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## **EIC's Historical Notes and Papers Collection**

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EIC Articles, Cedargrove Series, and EIC Working Papers)

# **ENGINEERING HISTORY PAPER #53**

## **“Engineering When I Was Very Young”**

**by Andrew H. Wilson**

(previously produced as Cedargrove Series #26/2013 – December 2013)

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EIC HISTORY AND ARCHIVES

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## **Abstract**

This paper deals quite briefly with the kinds of engineering projects that were being carried out in Canada and throughout the world during the early years of the Great Depression.

## **About this Series**

Principally, the Cedargrove Series is intended to preserve some of the research, writings and oral presentations that the author has completed over the past half-century or so, but has not yet published. It is, therefore, the modern-day variant of the privately published books and pamphlets written by his forebears, such as his paternal grandfather and grandmother, and his grandfather's brother John.

## **About the Author**

He is a graduate in mechanical engineering and the liberal arts and has held technical, administrative, research and management positions in industry in the United Kingdom and the public service of Canada, from which he retired over 25 years ago.

He became actively interested in the history of engineering on his appointment to chair the first history committee of the Canadian Society for Mechanical Engineering in 1975 and has been active ever since in research, editing and writing on behalf of that Society, the Engineering Institute of Canada and the Canadian Society for Senior Engineers. He has also served as president of EIC and CSME.

## **Introduction**

This paper has its origin in a talk delivered by the author to the Ottawa Kiwanis SAGE Group - retired men, average age 82 - at Woodroffe United Church on 19 November 2013. It deals very briefly with some of the engineering projects that were being pursued in Canada and in various parts of the world during the years from 1928 until 1932 - the early years of the Great Depression. Projects under way did not necessarily stop during these years. On the other hand, some took longer to complete; others were finished more quickly. Some were not begun.

The text that follows is a little longer than the one that was delivered orally. Some of the illustrations used have been added.

## **The Text.....**

As it happened, I was born in 1928. By 1932 the Great Depression was in full swing. No doubt others in the audience would remember these years, although their recollections of them might be quite different from mine.

I was born in Scotland, not in Canada, but still experienced the Depression. My father was in business. My mother had taught school up until she married. Her university major was history, which helps explain in part how I became fascinated with its study. My earliest interest in engineering began around 1932. It was awakened when I became familiar with the diesel engine that provided power for the machinery in my father's feed store and was housed at the back of the building. It was a Ruston & Hornsby single-cylinder horizontal engine, with a bore of around eight inches and a two-foot stroke, a power take-off, and a four-foot diameter flywheel. I don't remember its working speed.

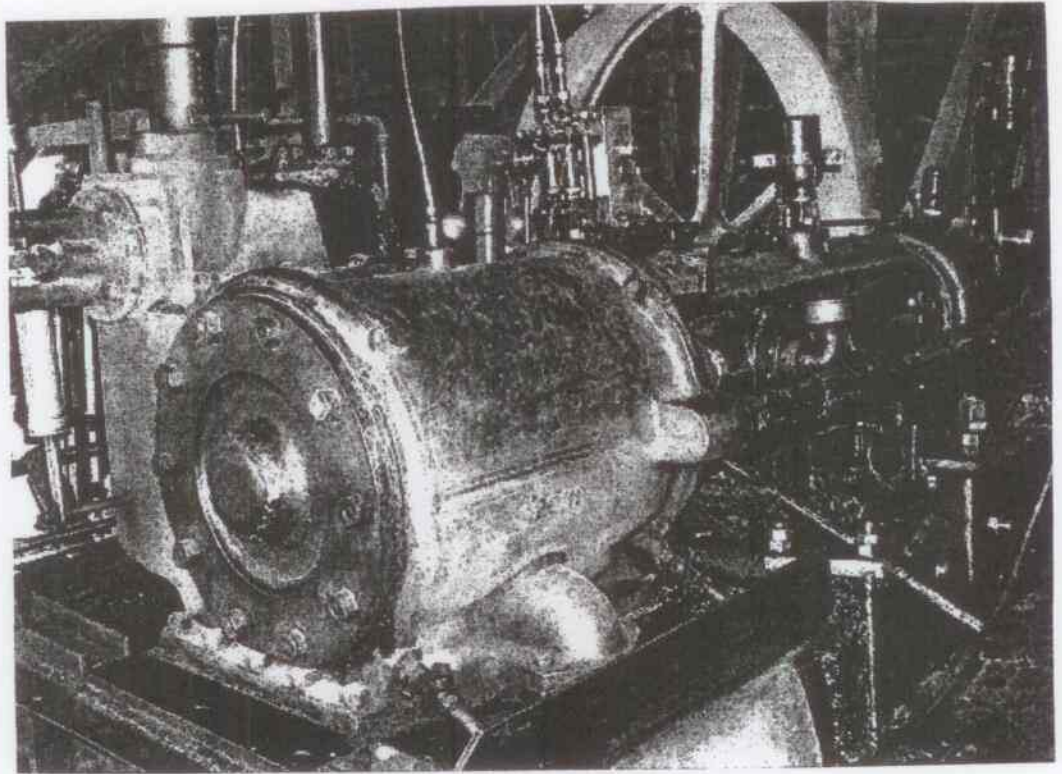
The engine was started using compressed air and happily made its characteristic diesel thumping noise during every working day. I was taken occasionally to watch it work, held firmly by the hand. My ambition at the age of four was to be allowed to start it. But this had to wait until I was an apprentice in a marine engine plant that made very much larger Burmeister & Wain multi-cylinder ships' diesel engines, ones that had three-foot bores, six-foot strokes, huge flywheels, and turned at something like 80 rpm.

The fact that there was a Depression in progress in Canada during the period I am talking about did not mean there was no engineering going on either there or elsewhere. But the effects of over-production in the primary sector were being felt internationally. No one was buying. The products of secondary industries in this country were hard to sell. Immigration ceased for the duration. Emigration did not.

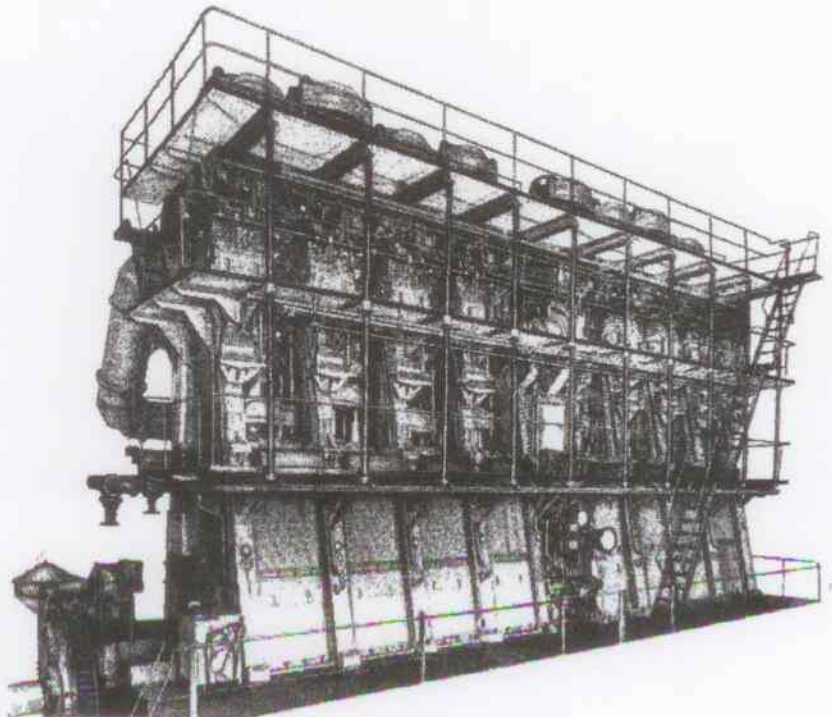
Some evidence of the effects of the Depression among Canadian engineers - though less severe perhaps than in some other groups within the workforce - can be found in the membership statistics of the Engineering Institute of Canada, the national society to which most engineers belonged at that time. Corporate (or professional) membership in 1928 was around 3,500. By



A Ruston engine.....



