THE ENGINEERING INSTITUTE OF CANADA
and its member societies
L'Institut canadien des ingénieurs
et ses sociétés membres

EIC's Historical Notes and Papers Collection

(Compilation of historical articles, notes and papers previously published as Articles, Cedargrove Series, Working Papers or Journals)

ENGINEERING HISTORY PAPER #83

"The *Canadian Geographic* and the History of Engineering in Canada"

by Andrew H. Wilson
(previously published as CSME History Cttee Working Paper 7/1995 – Jan 1995)

****
EIC HISTORY AND ARCHIVES
****

PO Box 40140, Ottawa ON K1V 0W8
+1 (613) 400-1786 / admin.officer@eic-ici.ca / http://www.eic-ici.ca

The Canadian Society for Mechanical Engineering/La Société canadienne de génie mécanique
A constituent society of The Engineering Institute of Canada/Une Société constituante de l'Institut canadien des ingénieurs

CSME History Committee

WORKING PAPER 7/1995

The *Canadian Geographic* and the History of Engineering in Canada

by

Andrew H. Wilson

January 1995

151, rue Slater St., Suite 307, Ottawa, Ontario K1P 5H3. Tel. (613) 232-8811 Fax: (613) 230-9607

Abstract

This paper analyses the issues of the Canadian Geographical Journal and its successor, the Canadian Geographic, published between 1966 and 1992 for articles broadly descriptive of engineering in a historical context in order to demonstrate that journals whose principal purpose is to disseminate information on geographical subjects can also be useful sources of information on activities, machinery and techniques associated with the history of engineering and on the museums that exhibit engineering artifacts. The paper then goes on to describe a selection of the activities, machinery and techniques from specific articles on the basis that the articles themselves were of historical interest in engineering terms at the time of publication, became of interest after publication, or are likely to become of interest sometime in the future. It also describes features of some of the museums.

About the Author

Andrew H. Wilson is a graduate mechanical engineer with training in economics. Currently a consultant in research policy and management, he served for almost 30 years in the Public Service of Canada. He is also the founding - as well as the current - Chairman of the History Committee of the Canadian Society for Mechanical Engineering. Parts of this paper were presented by the author at the Fourth CSME History Committee Seminar at McGill University in Montreal in June 1994.

About the Working Paper Series

In June 1991 the Board of Directors of the CSME agreed that its History Committee should be responsible for the production of a series of Working Papers on topics related to the history of engineering generally and to the mechanical discipline in particular. These papers may, or may not, be authored by members of the Committee or the Society. They will have limited initial distribution, but CSME Headquarters in Ottawa will maintain a small supply of copies for distribution on request. These Working Papers may subsequently be published, in whole or in part, in other vehicles.

Author's Note

The ILLUSTRATIONS included with this paper appear together at the end of it. The appropriate numbers have, however, been given in the corresponding items of the text.

The author wishes to thank Ian Darragh, the present editor of the Canadian Geographic, for kind permission to photocopy the originals of the various ILLUSTRATIONS for use in this paper.

Introduction

Sometimes we find interesting information on historical subjects in unexpected places. One of these may be a magazine devoted to geography, and an example of such a magazine is one now called the Canadian Geographic. And if we look further at the historical subjects covered in this particular magazine we see that some of them have a connection with engineering.

On the face of it, history and geography seem like strange bedfellows. History is predominantly concerned with people and societies, with politics and economics, while geography is concerned with the physical characteristics and resources of the earth's surface and crust, and with climate. But if we consider these bedfellows a little further we will realize that the people who appear in history have always been surrounded, and influenced, by geography. They have also moved from one type of surrounding to another. They have explored all of the very different corners of the Planet Earth. They have exploited the resources of its surface and crust, and have changed both. They have not perhaps had quite so much influence on climate although, nowadays, this influence seems to be increasing.

If we add engineering to the mixture we find that it has been influenced by both geography and history and has, in turn, influenced them. Indeed, it has been one of the important people-inspired agents of geographical and historical change.

The Canadian Geographical Society was founded in February 1929, before 'Black Friday' happened. But by the time the Society published the first issue of its Canadian Geographical Journal in May 1930 the Great Depression had begun. This magazine was intended to help stimulate awareness - and the general diffusion - of information about Canada's geography in a 'popular' way, and it has been doing so for nearly 65 years. But its subjects have not always been strictly geographical. Some, indeed, have had strong historical connections and, increasingly in recent years, environmental issues have intruded. Engineering subjects, as we will see in a moment, have also been covered explicitly or implicitly in its articles. The magazine was originally published monthly. By early 1976 it had become a bi-monthly, but with expanded content in each issue. In August 1978 its name was changed to the Canadian Geographic. The Society itself was dubbed 'Royal' in 1957.

In preparing this paper, the issues of this magazine published during the period from January 1966 to December 1992 were reviewed in order to identify those articles with links to both history and engineering. While historical criteria were relatively easy to apply, the engineering ones were somewhat more difficult. They were applied in the broadest way and to all of the disciplines. They were applied to articles having no hint of engineering history in their titles as well as to those whose titles had something to do with it. They were applied to articles about people, museums, cities, industries, and geographical regions with underlying connections to engineering. As a result, over 300 have been included in the analysis that follows although, in the balance of the paper, only a handful will be discussed. In broad terms, these articles cover subjects which have always been important for Canadian engineering: transportation and communications; the discovery and exploitation of resource materals and energy; and shelter.

