraries. In 1877 at the Toronto Mechanics' Institute, for example, 76% of the library circulations were works of fiction. See, *Forty-Sixth Annual Report of the Toronto Mechanics' Institute with an Abstract of Proceedings of the Annual Meeting Held on Monday, May 28th, 1877* (Toronto: Mechanics' Institute, 1877), 6.

58. *Thirty-Ninth Annual Report of the Mechanics' Institute of Montreal*, 7 and *Sixty-First Annual Report of the Mechanics' Institute of Montreal*, 9-10.

59. It might be argued that a "Mechanics'" Institute would naturally concentrate on the applied sciences. In the last century this seems to have been a matter of debate for the Institute itself. In the 1878 report the executive found it necessary to write that:

> It has been thought sometimes that "Mechanics" is too restricted an appellation for such an institution as ours, and possibly some may think it necessary to be a craftsman to be eligible for membership; but if we interpret it as meaning the culture demanded by the mechanics of the present day, the field will be broad enough, and include every department of knowledge. It would be well, perhaps, if we could hit upon a term which would embrace all other callings now on the roll of membership, but it would necessitate the coinage of a word. We think that the old designation is sufficiently distinctive, worthy of remembrance, and entitled to our regard to render any alteration undesirable.

Thirty-Ninth Annual Report, 3.

60. For example, of the 267 titles acquired in 1898 only eight treated science or applied science topics. Among these were: *Men, Mines and Animals in South Africa* by Lord R. Churchill, *Birds of Montreal* by E.D. Wintle, and *Factors of Organic Evolution* and *Inadequacy of Natural Selection* both by Herbert Spencer. See, *Fifty-Ninth Annual Report of the Mechanics' Institute of Montreal, with an Abstract of Proceedings of the Annual Meeting Held on 5th Dec., 1898* (Montreal: D. Bentley & Co., Printers, 1898), 18-25.

61. Quoted in B.J. Harrington, "Sir William Logan," *Canadian Naturalist and Quarterly Journal of Science* 8 (1976) 35.

62. *Message from His Excellency the Governor General, with Reports [for the Year 1843] on a Geological Survey of the Province of Canada, Presented to the House on 27th January, 1845* (Montreal: Lovell and Gibson, Printers, 1845), 10.

63. Morris Zaslow, *Reading the Rocks. The Story of the Geological Survey of Canada, 1842-1972* (Toronto: The Macmillan Company of Canada Limited, 1975), 143.

64. Harrington noted that the Survey was constantly indebted to Logan "for books, instruments and other aids." Harrington, "Sir William Logan," 11.

65. *Message from His Excellency*, 10-11.

66. Zaslow, *Reading the Rocks*, 65.

67. Diary for 1857, Tuesday, 1st December through Saturday, 5th December inclusive. Robert Bell Papers, National Archives of Canada, MG 29, B15.

68. Elkanah Billings to his mother in a letter dated 10th December 1862. Billings Family Papers. City of Ottawa Archives, MG 2-1-81. Billings ordered a number of books for his mother at the same time he prepared the purchase order for the Survey.

69. Zaslow, *Reading the Rocks*, 143. At this juncture, Zaslow wrote that the growth of the Survey library "echoed the proliferation of scientific research and publication throughout the western world in the last quarter of the nineteenth century."

70. Geological Survey of Canada, *Annual Report (new series). Vol. XI, Reports A, D, F, G, J, M, R, S, 1898* (Ottawa: Printed by S.E. Dawson, King's Printer, 1901), 207.

71. Geological Survey of Canada, *Annual Report (new series) Volume XIII, Reports A, D, DD, F & FF, K, L, M & MM, R, S* (Ottawa: Printed by S.E. Dawson, King's Printer, 1903), 202.

72. For the 1910 statistics see, "Summary Report of the Geological Survey Branch of the Department of Mines for the Calendar Year 1910," *Sessional Papers*, 1911, no. 26, p. 288. The 1911 data is contained in "Summary Report of the Geological Survey Branch of the Department of Mines for the Calendar Year 1911," *Sessional Papers*, 1912, no. 26, p. 396.

73. Since the actual date of publication of an issue is not known, the month printed on the issue was used as the month of actual issue. The evidence in the holdings of the library of the Geological Survey of Canada suggests that issues were actually published late in the month previous to the month printed on the title page of each issue since a few of the issues were received at the library a few days prior to the month printed on those issues. Most of issues were received at the library between the 2nd and 5th of each month. Sixty-seven of the issues were not date stamped by the library.

74. As with the *American Journal of Science* the actual dates of publication of each issue of the *Journal of Geology* are not known. Each issue covered a two month period, e.g., January/February 1893 and February/March 1893. Eight issues were not date stamped.

75. Exceptions to the pattern were the May, June, and July issues for 1896 received on 3rd August 1896 and the March, April, and May issues of 1897 received on 7th July 1897.

76. Appendix to "Report of a Committee of the Geological Survey Staff in Regard to the Library," addressed to Dr. Robert Bell, Acting Director of the Geological Survey. Robert Bell Papers. The appendix is undated but external evidence suggests it was prepared in 1902. See also, Zaslow, *Reading the Rocks*, 214. In a similar vein Mrs. Alexander commented in a note to Robert Bell on 25th September 1908 concerning a book that she had located for him: "The volume had been put on the wrong shelf, as is not infrequently the case in the crowded state of our Library. Wherever there is a vacant space, a book gets pushed in whether it properly belongs there or not." J. Alexander to Robert Bell, 25th September 1908, Robert Bell Papers.

77. Further details about the steps taken to increase the library space is found in the "Report of the Committee."

78. "The Official Career of Dr. Robert Bell, F.R.S., of the Geological Survey of Canada," Reprinted from the *Ottawa Free Press*, undated, p. 2.

79. Annual reports of the Librarian throughout the latter part of the Victorian period indicated that the library was open to more than just the staff of the Survey. However, surviving records of the Survey do not contain any information about the actual use of the collection. Occasionally, in the papers of individual scientists, records of the use of the library will turn up. In the Robert Bell papers, for example, there is a typed list of books and a note from the librarian, John Thorburn dated 25th April 1906 requesting the return of the borrowed books. Robert Bell Papers.

80. See, Canada Department of Agriculture, Information Division. *Canada Agriculture Library. The First Sixty Years* (Ottawa: Information Canada, 1971), Historical Series no. 7.

81. Ibid., 2.

82. See, William Saunders, "Report of the Director," In *Experimental Farms. Reports...for 1890* (Ottawa: Printed by Brown Chamberlin, Queen's Printer, 1891), 50. That Saunders' annual reports did not contain much information about the creation of a library and its annual acquisitions may be explained by the intended readership of the reports. Copies of the annual reports of the Central Experimental Farm were circulated in the thousands each year, mostly to farmers throughout Canada. The farming community would more likely be interested in the results of actual experiments conducted on the Farm and its branches throughout the country than in what books or periodicals were acquired by the Farm library.

83. "Experimental Farms Reports...for 1888," Appendix to the Report of the Minister of Agriculture, *Sessional Papers*, 1889, no. 5b, p. 17.

84. "Experimental Farms. Reports...for 1889," Appendix to the Report of the Minister of Agriculture, *Sessional Papers*, 1890, no. 6C, p. 40. Saunders wrote: "Exchanges of publications are now effected with the Experiment Stations in the United States, with some of those in Europe, and with the agricultural college at Tokio [sic], Japan."

85. "Report of the Auditor General on Appropriation Accounts for the Year Ended 30th June, 1888," *Sessional Papers*, 1889, no. 3, pp. 133, 137.

86. Records of subscriptions to agricultural and scientific periodicals are contained in "Report of the Auditor General for the Year Ended 30th June 1897," *Sessional Papers*, 1898, no. 1, part B, pp. 12-13; "Report of the Auditor General for the Year Ended 30th June 1898," *Sessional Papers*, 1899, no. 1, part B, p. 13; "Report of the Auditor General for the Year Ended 30th June 1899," *Sessional Papers*, 1900, no. 1, part B, p. 14; "Report of the Auditor General for the Year Ended 30th June 1900," *Sessional Papers*, 1901, no. 1, part D, p. 18; and "Report of the Auditor General for the Year Ended 30th June 1901," *Sessional Papers*, 1902, no. 1, volume 1, part D, p. 22.

87. William Saunders to Dr. A.C. True, 20th January 1899. Department of Agriculture Papers, National Archives of Canada, RG 17, A II 1, Volume 2099.

88. Saunders to Dr. A.C. True, 29th March 1899. In a letter to Dr. True dated 22nd August 1899 Saunders noted that the number of cards received by that date numbered 18,000. Department of Agriculture Papers.

89. Nineteenth century records of the library either were not retained or were lost in a number of devastating fires. It is, therefore, necessary to search for records of use from other sources. Among the Robert Bell Papers are an admission ticket and overdue notices from the Library of Parliament. Another who frequented the library for scientific literature was Dr. R. Tait McKenzie who went there "in search of natural history and particularly information on butterflies." See, Kenneth Binks, *Library of Parliament Canada* ([Ottawa]: KCB Publications, 1976?), 10. Other scientists and scholars also used the collections.

90. Binks, *Library of Parliament*, 13.

91. N.-E. Dionne, "Historique de la Bibliothèque du Parlement à Québec, 1792-1892," *Memoires de la Société royale du Canada*, 2nd s. 8 section I (1902): 3.

92. The library was destroyed in April of 1813 when the parliament buildings at York were burnt. Binks, *Library of Parliament*, 13.

93. Unsigned typescript contained in a scrap book entitled, "Throop's Library of Parliament," at p. 7, Library of Parliament Papers, Library of Parliament.

94. G.B. Faribault, Clerk Assistant of the Assembly, was delegated to go to Europe in 1851 to acquire new volumes for the library with a credit of £4,400 sterling. Some of the details of this project are found in the "Minutes of the Joint Committee of the Library, for the Session of 1851," especially the meetings of Friday, 8th August 1851, and Thursday, 14th August 1851 and "Joint Committee of both Houses on the Library Minutes for the 1st Session of the 4th Parliament, 1852," especially the meetings of Saturday, 9th October 1852, Saturday, 23rd October 1852, and Saturday, 6th November 1852. At the latter meeting a copy of Faribault's report was received. A typescript of the "Minutes of the Joint Committee on the Library of Parliament, 1850-1957" is held at the Library of Parliament, Ottawa. For further discussion on Faribault's buying trip and the fire in 1854 see Dionne, "Historique de la Bibliothèque," 8-10.

95. Todd had at his disposal £9,621 9*s*. 6*d*. sterling.

96. Records of the buying expedition are found in the minutes of the Joint Committee on the Library and in a file of Todd's documents associated with the trip.

97. For donations from the British Museum see, the manuscript list headed "London, 12th Sept. 1855. List of Publications Presented by the Trustees of the British Museum to the Public Library of Canada." Library of Parliament Papers, file box: "Mission to Europe, A. Todd, 1855." This list notes about forty titles donated to the Library of Parliament at that time. There were other donations from the British Museum throughout the century. For donations from the Geological Survey see, the manuscript headed "Museum of Practical Geology, Oct. 5, 1855. List of Publications herewith transmitted to the Library of the Provincial Legislature of Canada, Toronto," Library of Parliament Papers, file: "Mission to Europe, A. Todd, 1855." Additional documents in this file indicate that Todd was also successful in convincing other institutions to donate scientific publications to the Library of Parliament.

98. Todd to Hector Bossange, dated London, 9th August 1855. Library of Parliament Papers. Emphasis in original.

99. The order sheet included the following as listed in the original:

Agricultural Magazine
Annals of Natural History
Archaeological Mine
Bohn's Scientific library
Chemist
Civil Engineer and Architect's Journal
Floricultural Cabinet
Hooker's *Botanical Journal*
Horticultural Magazine
Lindley's *British Ferns*
Meyer's *Birds*
Midland Forest
Morris' *Birds*
Morris' *Nests and Eggs*
Naturalist
Newton's *Journal of Science*
Phil. Mag & Annals of Philosophy
Phytologist
Veterinarian
Zoologist
Geological Quarterly
Edinburgh Philos. Jour. (Jamieson's)
Journal of Royal Agricul. Society
Microscopic Journal
Quarterly Journal of Agriculture (Edinburgh).

Library of Parliament Papers, File: Mission to Europe. A. Todd, 1855." Other manuscript lists in this file show that additional scientific periodicals were acquired from other firms.

100. Canada. Library of Parliament. *Catalogue of the Library of Parliament* (Toronto: John Lovell, 1858), 2 vols.

101. In 1854, for example, the library acquired sixty copies of the journal of the Canadian Institute for distribution, and in 1863 the library allocated $500 to obtain thirty copies of Léon Provancher's *Flore canadienne* for the exchange programme. See, "Minutes of the Joint Committee on the Library, 1850-1957," meeting of Wednesday, 13th December 1854, and meeting of Thursday, 5th March 1863.

102. For the 1867 statistic see, *Annual Report of the Library of Parliament*, 7th November 1867, p. 6. At the time of Confederation the library of the province of Canada became the library of the federal parliament and Ontario and Quebec began new legislative libraries in each province. The 1887 statistic is found in "Report of the Joint Librarians of Parliament on

the State of the Library," *Sessional Papers*, 1888, no. 17, p. 2.

103. A number of catalogues and indexes to the catalogues were published during the 1850s and 1860s. Beginning in 1879 annual supplements were published and this practice continued up to 1951.

104. *Annual Supplement to the Catalogue of the Library of Parliament in Alphabetical and Subject Order, Containing all Books and Pamphlets Added to the Library from January 19th, 1889, to January 10th, 1890* (Ottawa: Printed by Brown Chamberlin, Queen's Printer, 1890), pp. 105-109. The actual number of periodicals received was greater than 456 since some were received in exchange and were not listed in the section of the catalogue under subscriptions.

105. *Annual Supplement to the Catalogue of the Library of Parliament in Alphabetical and Subject Order Containing all Books and Pamphlets Added to the Library from January 1st 1907, to January 1st, 1908* (Ottawa: Printed by S.E. Dawson, King's Printer, 1908), 107-13.

106. On the matter of deficiency of the scientific section of the library see the Minutes of the Joint Committee on the Library, meeting of Saturday, 5th May 1883 where it was noted that some of the scientific periodicals had been discontinued "owing to the want of funds." Library of Parliament Papers, Minutes of the Joint Committee on the Library. p. 74.

107. A.J. Meadows, *Communication in Science* (London: Butterworths, 1974), 81.

108. On faculty involvement in acquisition decisions see Gould to D.P. Penhallow, 24th June 1902; Frank D. Adams to Professor Penhallow, 17th December 1901, and E.W. McBride to Penhallow, 23rd December 1901, McGill University Libraries Papers.

109. Louis-Georges Harvey and Mark Olsen, "A Quantitative Study of Book Circulation: The Library of the Institut-Canadien de Montréal," *Historical Methods* 18 (Summer 1985): 98.

110. In the case of the Library of Parliament, because of a matter of privacy, a firm policy of not releasing circulation records to the public is maintained for twentieth century data. Circulation data for the Victorian period, as indeed many records of the administration of that library during the same time, appear to have been lost (probably as much a result of the number of disastrous fires as any other factor).

Chapter VII - Publishers & Book Sellers - Agents of Dissemination

As individuals, scientists promoted the dissemination of scientific information, but they were often helped in this endeavour by agents of the book trade, whose primary aim was publication and sales. Two questions arise about the role of booksellers and publishers: can these agents be identified? and how did they foster the distribution of scientific literature in Victorian Canada?

The answers to these two questions must be sought in the diffuse and often limited extent of surviving records of the publishing industry. The records of the six scientists shed light on which booksellers and publishers (the distinction between the two is sometimes blurred) were involved and the means by which they promoted scientific literature. In this chapter these records are explored in some detail.