And a Burmeister & Wain...



1932, it had fallen to 3,100, or by around 11 percent. However, the figure for 1932 included 300 or so members who had applied to the Institute's program of help in finding jobs. Numerically, the largest drop was in the membership living abroad, mostly in the United States, followed by Ontario, British Columbia, the Prairies, Québec and the Maritimes. Indications were that plants in the manufacturing sector were the most affected, and that a goodly number of these were branch plants.

In a world-wide engineering context, **1928** was the year in which: the first regular aeroplane flights between Europe and Australia began; the first colour motion picture and TV broadcasts were made in the U.S. and in England; sliced bread was sold for the first time; penicillin was discovered; the German dirigible *Graf Zeppelin* flew the Atlantic and later set a flight distance record of 4,000 miles; the first autogyros (predecessors of the helicopter) flew in Europe and the United States; the first *Plymouth* automobile came off the line in Detroit in June (and 58,000 of them were to be shipped before year-end); an iron-lung respirator was used for the first time in a polio case in Boston; cartoon character Mickey Mouse was 'born'; the only major engineering disaster was the failure in March of the St. Francis Dam, north of Los Angeles in California, in which 600 people lost their lives, although one of the Florida hurricanes killed 3,000 in September; W. L. Mackenzie King was Canada's prime minister; and Herbert Hoover won the U.S. presidential election in November. If your father drove a Buick in 1928, it would likely have looked like this one...

Uncle Jimmy's car...

actually a 1926 Buick





In Canada, in 1928, the Welland Ship Canal - the fourth 'iteration' of it and one of the most important engineering projects in North America and within the British Empire - was under construction. It would eventually be one of the largest links in the project to connect the Prairies and the Great Lakes with the Atlantic Ocean when the St. Lawrence Seaway was completed 30 years later.

The 'Ship' replaced the Third Welland, reduced its length by around two miles, had only eight locks instead of 26, and doubled its depth to around 30 feet. It also had 21 vertical lift, swing and bascule bridges across it. The Thorold flight of three locks had a combined lift of around 140 feet. The Ship's construction was planned so as to interfere as little as possible with the traffic using the Third Canal. It was completed in 1932. Among the principal engineers involved in the project were A.J. Grant and J.L. Weller. Grant had been involved earlier in the construction of the Trent-Severn Waterway, which was also completed in 1932.

Speaking of waterways, the Welland was part of what was called 'the St. Lawrence problem.' Large and complex, it was receiving study in Canada in 1928. Among the engineering factors being considered were lake and river levels, river discharges, channels, locations of dams and locks, ice, water temperatures, seasonal conditions, traffic flows, lake vessel designs, and potential power developments - all of which were later relevant to the eventual design of the Seaway.

In 1928 the 'rejuvenation' of the Cariboo Road in British Columbia, built originally during the Gold Rush of the 1850s, was underway. It extended from Hope to Prince George, followed the Fraser River throughout much of its length, and involved a number of spectacular bridges, rock galleries and cliff-hugging sections. Also underway was the building of the new Union Railway Station in Toronto.

Engineering-wise and internationally in **1929**, the U.S. and Canada agreed to preserve Niagara Falls (and the power plants dependent on it); the first airship flight flying eastward around the world was completed; Lieutenant Doolittle flew the first all-instrument flight in the United States and Admiral Bird flew over the South Pole; and on October 29 the stock market in New York crashed, triggering the Great Depression.

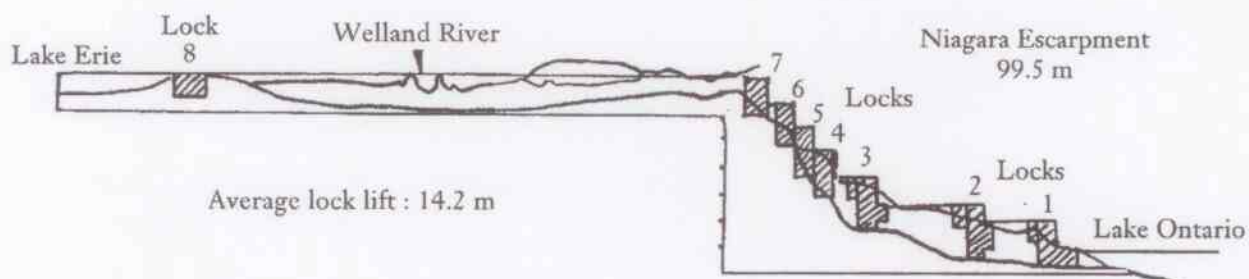
Canadian engineering under way in 1929 included what was then called the Montreal-South Shore Bridge and, five years later, the Jacques Cartier Bridge. It was of the steel truss, cantilever type, crossed the St. Lawrence River from Montréal Island on the north shore, by way of Île Sainte-Hélène, to Longueuil on the south shore. It had five vehicular lanes and was several miles long, including the approaches.

The Jacques Cartier was designed by Philip Louis Pratley, one of the country's most talented bridge engineers and one who has since been recognized as having national significance by the Historic Sites and Monuments Board of Canada. Its construction, by the Dominion Bridge Company, began in 1925. The superstructure was completed in September 1929 and the bridge



The Welland Ship Canal...

### WELLAND CANAL PROFILE



The Jacques Cartier Bridge...





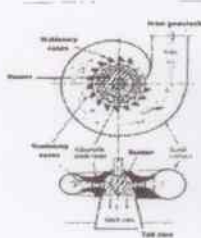
opened to traffic the following May, about 18 months ahead of schedule. This bridge was a familiar sight to those attending EXPO 67.

Another large bridge of 1929, the \$24 million Ambassador, between Detroit and Windsor, was opened to traffic in November of that year, after a two-year construction period. At the time, it was the longest suspension bridge in the world, with a main span of 1,850 feet and its apex 152 feet above the Detroit River. It took five lanes of traffic. It lost its title only two years later to the George Washington Bridge, which crossed the Hudson at New York, and which - in turn - lost the title to San Francisco's Golden Gate Bridge.

In the 1920s, water power was the primary source of electricity in Canada. Relatively speaking, coal-fired steam plants were few and oil-fired ones even fewer. By 1929, there was an installed capacity for turbine-generated water power across the country of just over 5.7 million horsepower - only 17 per cent of the conservatively-estimated exploitable water power potential. The leading province was Québec, with 2.6 million horsepower installed, followed by Ontario with 2 million, British Columbia with 0.6 million, and Manitoba with 0.3 million. Saskatchewan generated hardly any.

Most of the generating equipment for hydro-power in 1929 was of the Francis turbine variety. Both 25- and 60-cycle plants were in operation. The maximum generator size was 54,000 kva. A few transmission lines as long as 230 miles were in operation. The average transmission voltage at the time was 132 kv, although longer lines with higher voltages were under consideration.

Francis turbine.....



In 1930 the Coolidge Dam was inaugurated in Arizona; over 700 people died in severe flooding in the Languedoc region of France; the telephone connection between England and Australia went into service; the first round-the-world radio broadcast took place, originating in Schenectady, New York; the Chrysler Building - a 1,000-feet high and the tallest man-made structure at the time - was opened to the public in New York; construction of the Boulder (later the Hoover) Dam began in Colorado; R.B. Bennett was elected prime minister of Canada. One of his later cabinet ministers was Grote Stirling, a member of the Engineering Institute of Canada. And in 1930, A.J. Grant, whom I mentioned a moment ago, was elected president of the Institute.