In TABLE 1 (on page 3) the 308 articles have been broken down into 18 categories and three time publication periods.

The first of these periods - from 1966 to 1975 - covers the final decade when 12 issues of the <u>Canadian Geographical Journal</u> appeared annually. On average there were five main articles in each issue, or roughly 600 over the ten-year period. Of these, 135 covered subject matter that can be considered engineering-related in a historical context. The leading category was Resource Development/Extraction/Processing with 25 articles. During the second period - from 1976 to 1985 - the <u>Journal</u> and the <u>Geographic</u> appeared bi-monthly and each issue included an average of eight main articles, or roughly 480 over the ten years. 120 of them were engineering-related. The leading category was Ships/Boats/Harbours/Lighthouses with 20, followed by Museums with 17. During the third period - from 1986 to 1992 - the <u>Geographic</u> again appeared bi-monthly, and again each issue had an average of eight main articles, for a total of around 340 for the seven-year period. However, the number that were engineering-related dropped to 53, the leading category being Pollution/Environment with nine. Of the total of 308 articles that appeared over the full 27-year period, the leading categories were Ships/Boats/Harbours/Lighthouses with 39 articles, and Resource Development/Extraction/Processing with 38.

Another way to look at these 308 articles in a historical context (and the one used in the balance of this paper) is to place each of them in one of four broad groups, as follows:

(1) those that describe/discuss aspects of engineering that were historical at the time of publication;

(2) those that describe/discuss aspects of engineering that have become historical in the years since publication;

(3) those that describe/discuss aspects of engineering with relatively recent historical links; and

(4) those that describe/discuss museums.

TABLE 2 (on page 3) shows the relative sizes of these four groups. The first two - not unexpectedly - are dominant.

TABLE 1

History of Engineering Articles

Category	Time Periods 1966-75	1976-85	1986-92	Total
Ships/Boats/Harbours/Lighthouses	14	20	5	39
Resource Development/Extraction/ Processing	25	11	2	38
Cities/Towns/Villages	14	8	5	27
Arctic/Snow/Ice (incl. Transport.)	12	6	4	22
Aircraft/Airports/Space	10	9	2	21
Museums	2	17	2	21
Energy/Power/Generation/Transmission (incl. Hydro & Renewable)	5	9	5	19
Locomotives/Railroads/Trolleys	7	8	1	16
Automobiles/Highways/Roads	7	5	3	15
Building/Construction/Heritage	6	3	6	15
Pollution/Environment	3	3	9	15
Miscellaneous	7	4	3	14
Surveys/Mapping/Remote Sensing	7	4	1	12
Lakes/Rivers/Water Supply & Management	7	1	3	11
Canals/Waterways	6	2	1	9
Research/Research People	0	8	1	9
Bridges	3	2	0	5
	---	---	---	---
	135	120	53	308

TABLE 2

Historical Significance Groups

(1) Historical at time of publication: 114, or 37 percent

(2) Historical since publication: 142, or 46 percent

(3) Recent historical links: 31, or 10 percent

(4) Museums: 21, or 7 percent

Historical at time of publication

An article on Early Transportation in Canada by J.R.K. Main appeared in the July 1968 issue of the Canadian Geographical Journal. It began with the comment that the American Indian never discovered or invented the wheel and so, before the Europeans introduced it, these people made use of domestic animals such as the dog for land transportation - as in the dog travois. The Europeans also introduced the horse, and the horse travois became a natural extension of the earlier one. But let us not denigrate this piece of equipment. As Main has noted:

> One inestimable advantage the travois enjoyed over later and more elegant vehicles was that it never stripped a gear or had a flat. In fact, it never broke down. It was a simple and effective device, well suited to the needs of these highly nomadic people. But it did not measure up to the changing times.

The canoe was developed by the American Indians for water transportation and, when they turned to trapping and trading, it became the oldest commercial conveyance in Canada. The Inuit people had, of course, developed the kayak.

Around 1800 the large birch bark canoe gave way to the York Boat - so called because the first one was built at York Factory. This development was stimulated to a large extent by the competitive activities of the Hudson Bay and North West Companies and the need to save money in the fur trade, the continuing migration of that trade to the Far West, and improvements in the routes across portages. This boat was made from local timber. It was around 40 feet long and 10 feet in width, had a draft of three feet, a mast, and a stout keel which also helped it cross portages. It could be poled, rowed, towed or sailed. (Illust. #1)

The Métis of the Prairies were responsible for the development of the Red River cart. Its main uses in the early days were for farming and for carrying supplies to the annual buffalo hunts and returning with the pemmican and skins. Again the cart was constructed from local materials - wood and rawhide. It consisted essentially of an oblong platform about three feet wide and five feet long, with the outside members extended another five feet to form shafts. A stout cross-beam with rounded ends protruding a foot or more on each side was fixed under the centre of the platform to make an axle. The wheels had no metal tires, and the cart was usually drawn by oxen fitted with conventional horse collars. If made from oak and birch, it had a payload of around 1,000 pounds. With a poplar axle, however, this was reduced to 500 pounds. No grease was available for lubrication, so that dry wood would turn on a dry axle unless some natural bovine products could be pressed into service.

