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THE ENTREPRENEURS BEHIND THE ENGINEERS

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Introduction

The saying goes that "behind every successful man there is a determined woman." This might be extended to say that "behind every successful engineer there is a determined entrepreneur." Both may well be exaggerations, but with some essential truth to them. The purpose of this paper is to identify a few of the notable North American and British entrepreneurs who were behind notable engineers and engineering efforts at several points in historical time. In some cases the engineers can be identified; in others, they are too numerous.

In this context, and combining several formal definitions, the entrepreneurs concerned were individuals who undertook to manage risky but exploitable environments that permitted engineers to convert their technical brain-children into useful economic assets. I make no apologies for my selection of entrepreneurs. I simply want to illustrate how different they can be.....and yet how similar.

But first, two points of clarification. One is that there have not always been people called "engineers." But there have been - for a very long time - activities that can be defined as "engineering" in either the military or civilian contexts. The second is that there have been notable engineers who have acted as their own entrepreneurs. During the 19th century in Britain there were, for example: Maudslay, Whitworth, Napier, Fairbairn, and the Brunels, father and son. More recently, in North America, there have been George Westinghouse, Thomas Edison, Hewlett and Packard, and Simon Ramo.

Early 17th Century

The first entrepreneur I want to talk about is Samuel de Champlain, one of the very earliest explorers of what is now Canada. He can, from the historical evidence, be identified easily as an *entrepreneur*.....but for engineers?

The historical evidence about him is not always clear. Was he born in La Rochelle or in Brouage, both towns on France's Bay of Biscay? In 1570? Was he of a member of the French Royalty or nobility or of much more humble birth? Was he baptized a Protestant, only to become a Catholic later in life? What did he actually look like? Portraits and statues of him have been based on other people. His grave at Québec has never been found.

Champlain played major leadership roles in establishing New France - and a possible westward way to China....but was he always the boss? Evidently not. He had very good connections to France's King Henri IV, but was held in less favour by the chief ministers - such as Sully and Cardinal Richelieu - of later kings after Henri's death in 1610.

Abstract

This paper was originally presented orally to the Ottawa Branch of the Canadian Society for Senior Engineers on 19 February 2013. It has since been modestly edited and some illustrations have been added.

Its theme is the connection between successful engineers (or engineering efforts) and the entrepreneurs who backed them. Although the number of such 'pairs' included in the paper is very small, it covers engineers/entrepreneurs operating in the 17th, 18th, 19th and 20th centuries in Canada, the United States and Britain and draws several tentative conclusions from the discussions.

About the Series

Principally, the Cedargrove Series is intended to preserve 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, a 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, writing and editing historical material on behalf of that Society, the Engineering Institute of Canada and the Canadian Society for Senior Engineers. He has also served as president of CSME and EIC.



Champlain ?



Bridgewater



Brindley



Merritt

In his mature years he was an explorer, first of the West Indies and later of New France. He took a principal role in the establishment and fortification of the Ile-Ste-Croix, Annapolis Royal and Québec colonies in New France. Any *engineer* who worked for him on these was a military man. He introduced European tradesmen and tools into the new country, encouraged the development of water-power, prospecting for minerals, the fur trade and farming. At the same time, he was quick to encourage the adoption of the useful technologies of the aboriginal peoples. He fought frequently for the colonists and friendly aboriginal people, and ventured south on their behalf into what is now the Lake Champlain area of northern New York State, as well as north-west from his bases on the St. Lawrence River, up the Ottawa River. Eventually, by way of the French River, he reached Georgian Bay, which he called the "sweet water lake" and which he saw as a major stepping stone in the westward route to China.

Champlain was noted, among his contemporaries, for his ability to work with the Indian tribes in New France, such as the Algonquins, Montagnais and the Hurons, as well as for his hostility towards the Iroquois. However, it seems he often travelled back to France in the Fall of the year and avoided Canadian winters! He also lost the Québec colony to the Scottish Kirke brothers in July 1629, and New France nearly collapsed. He returned to Europe. However, in 1632, after lobbying by Champlain and others in England and France, the colony was restored to France by treaty. A year later he was back in Québec, bringing with him a fresh company of settlers to join those who had remained and survived. Champlain spent his final years rebuilding the Habitation at Québec. He died there after a stroke, in 1635.

I have included Champlain among my entrepreneurs because he *was* one, and because he played an important part in the founding of what later became Canada, from coast to coast to coast, and helped initiate the opportunities that Canadian engineers have taken since his time.

Later 18th Century

Next comes Matthew Boulton, whose partners included engineers James Watt and William Murdoch.