Late July-early August 1930 saw the visit to Canada of the British passenger-carrying airship, the R-100. This airship was the fourth to cross the Atlantic and had been built, with its sister-ship, the R-101, to test the possibilities for long-distance travel by rigid airships. The R-100 was 700 feet long, had a diameter of 133 feet, and a capacity of 5 million cubic feet. Its weight



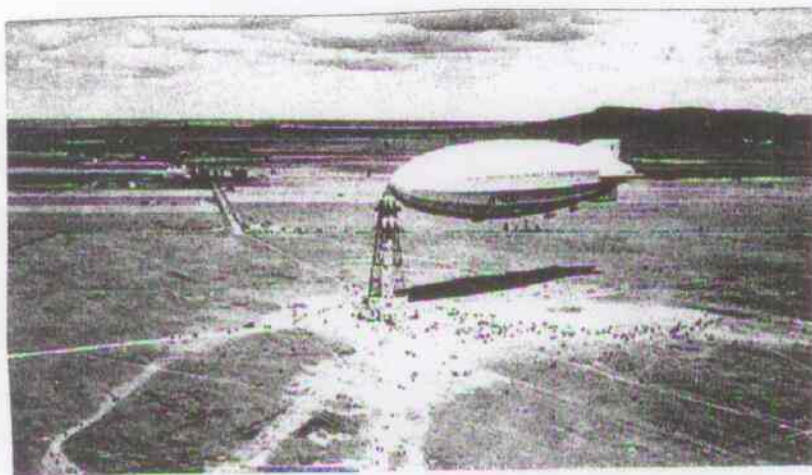
was 90 tons, but it could lift over 150 tons, including passengers. It had six propelling gasoline engines, in three cars, and cruised at a speed of 70 mph. The airship was also capable of rising at a maximum rate of 2,000 feet per minute.

One thing that should be realized about these airships is that they were totally dependent on the availability of mooring masts for charging and discharging cargoes and passengers. This restricted the routes they could serve, their ports of call, and the extreme danger of emergency situations when no mast was available.

The R-100 left England on 29 July and arrived at the mooring mast at St. Hubert, Québec - said at the time to be the most modern and efficient yet built - on 1 August, after crossing the ocean in 79 hours. Its navigation was assisted by RDF stations on land and ships at sea. The roughest part of the trip, apparently, was its journey up the St. Lawrence. It has been estimated that over one million people went to St. Hubert to see the airship.

During its stay there, the president and Council of the Engineering Institute gave a dinner at which the officers related their experiences of the voyage. Some days later, the airship flew over Ottawa, Toronto and Southern Ontario but, unfortunately, on its return to St. Hubert, suffered an accident to one of its engines, which could not be fixed in Canada. The result was that it made the return trip to England on five engines. Even so, with the tail wind, it took only 59 hours for this trip, which ended on 16 August.

Unfortunately, not long after the R-100 returned home, its sister-ship, the R-101, crashed at Beauvais in France on its way eastward to India, with the loss of 46 lives. This effectively ended the British airship program. The R-100 was scrapped the following year.



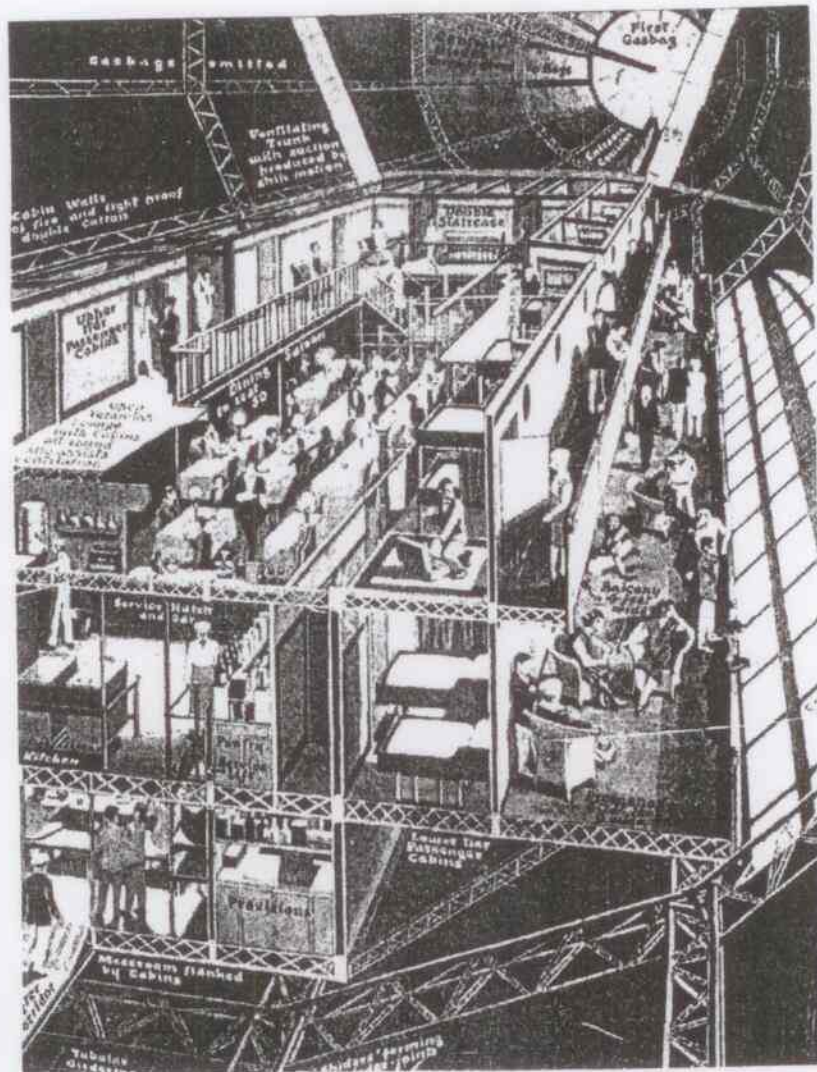
The R-100 at the St. Hubert mast...

The R-100 over Toronto...





R-100 passenger  
accommodation...



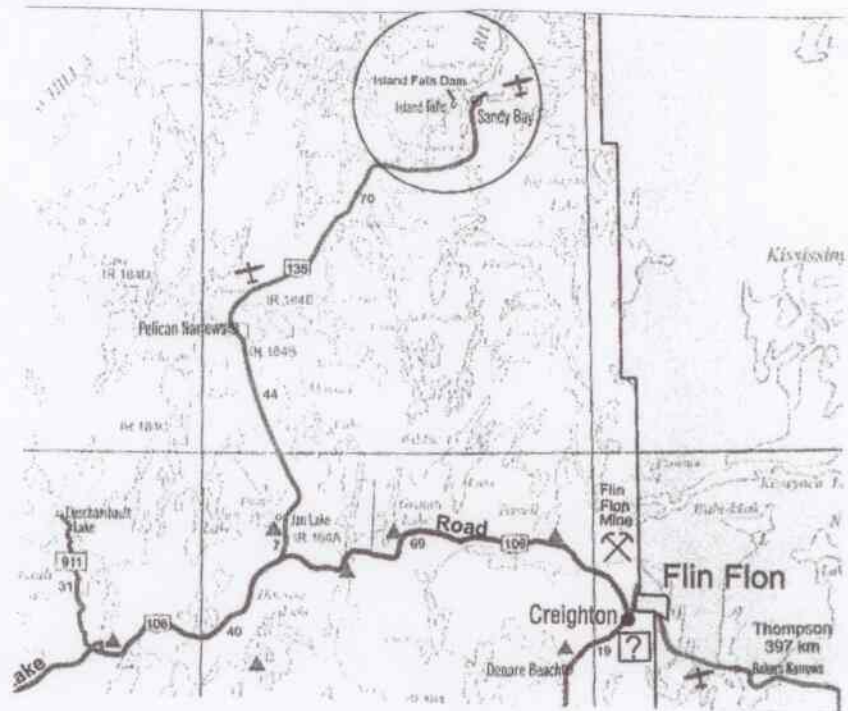
From the skies of eastern Canada to the northern plains of Saskatchewan, to the power plant at Island Falls. This large water-driven power plant was the first to be built in that province - by the Churchill River Power Company - between 1928 and 1930. Located some 60 miles northwest of Flin Flon, Manitoba, it generated 44,000 horsepower at 6,600 volts and served two mines in that province - one owned by the Hudson Bay Mining and Smelting Company at Flin Flon, and the other by the Sherritt-Gordon Company at Cold Lake. The drainage basin above the plant was about 80,000 square miles in extent and included a number of large lakes, which provided reservoir capacity for the plant.