Several articles in the Journal and the Geographic have been about canals in Canada. For example, the issue of September 1974 included one by George V. Sainsbury on Re-routing the historic Welland Canal. Its main focus was the opening in March 1973 of the 13.5 km by-pass from Port Robinson south to Ramey's Bend on the outskirts of Port Colborne, replacing a longer, more winding section of the canal. But the article also described in some detail the development of the Welland from the time that William H. Merritt began work on it in 1824. The article recalled that in 1829 the first ship had ascended the Niagara Escarpment through the wooden locks of the first of the four Welland Canals. Sainsbury then wrote:

> Over the past century, the number of locks dotting the channel has shrunk from 40 to eight. Today (in 1974), the Welland Canal offers the fleet of 730 ft (222 m) lakers and the world's ocean vessels a relatively straight course with few obstructions such as bridges, narrow passing zones, and other navigational hazards. Available draft throughout the system is 27 ft (8.1 m) - an impressive contrast to the 8 ft (2.4 m) available to the users of the first canal.

The January 1974 issue of the Journal included an article on the Shubenacadie Canal - The Canal that bisected Nova Scotia - written by Barbara Grantmyre. Apparently, none of the early Governors of this colony recognized the potential commercial value of the water system that included the Shubenacadie River and the chain of lakes that joined the Bay of Fundy with Halifax. However, in the 1790's this changed. As Grantmyre has noted:

> In 1797 the subject of the Shubenacadie Canal was brought before the Nova Scotia House of Assembly and the sum of 250 pounds was appropriated and a committee appointed to inquire into everything connected with the construction of the canal from Dartmouth Cove through the First and Second Dartmouth Lakes, Lakes Charles, William and Thomas, Fletcher's Lake, the Shubenacadie Grand Lake, thence along the Shubenacadie River to the Basin of Minas. Isaac Hildrith, a civil engineer, and Theophilus Chamberlain, a surveyor, made the survey. Their report, Nov. 15, 1797, estimated the cost of a four-foot navigation would be 3,202 pounds, 7 shillings and 6 pence.

A Bill to incorporate a company to complete the canal was brought before the Assembly in 1798, but it did not pass - for reasons that are not apparently clear, although political influence was involved. The scheme was revived in 1814, the delay having to do with the Napoleonic Wars in Europe and the War of 1812 in North America. However, there were further delays, and two more surveys were made. By June 1825 the cost of a four-and-a-half-foot deep passage had risen to over 44,000 pounds. The company, when it was incorporated in 1826, had capital of 60,000 pounds. One of its Vice-Presidents was Samuel Cunard. Francis Hall was appointed engineer, and Thomas Telford of London, England, was appointed consulting engineer. Hall had earlier been a pupil of Telford.

Ground for the canal was broken on 25 July 1826. The work went badly, and went on for years. Neither Telford nor Hall had experienced North American winters and the damage ice can cause. Debts piled up. Repair costs soared. In 1853 a new company - the Inland Navigation Company - was incorporated to complete it, and Charles Fairbanks was appointed engineer. He continued the work but, by this time, a competing mode of transportation - the railway - had begun to attract attention. Yet Fairbanks failed to see how it would take business from the canal. In fact, the railway destroyed it. The Shubenacadie Canal was opened in 1861, after 35 years of effort, frustration, and deep financial distress. There appears to have been some use made of it for commercial purposes for about eight years. (Illust. #2A and #2B)

There have also been several articles on wind- and water-driven mills. One of these, A History of Windmills and their Place in Canadian Life, by Tom Ritchie, appeared in the March 1969 issue of the Journal. Among Ritchie's comments were these:

> The windmill's superior rival was the watermill which also predated it in Canadian history, the first watermill having been constructed at Port Royal in Acadia soon after the French founded that settlement in 1605. From that time on, because watermills were generally more consistent in operation and more powerful than windmills, many more of them were built. But mill machinery was destined to be driven by power from a source even superior to the watermill - the steam engine...which, within a few decades of its appearance in Canada early in the nineteenth century...had rendered both the windmill and the watermill obsolete as prime movers of mill machinery.
>
> However, on the rural landscape a new form of windmill appeared. Much smaller and more compact than the old type, its windshaft had as many as 18 vanes closely spaced around it, but the diameter of the circle made by the vanes' tips was only five or six feet. A large 'rudder' kept the vanes facing in the direction of the wind. This type of windmill, mounted on simple metal towers 25 to 50 feet high, was used on thousands of farms to pump water. In the early days of the use of electricity in rural Canada thousands more of them were put to use in driving small electric generators which maintained the 'charge' in the batteries employed for lighting and for the operation of radios. But with the

> extension of electric power lines into rural areas the need for 'windchargers' disappeared, as did the need for wind-driven pumps. (Illust. #3)