George L. Parker in his 1985 study of the pre-1900 book trade in Canada characterized the industry by stating: "'Importation' was the name of the game." He went on to write that nineteenth century Canada "was a materialistic frontier society, hungry for all the information and entertainment that English authors and American publications could provide."[1] The volume of scientific literature produced locally in Victorian Canada was low in comparison with world-wide output, and as a result scientists of the time had to rely on importation of scientific publications for a sizeable portion of their information needs.[2]

Some scientists claimed that any number of scientific texts were "impossible to procure, except at a cost that was absolutely prohibitory."[3] Even so, as the two previous chapters have outlined, Canadian researchers accumulated scientific publications and institutional libraries built substantial collections of scientific literature. Book sellers and other members of the publishing industry were a contributing factor in the development of these collections for they frequently were called upon to procure and deliver scientific literature.

Who Were the Booksellers/Publishers?

To meet their information needs, Canadian scientists in the Victorian era dealt with a whole host of booksellers and publishers, some of whom can be identified. The composite picture that emerges from the evidence of all six scientists (which ranges from scanty in the case of Billings and Fletcher to much more extensive data in the Robert Bell papers) adds further features to our understanding of the dissemination of scientific literature in the nineteenth and early twentieth centuries in Canada. It will be seen, for example, that booksellers and publishers were actively involved in the dissemination process at several levels: at the level of alerting scientists to new scientific literature as it was appearing world-wide, at the level of sales, at the level of publishing the results of scientific research, at the level of support for scientific societies, and at the level of agents for libraries.

A. Sir William Logan and Sir John William Dawson

The earliest evidence of booksellers/publishers is found in the records of Sir William Logan and Sir John William Dawson. Logan, it will be recalled from earlier chapters, spent the early part of his career in Great Britain managing his uncle's business interests. When he moved to Wales in 1831 to oversee the Forest Copper Works his interest in geological matters was piqued and he ordered books on geology and mineralogy from London book dealers.[4] While the identity of the dealers is not known, London was a prominent publishing centre in the nineteenth century and scientists world-wide frequently arranged purchases there. Throughout the remainder of the century it was not uncommon for other Canadian scientists to follow Logan's example by purchasing books and journals from London firms. For a number of decades after his initial purchases Logan, too, continued to obtain scientific publications from London dealers.[5]

Logan frequently attempted to obtain relevant, current literature, an aspect of his purchasing habits illustrated in the following incident. In the year prior to his appointment as Director of the Geological Survey, he travelled in Canada and the United States. While in New York he visited the shop of Wilie & Putnam to locate a copy of a report by Benjamin Silliman on the coal fields of Pennsylvania. When he failed to find a copy of the report in New York, Logan kept looking, unsuccessfully, in a number of booksellers' shops in Philadelphia. He noted, however, that Dobson "below 4th Street is the scientific bookseller of Philadelphia & can give all kinds of information respecting the publications connected with the coal districts."[6] Later, while visiting a Pennsylvania scientist, Logan noted a book in his library by Edward Hitchcock, Professor of Chemistry and Natural History at Amherst College. This volume, *Report on the Geology, Mineralogy, Botany & Zoology of Massachusetts*, Logan wrote "is to be had in Boston & I must get it."[7]

Once established as head of the Geological Survey of Canada, Logan became the recipient of publishers' advertisements and catalogues. The well-known London firm of Bernard Quaritch, for example, forwarded a circular dated 15th January 1864 in which a number of scientific texts were promoted.[8] Since the headquarters of the Survey was situated in Montreal, Logan called on the services of nearby dealers. Evidence for this is found in the books and periodicals in his personal library. Numerous volumes of the scientific journals from the 1840s and 1850s contain labels of the Montreal firms: R. & A. Miller, John Lovell, and B. Hill.[9] Montreal book dealers served both personal and institutional collections and more will be said about this below.

Turning now to J.W. Dawson, we find that his contact with the publishing industry was made while he was still a teen-ager, largely because his father, James Dawson, was a book seller and publisher in Pictou, Nova Scotia. "Whilst I was still a student (in 1835)," Dawson wrote many years after, "my father became the proprietor of a printing establishment, and I had thus an opportunity of learning something of proof-reading, and matters connected with publication, which has not been without use to me in after life."[10] Young Dawson helped his father by travelling to Halifax and Boston to buy books from other publishing firms and dealers. In Halifax, for example, he dealt with Joseph Howe, a prominent newspaper proprietor and, in Boston, he carried on transactions with the editor and publisher, Nathaniel Willis.[11] No doubt it was through these book buying excursions for his father's firm that Dawson obtained his earliest acquisitions of scientific publications.[12] While still in his father's employment Dawson undertook university education in Edinburgh where he was brought in contact with British publishers and booksellers, some of whom would later supply him with scientific publications.

Returning to Canada after a year in Scotland, Dawson continued to work in his father's publishing enterprise for a number of years until educational and geological pursuits led to his appointment first as the Superintendent of Education for Nova Scotia and in 1855 to the position of principal of McGill University. Once settled in Montreal, Dawson became the focus for publishers and book dealers who sought to sell books to McGill University as well as to Dawson personally.

In the records of Dawson's early years at McGill one finds an 1855 trade list from the Montreal firm of R. & A. Miller. A year later another trade list, this one from the New York enterprise, A.S. Barnes & Co., identified books available through the mails.[13] Still one year later, a 12th August invoice from Hill and Martin, Booksellers itemized 46 titles including Thomson's *Mineralogy*, Griffin's *Crystallography* and Cuvier's *Theory of the Earth*.[14] A firm that figured prominently in the nineteenth century Montreal book industry, B. Dawson, was also a dealer that J.W. Dawson patronized.[15] Several volumes in his personal library contain the label of this bookseller. The book *Die Fossilen Farrnkrauter* by H.R. Goeppert published in Bonn, F. Cyrille Grand'Eury's *Flore Carbonifere du department de la Loire et du centre de la France*, published in 1877 in Paris, and an 1870 Boston title, *Scientific Results of a Journey in Brazil* by Louis Agassiz with a section on the geology and physical geography of Brazil by Charles F. Hartt all carry a label from the Dawson firm.

Outside of Canada, publishers in the United States and Great Britain offered books and periodicals for sale. In July 1874, for example, the American publishers of Spencer F. Baird's *The Land Birds, A History of North American Birds* forwarded a prospectus.[16] Also from the United States, the New York firm, C.M. Saxton & Co., sent an advertisement for agricultural books, and from England the London company, Day and Son, announced physiological diagrams that they had recently published.[17] On occasion, publishers dispensed with advertisements altogether; instead, they sent along complimentary copies of books they published. This was the case in 1884, for example, of Charles Griffin & Co. of London which sent to Dawson a complimentary copy of John Phillips's *Manual of Geology* recently revised by Prof. Seeley and W. Etheridge.[18]

Another British firm, which added a number of scientific titles to Dawson's library, was the London establishment, Dulau & Co. Among other publications this company distributed reprints of scientific papers. During the 1860s, 70s, and 80s Dawson received reprints by such British authors as Joseph Hooker, Maxwell Close, W.C. Williamson, William Heiller Baily, J. Starkie Gardner, and the European scientist, D. Stur all forwarded from Dulau & Co.[19]

B. Elkanah Billings

Elkanah Billings's early book and journal needs were determined by his work as a lawyer. He wrote to this father on 11th September 1844 asking for money to buy $91.00 worth of legal texts, stating that the books he listed were ones "which no lawyer should be without."[20] In the same letter Billings identified a New York bookseller where most of the texts could be purchased and noted that he could get a number of other books more cheaply in Toronto by buying them second hand. Billings's career in law was short-lived, as noted earlier in Chapter III. By the early 1850s he had moved to Bytown (Ottawa) to become editor of the *Bytown Citizen*, and in 1856 he had moved to Montreal to become the palaeontologist with the Geological Survey. Along the way he had acquired scientific texts, among them Charles Lyell's *A Second Visit to the United States of America* obtained at the Toronto bookstore of A.H. Armour & Co.[21]

While still in Ottawa, Billings entered into an arrangement with the Montreal publisher, Benjamin Dawson, who in 1856 began publishing Billings's new scientific periodical, *The Canadian Naturalist and Geologist*. This periodical, which in the next year became the official journal of the Natural History Society of Montreal, went on to become one of the most important scientific journals in Victorian Canada. In addition to the relationship of editor/publisher Billings also purchased scientific books and journals from the Dawson firm. In late December 1862, for example, while writing to his mother, Billings commented that he had placed an order with Dawson's for a "large number of books...from England for the library of the Survey" in addition to ordering books for himself and his mother.[22]

From Billings's personal library there is evidence that he patronized two other Montreal booksellers, namely R. &. A.

Miller and B. Hill. In 1867, for example, he purchased from the latter the work by Viscount Milton and W.B. Cheadle entitled, *The North-West Passage by Land, Being the Narrative of an Expedition from the Atlantic to the Pacific Undertaken...in the Rocky Mountains.*[23]

C. James Fletcher & William Saunders

The two agricultural scientists in this study made use of both local Ottawa book dealers and foreign firms. As the accountant for the Library of Parliament for about a decade, James Fletcher became well aware of the services offered in the publishing industry. He illustrated this knowledge, some time after he had moved to the Central Experimental Farm, when he wrote to a scientific colleague in British Columbia that "books on entomology can be imported free."[24]

Fletcher's correspondence demonstrates that he took numerous opportunities to obtain relevant scientific publications and as his reputation in the discipline became established he, too, was the recipient of publishers' promotional material. In 1888, the New York firm, Houghton, Mifflin and Company mailed out a flyer promoting a new section of W.H. Edwards *The Butterflies of North America* accompanied by a review published in *Science* on the 8th June of that year.[25] Twenty years later publishers' announcements were still noticed and commented upon.[26]

Depending on the nature of the scientific publication, Fletcher either enquired locally from book sellers in Ottawa or recommended foreign dealers. In the mid-1880s, for example, he arranged a number of purchases at the Ottawa bookstore of Durie & Sons.[27] A few years later, however, in reply to an enquiry from a Banff correspondent, he recommended the writer contact the Philadelphia dealer, E.J. Gerherd.[28]

As well as recommending American dealers, Fletcher also purchased scientific books for himself from U.S. firms, as is evident from an invoice tipped into the 1899 book, *Every-Day Butterflies* by the well-known American entomologist, Samuel Scudder.[29] Publishers, however, sometimes priced their publications out of the market as Dr. Eleanor Ormerod suggested in a letter to Fletcher on 16th July 1894. After noting that she had forwarded a copy of Dr. Ritzema Bos's *Agricultural Zoology* in English translation by Professor Ainsworth Davis, she went to write: "It seems to me a very useful book, but I think it is a mistake of Messrs. Chapman & Hall to have so arranged it that the price is 6*s*. This is almost a prohibitory price to many who could find 2*s*. 6*d*. or 3*s*....I should mention this copy is one of a few sent me for friends. I did not buy it or I would not have enlarged on the price!"[30]

But publishers did not always wait for scientists to purchase their new books and periodicals. As was noted earlier with Dawson, key scientists were targeted to receive complimentary copies in the hopes that these individuals would recommend the publications to their correspondents and readers. In this regard, Fletcher's library contains the book *Weeds, and How to Eradicate Them* by Thomas Shaw sent to him in 1893 by the Toronto company J.E. Bryand Company Limited.

William Saunders, too, was the recipient of publishers' complimentary books. On the 20th July 1899 he wrote to the Linscott Publishing Company of Toronto thanking them for a copy of Volume V of the *Encyclopedia of Canada* which contained an article that he had written. In spite of an offer from the Toronto company to provide other volumes of the encyclopedia at reduced charge, Saunders begged off by stating that he "would not make sufficient use of the work to warrant me in making the outlay."[31]

In some years Saunders's correspondents numbered in the thousands, and, as with Fletcher, he was often called upon to recommend scientific and agricultural publications. Writing to a correspondent from Digby County, Nova Scotia on 6th April 1899 he listed a number of horticultural books that he considered suitable and advised that all the books were available from a Toronto company.[32]

Travel outside the country provided Canadian scientists with the opportunity to consult foreign book dealers first hand. In a trip to England in 1886, Saunders did just that, making arrangements to acquire books and periodicals from a London dealer. He wrote to his son twice in May 1866 stating that he had purchased a variety of books, and added "we have made arrangements with a dealer here to get 25% [from advertised prices] off any books we want" and if they were mailed to Canada an additional 4% was included in the total.[33]

As a published author, Saunders dealt directly with the Philadelphia firm of J.B. Lippincott & Co. which had brought out his *Insects Injurious to Fruits*. Lippincott & Co. kept Saunders informed of its scientific publications, promoted his book through two editions, and was negotiating a third at the time of his death.[34]

D. Robert Bell

Of the six scientists in this study, the Robert Bell papers contain the greatest range of evidence of publishers and booksellers. Bell, a compulsive collector, saved items that others frequently discarded and this may account for the greater variety of documents relating to the publishing industry.

Throughout his career Robert Bell acquired books and journals from a variety of dealers. Texts that he bought as a student at McGill carry evidence of Montreal bookstores. Complementing the evidence within the books themselves are entries in Bell's diary for his early years in Montreal. On several occasions throughout 1859, for example, he recorded book purchases. In the latter part of November, in particular, he noted that he had procured "Livingstons [sic] Travels in Africa 10/6...Practical nat. Guide 2/6 Dawson's Synopsis of Zoology 1/-" "Bersillius on the Blow pipe $1.00," "Manual of Hydrostatics $0.70. Chalmers Practical mathematics $1.50 Jukes Manual of Geology 2.25 Gillespies Land Surveys 2.25. Danas Mineralogy $5.00" and "Lyell's Elements 12/6." On the basis of a bookseller's ticket in one of these volumes it is likely that Bell obtained all of these books from the firm of B. Dawson.[35] Additional diary entries suggest that Bell visited the Dawson bookshop on many occasions.[36] Bookshops were not the only source of scientific books and periodicals for Bell, however. In 1869, at a Montreal auction run by A. Booker, Commission Merchant & Importer, Bell acquired eight volumes of the *Canadian Naturalist and Geologist.*[37]

When Bell moved to other locations he extended his experiences gained from Montreal bookshops to other dealers. For upwards of three decades while he was in Ottawa he was a frequent customer at James Hope & Sons, "Booksellers, Importing & Manufacturing Stationers, Bookbinders and Job Printers." In addition, the firms of C.H. Thorburn, "Bookseller, Stationer & Newsdealer," James Ogilvy, Jr. "Bookseller, Stationer and Publisher," and Rolla L. Crain Co. were patronized.[38]

As with the other scientists in this study, Bell purchased books and periodicals through establishments outside his city of residence. Within Canada, the Toronto firm of Albert Britnell, which advertised itself as the "largest book store in British America" claiming to stock "100,000 volumes of rare choice and out-of-the-way books...constantly being replenished from European markets, purchases from private libraries, etc.," assisted Bell in acquiring publications for his library in 1904.[39] Outside of the country, Bell completed transactions with a number of British dealers including the following: James Thin in Edinburgh in 1881; Thomas Thorp in Reading, England in 1904; and, over a number of years during the 1890s he dealt with Francis Edwards in London.[40] In the United States, Bell carried on business with the Philadelphia establishment of A.E. Foote for over a period of thirty years beginning in 1867.[41]

Bell augmented his library by numerous individual one-time transactions with publishers. In addition, promotional activity by periodical publishers led Bell to subscribe to a variety of scientific periodicals, although some of the subscriptions seemed to have been of short duration.[42] Besides commercial publishers, professional societies invariably brought out proceedings and reports and these societies arranged for distribution of their own publications. A clear example of this can be found in the volume of preprints mailed out regularly by the American Institute of Mining Engineers prior to annual conferences.[43]

That publishers actively promoted scientific publications is readily apparent from the extensive number of catalogues, advertisements, brochures, advance notices, etc. found in the Bell papers. These came from a large number of North American and European publishers alerting Bell to new, forthcoming, and previously released publications. The range and extent of these promotional documents is illustrated by the list in Appendix II. For over a half century, extending from the 1860s through the first decade of the twentieth century, a variety of publishers and book sellers championed their books and periodicals through advertising directed to individual scientists, in this case, Bell. As the Victorian period ended the number of publishers represented in the list increased and the type of advertising, particularly the monthly lists provided by F.A. Brockhaus, aimed to draw a wide range of international literature to the attention of scientists.