The transportation of materials and supplies for the construction at Island Falls was difficult since no routes then existed from the railhead at Flin Flon to the site. So a chain of roads had to be built between a series of lakes, on which scows operated. The 'heavy lifting' was done in winter when the lake ice was thick enough, using trains of tractor-pulled sleighs. Over the two winters of construction, some 36,000 tons of material were moved in this way. A small, temporary turbine-driven power plant was built 14 miles downstream to service the construction site. The power dam plant and spillway spanned the main channel of the Churchill River. The available head was 56 feet. A number of earth dams were also built to prevent unwanted outflow

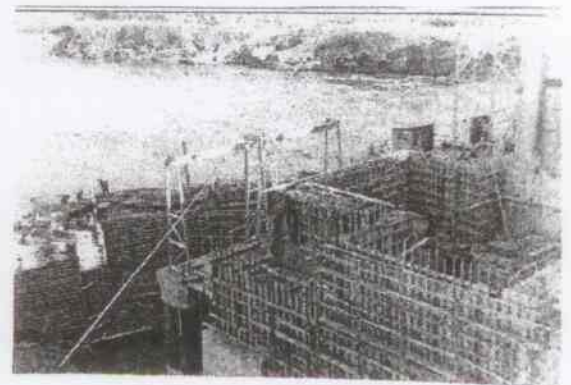
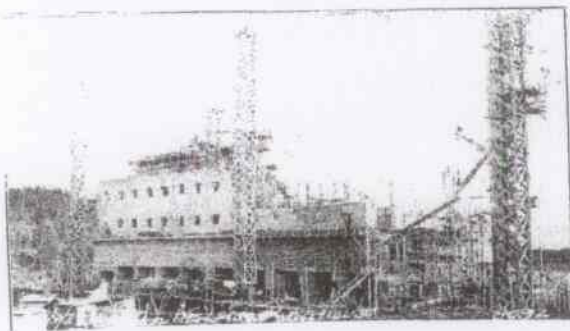


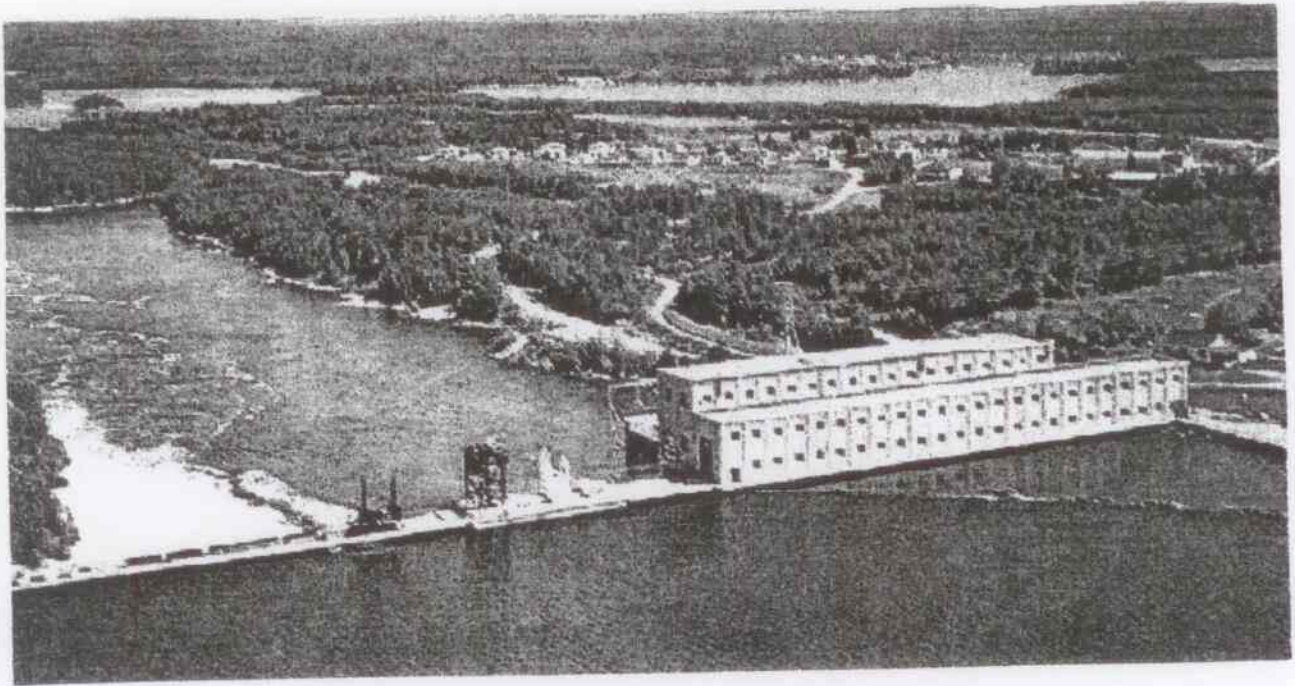
from the headpond. A second spillway was also built. Today, this Churchill River plant is remotely controlled and has no resident staff.

Location of Island Falls power plant...



Island Falls power plant under construction...





Island Falls Power Plant, Saskatchewan

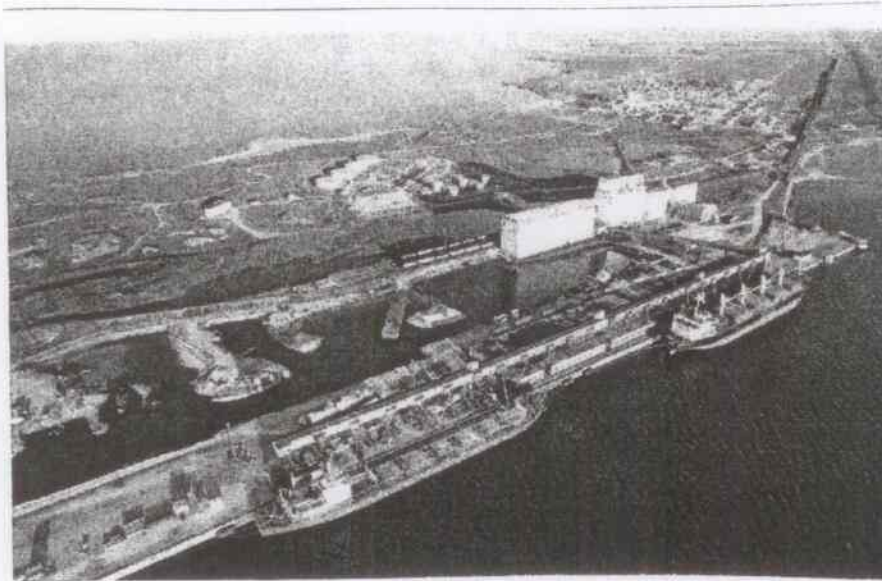
From one Churchill to another...

In 1913 the Government of Canada began the construction of a proposed deep seaport at Port Nelson, Manitoba, on Hudson Bay to speed up the transportation of Prairie wheat to European markets. At the same time, the Hudson Bay Railway was being extended northwards from The Pas, Manitoba, almost to the proposed port site. This work was stopped during World War I due to shortages of men and materials. Feasibility studies and political pressure to restart these projects continued after the war and until the end of 1927, when they were allowed to go ahead.