Other examples of early Canadian engineering are to be found in the wooden covered bridges scattered around the eastern part of the country. An article on them, Covered Bridges in Canada, written by Jacques Coulon, was included in the August 1969 issue of the Journal. Nowadays they are dwindling in numbers as a result of fires, old age, and replacement by steel and concrete structures. However, in the 1960's, some 400 survived. There had been as many as 1,000 in Québec alone at the turn of this century, and 500 in 1940. There were 400 in the forested farmland of New Brunswick at the turn of the century, but only 200 by 1960. Coulon commented that the fishing provinces - where inland roads were scarce - had relatively few covered bridges. He went on to say:

> With the crude, unreliable 'bridges' of old, which were roughly cut timbers fastened together and flung across rivers, commerce and communications were suffering greatly. Merchants, travellers and military couriers had to travel at the risk of breaking their necks. So the bridge topped with a roof - the first one was built across the Schuykill River at Philadelphia in 1805 - was designed to shelter the floors from the rotting effects of sun, wind, rain and indiscriminate snow storms, but snow had to be spread over the flooring in winter to help the sleighs and bobsleds travel through. The covering on them was strictly for practical purposes. If a wooden uncovered bridge lasted about ten years, roofed ones had a life expectancy of 80 years, and sometimes more.

Speaking of wood, two special types of boat deserve some attention. The first is The Pointer Boat, and its development has been described by Brenda Lee-Whiting in the article of this title in the February 1970 issue of the Journal.

In the mid-19th century when the lumbering era on the Ottawa River and its 20 narrow, winding tributaries was at its height, the famous J.R. Booth suggested to John Cockburn - a skilled carpenter, woodcarver and boatbuilder - that a rugged, shallow-draft boat was required to help log-drivers push and pull hewn timbers on their way from the tributaries to the main river where they could be rafted. The result was a type of boat, from 16 to 50 feet in length and pointed at both ends, which became known as the Cockburn Pointer, the Pembroke Pointer, or the Ottawa Valley Pointer. The first of them was built in Ottawa under contract to the Booth Company and hauled by horse and sleigh to the site of the logging operations. But as these operations moved further and further from Ottawa, and as their worth became established, Cockburn moved his business in 1865 to Pembroke - 100 miles nearer many of these operations. This move was also wise since the railroad reached

Pembroke in 1876 and tracks were laid just behind Cockburn's sheds. And as Lee-Whiting has noted:

> The raw materials were...obtained from the vicinity of Pembroke, mainly from the Québec side of the Ottawa River; white pine was used for the planking, white cedar for the boat ribs, red pine or white spruce for the oars and yellow birch or white oak for the paddles. The wood was air-dried for 12 months in a shed alongside the boat-building workshop. (Illust. #4)

Another type of boat associated with lumbering was the steam-driven, amphibious one known as the warping tug or 'Alligator.' Again the article - The Alligator - Unique Canadian Boat - was by Brenda Lee-Whiting and it appeared in the Journal in January 1968. This boat was used mainly in the northern areas of Ontario and Québec, as well as in the United States from Maine to Michigan, where shallow lakes connected by narrow rivers made log movement more difficult. A Canadian, John Ceburn West, devised a solution to this general log movement problem in 1889 by designing and building the Alligator. He secured both U.S. and Canadian patents for this craft, and the firm of West and Peachey in Simcoe, Ontario, built it for use on both sides of the border.

West, himself, was neither a lumberman nor a boat-builder by trade. He and Peachey had gone into the foundry business, principally to make sawmill machinery. But the Alligator became the firm's principal product and its construction continued there until 1932 when another company took on its manufacture. This was still continuing in 1968. There were two main models: the smaller was 37 feet long and 10 feet across and drew 30 inches to the bottom of the runners; the larger was 45 feet long and 11 feet across but drew only 26 inches. (Illust. #5)

The 'basic' Alligator had a 12 hp steam engine, and was a combination of a steamboat and steam winch. The engine could drive either the paddles on each side or a cable drum that held a mile of 5/8 inch steel wire cable. The author noted:

> The winch was used when logs were being hauled. The boat dropped anchor up the lake and then moved back to the logs, unwinding the cable. Hooking on to the boom of logs by the boom post at the rear, the Alligator then winched itself and the logs up the lake...
>
> The boat was sufficiently powerful to move a bag boom containing 60,000 logs if there was no wind to interfere, or 30,000 logs against a head wind...the draft of the boat was shallow enough to clear most underwater obstacles...
>
> The hull of the boat was scow-shaped; the bottom was

> constructed of three-inch white oak plank, the sides of pine six inches thick, laid in white lead. Steel boiler plate covered part of the bottom and all up the bow of the boat. On the flat underside two runners were placed six feet apart, each one being six by eight inches and shod with steel or iron. It was on these sturdy runners that the boat journeyed along a portage.
>
> The boiler, fed with three-quarters of a cord of wood, could furnish sufficient steam to warp for ten hours. In order to keep it level when going up or down hill, the boiler was hung on an axle in the centre, a screw being arranged on the front end to enable the fireman to tip the boiler forward or back.