Bolton was born in 1728, in Birmingham, England, the third child of a metalworking manufacturer - known in these days as a 'toymaker' - who specialized in making buckles and buttons. Matthew has been described by some historians as an engineer. But although he was certainly technically literate, an innovator and a problem-solver, he was basically a businessman and manufacturer. He did, however, enjoy membership in the Lunar Society of Birmingham - a group that met regularly for scientific discussions and included such people as Erasmus Darwin, grandfather of Charles, Joseph Priestley, the chemist, Josiah Wedgwood, the ceramicist, John Smeaton, the first *civil* engineer, and James Watt. Also, by 1785 both he and Watt had been elected to the Royal Society of London.

Matthew was made a partner in his father's business at the age of 21 and, when he died in 1759, became the principal. By 1765 the Soho Foundry had been built. It was to become famous,

world-wide, thanks to Boulton, Watt and Murdoch. Boulton became a silversmith, turning out jewellery products, in partnership with John Fothergill. He also established a mint, which made coinage - mostly for jurisdictions abroad - and manufactured Sheffield plate. In the 1770s, when Roebuck's partnership in Watt's separate condenser patent faltered, it was sold to Boulton, and Watt became his partner. Boulton was also responsible for obtaining the extension of Watt's steam engine patent to 1800, which gave them longer to exploit it. These engines were not actually built at the Soho plant, but were assembled on site by Boulton's men - notably William Murdoch. They were used initially to drain the Cornish tin mines but were eventually used in many other applications, including small ship propulsion. The Boulton-Watt partnership was eventually dissolved and turned over to their namesake sons.

James Watt was born in Greenock, Scotland, in 1736 and so was eight years younger than Boulton. A sickly youth, his education was intermittent. However, he was the son of a master-wright and was given his own spot in his father's workshop. He developed talents for mathematics, woodworking and metalworking. He also made models. Through contacts, he got his first jobs in Glasgow and London as a scientific instrument maker. But he also learned surveying and took part, for example, in the routing of the proposed canal between the Rivers Clyde and Forth. He formed a partnership in 1759 with John Craig in Glasgow for the sale and repair of instruments and steel ornaments, but retained his connection with the University of Glasgow. Watt married in 1764. That same year he was asked to repair a Newcomen steam engine belonging to the University. This led to the development of the separate condenser and to Watt's famous patent. He formed a partnership to exploit it with John Roebuck, of Birmingham, who had an interest in draining a mine in Scotland. In 1773, Roebuck sold his share in Watt's engine to Boulton - the same year that Watt's first wife died. The following year he moved to Birmingham and began his partnership with Boulton. Watt died in 1819.

William Murdoch was also a Scot, born in Ayrshire in 1754, not many miles from Watt's birthplace. His father was a millwright, in whose workshop William learned the trade and for whom he first worked. Throughout his career, he made many significant inventions and improvements, principally associated with the performance of steam engines, and cooperated with Watt in some of this work. He was also significantly involved in the manufacture of gas for lighting, replacing oil and tallow. The first industrial factory to be illuminated by Murdoch's gas was a cotton mill in Manchester. He received the Rumford Medal of the Royal Society of London in 1808 for a paper on 'the economics' of gas. Murdoch was also involved in the building of a prototype steam locomotive, in the development of a pneumatic system for propelling a cylinder containing a message through a tube, and in the development of British isinglass - used in the making of beer - which replaced material previously imported from Russia.

Murdoch was hired by Bolton originally in 1777, at the age of 23 and having walked the 300 miles from Glasgow to Birmingham, to make patterns for castings for machine parts. After two years he was moved into the business of erecting, maintaining and repairing Boulton-Watt engines on site, mostly in mines in Cornwall. He also kept a wary eye out for patent infringements by competitors and, in this activity, his physical safety was sometimes at stake. In



Boulton



Watt



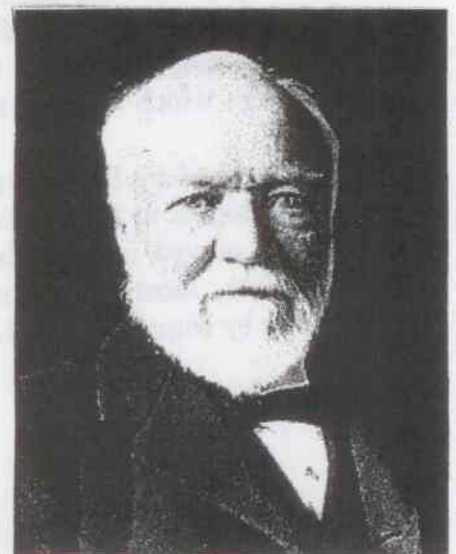
Murdoch



Holley



Smith



Carnegie

1810 he became a partner in Boulton and Watt, by then run by their sons, and remained one until 1830. He died in 1839 at the age of 85.

Later 18th, Early 19th and Mid-20th Centuries

These next three entrepreneurs I call 'the ditchdiggers' since they were all involved in the building of canals of one sort or another.

The earliest historically is Francis Egerton, the third Duke of Bridgewater, and the entrepreneur behind the building of what was said to be the second 'true canal' in Britain (after the one at Sankey). It has also been said that he was inspired to do so after visiting the *Canal du Midi* in France.