However, the site for the port was changed to Churchill, by then deemed the more suitable from the engineering and financial points of view, although extra rail mileage was required. The work progressed rapidly on both fronts during 1928. The rail line was in operation to Churchill by September 1929. However, the first commercial grain cargoes did not leave the new port until two years later. The Churchill facilities included docks, freight sheds, a power house, grain elevators, storage bins and a dredged channel.

Notably, in 1931, Thomas Edison submitted his last patent application; the State of California was granted permission to build the Oakland Bay Bridge; the Schick Company put the first electric shavers on the market; the Empire State Building was opened to the public in New York; the first rocket-powered aircraft design was patented in the United States by Robert Goddard; the first LP record was demonstrated by RCA Victor in New York, but it failed commercially; the world air-speed record was raised to just over 400 mph; the first trans-Pacific aircraft flight took place, from Japan to Washington State; Dupont marketed one of the first synthetic rubbers –





Churchill, Manitoba...

neoprene; the Statute of Westminster passed through the British Parliament, giving legislative independence to Canada and other dominions within the Empire.

To digress for a moment...

Historically, municipal/city sewage systems have been of great importance for public health in order to control infectious diseases, such as cholera, and to eliminate smells. For example, in the 1850s, the cesspit, open sewer, direct-to-river disposal system in London, England, was responsible for continued and extensive outbreaks of cholera and for constant atmospheric pollution. The civil engineer, Joseph Bazalgette (later Sir Joseph) designed and supervised the construction of an extensive and expensive (paid for by the British Parliament) underground sewer system extending for hundreds of miles that stopped both outbreaks and smells.

In the 1850s, also, Canadian engineer Thomas Coltrin Keefer brought similar changes to Hamilton, Ontario, when he designed and built the Hamilton Water Works, drawing fresh water from Lake Ontario. It provided the city with the clean drinking water that banished cholera, as well as an effective fire protection system. Keefer also built Ottawa's water system. The water for the Hamilton plant was pumped by steam-driven beam engines of James Watt's design and built at Ancaster, Ontario, by John Gartshore.

By 1931, the city of Toronto had neither cholera nor smells. It did have a 720-mile long sewer system that could also clear storm waters. It served a population of 600,000 over a 35 square-mile area. Its great advantage was the fact that the city's northern limit was 350 feet above the lake level, with fairly even drainage to the lake to the south and to the Don and Humber Rivers to the east and west.

In late 1931 a famous Toronto building was opened for business: Maple Leaf Gardens. This may

have been a good omen for the occupant hockey team. It won the first of 11 Stanley Cups at the end of that season.

The subject of a series of technical papers in the EIC's *Engineering Journal* that same year was the significant extension of the Sun Life Assurance Company of Canada building in the downtown business district of Montréal.

The original eight-storey Sun Life building on the same site, completed in 1922, had columns and footings that were designed to take the load of a higher building later on. Its basic structure was reinforced framed steel. The walls were of granite, backed with brick. The beams were 18 inches deep and fireproofed, and the floors were long-span ribbed slab concrete. The building was heated by forced circulation hot water in three systems, and was mechanically ventilated throughout. There was also an ammonia refrigeration plant for service to the kitchens and cafeteria.

The 1931 building covered two acres, had 28 floors and three basement levels. The first eight floors covered the entire lot, with the tower portions covering about half of it. When completed, it was - at that time - the largest building by available square-footage in the British Empire. Today, it is only the 17<sup>th</sup> tallest building in Montréal.

Sun Life Building,  
Montréal...

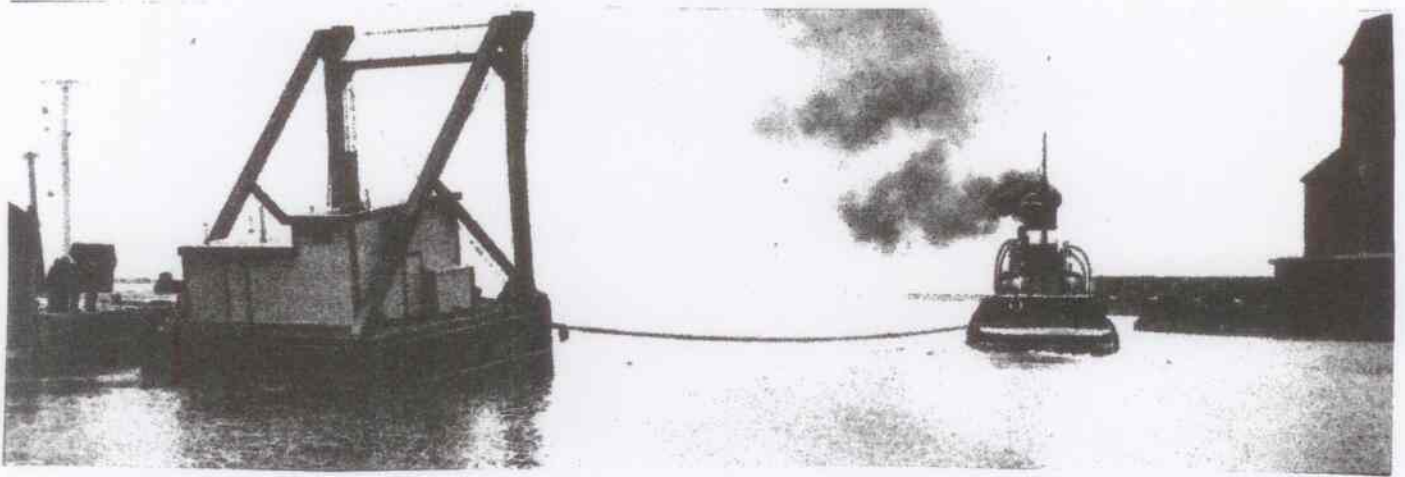


From the time I was very young, I have enjoyed ships - looking at them as well as sailing in them. These feelings have grown deeper with the years and especially after I became involved with marine engines and other mechanical and electrical equipment. So I have taken the liberty of including a relatively long list of the relatively few numbered vessels built at the Collingwood Shipyard on Georgian Bay between 1928 until 1932. This yard, in addition to

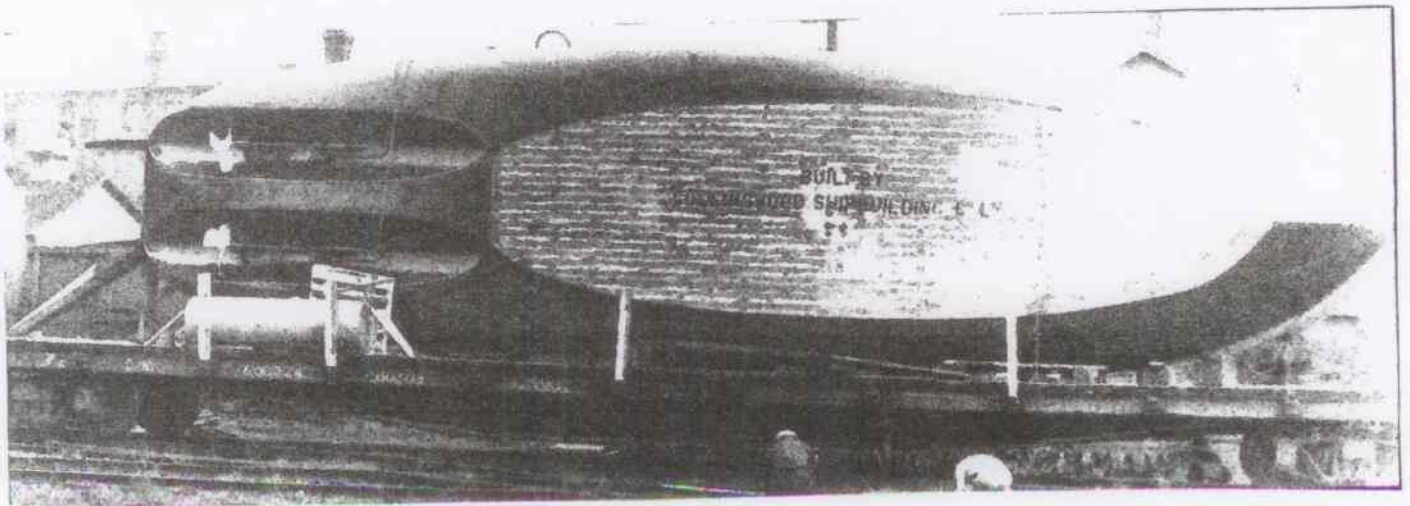


turning out some spectacular vessels in its lifetime, also employed the uncommon technique of sideways launching.