In summary, the evidence drawn from the six scientists shows that book sellers and publishers both in Canada and abroad assisted Victorian Canadian researchers in acquiring scientific literature. They did this primarily by advertising which took several forms: catalogues, lists, flyers, brochures, leaflets, and others. Members of the publishing trade were interested in making sales, but even so, their promotional work encouraged the dissemination of scientific literature. Canadian scientists took advantage of local book shops and they also went further afield to acquire scientific literature. When the volume of scientific literature grew to large numbers at the turn of the twentieth century members of the book trade took steps to alert scientists to new scientific publications. In this regard, the monthly lists published by F.A. Brockhaus is an example.

E. **Institutional Libraries**

It is clear from the discussion above that members of the book trade regularly funnelled information about scientific publications (and/or sold actual books and periodicals) directly to scientists in Victorian Canadian. In addition, booksellers and publishers also provided this service by promoting and selling their stock to libraries. Attention is now turned to the institutional libraries in this study to obtain additional information concerning the dissemination of scientific literature in Victorian Canada.

a. **Natural History Society of Montreal Library**

Five of the libraries examined in Chapter VI can trace their origins to the early years of the Victorian period. But surviving records of booksellers and publishers that serviced the institutional libraries in those decades are few. The library of the Natural History Society, as noted in Chapter VI, was begun in 1827 at the time the Society itself was established. The Society's first location was in a room over a bookseller's shop but as the early holdings of the library of the Society were limited, it is doubtful if the Society received any special benefit from its co-resident of the building.[44] Robert Armour, Jr., editor of the Montreal *Gazette* was a charter member of the Natural History Society, and his brother, Andrew, who established the bookselling firm of Armour & Ramsay in 1835, held executive positions during the 1840s. During the same decade Armour & Ramsay was a wholesale dealer in magazines and books, so it is likely that the Armours had a hand in providing scientific literature for the library of the Society.[45]

Unfortunately, as early as the 1850s the Society reported that its records for the early decades had been irretrievably lost. Thus, the identity of the booksellers and publishers that sold books and periodicals to the Society during those early years is difficult to determine. Even in later years, when the records are more complete, publishers or booksellers are rarely noted even on the infrequent occasions when the Society allocated funds for purchases for the library. Three of the few occurrences when publishers were identified include: in 1861 S.E. Bragg travelled to Philadelphia and inquired about the availability of selected titles at the firms of J.B. Lippincott & Co., Hazard, and Henderson & Co.; in 1862 the Society reported that it had made arrangements with the London publishers of the *Geologist*, *Technologist*, and *Phytologist* to exchange periodicals (an arrangement that was maintained for a number of years); and, in 1894-95 the Library Committee listed Macmillan & Company of New York as having donated a number of books to the library.[46]

In the late 1850s, one Montreal publisher, as noted earlier, became an important partner with the Natural history Society. Benjamin Dawson, a native of Prince Edward Island, operated a Montreal bookstore from 1846, and by the mid-1850s ly relevant to their research.

Further evidence of the "working" description is found in marginalia scattered throughout publications. Annotations by the scientists were not extensive, but their frequency was sufficient to demonstrate that many of the publications had been examined. The scientists' valued their personal libraries. There appeared to be no difference between the geological and agricultural scientists in this regard. Personal bookplates were used and both reprints and issues of periodicals were organized and bound. Some scientists, such as Bell, wrote their name on almost all of their holdings to provide a clear indication of ownership.

A sizeable portion of the literature in these collections was distributed free of charge directly from other workers, and when particular publications were not received in this manner, the scientists wrote to the authors and asked for copies. Complimentary copies of publications is the second notable characteristic about the personal libraries. Books, reports, and reprints of scientific papers circulated with considerable regularity, although the latter figured much more prominently. The flow of reprints was not unidirectional, of course. Canadian scientists sent copies of their reports and papers to other researchers. As one example, Fletcher's correspondence bears this out, and Bell drew up lists of recipients for his publications.[59] Complimentary copies of publications were sent to institutional libraries

4 of/de 4

1.0 2.8 2.5 3.2 2.2 3.6 2.0 4.0 1.1 1.8 1.25 1.4 1.6

MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS
STANDARD REFERENCE MATERIAL 1010a
(ANSI and ISO TEST CHART No 2)

his sons had taken over the business. When the *Canadian Naturalist and Geologist* was transferred from the editorship of Elkanah Billings to the Natural History Society in 1857, Dawson continued to be the supportive publisher. In fact, as the editorial committee reported in 1859: "Messrs. B. Dawson & Son...intimate their present determination to undertake all the risks of publication, so long as the Society will provide the editors and contribute the articles."[47]

b. Mechanics' Institute of Montreal Library

Like the Natural History Society, the Mechanics' Institute of Montreal traces its origin to the late 1820s and like the Natural History Society, the Institute also relied on donations for many of its early book and periodical holdings. The first substantial purchase of books and periodicals was made in 1834 when a member travelled to London, England and made direct contact with booksellers.[48] A few years later John Lovell, who was to become probably the most important publisher in nineteenth century Canada, joined a group of Montrealers in re-establishing the failing Institute.[49] Even with a prominent publisher among the ranks, very few books or periodicals were actually purchased over the next decade, which led Nora Robins to conclude that "the library clearly ranked third to lectures and classes and frequently bore the brunt of the institutes indebtedness."[50]

Other Montreal publishers besides Lovell were members of the Mechanics' Institute as well. Benjamin Dawson, S.E. Dawson, and William Drysdale, a publisher in the latter part of the nineteenth century, were listed as life members, and William Foster Brown, who acquired the Dawson Brothers' retail book store in the 1890s, was registered as an annual first class member in 1889.[51]

The Mechanics' Institute frequently relied on publishers for support of its library and reading room. Throughout the latter part of the Victorian period, for example, Canadian and foreign publishers fulfilled this role by providing complimentary subscriptions to a variety of newspapers and magazines regularly received at the Institute.[52]

c. McGill University Library

Except for a few books and journals that were accumulated mostly through donations, the library of McGill University prior to the mid-1850s was virtually non-existent. But, as noted in Chapter VI, the appointment of John William Dawson as principal in 1855 led to improved fortunes for the library, and indeed the whole university. Still, for many years donated volumes were actively solicited and obtained. Funds for purchases were limited and this, in part, may account for spotty evidence of transactions with booksellers and publishers until the latter part of the Victorian period.[53]

During Dawson's early years at McGill local firms such as R. & A. Miller, H. Ramsay, and Hill and Martin delivered books to the McGill library.[54] Later in the century, as discussed below, publishers and agents in a number of countries handled book and periodical orders.

The historical records of the McGill library from the latter part of the Victorian period make it plain that publishers employed the same techniques to induce libraries to purchase scientific publications as they did with individual scientists. Brochures, leaflets, catalogues, and other promotional material were forwarded to the attention of librarians in an attempt to influence acquisition decisions. During this period primary responsibility for choosing titles for the library at McGill rested with faculty members. Nevertheless, librarians could influence particular acquisitions and publishers took advantage of this possibility. The American Book Company in New York, for example, forwarded a leaflet advertising a revised edition of James Dana's *Text-Book of Geology*. Gustav Fischer in Jena, Germany sent out an advertisement for R. Korschelft and K. Heider's *Lehrbuch der Vergleichenden Entwicklungsgeschichte der Wirbellosen Tiere*. Similarly, the publishing house of A. Stuber in Würzburg promoted a number of titles including Max Braun's *Die Tierischen Parasiten des Menschen* and Ginn & Company of Boston publicised *The Journal of Morphology*.[55] As was the case with individual scientists, publishers also donated books and periodicals to libraries. In 1890-91, for example, Macmillan and Company of London, England presented the McGill library with a number of volumes.[56]

In the decades leading up to the end of the Victorian period, it is clear that McGill University engaged both local and foreign agents for the purchase of books and periodicals. To illustrate this point, we need only look to the daily journal for 1889 as one example. In that year W. Foster Brown, who had bought out the retail division of Dawson Brothers, responded on fifteen separate occasions to purchase requests from McGill. Included among these transactions was a lengthy list of subscriptions to periodicals, many of them scientific. The McGill library also purchased titles from William Drysdale & Co. on six occasions, and received titles from Beauchemin et fils on one date, and on four dates from E.M. Renouf.[57] Outside of the province the library dealt with Elliot Stock of London, England (four occasions) and Macmillan & Co., London, England, (two occasions). Transactions with Scottish and American firms were recorded but none of these were purchases of scientific publications.[58]

The number of dealers with whom the library dealt broadened after Charles H. Gould became the librarian in 1893. F.A. Brockhaus, the Leipzig company that figured in the acquisitions of other personal and institutional libraries, received book orders from McGill in 1897.[59] The next year William F. Clay, "Technological and Scientific Bookseller" of Edinburgh, filled requests for books and periodicals, and William Rice of London was also engaged as agent. In that same year, Gould wrote to John Wiley & Sons in New York seeking "special rates" for scientific publications.[60] At the turn of the century Brockhaus was still filling orders for the library and, in addition, Charles Scribners' Sons in New York, Henry Sotheran in London, and H. Le Soudner in Paris were responding to purchase requests.[61] Gould carefully monitored the disbursement of the limited acquisition funds available to him and noted, as the Victorian period was drawing to a close, that employment of agents was wise because "to subscribe to all periodicals direct would involve a considerable loss in the way of discounts besides causing much extra detail and labour in the Library..."[62]

d. The Geological Survey of Canada Library

In the first years of the Geological Survey of Canada, acquisitions for the library were intertwined with acquisitions for W.E. Logan's own personal library. The library of the one was the library of the other for most of the first decades of the Survey's activities. Logan, as was noted earlier in this chapter, obtained books and periodicals wherever it was most convenient.

In the 1850s, at least some of the acquisitions were secured from Dawsons in Montreal. Evidence for this is found in two sources, the correspondence of Elkanah Billings noted above, and books and periodicals from the Survey library. An example of the latter is an 1858 title of the Geological

Society of London, published in London by Taylor and Francis which carries a label of B. Dawson, Bookseller & Stationer.[63] It is also possible that the Montreal firm of R. & A. Miller was the source of some scientific publications.[64]

When attention is directed to the latter part of the Victorian period, further details about booksellers and publishers that dealt with the Survey library can be obtained from the federal Public Accounts. Taking the year 1888 as an example, the Survey purchased $259.51 worth of books and subscriptions through the London firm, Gurney & Jackson, as well as books from G.W. Tryon of Philadelphia, C.L. Woodward of New York, R.V. Douglass of Toronto, and A.E. Foote, of Philadelphia.[65] Four years later, in 1892, books and periodicals were obtained from a variety of firms including: John Lovell & Co., Might Directory Co., B. Westerman & Co., Boulanger & Marcotte, F. Brockhaus, William Wesley & Son, Scientific Publishing Co., Ch Chadenant, Max Weg, and R. B. Hough.[66] In that year the Auditor General, J.L. McDougall, advised the Director that books and periodicals for the Geological Survey had to be obtained through the federal Department of Printing and Stationery rather than placing orders directly with publishers or dealers. To do otherwise, as the Survey had been doing, was in violation of the Act which created the Printing and Stationery Department.[67] In subsequent years acquisitions for the Library were obtained via the Department of Printing and Stationery and the public accounts for that

Department contain information that identifies book sellers and publishers who sold scientific works to the government. In 1894, for example, scientific books and periodicals were purchased from the North American firms: D. Appleton & Co. (Toronto), E.G. Biggar (Toronto), G.R. Blanchard (Chicago), Wm. Foster Brown & Co. (Montreal), S.E. Cassino (Boston), A.S. Clark (New York), Copp, Clark Co. (Toronto), J. Durie & Son (Ottawa), John Lovell & Son (Montreal), S.R. Roberts (Philadelphia), the Scientific Publishing Co. (New York), and Charles Scribner's Sons (New York). In the same year the library acquired publications from the European firms of F.A. Brockhaus, Eyre & Spottiswoode, and Henry Sotheran, among others.[68]

Throughout the remaining years of the nineteenth century, many of the same booksellers and publishers were engaged on an annual basis by the Department of Printing and Stationery. In 1897, Ellen Brunchorst (Bergen), James G. Commin (Exeter), Comptoir Géologique (Paris), E. Defosse (Paris), Gurney & Jackson (London), Henrich Lesser (Breslau), and Julius Springer (Berlin), all British or European firms, received orders for books and periodicals specifically intended for the Geological Survey.[69] Until the end of the Victorian period, the Department of Printing and Stationery continued to act as local agent for the Geological Survey.

e. The Library of the Central Experimental Farm

The library of the Central Experimental Farm was the last of the six in this study to be established. All of the records for this library come from the closing decades of the Victorian period. In contrast to the Geological Survey which spent between $500.00 and $1000.00 each year on acquisitions for its library, the Central Experimental Farm had a more modest budget. Annual allocations were in the order of $225.00 or less. With this moderate fund books and periodicals were acquired in North America and in Europe. A few years after the Experimental Farm System was established the Public Accounts report that books were obtained from the local Ottawa bookseller, J. Durie & Sons, and from the American firms, J.B. Lippincott & Co., Philadelphia, A.E. Foote, also in Philadelphia, Munn & Co., New York, and S.E. Cassino, Boston.[70]

While the Geological Survey was admonished to follow the rules and purchase scientific publications through the Department of Printing and Stationery, the Central Experimental Farm seemed not to have come under the same regulation. During the years of the last decade of the nineteenth century and the first of the twentieth when the Public Accounts provide sufficient detail, all book and periodical acquisitions for the library were directly controlled by the staff at the Experimental Farm.[71] Also in contrast with the Geological Survey subscriptions to scientific periodicals were placed with individual publishers rather than ordering journals through an agent who would handle a variety of requisitions. By way of illustration, orders, in 1897, were placed with the Chemical Publishing Co, Easton, Pennsylvania for *Wiley's Analysis*, Clarendon Press, London, England for *Annals of Botany*, the Scientific Press Ltd., of London, England for a year's subscription to *Science Progress*, and H.B. Donavan in Toronto for *Canadian Poultry Review*.[72] This subscription pattern was followed for a number of years.

Perhaps the more characteristic feature about the library of the Central Experimental Farm was transactions completed with distinctively agricultural publishers. The annual volumes of the Holstein-Friesian Association and the Dominion Short Horn Breeder's Association were obtained by taking out membership in the respective societies, and the agricultural press, both in North American and in England and Europe, added publications to the library. Among the latter were such titles as *The Live Stock Journal* published in London, England, the *American Agriculturist* out of Chicago, *American Gardening* issued in New York, and *Nor' West Farmer* produced in Winnipeg. All of these periodicals, as well as others, were obtained directly from the individual publishers.

f. The Library of Parliament

The Library of Parliament, the oldest library examined in this study, had the largest endowment, the best of any library in the country during the Victorian period. Because of its lengthy history the number of booksellers, publishers, and agents that the library dealt with is extensive and to itemize them here would be a story in itself. Among the detail of names, however, are two features that merit noting - the reliance on a small number of agents and buying trips abroad.

In the early decades of the Victorian period, as noted in Chapter VI, the library endured two disastrous fires (one in 1849 in Montreal when the library was virtually destroyed and the other in 1854 in Quebec City when a sizeable portion of the library was lost). It was during this period that two major buying trips abroad were undertaken and dependence on agents was established.[73]

In 1851, G.B. Faribault, assistant clerk in the Legislature, was dispatched to Europe (principally England and France) with a credit of £4,400 to arrange acquisitions for the recently devastated library. A few years later, in 1855, the librarian, Alpheus Todd, repeated the process, again both to find replacements for lost books and periodicals and to obtain new publications. But with £9,621 9*s*. 6*d*, Todd had more than twice the money at his disposal than Faribault did four years earlier. Faribault and Todd completed their transactions in Europe and returned to Canada with thousands of volumes for the library.[74]

Both Faribault and Todd were aided in their work in

London and Paris by the fact that by that date the library had already established accounts with two principal agents, one in each city, who filled most of the orders emanating from the library as well as handling exchanges, binding requirements, and other matters for the library.