His Grace was born in May, 1736, the younger son of the first duke and the younger brother of the second. He became duke at the age of 12. He never married, so he was also the *last* Duke of Bridgewater. He did in fact become engaged, at the age of 21, but when this was broken off he retired to his estates at Worsley, near Manchester in Lancashire.....and made canals. The first was needed, essentially, to transport the coal mined on his estates to its markets. This canal, from Worsley to Manchester, with its famous aqueduct across the River Irwell, was built for the Duke by engineer James Brindley and others and completed in 1761. Subsequently, in 1762, he obtained permission to build a more ambitious waterway between Liverpool and Manchester. This one involved the difficult task of carrying the canal over Sale Moor Moss. Again, Brindley was the engineer. His Grace was only 36 when the Liverpool-Manchester one was completed. He spent the rest of his life improving and extending the canals, as well as his estates, and enjoying financial success from his enterprises. He died in March, 1803, at the age of 66. The ownership of the canals was transferred from the Edgerton family to the Bridgewater Navigation Company in 1872 and sold to the Manchester Ship Canal Company in 1887.

James Brindley was born at Tunstead, Derbyshire, in 1716, into a family of yeomen farmers and craftsmen. At 17 he was apprenticed to a millwright at Macclesfield. He showed ability and, at the end of his time, set himself up in business at Leek, in Staffordshire, expanding it in 1750 at Oakham. In 1752 he built an engine for draining a coal mine at Clifton in Lancashire and, three years later, built a machine for a silk mill. His work and abilities came to the Duke of Bridgewater's attention and he was commissioned to participate in the building of the Worsley-Manchester canal. He also worked on Bridgewater's second canal and on the extensions. His reputation spread and he became involved in the building of the Trent-Mersey canal, which included locks. Since he had never built one, he first made a model before incorporating the full-scale versions into the canal. Its design influenced the construction of the 'narrow boats' that have since then carried freight on English canals. This canal included a long tunnel, which took a long time to build, with the result that the completed canal was not opened until some years after Brindley's death in 1772, at the early age of 56.

The second 'ditchdigger' - associated with the building of the First Welland Canal - is an

American-born (in 1793) Canadian, William Hamilton Merritt, whose Loyalist family settled on a farm at Twelve Mile Creek (now St Catherines) on the Niagara Peninsula. At school, he learned both mathematics and surveying as well as some of the classics, but returned to Lincoln County in late 1809 to the family farm. He also opened a general store. He served as a commissioned officer in the War of 1812, took part in several battles, was taken prisoner at the Battle of Lundy's Lane and remained a prisoner-of-war in the U.S. until the War's end. On his return to Canada, he became involved in farming and in a variety of commercial ventures, including several mills and the manufacture of salt, in and around 'the Creek.'

Some years later, he became concerned about the supply of water to his mills. He was also concerned about the threat to Canadian trade of the opening of the Erie Canal, from Buffalo to New York. At that time the Niagara Escarpment, rising more than 300 feet from Lake Ontario to Lake Erie, presented a barrier to transportation that meant water traffic had to be unloaded for a land journey over the escarpment. In January 1824, the Legislature of Upper Canada formed the Welland Canal Company, with Merritt as the first general manager and financial agent. He, in turn, recruited Alfred Barrett as the chief engineer of the project.

The first stage of the First Canal - "Mr Merritt's Ditch" - was opened in 1830. It ran from Port Dalhousie on Lake Ontario, winding up the Niagara escarpment and across to Thorrold and to Port Robinson on the Welland River, where the ships turned left and followed this river to Chippawa on the Niagara River and from there into Lake Erie. A southern extension from Port Robinson to Port Colborne on Lake Erie was opened in 1833. The canal then had 40 wooden locks and stretched 27 miles between the two Great Lakes. But while the minimum lock size of 110ft. by 22 ft., with a depth of 8 ft., could accommodate the original boat traffic, it was soon too small and had to be enlarged. This became the Second Welland in 1845.

I have been unable to find information about the engineer, Alfred Barrett. However, the Welland Canal in its various forms provided engineering experience for several generations of Canadian engineers, including Samuel and Thomas Keefer whose father, George, was a close friend and colleague of William Hamilton Merritt. And engineers John L. Weller and Alexander J. Grant played significant parts in the work of transforming the Third Welland into the Fourth in the 1930s.

Merritt's fame as an entrepreneur rests significantly on his participation in the building of the First Welland. But his business interests were, in fact, much wider and the activity that consumed much of his energy was raising the money for his projects. He was also in politics, in Ontario, for many years.

The third 'ditchdigger' is also a Canadian politician, although much more contemporary than Merritt - Premier Roblin, of Manitoba, who was the man behind the Greater Winnipeg Floodway, nicknamed "Duff's Ditch." Businessman, airman, politician and finally senator, Dufferin Roblin was born in 1917 and was premier from 1958 to 1967.