Hull 80, a gatelifter for the Third Welland Ship Canal, was completed in three months and left Collingwood in May 1928. Hull 81 was a twin-screw motor launch, also completed in 1928, but made its journey to Montréal by rail.

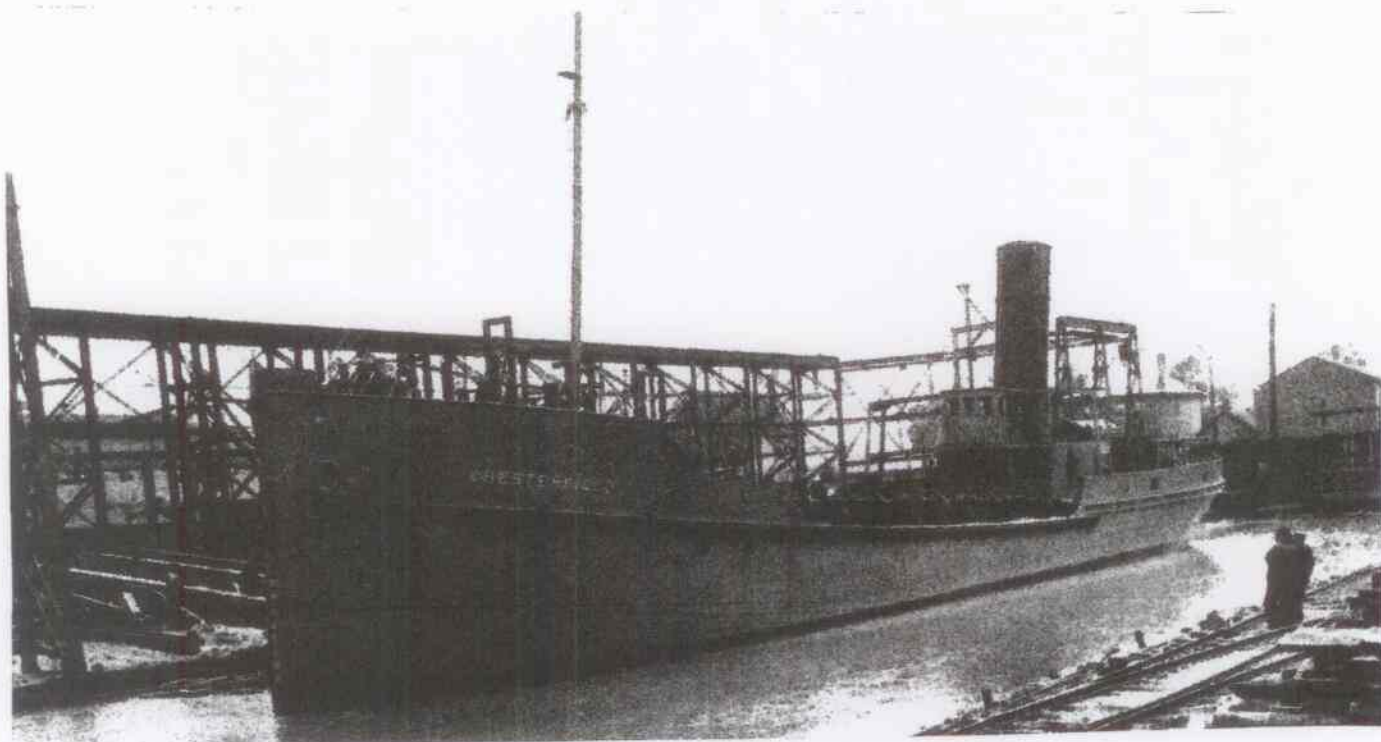


Hull 80...



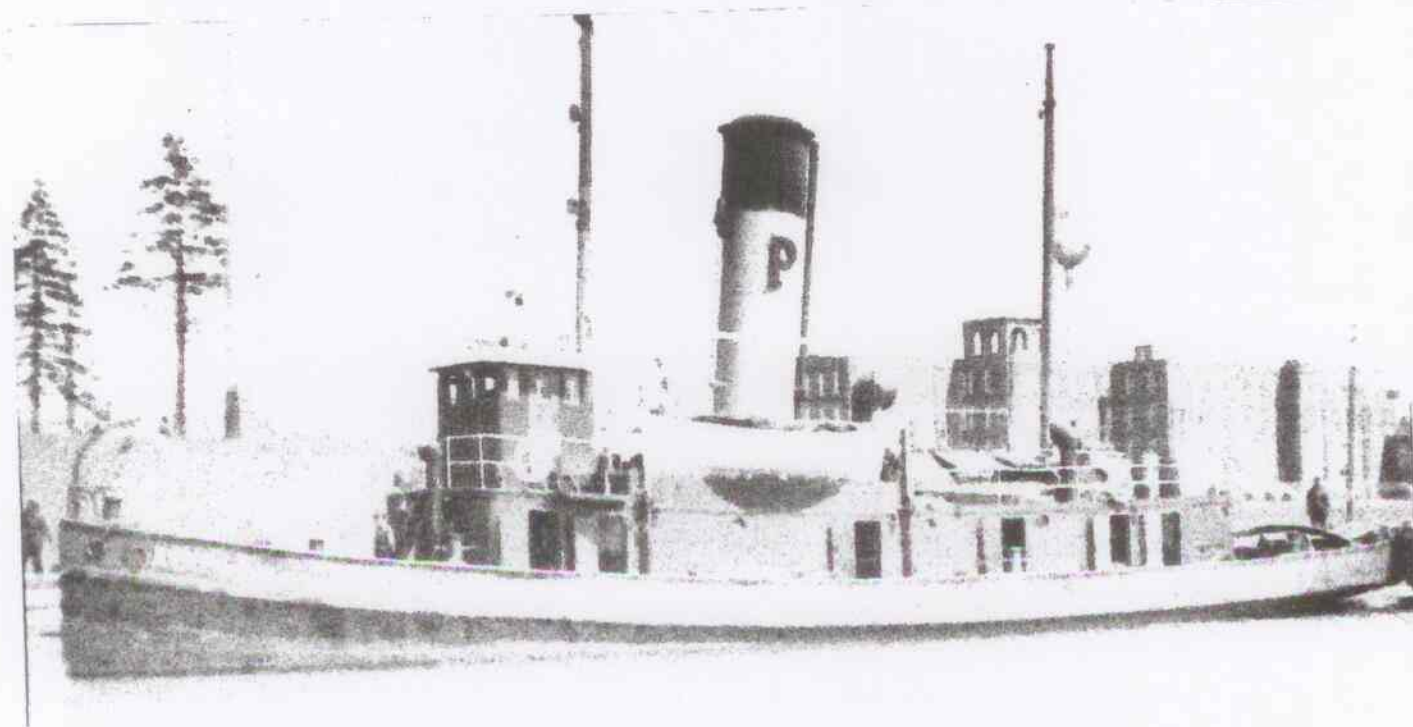
Hull 81...