The Alligator's speed - forwards or backwards - when travelling on its own as a steamboat was around five miles and hour. It was claimed that the craft could portage a gradient of one in three. The 'modern' version of the boat had a steel hull, a diesel engine, and a pointed bow.

Canadians may have to be reminded from time to time that the first commercial oil well in North America was opened up in Canada - not the United States - by James Miller Williams in 1858 at Oil Springs, a small village in the Township of Enniskillen in Lambton County, Ontario, some 16 miles southeast of Sarnia. The story of this and subsequent early Canadian oil field activity was told in the article Oil, Then to Now by Jean Elford and Edward Phelps that appeared in the November 1968 issue of the Journal. Williams' well went down a year later than the world's first - in Rumania - and a year before America's - Drake's well in Pennsylvania.

The original geological report on the Enniskillen gum beds was written in 1851, as a result of which the area around them was bought by Charles Nelson Tripp, who intended to make japan, asphalt for caulking ships, and varnishes from the seepage and the underlying oil. But although Tripp won a prize for his asphalt at the 1855 Paris Exhibition, he had no means of getting the necessary production equipment to the site, or his products out, and his land was put up for sale. Williams acquired the land and discovered the abundant supply of mineral oil. He was also fortunate that, in 1858, the Great Western Railway completed its Sarnia to London line which enabled him to get his equipment in and his crude product out for refining and marketing at Hamilton. He also won medals - at the 1862 International Exhibition in London, England - for being the first to produce crude oil, and for his samples of refined oil.

The authors noted that Williams' success soon led to the area around Oil Springs being riddled with similar wells, all of which were pumped by hand. They went on to say that, by 1860, the oil men were drilling rather than digging their wells, using the spring-pole method. A line and bit were lowered on a string of ash poles hung from a beam, which rose and fell through the power provided by a man throwing his weight off and on a teeter-totter arrangement. Hugh Nixon Shaw, using this device, took from June to January to sink a well 240 feet deep. He dug the first 50 or so feet, cribbed them with logs, and then employed the spring-pole to take his bit into the limestone. On Friday, 22 January, 1862 his well gushed 20 feet into the air, and was still gushing the following Monday. One result of this wasteful flow was that Shaw began developments that led to the 'Christmas Tree' which was later used to regulate the flow of crude oil from wells.

A series of marketing and other setbacks during the later 1860's - such as the offensive odour of the oil - effectively took the Oil Springs product off the market. However, the field at nearby Petrolia began to flourish. The offensive odour was also modified. But by 1873 competition from the U.S. had reduced Canadian sales. During the period of depression that followed, as well as in later years, drillers from the Lambton field took their skills to Alberta and the U.S., and abroad to countries such as Borneo, Burma, Sumatra, Russia, Venezuela, and Australia. The authors have noted:

> In drilling, they used a cable tool that dropped a bit to pulverize the rock. It had evolved from the spring-pole Shaw first used in Oil Springs. Cheap to run up to a depth of 1,400 feet, it served well on new fields but gave way to the rotary drills starting about 1926.
>
> On the home front several innovations appeared in the seventies and eighties, among them underground storage tanks and the jerker system of pumping. The storage tanks originated after the surface of 33 acres charred to cinders in a $75,000 fire that consumed 40,000 barrels of oil in 1867. The presence of natural gas that came in with the oil led to this fire and to a number of others, and to considerable loss of life (including Shaw's)...With oil stored in wooden tanks, fire always presented a hazard...
>
> J.H. Fairbank, a prominent Petrolia oilman, invented the jerker system of pumping, doing away with the need for a separate engine for each well. A horizontal wheel, activated by an engine, controls the movement of a series of rods laid down two feet above the ground and running from well to well. The jerker rods still keep the pumps nodding on the old Lambton field...(Illust. #6)

The authors went on to say that the earliest tank car in the Canadian oil industry appeared in Lambton in the form of a barrel mounted horizontally on a waggon frame. The first tank cars that the Great Western Railway ran into Petrolia on the spur line opened in 1866 consisted of vertical wooden tanks erected on flat cars.

In 1878 the Michigan Central Railroad ran a line into Petrolia and broke the Great Western's monopoly and the higher freight rates it had charged - in the interests of refiners to the east - for the refined product, in comparison with crude. This made possible the development of effective refining capacity at Petrolia, which became the first home of Imperial Oil.

It was not until 1881 that deep drilling began again in the Oil Springs field. The oil from it went to Petrolia for refining, through a six-mile pipeline, which then became the 'remote ancestor' of very much longer pipelines many years later.

Quite a few articles on railways have appeared in the Journal and the Geographic over the years. For example, the one on Canada's First International Railway by W.E. Greening was in the December 1974 issue of the Journal.