In London, George Rich was employed as agent and in Paris the firm of Hector Bossange filled this responsibility.[75] Both agencies maintained long standing accounts with the Library. This practice of depending on agents for large portions of the annual acquisitions extended well into the twentieth century. In a memorandum dated July 1920 the principal agents at that time were identified and their services described. For "something like fifty years," the memo states, E.G. Allen & Son of London (which had taken over the George Rich agency in the late 1850s) rendered excellent service to the Library.[76] A significant portion of the annual budget for books was taken up by the Allan account. In the early 1890s, for example, over $5000.00 went to the London agent for collecting books, keeping lists of exchanges, paying subscriptions to periodicals, collecting official publications, and obtaining second-hand books when required.[77]

During his buying trip to Europe in 1855, Alpheus Todd dealt with the Paris agency of Hector Bossange.[78] Later in the century Charles Gaulon handled the Paris account. In 1890 $2,130.42 was allocated to the Paris agency and in 1892 the figure was $2,070.62. Gaulon, and before that Bossange, were primarily responsible for French language publications, but they also arranged delivery of other European works as well.

The 1920 memo noted that another agent, that had been employed by the library for "nearly half a century," was Little, Brown & Co., in Boston. This company dealt in American publications, and, in addition, two other American firms (Charles Scribner's Sons, New York and W.H. Lowdermilk & Co., Washington) also received significant patronage from the library.[79]

At home in Canada, at least in the early period, an agent was engaged as well. In 1852, the minutes of the Joint Committee on the Library of Parliament, a committee that was responsible for the overall policy and administration of the Library of Parliament, recorded that Peter Sinclair of Quebec City handled orders for American publications. The Library continued to employ Sinclair's services even when an offer came in from an American bookseller, C. Goodrich of Burlington, Vermont, to take on that obligation.[80] At end of the decade the Library Committee seemed to have changed its mind about engaging a local Canadian agent. When John S. Geikie, a Toronto bookseller, applied to the committee to be employed in the purchase of books for the library, the committee noted that "a resident Agency had been tried, once or twice, in Montreal, and had proved so unsatisfactory and extravagant, that they were unanimously of the opinion that they could not do better than adhere to the present system," that is, refer most of their orders to the agents in London and Paris.[81]

Although the larger portions of the annual acquisition budgets were allocated to three or four agents in North America and Europe, the Library also placed many smaller orders with a wide variety of booksellers and publishers, both in Canada and elsewhere. This was true in the 1850s and was also the case at the end of the Victorian period. Invoices and purchase orders for 1859, for example, include a subscription for *The Canadian Naturalist and Geologist* placed with B. Dawson & Son of Montreal, an invoice from Andrew H. Armour & Co. for Miller's *Popular Geology* and *North American Insects*, and an invoice from John Wiley & Ralsted, New York for Roger's *Geology of Pennsylvania* (3 volumes) and Hall & Whitney's *Geology of Iowa* (2 volumes).[82] At the end of the century, the Public Accounts illustrate that this pattern of placing many small orders with individual booksellers and publishers had continued.[83]

The Library of Parliament, possibly because of its larger buying power, found it more efficient to depend on a few agents for the bulk of its acquisitions. Agents, too, found the accounts worthwhile. Throughout the Victorian period, individual publishers of scientific publications might use their persuasive techniques to encourage the Library to acquire their publications, but, if purchases were actually made, such transactions were handled indirectly through agents. The system of agents was not fool-proof, however.

It was still necessary to place orders with individual publishers when some scientific publications were not carried by the agents.

The identification of many booksellers and publishers has been determined with some degree of ease from the records of each of the six scientists and each of the six libraries in this study. The discussion now turns to the significance of the role that these members of the publishing trade played in the dissemination of scientific literature.

The Role of Booksellers/Publishers

Booksellers and publishers, functioning in a manner that complemented the activities of individual scientists and institutional libraries, were agents for the distribution of scientific literature in Victorian Canada. To encourage dissemination, the publishing industry used a variety of methods, all marketing ploys designed to sell stock and ultimately get publications into the hands of individual scientists.

A method used to reach a wide reading audience involved placing advertisements in newspapers of the day. In October 1845, for example, every issue of the *Montreal Gazette* carried advertisements of the firm, Armour & Ramsay. "Just Received" claimed one advertisement, which appeared on several occasions, and among the titles it announced was the English edition of Charles Lyell's *Travels in North American with*

Geological Observations of the United States, Canada, and Nova Scotia published in that year. Another advertisement drew attention to a number of "Monthly Publications" including a section of *The Naturalist's Library* edited by Sir William Jardine dealing with Mammalia.[84] As the century progressed, however, advertisements that itemized specific titles became less common and by the 1880s Dawson Brothers were simply advertising "All the New Books of the Day, Whether Published in England or America," or "New Books! The Latest Issues of the English & American Press Received Daily by Express. United States Books Sold at New York Prices."[85] The attempt, in the early decades of the Victoria era, to reach the public at large in "scatter-shot" fashion was discontinued in favour of the more successful targeting of advertising toward a more select audience.

Inclusion of lists or catalogues as supplementary matter in books was another method of alerting scientists to relevant publications. This was a wide-spread custom adopted by both North American and European publishers and, from the 1830s through to the end of the Victorian period, publishers promoted their publications with such lists. An early example is an 1837 volume in Dawson's library published by the London firm, Longman Orme, Brown, Green & Longman's and John Taylor which has a 16 page catalogue of books preceding the text. Many books from each of the scientist's libraries illustrate this method of advertising. Some of the catalogues were extensive, running to 30 or more pages, others were more restricted, such as lists forming the endpapers of books.[86] Catalogues could list publications on a wide range of topics, but more frequently the content of the lists matched the subject content of the book in which they appeared. While catalogues of this nature were most often included in books, to a smaller degree publishers extended this method of advertising to reprints as well.[87] Scientific journals were also a location for publishers to place advertisements. As an example, *The Canadian Naturalist* carried advertisements from B. Dawson & Son. In the September issue for 1857 over 35 books on scientific topics available at the Dawson shop were listed. A few years later, Dawson's featured their own publications in their ads.[88] Advertisements printed in scientific periodicals were common throughout the Victorian period and it is a practice still widely followed today.

To be effective, advertising contained within scientific works had to actually reach scientists -- that is, researchers had to have access to those publications. Of course, this was not always the case. When access was limited, direct mail advertising (catalogues, brochures, pamphlets, etc.) was used. Accompanying the increasing volume of scientific publications as the nineteenth century progressed was an escalating quantity of stand-alone promotional material. This trend is best illustrated from the Bell papers, as noted earlier. Scientists around the world were targeted to receive such advertising and, if Bell is used as an example, it is evident that publishers widely exploited this method of disseminating scientific literature.

Publishers and booksellers placed scientific literature in the hands of scientists by direct sale. On a more selective basis, they ensured scientists received publications by sending along complimentary copies. Clearly, this latter method of dissemination could not be practised on a wide-scale basis, but books and periodicals placed in the hands of selected individuals ensured future citations and inclusion in announcements of recent publications in key journals. In a corresponding manner, publishers sent out review copies of scientific titles in the hopes of getting good reviews.

The data and discussion presented in this chapter makes it readily apparent that publishers and booksellers had a stake in the dissemination of scientific information in Victorian Canada. They advertised and promoted their products vigorously. To the extent that their stock or publications was concentrated in the sciences, their livelihood depended upon it. Some, such as B. Dawson, had a more altruistic view and bore some of the costs of launching scientific journals. But no publisher or bookseller could afford to underwrite longstanding losses on scientific publications.

Booksellers and publishers fulfilled an important function in the dissemination of scientific literature. To return to the questions posed at the beginning of this chapter, we can now affirm that the agents of the book trade can be identified. Both Canadian and foreign firms were involved. Canadian firms acted as distributors for scientific literature published outside the country as well as books and periodicals produced in Canada. Although Canadian scientists and libraries took advantage of the services of local booksellers and publishers, they often dealt directly with foreign firms. Scientists forwarded individual orders to dealers and publishers in Britain and the United States and to a lesser extent to those in Europe. Libraries acquired publications from Canadian firms but also dealt directly with foreign publishers. Libraries often found it more efficient and convenient to place orders for many of their books and periodical requirements with single agents, principally agencies in London and selected European and American cities. Some agencies maintained long standing accounts with Canadian libraries. They became familiar with the requirements of their clients and forwarded publications without the libraries needing specifically to request them. Because the staff of agencies made it a policy to be well informed about literature published in many locations, the employment of agencies reduced the chances of scientific publications being missed by Canadians. At the end of the Victorian period the larger libraries were well served by agencies.

In answer to the second question about how members of the publishing industry fostered the distribution of scientific literature in Victorian Canada, we can now say they did this in a variety of ways. The most important was through advertising, which brought new and previously published scientific literature to the attention of scientists and librarians. Booksellers and publishers sent promotional material directly to scientists and librarians who, like Robert Bell, received a large number of catalogues, lists, flyers, etc. Scientists scanned the promotional material for new titles, wrote their names on their copies, or otherwise marked up lists. All this ephemeral material helped to promote the distribution of scientific publications.

Publishers' agents, whether located in Canada or abroad, also promoted the dissemination of scientific literature in a second way. As the volume of scientific literature increased throughout the nineteenth century, agencies arose that specialized in scientific literature. One such agency was F.A Brockhaus of Leipzig. This firm prepared a "Monthly Gazette of Current Literature" published in several European languages. Each issue of the *Gazette* brought together an extensive list of scientific publications that had been published in a wide variety of locations around the world. In 1906, Robert Bell received this service. It was no doubt costly to compile these lists, but Brockhaus was a prominent agency serving libraries and individuals in North America and Europe. Smaller agencies also produced more limited lists of publications. In a manner akin to SDI (Selective Dissemination of Information) practices of the late twentieth century, agents fostered the dissemination of scientific literature with their published lists.

A third way in which members of the publishing industry furthered the dissemination of scientific literature was by publishing the scientists' findings. Canadian publishers, such as Benjamin Dawson, were instrumental in launching Canadian periodicals and they also published books that Canadian scientists wrote.[89] The Dawson firm played an active part in publishing the work of Canadian scientists, bringing out *The Canadian Naturalist & Geologist* along with a number of scientific books by Canadian authors.[90] In addition, Canadian firms printed the thousands of copies of reports authored by geological and agricultural scientists, which formed the backbone of exchange programmes so successfully maintained by libraries and individual scientists. Victorian Canadian researchers, as illustrated by the six scientists of this study, also sought and obtained publication of their research outside the country where foreign firms helped to disseminate scientific literature by promoting books and periodicals internationally.[91]

By joining local scientific societies, Canadian members of the book trade promoted the dissemination of scientific literature in a fourth though less direct way. One of the functions of these associations was to disseminate scientific information and a healthy active society depended on its members for support. Benjamin Dawson and his sons, for example, were members of the Natural History Society of Montreal and the mechanics' institute in that city. The publishers, Robert and Andrew Armour were members of the Natural History Society as well.

In the important matter of reprints, members of the publishing industry helped to disseminate scientific literature in a fifth way. Some companies collected reprints and mailed them out in packages. J.W. Dawson, for example, was the recipient of reprints of a number of British authors handled by the London establishment, Dulau & Co. Papers presented at conferences of scientific societies were sometimes distributed by the associations which had acted as publishers. An illustration of this practice is found in the preprints of conference papers that Robert Bell had received. Other scientists benefited from this type of service, too.

To sum up, both Canadian and foreign booksellers and publishers fulfilled an important role in the distribution of scientific literature in Victorian Canada. Libraries were enhanced, scientists became aware of scientific literature, and scientific research was published through the efforts of members of the publishing industry.

Notes to Chapter VII

1. George L. Parker, *The Beginnings of the Book Trade in Canada* (Toronto: University of Toronto Press, 1985), ix. In Appendix C of this book Parker provides import statistics for the period 1867 to 1900. See also, G.P. de T. Glazebrook, *Life in Ontario. A Social History* (Toronto: University of Toronto Press, 1975), 213-214.

2. Even in latter part of the twentieth century the picture has not changed dramatically since Canada today produces only about 2 to 3 percent of the world's scientific literature and importation is still the "name of the game."

3. Charles J.S. Bethune, "The Rise and Progress of Entomology in Canada," *Proceedings and Transactions of the Royal Society of Canada* 4, sect. 4, (May 1898): 159.

4. J.M. Harrison and E. Hall, "William Edmond Logan," *Proceedings of the Geological Association of Canada* 15 (1963): 34.

5. See, for example, a letter dated 9th April 1858 from W.B. Lowenby of London, England requesting an "order for payment" to send the last two parts of the "Thesaurus Conchylliorum" to Canada. William Edmond Logan Papers, McGill University Archives, MG 2046, Accession 1207/11.

6. Entry for 14th August 1841 and later dates in a diary, dealing with Canada and the United States, 1840-1841. William Logan Papers. Metropolitan Toronto Reference Library.

7. Ibid.

8. Bernard Quaritch, to William Logan, dated London, 15th January 1864. William Edmond Logan Papers. MG 2046, Accession 1207.

9. The presence of the labels (or, in some cases, binder's tickets) is not direct evidence of actual purchases from these Montreal firms, however. Logan may simply have sent unbound issues of journals that he could have bought elsewhere to these firms for binding.

10. J.W. Dawson, *Fifty Years of Work in Canada. Scientific and Educational*, ed. Rankine Dawson, (London and Edinburgh: Ballantyne, Hanson & Co., 1901), 31.

11. Ibid., 31-33.

12. For a description of the those early acquisitions see the discussion of Dawson's personal library in Chapter V.

13. R. and A. Miller Trade List, dated April 1855 and A.S. Barnes catalogue, dated January 1856. John William Dawson Papers, McGill University Archives, MG 1022, Accession 927.

14. Invoice from Hill and Martin, Booksellers, dated 12th August 1857. John William Dawson Papers.

15. This firm later became B. Dawson & Son. Still later it was named Dawson Brothers, and in the last decade of the nineteenth century it became W. Foster Brown & Co.

16. Publisher's advertisement for "The Land Birds" by Spencer F. Baird, Thomas M. Brewer and Robert Ridgway, dated July 1874. John William Dawson Papers.

17. Undated advertisement for agricultural books published by C.M. Saxton & Co., 140 Fulton Street, New York. One page undated prospectus from Day and Son, Lithographers to the Queen, London. John William Dawson Papers.

18. Charles Griffin & Co., Exeter Street, Strand, London to J.W. Dawson, 28th October 1884. McGill University Libraries Papers, McGill University Archives, RG 40.

19. Ellen Wells has noted that catalogues for the more scholarly trade, which began to appear after the mid-nineteenth century, at least in the sciences, contained lists of reprints under particular scientific subjects. Ellen B. Wells, "Scientists' Libraries: A Handlist of Printed Sources," *Annals of Science* 40 (1983), 320.

20. Elkanah Billings to his father, dated Toronto, 11th September 1844. Billings Family Papers. Ottawa City Archives, MG 2-1-7.

21. The two volume work by Charles Lyell was published in New York by Harper & Brothers in 1849 and contains the label: "A.H. Armour & Co., Booksellers, King Street, Toronto." Billings seemed not to have acquired many scientific publications prior to his move to Ottawa and later Montreal. While still practising law he wrote to this mother from Renfrew, Ontario on 29th March 1852 despairing his financial situation: "...when I came here I had nothing but my law books. I had no money and was out of clothes..." Elkanah Billings to his mother, 29th March 1852. Billings Family Papers, MG 2-1-12. The Charles Lyell publication may not, therefore, have been acquired while Billings was in Toronto.

22. Elkanah Billings to his mother 10th December 1862 and 31st December 1862. Billings Family Papers. Ottawa City Archives, MG 2-1-81, MG 2-1-84.

23. This volume published in 1865 in London by Cassell, Peter, and Galpin has the label: "Hill, Bookseller, Montreal."

24. James Fletcher to "My dear Taylor" [Rev. G.W. Taylor, Wellington, B.C.] 10th March 1908. Department of Agriculture Papers. National Archives of Canada, RG 17, A II 7, volume 2368.