Hull 82 - the *Chesterfield* - was a hopper barge for the Canadian Government, which was launched in June 1928 and completed in August.



Hull 82...

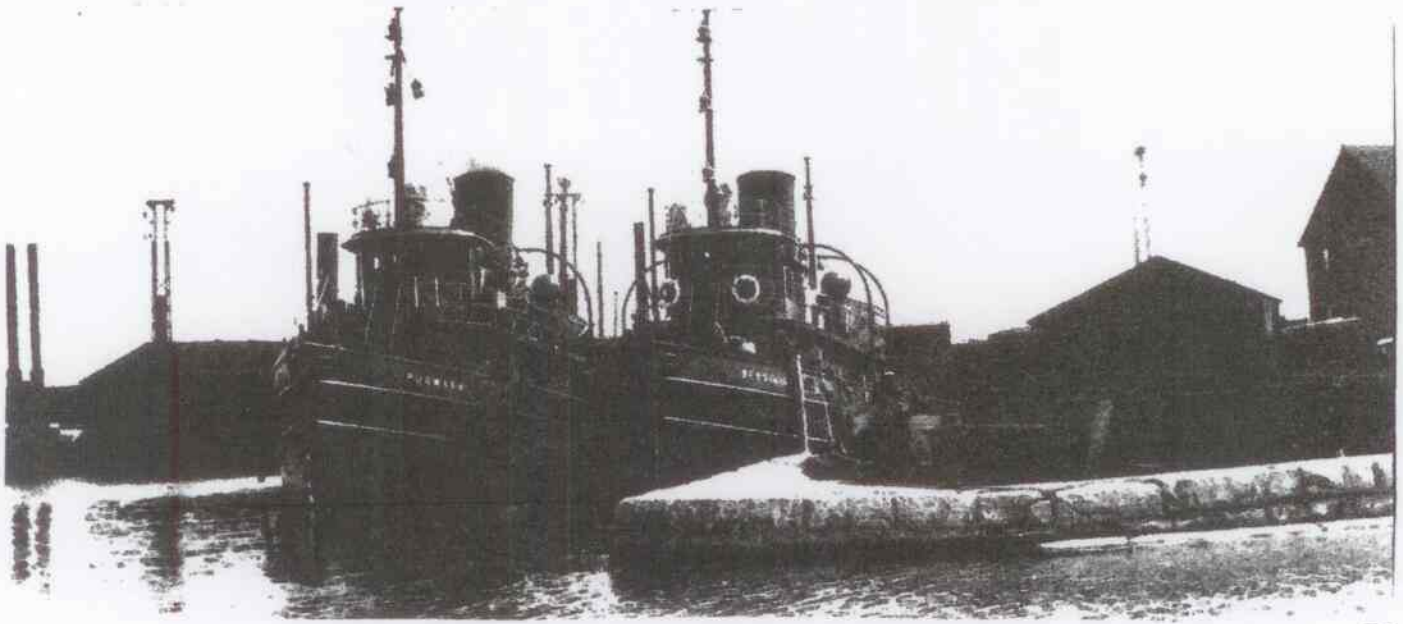
Hull 83 was the tug *Rouille*. It was completed in October 1929 for the Toronto Harbour Commission, for work on ice-breaking and fire-fighting.



Hull 83...



Hulls 84 and 85 were the sister tugs *Bersimis* and *Pugwash*, destined for work on the east coast. They were launched in April and completed in May, 1930.



Hulls 84 and 85...

Hull 86 was a gatelifter for the Welland Ship Canal. Its keel was laid in December 1929 and it was completed in October 1930.

No ships were built in 1931.

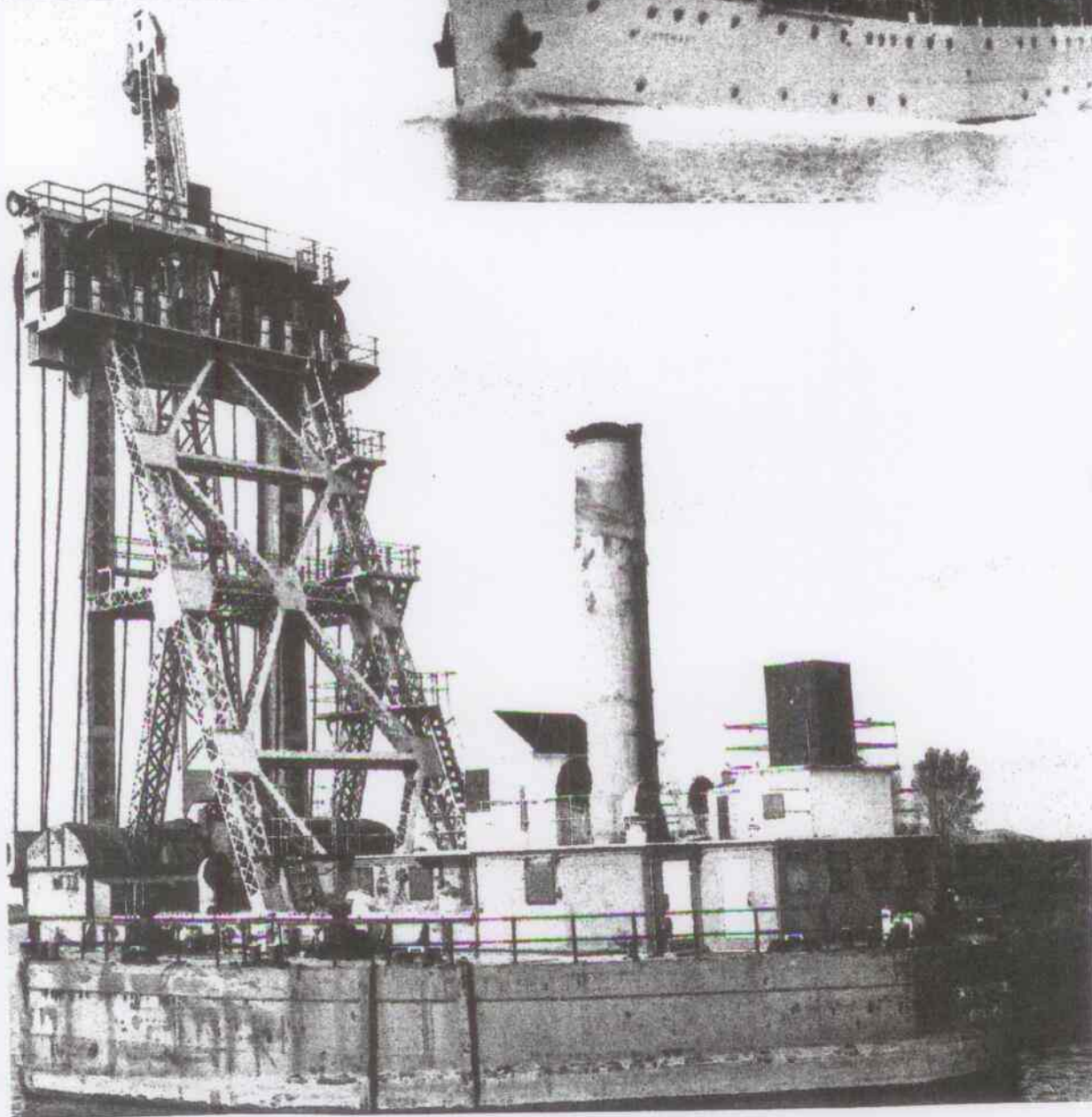
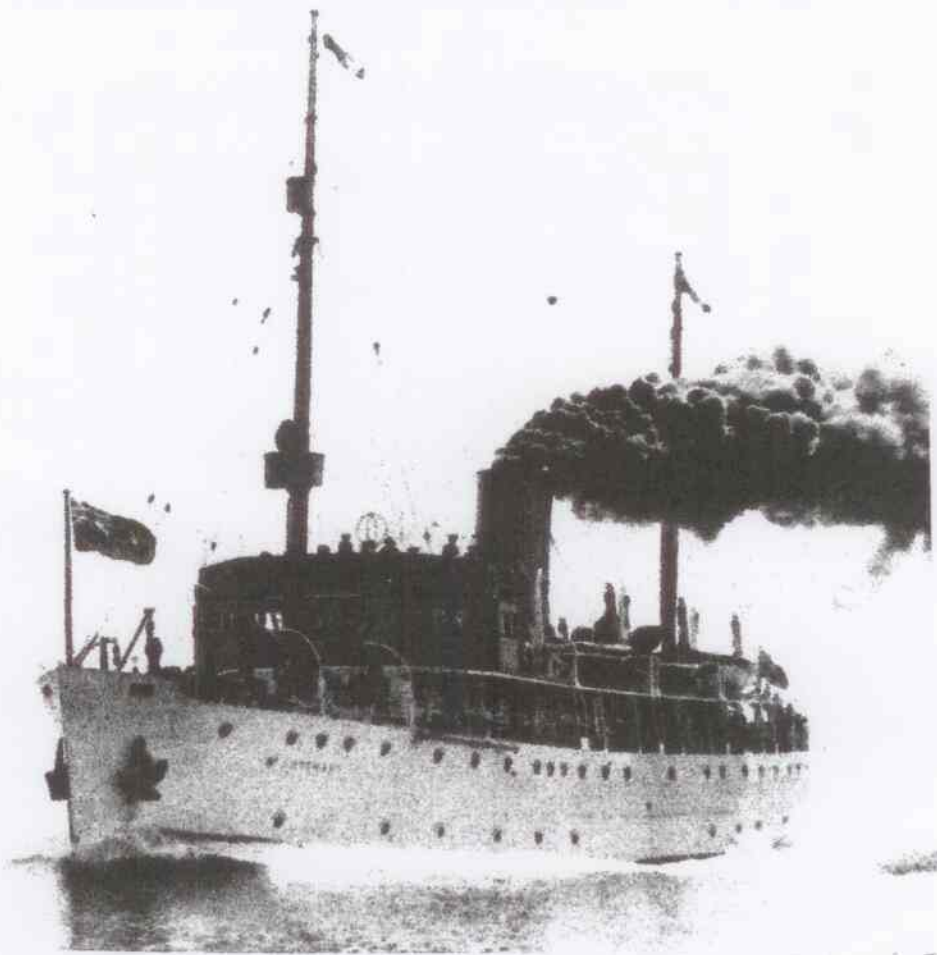
The largest ship came last. Hull 87 - the *Wm. J. Stewart* - was a hydrographic ship built in 1932 for the Canadian Government.