Promoters from Massachusetts and Maine competed to interest Canadian entrepreneurs in schemes that would link the Atlantic Seaboard with the Great Lakes. For the first one, two companies were incorporated: the St Lawrence & Atlantic in Montreal, and the Atlantic & St Lawrence in Portland, Maine. Work from Montreal - south of the river - began slowly in 1846 but speeded up after a number of financial impediments were removed, and Casimir Gzowski became associated with the project. The start was faster in Maine. The two lines met in 1853 at Island Point in northern Vermont, and soon afterwards the first trains ran between Montreal and Portland. The engines of the time were woodburners, and the passenger seats were initially of wood, making journeys uncomfortable. (Illust. #7)

The St Lawrence and Atlantic was sold after 20 years or so to the Grand Trunk Railway and became part of the network that extended westwards into the Americam Mid-West. The Victoria Bridge was built across the St Lawrence to join the two Canadian railways.

Another article, by Vera Fidler, Spiral Tunnels - Engineering Marvel and Tourist Draw, was in the February 1967 issue of the Journal. It discussed the CPR tunnels built in 1908-09 through Cathedral Mountain and Mount Ogden, a few miles west of the Alberta-B.C. border, thereby eliminating what had been called the 'Big Hill' - in regard to which Fidler noted:

> To haul a 15-car train up the Hill required four specially designed 154-ton engines, two in front and two 'pushers' behind. Even then, spinning drive-wheels on a slippery track would sometimes cause a train to stall and its whistle would echo through the mountains until another 'pusher' came to the rescue. But going up was routine compared to the trip down. In a day of wood-burning, hand-braked locomotives, the engineer rode with one hand on the gear bar and the other on the sand valve. At the top of the Hill the brakeman got off and walked

> alongside, watching for signs of heating brakes or sliding wheels, two of the main causes of runaway engines...When a train did get out of control, there was nothing to do but switch it into a spur line and hope for the best.

N.W. Emmott wrote about <u>These Magnificent Royal Hudson Locomotives</u> in the April/May 1981 issue of the <u>Geographic</u>. These steam locomotives hauled the crack trains of the CPR for 30 years but went out of regular service in 1960. Even so, they still exercised an attraction for steam buffs 20 years later. At that time only two Royal Hudsons remained in service - one pulling excursion trains between Vancouver and Squamish in British Columbia, and the other also on excursion duty for the Southern Railroad in the United States.

As Emmott has noted, Canadian railways in the early days specialized in light engines since the challenge was the long distances and not the weight of the freight or the number of passengers - as was the case with the leviathans used in the U.S.. But in the 1920's, when heavier steel cars replaced the wooden ones and the population of Canada grew, stronger locomotives were required. The Hudsons evolved from the Pacifics which had been used in Canada for more than two decades. Emmott wrote:

> The Pacifics could start heavy trains, but their fireboxes could not generate enough heat, nor their boilers produce enough steam to deliver speeds of 70 or 80 mph over long distances. For the engines which replaced them, (CPR chief motive power engineer Henry) Bowen redesigned the boilers and provided a bigger and more efficient firebox. He did this by putting a second axle under the cab, lengthening the firebox, and putting in an extra combustion chamber ahead of the grates...Bowen oversaw the production of the first batch of Hudsons...which were turned out in 1929 by the Montreal Locomotive Works...The new Hudsons were tried out on long runs in the summer of 1930...The success of the first 10 engines led to an order for 10 more, which incorporated several improvements.

These engines acquired their 'Royal' title in 1939 when one of them - No 2850 - pulled the special 12-car train carrying King George and Queen Elizabeth to Western Canada. In 1940 the last five of the 65 Royal Hudsons were delivered. They were designed for use in British Columbia and burned oil to reduce the forest fire risk from flying sparks. (Illust. #8)

From water to land to air. As might be expected of magazines concerned with geography and with Canada, the <u>Journal</u> and the <u>Geographic</u> published a number of articles about aircraft. For example, the <u>Journal</u> in January 1973 carried <u>The Story</u>

of the R-100, which had appeared originally in the October 1930 issue (and in the very first Volume of the magazine), giving an account of this airship's successful flight from England to Canada and back earlier that year. Unusually, it had been put together from reports in the Montreal newspapers. The flight itself had been part of a program to develop the use of airships for air communications throughout the British Empire. However, this program was abandonned in favour of a flying-boat service after the R-100's sister-ship, the R-101, crashed in the Alps on its way to India. The reason for repeating the article in 1973 was that the possibility of using lighter-than-air craft instead of airplanes for carrying heavy freight and bulky cargoes was again being studied in several countries in Europe and in regard to the Canadian Arctic.

The R-100 was of rigid design and had a capacity of 5 million cubic feet, a gross lift of 156 tons, and a carrying capacity of about 45 tons. Hydrogen gas contained in a series of balloons within the hull provided the lifting power. Its length was 709 feet, and diameter 133 feet. The engine power was 3,960 hp provided by six Rolls-Royce gasoline engines externally suspended in three cars. In two of the cars were AC automobile engines coupled to dynamos which supplied the electric power needed for lighting, heating, cooking and radio. The airship's maximum speed was 80 mph, and its range at a cruising speed of 71.5 mph and with a full load was 3,500 miles. The article noted that the original intention was to equip the R-100 with either diesel or hydrogen-kerosine engines but, at the time of construction, neither of these types had been sufficiently developed for such an application. The article went on to say:

> The R-100 framework is primarily of duralumin while the principal members of R-101 are of high tensile steel. Although designed to the same specification as to performance, R-100 is totally dissimilar to R-101...
>
> The R-100 sailed from Cardington with 5.4 tons of water ballast aboard. She arrived in Montreal with 9.8 tons, showing that 4.4 tons had been collected during the 79 hour flight from England to Canada. Rain was not alone responsible for this fact, for water was gathered while passing through clouds. The moisture collected on the top of the airship flowed towards the stern, where it encountered a tape that diverted the stream into special ballast tanks aboard. This was the first time that the experiment of collecting water had been attempted...A further advantage was derived in the matter of financial saving. As fuel is burned by the ship's motors, hydrogen must be released to compensate for the loss of weight. If, therefore, additional water can be taken aboard equal to the amount of gasoline consumed, no hydrogen need be sacrificed. On her flight to Montreal, the R-100 used 29 tons of petrol, while only 4.4 tons of water were

collected. It is apparent, therefore, that a considerable volume of hydrogen had to be released, though not an amount equivalent to the weight of gasoline burned up.

On the outward trip from Cardington to St Hubert, the R-100 flew the 3,360 miles at an average speed of 44 mph, securing for Britain the west-bound trans-Atlantic record at the expense of the Americans. The return trip took 20 fewer hours, but adverse winds prevented the airship from taking the east-bound record set by the Germans in 1929. (Illust. #9)

Frank H. Ellis - himself a Canadian aviation pioneer - wrote Bold venture into a northern winter, which appeared in the April 1971 issue of the Journal and which helped celebrate 50 years of flying in the Northwest Territories.

As Ellis noted, two single-engined Junkers monoplanes were purchased by Imperial Oil in New York in the fall of 1920. The Company had decided to buy aircraft in order to get a government geologist into Fort Norman on the Mackenzie River in advance of the spring break-up so that he might make some vital surveys in connection with its already-established oil discoveries. Named 'Vic' and 'Rene' (Ellis's spelling), the two aircraft were flown west and north to a base at Peace River Crossing where their wheel-based undercarriages were changed for specially-designed ski undergears for the first time.

Frank Ellis continued the story of 'Vic' in a second article - Flying Dutchman of the skies - which was in the Journal in December 1973. The work for which the two planes had been bought was abandonned after a series of mishaps. 'Rene' was damaged beyond repair and 'Vic' was put into storage at Peace River. It was bought in the spring of 1922 by the Railway Employees Investment & Industrial Association of Prince Rupert as a commercial venture involving charter trips into the remote areas of northern British Columbia. 'Vic' was converted permanently into a seaplane and renamed 'Hazelton' - the town nearest its new base at Mission Point on the Skeena River. However, the venture failed and the plane was tethered on a high bank of the Skeena for the next five years, open to the wind and weather. (Illust. #10)

In 1929 the 'Hazelton' was bought by a businessman, shipped by railroad flatcar to Tabor Lake, and renamed the 'Prince George' after its owner's nearby home town. As Ellis has pointed out, the years of neglect took their toll on the metal sheathing of the Junkers, but its new owner felt the damage could be repaired. However, he could not get the needed airworthiness certificate and operated it illegally in conjunction with an illegal placer gold mining operation he had in north-central B.C.. The Junkers eventually came to grief during a landing at Stuart Lake in September 1929. Left to rot, it was eventually vandalized. However, the owner removed the propeller and the engine before this happened. He converted the engine into a small air compressor, which eventually disappeared. It was the engine that helped make the plane famous and enabled it to fly throughout the mountain areas of northern B.C..

Hugh A. Halliday wrote about the Laurentide Air Service Limited: Commercial Pioneer in the April 1970 issue of the Journal. The first of the commercial air services that blossomed in Canada in later years, Laurentide started in business in 1919 in the St Maurice River Valley. The Government of Canada supplied two Curtiss HS2L flying boats (G-CAAC and G-CAAD) which had been in storage at Halifax and Sydney, where they had earlier been used for wartime U.S. anti-submarine patrols. The boats were reassembled at the Dartmouth Air Station and flown, by stages, to Lac à la Tortue, some ten miles from Grand'Mère, Québec. Forest survey and protection were the first jobs of the new Air Service. The Company helped to pioneer aerial photography in 1920.

In 1922 the Air Service separated from its parent company - the Laurentide Pulp and Paper Company - and was authorized to: carry freight, passengers and mail; design, repair and manufacture aircraft; undertake photography; and carry out experiments in military aviation. It did not do all of these things, but it did expand into work for other customers and added more HS2L's to its fleet. In 1922, also, an HS2L piloted by Donald Foss was involved in an accident while taking off from a lake 20 miles northeast of Kapuskasing in northern Ontario. This aircraft (G-CAAC) - then called 'La Vigilance' - was considered to be wrecked beyond repair and was left to rot. However, 47 years later the National Museum of Science and Technology retrieved the remains, rebuilt the aircraft, and put it on display. (Illust. #11)

From May to September 1924 the Laurentide Air Service flew mail, passengers and freight into the Rouyn gold fields - the first such regular service in Canada - but it was not financially successful. Added to this were the aircraft losses, accidents and other problems of earlier years. The Company closed down in 1925.