25. James Fletcher Papers. Canada Agriculture Library, Entomological Division, Ottawa.

26. Arthur Gibson to James Fletcher, 9th October 1908. Department of Agriculture Papers. RG 17, A II 7, vol. 2369.

27. James Fletcher to George Henry, Bowmanville, Ontario, 6th November 1886, 22nd December 1885, and James Fletcher to Thomas Henry, Bowmanville, Ontario, 12th February 1886. Department of Agriculture Papers. RG 17, A II 7, Volume 2330.

28. James Fletcher to N.B. Sanson, Banff, Alberta, 28th March 1908. Department of Agriculture Papers. RG 17, A II 7, Volume 2368.

29. Invoice addressed to Mr. J. Fletcher, 5th June 1899 tipped into the inside front cover of Samuel Hubbard Scudder. *Every-Day Butterflies. A Group of Biographies* (Boston: Houghton, Mifflin and Company, 1899), 391 p. Canada Department of Agriculture Library. Entomological Division, Ottawa.

30. Eleanor Ormerod to James Fletcher, 16th July 1894. Reprinted in *Eleanor Ormerod, LL.D. Economic Entomologist. Autobiography and Correspondence*, ed. Robert Wallace, (New York: E.P. Dutton and Company, 1904), 222.

31. William Saunders to J. Galloway, at the Linscott Publishing Company, Toronto, 20th July 1899. Department of Agriculture Papers. National Archives of Canada, RG 17, A II 1, Volume 2099.

32. William Saunders to Rev. Ed. LeBlanc, Meteghan, Digby Co., Nova Scotia, 6th April 1899. Department of Agriculture Papers. RG 17, A II 1, Volume 2099. At certain times of the year the mail received at the Central Experimental Farm was massive. In a letter dated 8th March 1899 to W.A. Whitney, President of the Horticultural Society, Saunders commented on the heavy workload of dealing with "about one thousand letters a day, so you can imagine how my correspondence piles up..." William Saunders to W.A. Whitney, 8th March 1899. Department of Agriculture Papers.

33. William Saunders to W.E. Saunders, 12th May 1866 and 19th May 1866. Saunders Family Papers. Regional Collection, D.B. Weldon Library, University of Western Ontario. Box 5434.

34. Some of the correspondence concerning the third edition of *Insects Injurious to Fruits* is held in the Saunders Family Papers, Regional Collection, D.B. Weldon Library, at the University of Western Ontario, and other correspondence is contained in William Saunders Papers, in the Rare Book Collection, Canada Agriculture Main Library, Ottawa.

35. Diary entries for 19th, 23rd, & 24th November and 5th December 1859. Robert Bell Papers. National Archives of Canada. MG 29 B15. The W.M. Gillespie title, *A Treatise on Land-Surveying: Comprising the Theory Developed from Five Elementary Principles* (New York: D. Appleton & Co., 1858) carries the label: B. Dawson, Bookseller & Stationer, Montreal. Another title, *Handbook of Geological Terms and Geology* by David Paige (Edinburgh & London: William Blackwood and Sons, 1859), probably purchased around the same time, has the bookseller's label: Dawson Bros., 23 Great St. James Street, Montreal.

36. On 9th November 1863, for example, Bell wrote in his diary: "Books bought at Dawson's $16.90. Subscription for Naturalist $3.00." On 22nd June of that year he had purchased James Dana's *Manual of Geology* for $3.75, probably also at Dawson's. Among the Bell papers for that same year is an invoice addressed to "Robert Bell, Esq. Geological Survey" from "Dawson Bros. Booksellers, Stationers, Printsellers and Periodical Agents" dated 8th April 1863. In January 1868 Bell recorded in his diary that he obtained the "'Canadian Naturalist' 64 & 65 6.00 [and] Chambers' Practical chem. 0.75" at Dawson's. Robert Bell Papers.

37. Statement of A. Booker, dated: "Warehouse, no. 359 Notre Dame Street, Montreal, 5th May 1869," and addressed: "Professor Bell by Auction at Rooms, Cash & Duty - 8 volumes books $5.26." Bell wrote on this statement: Receipt from A. Booker auction $5.26 for 8 vols. "Canadian Naturalist Montreal 5th May '69." Robert Bell Papers.

38. The Bell papers contain a number of invoices and statements from James Hope & Sons with varying dates covering the early years of the twentieth century. In addition, for the same years the papers contain statements or invoices from the firms: C.H. Thorburn, Rolla L. Crain Co., Limited, and James Ogilvy. Robert Bell Papers.

39. Two statements from Britnell's addressed to Bell one on 11th February 1904 and the other on 1st October 1904. The declaration of the size the Britnell stock is contained on the invoice of 11th February 1904. From this latter invoice it

is evident that Bell had ordered an item from a catalogue. Robert Bell Papers.

40. James Thin, "New and Second Hand Bookseller," South Bridge and Infirmary Street, Edinburgh to Robert Bell 27th January 1881 in which a number of scientific publications are itemized. Statement of Account dated 22nd February 1904 from Thomas Thorp, "English & Foreign Bookseller, 4 Broad Street, Reading." Robert Bell to Francis Edwards dated 24th April 1890 in which he ordered a number of items from an Edwards' catalogue and subsequent letters from Edwards to Bell dated 14th June 1890, 16th March 1891, and 16th April 1895. Bell also listed a number of books available from an Edwards' catalogue on two undated sheets from a small note pad. Robert Bell Papers.

41. See a number of letters and notes between Bell and A.E. Foote covering the period from 1867 to 1894. Foote dealt not only with scientific publications but also with minerals as well. Robert Bell Papers.

42. An example of an individual purchase is the order Bell placed in 1898 for Volume VI of *Mineral Industry*. Business Manager of The Mineral Industry to Robert Bell, 30th June 1898. Among the periodicals that Bell subscribed to were: *Stone* (almost continuous holdings for the period 1893 to 1904 have been identified); *The Canadian Mining Review* (selected holdings the period 1887-1906); *American Journal of Mining* (selected holdings for 1866-1867); *The Mining Review and Metallurgist* (selected holdings for 1894-1895); *The New Zealand Mines Record* (selected holdings for 1901-1905); *American Forestry* (selected holdings for 1910-1920); *The Engineering and Mining Journal* (selected holdings for 1890-1916), *The Canadian Mining Journal* (selected holdings for 1907-1917), and *Cassier's Magazine* (selected holdings for 1897-1898). In addition, there is a wide assortment of periodicals of which only one or two issues can be identified, and it is clear that sample copies were sent to Bell as an enticement to subscribe on a regular basis. Among these latter titles are: *The Popular Science Monthly* published in New York, *The Polytechnic* issued by the Rensselaer Polytechnic Institute in Troy, New York, *Mining Science* published in Denver Colorado, *Electric Power* published by the Electric Power Publishing company of New York, *The Microscopical Bulletin and Science News* issued from Philadelphia, and *Modern Medical Science* published in New York. All of the above are held in the Robert Bell Papers.

43. Throughout the last decade of the nineteenth century and the first decade of the twentieth Bell received a large number of conference preprints from the American Institute of Mining Engineers. For example, a list accompanying a package of preprints sent out in March 1903 itemizes seventeen titles.

Some of the preprints are still in the original mailing package, and of these some were probably left unread by Bell. The American Institute of Mining Engineers was not alone in actively distributing its own publications. Other engineering and scientific societies followed the same pattern. Robert Bell Papers.

44. Dr. Andrew Holmes, a long standing member of the Society, commenting on the early history of the Society stated in 1859: "...the Society met at first in a small room, over a bookseller's shop in St. Paul Street, and remained their for several years until their collection [the museum] became too large for this room." "Inauguration of the New Buildings of the Natural History Society, Cathcart Street, Montreal," *Canadian Naturalist and Geologist* 4 (1859): 141.

45. Robert Armour, Jr. is listed as a charter member of the Natural History Society in the *Constitution and Bye-Laws of the Natural History Society of Montreal* (Montreal: Printed at the Montreal Gazette Office, 1828), 23. For a discussion on Andrew Armour and the firm of Armour & Ramsay, see Parker. *The Beginnings of the Book Trade in Canada*, 111-114.

46. For the 1861 notice of Philadelphia firms see, *Annual Report of the Natural History Society of Montreal for the Year Ending May, 1861...* (Montreal: Printed by John Lovell, 1861), 15. For the 1862 report see "List of Donations to the Library," *Canadian Naturalist and Geologist* 7 (1862): 235. Finally, for the 1894-95 account see E.T. Chambers, "Report of the Library Committee," *Canadian Record of Science* 6 (1894-95): 381.

47. "Report of the Editing Committee," *Canadian Naturalist and Geologist* 4 (1859): 239. A year later, the Society reported that Dawson's continued "with great liberality to publish the Magazine at some loss to themselves." *Annual Report of the Natural History Society of Montreal for the Year Ending May, 1860* (Montreal: Printed by John Lovell, 1860), 29. Dawson's had been supportive of the *Canadian Naturalist* right from the beginning, having provided illustrations, copies for exchange, and review copies of books. For further discussion of the Dawson firm see, Parker, *The Beginnings of the Book Trade in Canada*, 132.

48. Patrick Keane, "Priorities and Resources in Adult Education: The Montreal Mechanics' Institute (1828-1843)," *McGill Journal of Education* 23 (Spring 1988): 176.

49. Ibid., 177. Earlier in the century, another Montreal publisher, Robert Armour, had been instrumental in founding the first Mechanics' Institute in the city. It was not uncommon for Canadian publishers to be instrumental in establishing Mechanics' Institutes. Besides Lovell and Armour in Montreal,

John Neilson in Quebec City and Joseph Howe in Halifax played active roles in the formation of institutes in their respective cities. Parker, *The Beginnings of the Book Trade in Canada*, 98.

50. Nora Robins, "The Montreal Mechanics' Institute: 1828-1870," *Canadian Library Journal* 36 (1981): 377.

51. *Fiftieth Annual Report of the Mechanics' Institute of Montreal, with an Abstract of Proceedings of the Annual Meeting Held on the 2nd December, 1889* (Montreal: Printed by D. Bentley & Co., 1890), 13-14.

52. Any number of annual reports of the Institute during the last quarter of the nineteenth century and the early years of the twentieth acknowledged the complimentary subscriptions received at the library.

53. As noted in Chapter VI, there are records of acquisitions from the mid-1850s onwards, but only later in the century do actual transactions with members of the book trade become evident in the historical records.

54. The three firms can be identified from invoices or purchase orders for books for the McGill University Library in the John William Dawson Papers.

55. The brochures and flyers are found in the records of the McGill University Library. McGill University Libraries Papers, RG 40, C15. There are two letters from Ginn & Company, Boston, in 1895 promoting *The Journal of Morphology*. McGill University Libraries Papers, RG 40, C3.

56. See, "Donations to Library and Museum, From June, 1890, to May, 1891," *Annual Calendar of McGill University, Montreal...- Session 1891-92* (Montreal: Printed for the University by John Lovell & Son, 1891), 201-210.

57. E. N. Renouf, a native of Newfoundland, acquired the publishing side of Dawson Brothers, and in the twentieth century brought out mostly scientific texts. Parker, *The Beginnings of the Book Trade in Canada*, 181.

58. Daily Journal 1889. McGill University Libraries Papers. RG 40, C2.

59. See, for example, two lists of "Chemical Books" sent to B.A. Brockhaus in December 1897. McGill University Libraries Papers, RG 40, C15.

60. For William F. Clay see invoice sent to McGill University Library dated 7th May 1898. McGill University Libraries Papers, RG 40, C3. For the London agent, William Rice, see C.H. Gould to G.W. Prothero, Edinburgh, 2nd April 1898 and for John Wiley & Sons, New York see, C.H. Gould to John Wiley & Sons, 22nd January 1898. McGill University Libraries Papers. RG 40, C56, Letter book no. 3.

61. Publication orders sent to Brockhaus, Scribners, and Sotheran were noted in a letter from C.H. Gould to Professor Penhallow, 24th June 1902. McGill University Libraries Papers, RG 40, C15. Subscriptions for scientific journals published in France were placed with H. Le Soudner in Paris. C.H. Gould to H. Le Soudner, 8th January 1901. McGill University Libraries Papers. RG 40, C56, Letter book no. 5.

62. C.H. Gould to Dr. Henry T. Bovey, 20th March 1902. McGill University Libraries Papers, RG 40, C56, Letter book, no. 6. Gould was responding to complaints from Bovey and others that scientific periodicals were "invariably" late in being received. In his letter Gould demonstrated that the complaint was unfounded.

63. For the correspondence of Elkanah Billings see the earlier note (#22) in this chapter. The 1858 volume containing the Dawson label is George Wareing Ormerod. *A Classified List to the Transactions, Proceedings, and Quarterly Journal of the Geological Society of London: Including All the Memoirs and Notices to the End of 1855.* (London: Printed by Taylor and Francis, 1858).

64. The evidence is not unequivocal. Numerous volumes of scientific periodicals from the period, such as *The American Journal of Science and Arts*, contain the label of R. & A. Miller, Booksellers, Stationers and Bookbinders. R. & A. Miller may have only completed the binding of the volumes rather than arrange the initial purchase, however. Another Canadian firm that the Survey may have patronized is Henderson & Co. of Ottawa. An 1874 book by John Tyndall, *Address Delivered before the British Association Assembled at Belfast* (New York: D. Appleton and Company) contains a label: Henderson & Co., 39 Sparks Street, Ottawa. There is no indication when this title was acquired by the Survey library. It may have been obtained after the Survey moved to Ottawa in the early 1880s rather than in 1874 when it was published.

65. "Report of the Auditor-General on Appropriation Accounts for the Year Ended 30th June, 1888," *Sessional Papers*, 1889, no. 3, p. D214.

66. J.L. McDougall to the Director of the Geological Survey, 28th April 1892. In "Report of the Auditor General for the Year Ended 30th June 1892," *Sessional Papers*, 1893, no. 1, p. D10-D11.

67. Ibid.

68. "Report of the Auditor General for the Year Ended 30th June 1894" *Sessional Papers*, 1895, no. 1, part N, pp. 11-14.

69. "Report of the Auditor General for the Year Ended 30th June 1897," *Sessional Papers*, 1898, no. 1, part O, pp. 22-23.

70. "Report of the Auditor-General on Appropriation Accounts for the Year Ended 30th June 1888," *Sessional Papers*, 1889, no. 3, p. C131-C137.

71. Varying degrees of detail are provided in the Public Accounts. In some years only general statements, such as "German books" are listed. In other years, actual titles and publishers or dealers are itemized.

72. "Report of the Auditor General for the Year Ended 30th June 1897," *Sessional Papers*, 1898, no. 1, p. 12. A variety of other periodicals are listed in this same statement.

73. While there were two major buying trips abroad, others on a smaller scale were also undertaken. For example, in 1856, a Mr. Moore was appointed to "conduct the purchase of books in the U.S." His task was to obtain selected public documents, and he "was not expected to go into the Book market, and select miscellaneous America books: This duty would be fulfilled by the Librarian." Minutes of a meeting held Wednesday, 14th May 1856. "Minutes of the Joint Committee on the Library, 1850-1957," (Ottawa: Library of Parliament), typescript, 161-162.

74. For a discussion of the Faribault and Todd trips see, N.-E. Dionne, "Historique de la Bibliothèque du Parlement à Québec, 1792-1892," *Memoires de la Société royale du Canada*, 2nd s. 8 section I (1902): 3-14.

75. Faribault made reference to "MM Rich Freres" in his report submitted to the Legislative Assembly. While in London he was assisted by a G.W. Wicksteed, and in Paris Adolphe de Puibusque, a former resident of Quebec, helped with purchase arrangements. See, "Rapport De M. Faribault," tabled at a meeting of the Joint Committee on the Library of Parliament, 6th November 1852. "Minutes of the Joint Committee of the Library of Parliament," 45-56.

76. The memo is contained in a scrapbook entitled, "Throop's Library of Parliament" held at the Library of Parliament, Ottawa, p. 137. The memo was incorrect in stating that E.G. Allen was employed for "something like fifty years" because, in fact, the period was more like seventy if his predecessor George Rich is included.

77. See the statistics in note no. 79 below.

78. See, for example, a letter Todd addressed to Hector Bossange from London on 9th August 1855. Library of Parliament. File box marked "Mission to Europe. A Todd, 1855." At the head of the letter Todd had written: Preserve this letter, as I wish to refer to it when we meet.