For the record, the contract for Collingwood's next ship, Hull 88, was not awarded until late in 1937. The yard closed permanently in the mid-1980s.

Back to 1932...

In 1932 the invasion of Manchuria and China by Japan began; the U.S. airship *Columbia* crashed during a storm at Flushing, New York; Malcolm Campbell set a new world land speed record of 254 mph at Daytona, Florida; the Sydney Harbour Bridge - a Depression-era project - was opened; Amelia Earhart became the first woman to fly solo over the Atlantic, from west to east; Canada and the United States signed a treaty to develop what became the St. Lawrence Seaway; the (then) world's largest dam, on the Dnieper River in Russia, began operation; and Franklin D. Roosevelt won the U.S. presidential election in November.

Hull 87...



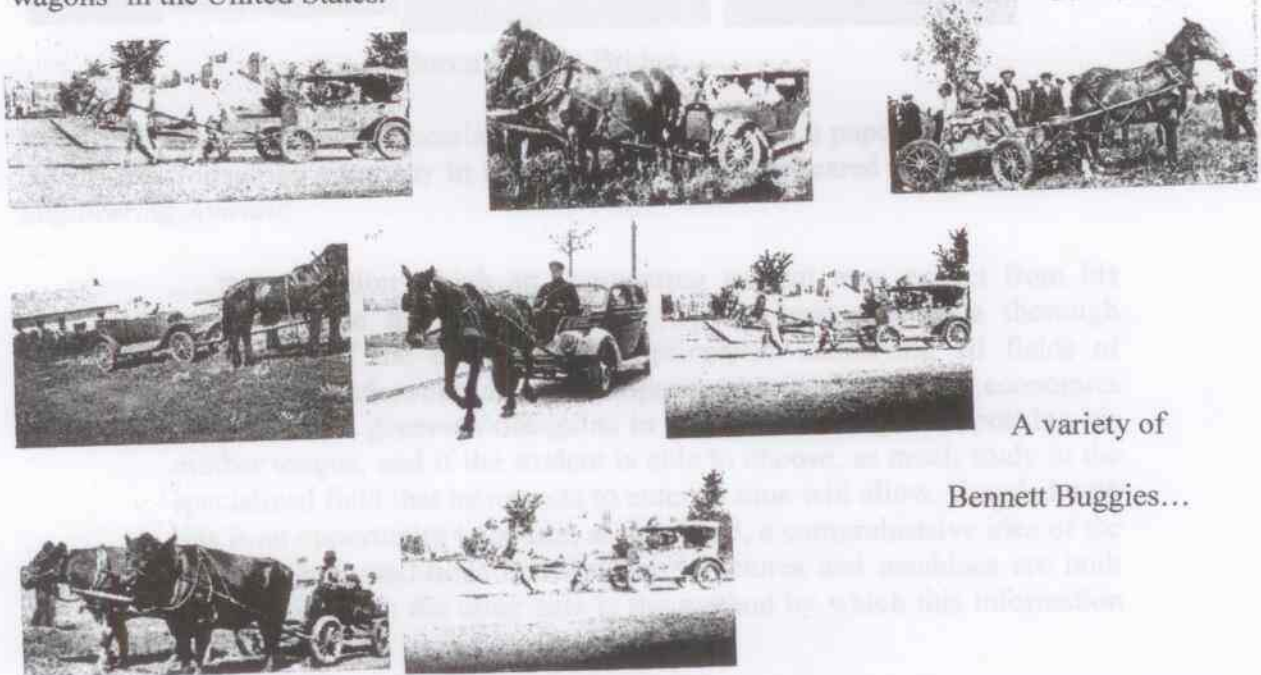
Hull 86...



The Depression years in Canada were also known as the years of the Prairie drought and soil erosion, especially in southeastern Alberta, the southern half of Saskatchewan and southwestern Manitoba. With the disappearance of their markets, the farmers in these regions were therefore facing a double whammy of problems.

The soil/drifting problem was discussed in a paper by T.C. Main (an engineer with the CNR's Division of Water Supply in Winnipeg) that appeared in the June 1932 issue of the EIC's *Engineering Journal*. Among his conclusions and recommendations for curing this problem were the following: while it is not known how long the drought will last, it is possible that it will not extend beyond 1932, since such droughts appear to have three-year cycles; that hedges of between five and eight feet in height be planted on each quarter section; that strip farming be used; that varieties of wheat be developed that ripen earlier and consume even less water than at present; that more young trees be planted and more mature ones cut; that draining lakes, sloughs and marshes be stopped; that as much spring run-off water as possible be stored and that as much evaporation as possible be prevented; and that the construction of public water supplies be encouraged. Not all of them were implemented.

Speaking of the Prairie drought, and the Depression years, the horse-drawn Bennett buggy was the farmer's engineered solution to his inability to buy gasoline. They were called 'Hoover wagons' in the United States.



A variety of

Bennett Buggies...

Moving further west, to the coast, and to the Burrard Bridge, which was opened in July 1932. Spanning False Creek. This bridge carried Burrard Street from downtown Vancouver to Kitsilano. Originally a six-lane bridge, it took two years to build. In addition to the vehicle deck, it also had sidewalks on both sides. The two approach spans had Warren trusses placed below the