Helicopters: workhorses of the Canadian air was written by Larry Milberry and was included in the February/March issue of the Geographic in 1980. In spite of its relatively recent date of publication, it had a good deal to say about the early days of helicopter operations in this country. Milberry wrote that rotary-winged flight came to Canada in the early 1930's with the arrival of two Pitcairn gyroplanes. These were not helicopters, but aircraft powered by traditional aircraft engines, with lift provided by a big free-wheeling rotor. The gyroplane enjoyed some popularity in North America and Europe from the late 1920's but, for 20 years, the Pitcairns were the only gyros registered in Canada. One was operated by Leavens Brothers in southern Ontario until the early 1950's. Milberry went on to say:

> Canada's first helicopter appeared in 1938. (The three Froebe brothers), farmers by occupation but tinkerers on the side, designed, built and flew this pioneer machine. The project was centred on their farm in Homewood, Manitoba.
>
> The Froebes' helicopter was small, and it resembled a flying bedstead. Mounted on an ungainly-looking frame were a Gypsy II engine, a pair of counter-rotating vanes or rotors, a fuel tank, and a pilot's seat. With rudimentary knowledge of flying, Douglas (Froebe) made the first successful flight in late 1938.

On this flight, the machine was found to be nose-heavy, and adjustments were made. But a more serious problem with the rotor hub bearings appeared later, which the Froebes could not rectify, and the project was abandonned. However, their machine survived and became part of the collection at the Western Canada Aviation Museum in Winnipeg.

The next group of Canadian helicopter pilots were the six who trained on the Sikorsky R-4 machine with the United States Navy during World War II. This machine was the first of its kind in the world to be mass-produced. One of these pilots helped set up the first RCN helicopter unit at HMCS Shearwater in 1951. One Canadian civilian pilot was also trained by the U.S. Army before the War's end.

In 1946, Bell Aircraft set up a helicopter training school at Buffalo and a number of Canadians enrolled in the mechanics' and pilots' courses, some of the latter being former fighter pilots who could not find jobs flying conventional aircraft. One of the graduates of this course ferried the first Canadian-registered Bell helicopter to Toronto in March 1947, for delivery to the Photographic Survey Company Ltd. It was soon put to work - on forestry patrol in northwestern Ontario for the Department of Lands and Forests. Other graduates flew Bells in different parts of Canada, on a variety of jobs, and with varying degrees of success.
One of the companies that began in a small way about this time was Okanagan Air Services, which later became Okanagan Helicopters Ltd. - the operator of one of the world's largest helicopter fleets. Another active owner/user of helicopters was the federal Department of Transport which pioneered the use of these machines for reconnaissance and communications work alongside icebreakers in the Arctic.

The difficulty of producing a Canadian-designed and -built helicopter was illustrated in Mulberry's article. He wrote:

> In 1945, a Polish aeronautical engineer, Bernard W. Sznycer, came to Montreal from New York. Sznycer was a pioneer in helicopter design in the United States during

> the War...(He) accepted the offer of a group of Montreal financiers...to finance development of a small helicopter for Canadian use.
>
> Sznycer, aided by Selma Gottlieb, a mathematician from Philadelphia, set to work and by late 1946 had designed and built a prototype. This was the SG-VI-C, a small three-seater powered by a 178 hp Franklin engine. It was successfully flown for the first time in July 1947 by an American pilot, Henry J. Eagle Jr. He found it an excellent machine, easy on the controls and free of vibration and stick shake.
>
> Though restricted by budget limitations, Sznycer refined his helicopter as the SG-VI-D, christened the 'Grey Gull.' It first flew on February 6, 1948 with much fanfare from the Montreal press.
>
> The SG-VI-D was successfully put through a rigid flight test program and was shown to be as fine a light helicopter as any then in production in the U.S.. Sznycer devised plans to mass produce it, subcontracting the manufacturing of parts. These, he claimed, could be assembled into a complete helicopter with 16 hours' labour.
>
> In March, 1951, despite delays caused by the shortage of development funds, the 'Grey Gull' was certified by the Department of Transport...The test criteria had been based on existing American standards for helicopter certification, but tightened to meet the needs of Canada's environment...
>
> The 'Grey Gull' was also the first helicopter certified in the British Commonwealth. Ironically, its backers chose that time to withdraw their funding. The project folded...

Aerial photography - an early manifestation of what we now call 'remote sensing' - was discussed by H.R. Jackson in <u>What aerial photography does for us</u>, which was published in the August/September issue of the <u>Journal</u> in 1976. The author wrote that photographs taken from aircraft had greatly assisted in the development of Canada, but the technology had not always had the sophistication found in the mid-1970's. The beginnings, he said, were shaky. The first known air photo in Canada was taken over Halifax in 1883 from a balloon. But it was not until World War I that air photos were used for other than 'curiosity' purposes. The air reconnaissance of enemy lines started the technology of aerial photography and its interpretation.

Jackson wrote that, in Canada, the first work on civilian uses