79. The information contained in this memo is borne out by actual expenditures. The Public Accounts for 1890, 1892, and 1893 contain the following statistics:

<u>1890</u>

Edward G. Allen	$4,240.05
Charles Gaulon	$2,130.42
Charles Scribner's Sons	$ 480.64
Little Brown & Co.	$ 411.79
W.H. Lowdermilk & Co.	$ 312.56

<u>1892</u>

Edward G. Allen	$5,109.42
Charles Gaulon	$2,070.62
Charles Scribner's Sons	$ 658.94
Little Brown & Co.	$ 235.72
W.H. Lowdermilk & Co.	$ 244.47

<u>1893</u>

Edward G. Allen	$5,004.02
Charles Gaulon	$1,649.78
Charles Scribner's Sons	$ 548.27
Little Brown & Co.	$ 523.83
W.H. Lowdermilk & Co.	$ 236.25

80. In the minutes for Saturday, 6th November 1852 it was noted that "A list of certain American Works, ordered by the Committee last year, and which Mr. Rich was unable to procure, was directed to be placed in the hands of Mr. Sinclair, Bookseller, of John Street, to be by him obtained from the United States." A few months later at the meeting of Saturday, 11th June 1853, the minutes report that "A letter from C. Goodrich, Bookseller, Burlington, Vermont, offering to purchase the American Works for the Library, was read, - but it was resolved to continue for the present to employ P. Sinclair, of Quebec." "Minutes of the Joint Committee on the Library," 38, 76-77.

81. Minutes of the meeting for Tuesday, 27th July 1858. "Minutes of the Joint Committee on the Library," 222. In 1858, Geikie advertised his firm as "Law, Medical, University, Educational, and General Bookseller. English Publisher's Agency. Agent for Messrs. Stevens & Norton, Law Publishers, London; Messrs. H.P. & R.H. Small, Law Publishers, Philadelphia; Messrs. Blackwood & Son, Edinburgh and London; Messrs Constable & Co., Edinburgh." This caption for the firm is contained in an invoice to the Library of Parliament dated 31st December 1858. Records of Parliament, Legislative Assembly, Vouchers, 1859. National Archives of Canada. RG 14, C5, vol. 11.

82. Invoices and purchase orders are included in the Records of Parliament, Legislative Assembly. The B. Dawson & Son invoice is dated 31st January 1859, the invoice from Andrew H. Armour & Co. is dated 1st July 1859, and the John Wiley & Ralsted invoice is dated 5th September 1859. Numerous other booksellers and publishers are represented by invoices and statements in this collection. Other data, which also demonstrates that small orders were placed, in addition to the larger accounts with agents, is contained in minutes of the Joint Committee on the Library of Parliament. See, for example, "Abstract of Payments Made by Mr. Todd, Out of Library Funds in his Hand,: per Bank-book and Vouchers," 10th April 1856. "Minutes of the Joint Committee on the Library," 174-177; "Statement of Disbursements, Paid by the Accountant of the Legislative Assembly, on Books for the Library of Canada," "Minutes of the Joint Committee on the Library," 193-211; and "Report of the Librarian, Upon the State of the Library of Parliament," Presented at the Third Meeting, Wednesday, 1st May 1861, "Minutes of the Joint Committee on the Library," 42-53.

83. See, for example, "Report of the Auditor-General on Appropriation Accounts for the Year Ended 30th June, 1890, *Sessional Papers*, 1891, no. 3, p. B166-B167; "Report of the Auditor-General for the Year Ended 30th June 1892," *Sessional Papers*, 1893, no. 1, p. B83-B84; and "Report of the Auditor-General for the Year Ended 30th June 1893," *Sessional Papers*, 1894, no. 1, p. B101-B102.

84. Every issue of the *Montreal Gazette* during October 1845 carried one or more advertisements from Armour & Ramsay. The "Just Received" advertisement appeared on 10th, 13th, 14th, 15th, 16th, 23rd, 24th, and 29th October. The "Monthly Publications" advertisement was printed in the issues for the 10th, 11th, 25th, 27th, 29th and 30th October. On the 22nd of the same month, another Montreal bookseller, Robert Weir, advertised *The Naturalist's Library*, a forty volume set by Sir William Jardine.

85. The advertisements for Dawson Brothers appeared in the 16th and 17th January 1880 issues of the *Montreal Gazette*.

86. The 35 page catalogue in a book from James Fletcher's library (M.C. Cooke & M.J. Berkeley, *Fungi: Their Nature, Influence, and Uses* (London: Henry S. King, 1875)) is an illustration of one of the more extensive catalogues. This list itemized books on a variety of topics published by Henry S. King & Co. With reference to advertisements on end papers George Parker has written that "the paper covers and end papers of many books were filled with advertisements for books from the same printer, which has become a useful source in our day for discovering what was printed." Parker, *The Beginnings of the Book Trade in Canada*, 133. E.W. Padwick has pointed out that the publishers' catalogues inserted in books were frequently subject to change as new impressions were printed or sheets already printed were bound for sale. Eric W. Padwick, *Bibliographical Method: An Introductory Survey* (Cambridge, England: James Clarke, 1969), 238.

87. An example of a list of publications printed as part of a reprint can be found in Dawson's library in A.G. Nathorst, *Sur Fossilen Flora Japan's* (Berlin: Druck and Verlag von Georg Reimer, 1888). The back cover of this reprint has a list of other publications available from Georg Reimer.

88. Unfortunately, advertisements printed on the paper covers of the issues of scientific journals are now frequently unavailable, because the covers were usually removed and destroyed as part of the later binding of full volumes. The cover of *The Canadian Naturalist & Geologist* for September 1857 contained the following list of "valuable scientific books" available for sale at B. Dawson's, Great St. James Street, Montreal:

    Lyell's Elementary Manual of Geology
    Lyell's Principles of Geology
    Chamber's Ancient Sea Margins
    Nichol's Manual of Mineralogy
    Dana's System of Mineralogy
    Sir Roderick Murchison's "Siluria"
    Anstead's Scenery, Science and Art
    Hugh Miller's Testimony of the Rocks
    Hugh Miller's Footprints of the Creator
    Hugh Miller's Old Red Sandstone
    Richardson's Geology and Palaeontology
    Mantell's Geological Excursions
    Mantell's Fossils in the British Museum
    Gray's Lessons in Botany
    Gray's Manual of Botany
    Gray's Botanical Text-Book
    Flint's Grasses and Forage Plants of the United States

Agassiz and Gould's Zoology
Seebold's Anatomy of the Invertebrates
The Ocean, by P.J. Gosse
Life, by P.J. Gosse
Cuvier's Animal Kingdom
Maury's Physical Geography of the Sea
Somerville's Physical Geography
Guyot's Comparative Geography
Kerby and Spence's Entomology
Rennie's Insect Architecture
The Annual of Scientific Discovery from 1849 to 1857
Timb's year Book of Facts in Science and Art
Blair's Chronological Tables, revised and enlarged
Humboldt's Cosmos
Humboldt's Aspects of Nature
Joyce's Scientific Dialogues
Orr's Circle of the Sciences
Herschell's Outlines of Astronomy
Richardson's Geology and Paleontology.

An issue in volume 6 for 1861 of *The Canadian Naturalist & Geologist* advertised James L. Willson and Charles Robb's *The Metals in Canada* "just published" by B. Dawson & Son's as well as J.W. Dawson's *Acadian Geology* and the supplement, which covered discoveries up to the end of 1860.

89. For example, Hugh Scobie, a leading Toronto bookseller and publisher, took a prominent role in launching *The Canadian Journal* in 1852, which was devoted to scientific research, and Copp, Clark, another Toronto firm, published the first volume of *The Canadian Entomologist* brought out in 1869. Parker, *The Beginnings of the Book Trade in Canada*, 77, 207.

90. For further discussion on this latter point see Parker, *The Beginnings of the Book Trade*, 181.

91. This was true not only for Saunders, as discussed in this chapter, but also for the other scientists as well.

Chapter VIII -- Discussion and Conclusions

The communication of scientific research via the published literature was fundamentally important to scientists in Victorian Canada. They recognized this requirement and within their means they vigorously promoted the dissemination of scientific publications in the country, primarily to fill their own needs.

In the preceding chapters, this dissertation charted the characteristics of the flow of scientific publications in Canada during the Victorian era. The evidence gathered from the careers of the six scientists revealed that they had access to and read a wide range of scientific literature. In an age when science was becoming increasingly specialized and when the quantity of scientific information was growing significantly, Canadians coped by taking advantage of mechanisms that promoted the dissemination of scientific literature.

This concluding chapter will point out the salient features that characterized the flow of scientific literature in Victorian Canada. The discussion will retrace briefly some of the discoveries recounted in previous chapters and then answer the question about how well served Canadian scientists of the period were with regard to access to scientific literature.

The Need

At various points throughout the Victorian period Canadian scientists expressed their views about the importance of scientific information. It will be recalled that William Logan was the first to note the importance of scientific publications. "The value of these reports [of geological surveys] cannot be over-rated," he wrote in 1843, "and the study of them will tend to save a vast amount of labour and difficulty in the geological investigation" of Canada.[1] A decade and a half later Francis Fulford claimed that collections of scientific literature in Canada were far from adequate.[2] Thirty years after that, when speaking about the rapid developments in the sciences, John William Dawson maintained that "it is impossible for any man to keep pace with the progress of more than one limited branch of science."[3] At the same time, however, G.F. Matthew wrote that advances could be made if scientific literature was "more available."[4]

At the end of the Victorian period a committee of scientists at the Geological Survey of Canada summed up their view on the role that scientific literature played in their work. They wrote:

> As practical students of mines, mining propositions, agricultural possibilities, building materials, irrigation projects, waterpower/watersupply, mineral springs, artesian wells, etc., the members of the Survey are responsible for analytical comparison of Canadian occurrences with each other and with those already studied out at enormous expense by other governments. We must use the experience of other countries if we are not to duplicate their costly mistakes in many cases. To do this we must

> be provided with facilities which will enable us to carry on critical discussions or analyses of the conclusions arrived at by the experts of other countries as well as our own. Such analyses must often lead far beyond the limits of even the most elaborate general mining and other treatises; we must then resort to the original memoirs.
>
> The government topographers, geologists, hydrographers, chemists, assayers, etc., are responsible for adopting the best, often the latest invented methods, in recording, discussing and publishing their observations. Since these methods as well as the principles of the science and art of exploiting the country's resources are often dependent on the aid of auxiliary sciences it follows that the Survey's library should contain complete and readily accessible works, journals, government reports on chemistry, physics, botany, zoology, mineralogy, etc., in addition to those dealing more particularly with the concrete problems of this survey.[5]

For the whole of the Victorian period, then, Canadian researchers commented about scientific information, forthrightly claiming the need for access to the world's scientific literature and noting that there were difficulties both with access and in keeping up with the burgeoning increase in scientific publications.

Characteristics of Scientific Literature That Was Consulted

Canadian scientists looked abroad for most of their information requirements during the Victorian period. They did not disregard work done in Canada, as the Robert Bell's reading patterns show. But scientific literature from foreign sources captured the greater portion of their attention, both in their reading and their collecting. Since the volume of scientific publications produced in Canada was modest in comparison with that brought out in Europe and the United States, it is not surprising that Canadians placed a high emphasis on foreign literature. The fact that they did, though, demonstrates that Canadians were not insular.

Much of the foreign literature came from the United States and the United Kingdom, which meant that most publications were in English. European scientific literature disseminated in Canada was usually published in French or German, but other languages were also represented. Dawson, for example, consulted scientific literature written in Scandinavian languages. When a language was unfamiliar, as the case of a publication in German was for Fletcher, translations were arranged. Language was not a barrier in the distribution of scientific literature.

Of the scientific literature that was distributed about the country, two forms were given prominence -- periodicals and research reports, a preference demonstrated by both agricultural scientists and geologists alike. The nature of the research that a scientist was conducting dictated which form of the literature was emphasized. The high proportion of geological survey reports in Robert Bell's reading remained unchanged throughout his years of scientific work and William Saunders, in the latter part of his career, considered the reports of agricultural research institutions to be the most useful scientific publications. The other four scientists either consistently gave prominence to periodicals, as in the case of Dawson, or gave increasing attention to scientific journals as their careers developed, as in the case of the remaining three. This discovery about the formats of scientific literature prominently used in Victorian Canada is an expected outcome, given our knowledge about the developments in publishing in the sciences in the nineteenth century. Scholars who have looked at publishing patterns in the last century have emphasized that for a variety of reasons, primarily speed of publication, periodicals became the dominant form of scientific literature during the Victorian period. For the geological and agricultural sciences, reports published by research institutions were a second common form of the scientific literature. By the attention Canadian scientists gave to the two forms of the literature, they demonstrated once again that they were not insular.

When the findings concerning the forms of the literature and the place of publication are considered together, it is evident that scientists in Victorian Canada were conscious of the need to be up-to-date. They had access to and read publications that were as little as a few weeks or months old. The speed with which periodicals arrived at the library of the Geological Survey of Canada illustrates that both American and European scientific information arrived in this country in relatively short order.[6] Current information was a requirement, particularly for scientists whose primary work was taxonomic. Both Billings and Dawson who named and described numerous fossil species and Fletcher in his work with insect species needed to read the current literature to ensure that their discoveries were properly placed in the context of international research. Priority in naming new species necessitated being aware of developments elsewhere. These Canadian scientists, therefore, looked for and read up-to-date scientific literature.

Mechanisms for Learning About Scientific Literature

Before a scientist could read a scientific publication he had to know of its existence and then gain access to it. Knowledge about the existence of scientific literature was accomplished by a number of means in Victorian Canada.

One method of learning about scientific publications, available to all scientists of the period, was actually reading some of the literature. As was noted in Chapter IV, the literature itself alerted readers about other publications. There were limitations with this method, of course. G.F. Matthew made this clear in his letter to J.W. Dawson quoted at the beginning of this dissertation. If there was a restricted flow of literature into a particular locale, as Matthew claimed was the case in Saint John, then the notifying function of the literature is confined to only those few publications that were available. Further, the alerting function was not equally spread over all scientific publications. Canadian periodicals, as the discussion in Chapter IV pointed out, did not attempt to duplicate extensively notices of scientific publications that were printed in foreign periodicals. The effectiveness of the alerting function found in the scientific literature depended, therefore, on which scientific publications were available locally.

A second method by which scientists in Victorian Canada could learn about the existence of scientific literature was through the variety of promotional tactics adopted by members of the publishing trade. Chapter VII amply demonstrated that booksellers and publishers were actively involved in the dissemination of scientific literature in Canada in the nineteenth century. At the level of the individual, agents of the publishing trade, throughout the Victorian period, inundated scientists with brochures, flyers, catalogues, and lists of all sorts, all designed to promote scientific books and periodicals. Robert Bell is a good illustration of how publishers and booksellers functioned. He also provides an example of how large agents, such as F.A. Brockhaus of Leipzig, late in the Victorian period, began to publish and distribute extensive periodic lists of scientific literature on a variety of scientific subjects, which again were designed to encourage the dissemination of the literature. The publishing industry attempted to overcome breakdowns in bibliographic control brought about by the growing volume of scientific literature published throughout the nineteenth century.

Besides advertisements, publishers often sent out complimentary copies of publications, seeking a favourable review. Within the country itself, Canadian booksellers attempted to alert scientists about scientific literature. They stocked books and periodicals in their stores and advertised locally.

The second means of learning about the existence of scientific publications, like the first, had limitations. To get on the mailing lists of the publishing trade a scientist had to have built a reputation that would catch the attention of the industry or he had to be attached to a research institution that members of the publishing trade recognized for its prospective customers. On another score, sales prospects for Canadian booksellers were more likely to be found in the larger urban centres leading many booksellers to locate there. Therefore, scientists who were resident in Montreal, for example, where the Dawson firm was very active, were more likely to learn about scientific publications through booksellers than researchers located in smaller locales, such as Saint John.

The third means by which Canadian scientists could become aware of scientific literature was through bibliographic reference works, which became more common as the nineteenth century progressed. Both individual scientists and institutional libraries acquired bibliographies, indexes, catalogues, and directories. As the volume of scientific literature grew in the nineteenth century it became obvious that individual, haphazard retrieval of information was less efficient than a "more systematic and organized approach" to use the words of A.J. Meadows.[7] Reference publications were brought out to provide system and organization. These publications, however, were often expensive or had limited distribution and might only have been acquired by the larger libraries. The card index to American agricultural publications acquired by the library of the Central Experimental Farm is only one example of larger libraries acquiring reference works of limited distribution. Only those Canadian scientists with access to libraries holding such reference publications could take advantage of this method of learning about the existence of scientific literature.

A fourth method of learning about scientific literature, which, too, was available to all scientists of the period, was through contact with other scientists. G.F. Matthew also noted this point in his letter to Dawson. All six scientists in this study capitalized on the benefits of contact with other researchers. If geographic distances limited direct personal contact, the postal system imposed fewer restrictions.[8]

A "revolution in communication" is how two scholars have described the development of the mass postal system in the latter half of the nineteenth century.[9] Beginning in 1851, when the British government turned over control of the colonial postal system to direct administration in the colonies, large increases in the use of postal services occurred. Prior to that date "the high cost and limited availability of mail services and facilities deterred many would-be users of the official mails, who resorted instead to the use of private carriers."[10] The impact of the mass postal system can best be demonstrated by examples. Between 1851 and Confederation in the two central Canadian colonies the number of post offices quadrupled and in the same period the volume of letters and postcards mailed annually increased sevenfold. In 1851 the number of letters and postcards mailed in Ontario and Quebec was 2.13 million. By 1875 this figure had increased to 34 million and by 1911 to 323.56 million. The total number of letters mailed was even larger, however, since registered letters were in addition to these figures.[11] The increased volume of mail was partially due to a growing population, but on a per capita basis the volume increase was also substantial.[12]

Victorian Canadian scientists took advantage of improvements in postal services as the correspondence files of the six scientists clearly shows. The mail system allowed them to communicate with their Canadian peers, and more importantly, for the purposes of obtaining scientific literature, it permitted access to the international scientific community. Scientific periodicals were distributed through the postal system and during the Victorian period reprints by the thousands were circulated via the mails to scientists around the globe.[13]

The importance of the mails cannot be undervalued. When Canadian scientists had no other means of learning about scientific publications they could always write to other scientists and ask for their publications. And scientists in Europe, the United Kingdom, and North America often forwarded copies of their publications to Canadian scientists without their prompting. Contact with other scientists by correspondence was an important means of being informed about scientific literature and an equally important means of obtaining copies of publications.[14]

Collections of Scientific Literature

Once the existence of scientific publications was known, access to them became necessary. It will be remembered that there were complaints about the inadequacy of collections of scientific literature in the mid-nineteenth century. But this dissertation shows that by the end of the Victorian period complaints were less justified. Respectable collections of scientific literature had been accumulated and these were found in the leading institutions of the time.

The best library of the period with respect to size and range of subjects was the Library of Parliament. Its annual budget for acquisitions was by far the largest of any of the institutional libraries and scientific literature numbered prominently among the publications that were acquired. The libraries of the Geological Survey and the Central Experimental Farm had acquired specialized coll ctions whereas the scientific holdings at McGill University and the Library of Parliament were more wide ranging. The Natural History Society of Montreal came to an end early in the twentieth century, but its library enriched the McGill University library when the two collections were merged. At the end of the Victorian period when specialization in the sciences was well advanced, the library of the Mechanics' Institute of Montreal, like the libraries of mechanics' institutes everywhere, could meet few of the information needs of researchers.

Canadian scientists, on their own, could not cope with acquiring scientific publications to answer all their information requirements. No scientist, for example, was in a financial position to purchase the increasing number of relevant periodicals that were being published. Few scientists anywhere were. So they turned to the larger institutional libraries for the scientific literature that was held there. Personal libraries were important nonetheless. Individual scientists could be selective and collect publications on specialized topics or by particular authors which an institutional library might not consider appropriate for its holdings. Dawson, for example, accumulated palaeobotanical literature that would have been missed by nearby institutional libraries. There was also the distinct convenience of having personal copies of scientific publications near at hand that outweighed any concern about the duplication of holdings among libraries.

A significant characteristic about the diffusion of scientific literature in Victorian Canada was the central role that exchanges played. No collection, either personal or institutional, would have been as rich as they were in the absence of this means of acquiring scientific literature. Institutional libraries rarely had the financial resources to acquire by purchase the range of scientific publications demanded by researchers.

Individual scientists actively encouraged exchanges by sending out copies of their own publications and by corresponding with scientists in North America and Europe asking for copies of theirs. The value of institutional collections was enhanced by an equally vigorous efforts by both librarians and scientists who arranged exchanges with other organizations and individuals. The scientific society, the university, the two research institutions, and the *de facto* national library were all alike in this regard. Even when there might have been a conflict between institutions, such as when the Library of Parliament and the Geological Survey were both using publications of the Survey for exchange purposes, the libraries benefited from reciprocal distribution of scientific literature.[15] Well managed exchange programmes ensured that Canadian publications got wide distribution and brought large quantities of the world's scientific literature into Canadian hands. Exchanges frequently were the latest publications on a topic, so that libraries that acquired them obtained current literature in a field.

The six scientists in this study were familiar with the mainstreams of science during the Victorian period. They were aware of scientific work at home, but at the same time they needed to look outward to the literature of the international community of science. Their own research contributed to the advance of scientific knowledge and they received international recognition for their efforts.

At the beginning of the Victorian period Canadian scientists were not well placed to obtain scientific literature. But six decades later significant changes in the country had occurred.[16] In the larger centres, such as Montreal and Ottawa, scientific literature in substantial volume, currency, and subject matter had been accumulated and the collections were continuing to grow. Scientists in these locations could carry out research with reasonable assurance of finding the relevant scientific literature necessary for their work nearby.

There were advantages in being in the larger centres where factors that supported the pursuit of science were more likely to be found. One of the important reasons was the availability of scientific literature. Urban centres allowed a concentration of resources, and science at the end of the Victorian period was becoming expensive.[17] The presence of libraries, bookstores and publishing houses, universities, and research institutions all combined in the larger centres promoted better distribution of scientific publications than could be found elsewhere. The six scientists in this study chose well by living in Montreal and Ottawa.

Even if Canada was on the periphery of scientific endeavour in the Victorian period, scientists who resided in the major centres in Canada were still well informed about national and international scientific research. This situation was accomplished because sizeable collections of scientific literature were available for reading and reference. Achievements in Canadian science were obtained because the scientific literature was accessible.

Notes to Chapter VIII

1. *Message from His Excellency the Governor General, with Reports [for the Year 1843] on a Geological Survey of the Province of Canada, Presented to the House on 27th January, 1845* (Montreal: Lovell and Gibson, Printers, 1845), 10.

2. Francis Fulford, *Five Occasional Lectures, Delivered in Montreal* (Montreal: Printed and Published by John Lovell, 1859), 103.

3. John William Dawson, "Presidential Address Before the British Association for the Advancement of Science, Sept. 1886," *The Canadian Record of Science* 2 (1886): 207.

4. G.F. Matthew to J.W. Dawson in a letter dated Saint John, New Brunswick, 28th December 1886. Rare Book Collection, McGill University, Box 36 of J.W. Dawson's library.

5. Appendix to a "Report of a Committee of the Geological Survey Staff in Regard to the Library," addressed to Dr. Robert Bell, Acting Director. Robert Bell Papers, MG 25 B19. The report is undated but external evidence places it in 1902.

6. Another example of the speed of distribution is given by Rudolf Schmid who examined the transit times for three European scientific periodicals from Germany and England to California and discovered that the average time in transit varied between three and four weeks. Rudolf Schmid, "Intercontinental and Transcontinental Mail Transit Times from Europe and Berkeley, 1892 to 1941," *Archives of Natural History* 13 (1986): 141-154.

7. A.J. Meadows, "Access to the Results of Scientific Research: Developments in Victorian Britain," in *Development of Science Publishing in Europe*, ed. A.J. Meadows, (Amsterdam: Elsevier Science Publishers, 1980), 43. For the fuller quotation see Chapter I.

8. The six scientists in this study made a habit of maintaining contact with scientists locally, nationally, and internationally. Within Canada, improvements in transportation, particularly with the building of railroads, facilitated contact between scientists as the Victorian period progressed. An

example from the mid-1850s illustrates the difficulty of travel between major centres. In December of 1855, shortly after he was appointed principal of McGill University, Dawson was asked by the governors of the university to visit the seat of government then located in Toronto to lobby for legislative aid. Dawson described his journey: "There was as yet no direct railway communication between Montreal and Toronto, and of course no Victoria Bridge. I crossed the river in a canoe, amidst floating ice, and had to travel by way of Albany, Niagara, and Hamilton. The weather was stormy, and the roads blocked with snow, so that the journey to Toronto occupied five days, giving me shorter time there than I had anticipated." J.W. Dawson, *Fifty Years of Work in Canada, Scientific and Educational*, ed. Rankine Dawson. (London and Edinburgh: Ballantyne, Hanson & Co., 1901), 102. Within a year Dawson could have made the same trip by rail in less than a day. Railroads were an answer to difficulty of travel by land and later in the century were used to promote meetings of international scientific societies in Canada. In 1884, for example, the railways offered free travel to members of the British Association for the Advancement of Science to visit the Rockies before or after the first meeting of that Association held outside of Great Britain. See Trevor H. Levere, "The British Association Goes West: Montreal 1884," *Transactions of the Royal Society of Canada*, 4th s. 20 (1982): 489-497.

9. Brian Osborne and Robert Pike, "Lowering 'the Walls of Oblivion': The Revolution in Postal Communication in Central Canada, 1851-1911," In *Canadian Papers in Rural History*, ed. Donald H. Akenson. (Ganonoque, ON: Langdale Press, 1984), 200-225.

10. Ibid., 202.

11. Ibid., 203, 205-206.

12. In Ontario, for example, for letters alone the annual per capita use of the postal system increased from 14.74 letters in 1881 to 91.30 in 1911. Ibid., 208.

13. The history of reprints and their importance as "intellectual calling cards" in the nineteenth century is discussed in Ellen B. Wells, "Reprint," in *Encyclopedia of Library and Information Science*, ed. Allen Kent. (New York: Marcel Dekker, 1986), Vol. 40, supplement 5, p. 385-394.

14. Canadians were not alone in this respect. Leo Lesquereux, an American palaeontologist, wrote to J.W. Dawson in 1861: "As I am not in position of obtaining many periodical scientific memoirs, I have of course to rely on the kindness of the authors for communication of their new discoveries." Leo Lesquereux to J.W. Dawson, in a letter dated Columbus, Ohio,

14th March 1861. John William Dawson Papers, McGill University Archives, MG 1022, Scrap book, "Old Scientific Letters."

15. In May 1883, the Librarian of Parliament was instructed by the Joint Committee on the Library to acquire fifty complete sets of reports of the Geological Survey of Canada to be used in the library's exchange programme. "Minutes of the Joint Committee on the Library, 1850-1959." (Ottawa: Library of Parliament), minutes of the meeting of the Committee held on 5th May 1883.

16. In 1877, one American scientist bluntly told Léon Provancher, a French Canadian naturalist: "You say you have no library and no large collections, therefore why enter a field [entomology] where both of these are absolutely essential?" Quoted in Raymond Duchesne, "Science et société coloniale: Les naturalistes du Canada français et leurs correspondents scientifiques (1860-1900)," *HSTC Bulletin* 5 (May 1981): 112. Provancher persevered against some considerable odds, however. He found it necessary to build a sizeable personal library to meet his information needs. For a discussion of this library see Raymond Duchesne, "La Bibliothèque scientifique de l'Abbé Léon Provancher," *Revue d'histoire de l'Amérique française* 34 (mars 1981): 535-556.

17. Robert Bruce has noted the increasing costs of scientific research in a description about changes in the sciences during the nineteenth century. He wrote: "In science as in other matters, the nineteenth century was a time of organizing. Until then, the scientific pursuit had for the most part been a small-scale, spare-time indulgence of individual curiosity. But science and technology had lately begun getting together to offer mankind a new range of possibilities for ease or adventure, pleasure of pain, increase or extinction. With such vistas opening men began pursuing science more urgently, and the farther they pursued it, the more it ramified. The proliferation of its branches meant that individual scientists had to become more specialized. The growing complexity of science demanded formal scientific education and full-time professional work, not the casual, intermittent attention of self-taught amateurs. This spread of scientific investigation in so many directions called for the recruiting of scientists, the systematizing of communication among them, and the reliable evaluation of their work. And all this required money, even beyond the rising cost of the more elaborate materials and apparatus." Robert V. Bruce, *The Launching of Modern American Science, 1846-1876* (New York: Alfred A. Knopf, 1987), 3-4. Scientific research ventures in Canada in the late Victorian period, as Richard Jarrell has discovered, did not come cheaply. At the beginning of the twentieth century, for example, Canadian expenditures in agricultural related research increased markedly totally over $800,000 per year by

1910. See Richard Jarrell, "Science and the State in Nineteenth-Century Canada: Nova Scotia Discovers Agriculture," Paper presented to the conference Science and Society in the Maritimes, Mount Allison University, September 1988.

APPENDIX I

Scientific Periodicals in Institutional Libraries

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MCGILL UNIVERSITY

Scientific periodicals sent to Dawson Brothers for binding in 1874:

American Journal of Science
Annalen der Physik und Chemie
Annals and Magazine of Natural History
Bulletin of the Harvard University Museum of Comparative Zoology
Comptes rendus
Journal de mathématiques pures & appliqués
Journal of the Academy of Natural Sciences of Philadelphia
London, Edinburgh & Dublin *Philosophical Magazine*
Memoirs and *Proceedings* of the Boston Society of Natural History
Memoirs of the Royal Astronomical Society
Monthly Microscopical Journal
Philosophical Transactions of the Royal Society of London
Popular Science Review
The Smithsonian *Contributions to Knowledge*
Transactions of the American Philosophical Society

Other journals sent for binding later in the century:

American Journal of Conchology
American Naturalist
Annales des mines
Annales des sciences géologiques
The *Canadian Journal*
Chemical News
Jahrbücher für Wissenschaftliche Botanik
Journal de physique
Journal of the Chemical Society
Magazine of Natural History
Mind
Moscow *Bulletin de la Société Impériale des Naturalistes,*
Nature
Neues Jahrbuch
Proceedings of the Zoological Society of London
Revue scientifique
Science
Transactions of the Chemical Society

GEOLOGICAL SURVEY OF CANADA

Scientific serials acquired in the early 1890s:[1]

American Anthropologist
American Geologist
American Journal of Science
Annals and Magazine of Natural History
Botanical Gazette
Bulletin of the Geological Society of France
Bulletin of the Torrey Botanical Club
Canadian Naturalist
Iron World
Jahresbericht der Chemie
Journal of Morphology
Manual of Conchology
Proceedings of the American Association for the Advancement of Science
Quarterly Journal of the Geological Society of London
Reports of the British Association for the Advancement of Science
Science
Transactions of the Palaeontographical Society
Transactions of the Royal Dublin Society
Transactions of the Royal Society of Edinburgh
Zittel's *Traité de Paläontologie*

Periodical titles added to the subscription lists in the early 1900s:[2]

The Auk
Annales Chemique et Physique
Chemical News
Geological Magazine
Jahrbuch für Mineralogie
Mineral Industry
Natural Geology Magazine
Neues Jahrbuch für Mineralogie
Philosophical Magazine
Revue Universelle des Mines
Transactions of the American Institute of Mining Engineers
Zeitschrift für Anal. Chemie

CENTRAL EXPERIMENTAL FARM

American periodicals received in the 1890s included:

Agriculturalists' Gazette
American Agriculturalist
American Gardening
American Poultry Journal
Bee-Keeper's Review
Botanical Gazette
Breeder's Gazette
Bulletin of the Brooklyn Entomological Society
Bulletin of the Torrey Botanical Club
Chicago Gardening
Country Gentleman
Entomological News
Farm Poultry
Garden and Forest
Hoard's Dairyman
Journal of Applied Microscopy
Journal of the New York Entomological Society
Meehan's Monthly
Poultry Craft
Poultry Monthly
Rural New Yorker
Scientific American
Sugar Beet
Wiley's *Analysis*

Periodicals acquired from England included:

Agricultural Students' Gazette
Analyst
Annals of Botany
Chemical News
Gardener's Chronicle
Journal of the Society of Chemical Industry
Livestock Journal
Mark Lane Express
Le Riona Horticole
Science Progress

Some of the Canadian periodicals that were obtained:

Canadian Entomologist
Canadian Poultry Review
Cooperative Farmer
Farmer's Advocate
Farming, and *Railway and Shipping World*
North-west Farmer

LIBRARY OF PARLIAMENT

Scientific periodicals that Alpheus Todd placed on subscription in 1855 included:

> *American Journal of Science*
> *Annals of Natural History, or Magazine of Zoology*
> *Comptes rendus de l'Académie des sciences*
> *Journal and Transactions of the Geological Society of London*
> *Journal of the Geographical Society*
> *Journal of the Royal Agricultural Society of England*
> *Scottish Journal of Agriculture*
> *Proceedings and Transactions of the Zoological Society of London*
> *Proceedings of the Agricultural and Horticultural Society of India*
> *Transactions of the Agricultural Society of Connecticut*
> *Transactions of the Linnean Society*

Notes:

1. Records of journal subscriptions for the late 1880s and early 1890s are listed in "Report of the Auditor-General on Appropriation Accounts for the Year Ended 30th June, 1888," *Sessional Papers*, 1889, no. 3, p. D-214; "Report of the Auditor-General on Appropriation Accounts for the Year Ended 30th June, 1889," *Sessional Papers*, 1890, no. 5, p. E-72; "Report of the Auditor-General on Appropriation Accounts for the Year Ended 30th June, 1890," *Sessional Papers*, 1891, no. 3, p. C-141; "Report of the Auditor-General for the Year Ended 30th June, 1891," *Sessional Papers*, 1892, no. 1, pp. D77-D78; "Report of the Auditor-General for the Year Ended 30th June, 1892," *Sessional Papers*, 1893, no. 1, p. D-2; "Report of the Auditor-General for the Year Ended 30th June, 1893," *Sessional Papers*, 1894, no. 1, p. 4; "Report of the Auditor-General for the Year Ended 30th June, 1894," *Sessional Papers*, 1895, no. 1, part D, pp. 4-5; and "Report of the Auditor-General for the Year Ended 30th June, 1895," *Sessional Papers*, 1896, no. 1, part D, p. 4.

2. These journals are listed in the reports of the Auditor General as follows: "Report of the Auditor General for the Year Ended 30th June 1897," *Sessional Papers*, 1898, no. 1, part E, p. 4; "Report of the Auditor General for the Year Ended 30th June 1898," *Sessional Papers*, 1899, no. 1, part E,

p. 5; "Report of the Auditor General for the Year Ended 30th June 1899," *Sessional Papers*, 1900, no. 1, part E, p. 5; "Report of the Auditor General for the Year Ended 30th June 1900," *Sessional Papers*, 1901, no. 1, part H, p. 5; and "Report of the Auditor General for the Year Ended 30th June 1901, Volume I," *Sessional Papers*, 1902, no. 1, part H, pp. 5-6.

Appendix II

Publishers' Promotional Material Sent to Robert Bell

The following list identifies many of the publishers' promotional documents in the Robert Bell papers. There are, in addition, letters addressed personally to Bell publicising individual books or periodicals.

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1860s

Academy of Natural Sciences, Philadelphia. A 3 page announcement and subscription form for two monographs, "A Monograph of the Fresh-Water Univalve Mollusca of the United States" by S.S. Haldeman, and "With Continuation, Containing the Species Discovered and Described Since that Period" by George W. Tryon. 1868.

Bailliere Brothers, New York. Unpaged leaflet giving preface and table of contents of "The Complete Writings of Constantine Smaltz Rafinesque, on Recent & Fossil Conchology" edited by Wm. G. Binney and George W. Tryon, Jr. 1864.

Chicago Academy of Sciences, Chicago. Form letter announcing the publication of the "Transactions of the Chicago Academy of Sciences", Vol. 1, part 1.

D.G. Elliot, New York. Prospectus for "A Monograph of the Tetraoninae or Family of the Grouse."

Essex Institute, Salem, Massachusetts. Letter dated March 1865 promoting the "Naturalists' Directory." A similar letter for 1866.

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1870s

John Filmer, New York. Folio size booklet containing specimen pages of the "Illustrated Catalogue of the Centennial Exhibition." 1875

Robert Clarke & Co., Booksellers, Philadelphia. American Archaeology. 2 p. 1879?

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1880s

Messrs Estes & Lauriat, Boston. Order form and brochure describing books by John Gould, "The Birds of Great Britain," "The Trochilidae, or Humming Birds," "The Birds of New Guinea, and the Adjacent Papuan Islands." 1883.

Felix L. Dames, Berlin, Germany. Bibliotheca palaeontologica. 59 p. 188-?

Geological and Natural History Survey of Minnesota, Minneapolis. Rules of the Secretary of State for the Distribution of the Final Report of the Survey. Single sheet, 188-?

Librairie Ch. Chadenat, Paris. Le bibliophile americain. Catalogue de livres, cartes & documents relatifs a l'Europe, Asie, Afrique, Amerique, Oceanie. 1889.

Prospectus for "Palaeozoic Fossils" by S.A. Miller. Second American edition. 1883.

William Wesley & Son, Booksellers & Publishers, London England. The Natural History and Scientific Book Circular; Mineralogy. Catalogue no. 95. 56 p. [and] ...Palaeontology. Catalogue no. 96. 36 p. 1889

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1890s

A.W. Mumford, Publisher, Chicago. Slip for "Birds and All Nature." 189-?

Bradlee Whidden Publisher and Bookseller, Boston. The Best List of Books in Botany, Entomology, Ornithology, Geology and Zoology... 80 p. 1895.

B.T. Batsford, Bookseller, London, England. A List of Sets and Series of the Transactions & Proceedings of Various Learned and Scientific Societies and of Some Technical Journals... 22 p. 189-?

Contemporary Publishing Company, Philadelphia. Leaflet advertising "The Arctic Problem and Narrative of the Peary Relief Expedition of the Academy of Natural Sciences of Philadelphia" by Prof. Angelo Heilprin. 1893.

The D.H. Ranck Publishing Company, Chicago. Letter promoting periodicals. 1893.

Elliot Stock, London, England. A Special List of New Books, Sold by Elliot Stock. 32 p. 1896.

Ginn & Company, Boston. Letter advertising "The American Naturalist." 1899?

John Wiley & Sons, New York. Leaflet promoting George P. Merrill's "Stones for building and Decoration." 1891? [and] Front material of Samuel F. Emmons' "Geological Guide Book for an Excursion to the Rocky Mountains. 1894. [and] Brochure advertising Eugene B. Wilson's "Hydraulic and Placer Mining." 1898.

Libraire C. Reinwald, Schleicher Freres, Editeurs, Paris. Catalogue, 8 p., 1897.

Macmillan & Co., New York. A Catalogue of Macmillan & Co.'s publications... 26 p. 1892.

Max Weg Buchhandlung und Antiquariat, Leipzig. Antiquarischer Katalog NR. 46. Geologie, Petrographie, Palaeontologie. 131 p. 1896. [and] Abtheilung I. Geologie und Palaeontologie im Allgemeinen. Physiographische, petrographische und dynamische Geologie. Allgemein palaeontologische

Schriften. 60 p. 1897. Lists 1,954 items.

Meyer & Muller, Berlin, Germany. Chemie, Mineralogie, Geologie, Astronomie, Meteorologie. 70 p. 1893.

Norman W. Henley & C., Publishers and Booksellers, New York. Henley's Quarterly Record of New Books. 32 p. 1892. Also, Monthly Record of New Scientific Books. Issue for April 1893. 4 p.

Review of Reviews, New York. Renewal letter. 1894.

R. Friedlander & Son, Berlin. Leaflet advertising "International Zoologist's Directory." Edited by the German Zoological Society. 1895?

Royal Society of London. Flyer announcing publications of the Society. 1901.

Science, New York. Letter seeking a subscription to the journal. March 1893.

The Scientific Publishing Co., New York. Brochure and order form for "The Mineral Industry", 1895?

Spon & Chamberlin, New York. Spon's Monthly List of Engineering Books. Catalogue, vol. 9, nos. 4 & 5, August-September 1899.

W. & A.K. Johnston, Edinburgh and London, England. Recent Publications. 1892.

West Virginia Geological Survey, Morgantown, W. Va. Letter announcing publication of volume 1 of the reports. 1899.

William Rider & Son, Limited, London, England. Promotional brochure with order form for "The Timber Trades Journal." 1896?

William Wesley & Son, London, England. The Natural History and Scientific Book Circular. Important Works for Sale on Geology: Part I. pp. 181-226. 1891.

Williams & Norgate, Publishers and Booksellers, London, England. Williams & Norgate's Book Circular. Scientific Series no. 70. 20 p. March 1899.

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1900s

American Book Company Publishers. Selected Price List of School and College Text Books. 48 p. 1904.

Bernard Quaritch, London, England. A Catalogue of books on Natural History. Part VIII. III. Botany. 190-?

Bowes and Bowes, Cambridge, England. A Classified Catalogue of Second Hand Books, Journals and Monographs on Zoology and Other Branches of Natural Science... 48 p. 190-?

Charles Scribner's Sons, New York. Brochure advertising "Life-Histories of Northern Animals. An Account of the Mammals of Manitoba," by E. Thompson Seton. 1909.

D. Van Nostrand, New York. Technical Books, Mining, Metallurgy, Mechanics, etc. 20 p. 190-?

F.A. Brockhaus, Leipzig. Brockhaus Monthly List of New Books Published in Germany, France, England, America, Italy, Spain, Scandinavia, Russia and Other Countries. Vol. 51, no. 4 for April 1906. Vol. 51, no. 5 for May 1906. Vol. 51, no. 6 for June 1906. Vol. 51, no. 8 for August 1906. Also titled "Monthly Gazette of Current Literature Containing a Classified List of Publications Issued During the Past Month with Occasional Notes and Illustrations."

Felix L. Dames, Berlin, Germany. Bibliotheca Mineralogica, Geologica et Palaeontologica. Catalogue no. 61. 50 p. 1901.

Grebel, Wendler & Cie, Geneva. A flyer for "Tableau systematique des mineraux" by Prof. Groth.

Harper & Brothers, New York. Subscription form for "Harper's Magazine." 190-?

Hermann Haack, Gotha. Folio size brochure in three languages describing the "Geographical Who's Who."

John Wiley & Sons, New York. Flyers [in original envelope] for "A Manual of Mining" by M.C. Ihlseng, Third revise and enlarged edition, "Hydraulic and Placer Mining," by Eugene B. Wilson, 1898, "A Manual on Assaying," by Alfred Stanley Miller, first edition, 1900, "Practical Instructions in Quantitative Assaying with the Blowpipe" by E.L. Fletcher, 1899; "The Chlorination Process" by E.B. Wilson, 1897; and "Cyanide Processes" by E.B. Wilson, 1900, second ed. 1900.

Librairie Armand Colin, Paris. Promotional brochure for "Annales de géographie." 4 p. 1902.

Mining and Scientific Press, San Francisco. Letter and flyer advertising publications. 1906.

The Mining Journal, London, England. Letter and sample copy of journal. 1907.

Norman P. McGirr, Philadelphia. Leaflet no. 10 of "Books for the Naturalist." 1900.

North Dakota Geological Survey, Grand Forks, N.D. Form letter announcing the publication of the fourth biennial report of the North Dakota Geological Survey, 1908.

Poole Bros., Printers and Publishers, Chicago. Letter concerning "Poole Bros. Mining Directory and Reference Book of the United States, Canada, and Mexico." 1907.

Renouf Publishing Company, Montreal. Letter and catalogues for foreign companies represented by Renouf, e.g., John Wiley & Sons, New York and Longmans, Green & Co., London. 1907.

Scottish Oceanographical Laboratory, Edinburgh. Promotional material, title page with folio size sample plates, etc. for "Report on the Scientific Results of the Voyage of S.Y. 'Scotia'...under the leadership of William S. Bruce... Vol. II. Physics." 1908.

United States Geological Survey. New Publications (List 4, January 1908). Also slip for 1903 publications.

Ward's Natural Science Establishment, Rochester, New York. Ward's Spring Announcements, May 1906.

West Virginia Geological Survey. Single sheet with perforated order form. 1905.

William Downing, Birmingham, England. A Brief Catalogue of Desirable Books. 12 p. lists 273 publications, October 1902.

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Undated

A.S. Clark, Bookseller and Newsdealer, New York. Good Books. 31 p.

D. Van Nostrand Company, New York. Brochure and flyers advertising "Mechanical Technology Being a Treatise on Materials..." by G.F. Charnock, "The Universe and the Atom" by Marion Erwin, and other publications.

Edward Stanford, London, England. A concise Catalogue of Edward Standford's Principal Publications and Departments. 32 p.

Ginn & Company Publishers, Boston. Leaflet advertising "The Elements of Geology," by William Harmon Norton.

Henry Gray, London, England. Brochure.

John Buchanan, London, England. A Catalogue of Second-Hand Books,..The Various Departments of Science and Natural History.

Lea & Febinger, Publishers, Philadelphia. Brochure advertising "Adami's Principles of Pathology."

Librarie Polytechnique Ch. Beranger. Paris. Promotional pamphlet for "L'evolution biologique et humaine." by Frederic Sacco. Also pamphlet promoting "Antropologia Generale Lezioni su l'uomo secondo la teoria dell'evoluzoine" by Prof. Enrico Morselli.

Macmillan & Co., New York. Advertisement for "Meteorology. Weather and Methods of Forecasting..." by Thomas Russell.

The Modern Heretic Press, Los Angeles. Leaflet announcing "Illogical Geology; The Weakest Point in the Evolution Theory" by George McCready Price.

Preston & Rounds Company, Providence, R.I. Catalogue of Books on Botany, Horticulture, Forestry and Landscape Gardening. 8 p.

The Republic Press, New York. Booklet advertising "Uses of Compressed Air" by Addison C. Rand.

R. Friedlander & Sohn, Berlin, Germany. Abteilung XX. 4. Geologie und Geognosie. II. Specielle Geologie und Geognosie....

S.E. Cassino, Boston. Brochure announcing "Handbook of Invertebrate Zoology..." by W.K. Brooks, and other scientific works. Also brochure promotion "Mineral Physiology and Physiography or Geological and Mineralogical Studies" by T. Sterry Hunt.

W. & A.K. Johnston, Edinburgh. Select list of...geographical and educational publications.

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Canada. Parliament. Library of Parliament. Library of Parliament Records.

Geological Survey of Canada. Central Library, Ottawa. Geological Survey of Canada Library Records.

Metropolitan Toronto Reference Library, Toronto. William E. Logan Papers.

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the Mechanics' Institute as well. Benjamin Dawson, S.E. Dawson, and William Drysdale, a publisher in the latter part of the nineteenth century, were listed as life members, and William Foster Brown, who acquired the Dawson Brothers' retail book store in the 1890s, was registered as an annual first class member in 1889.[51]

The Mechanics' Institute frequently relied on publishers for support of its library and reading room. Throughout the latter part of the Victorian period, for example, Canadian and foreign publishers fulfilled this role by providing complimentary subscriptions to a variety of newspapers and magazines regularly received at the Institute.[52]

c. McGill University Library

Except for a few books and journals that were accumulated mostly through donations, the library of McGill University prior to the mid-1850s was virtually non-existent. But, as noted in Chapter VI, the appointment of John William Dawson as principal in 1855 led to improved fortunes for the library, and indeed the whole university. Still, for many years donated volumes were actively solicited and obtained. Funds for purchases were limited and this, in part, may account for spotty evidence of transactions with booksellers and publishers until the latter part of the Victorian period.[53]

During Dawson's early years at McGill local firms such as R. & A. Miller, H. Ramsay, and Hill and Martin delivered