1.

Embedded Innovation

Canadian Bicycle-Related Patents 1868–1900

Glen Norcliffe[1]

Very rarely does innovation take the form of brilliant leaps of insight, such as Alexander Graham Bell's telephone and Frank Whittle's jet engine. The vast majority of innovations involve small—sometimes minuscule—advances which tend to be highly incremental. Typically, small advances are made to existing technologies, and they are made mainly in places where innovators are best placed to use available knowledge. This implies that innovation is an embedded process, both historically and geographically. The vast majority of innovations are not independent events conjured up in Leonardo-like minds, but are connected to all sorts of things that surround the innovation. In this paper the published record of Canadian bicycle-related patents from 1868 to 1900 is used to throw some light on this concept of embedded innovation. Note that the concept of embeddedness invoked in this paper is attracting much interest in contemporary social science, and forms a part of the "cultural turn" in recent geographical research.[2]

The paper is organized as follows. First, I summarize the idea of embeddedness, and argue why I feel that it is a useful concept in interpreting the record of Canadian bicycle patents during the later part of the nineteenth century. Second, three waves of Canadian patents are dissected with a view to showing that their pattern of clustering, both in time and space, was not accidental. Thirdly, I turn to specific Canadian-based innovations to illustrate some of the patterns of social embeddedness. And finally, two environmentally-embedded groups of innovations that connect very directly with Canada's geography—wooden bicycles and the ice-velocipede—are briefly reviewed.

Embeddedness

The concept of embeddedness can be traced back to the work of the great anthropologist Karl Polanyi, who used the term to capture the idea that in non-market economies, economic relations—buying, selling, producing and consuming—are "embedded and enmeshed" in social relations, and (implicitly) in the historical and geographical contexts in which these social relations have developed.[1] Thus one finds conventions that would seem to make no sense in the market-driven economies of today such as the practice of cargo-cult, or the presentation of large tributes to a temple. In 1985 the concept of embeddedness was given new life by Mark Granovetter, who

recognized that not only in non-market economies, but also in modern market economies, social conventions and institutional practices are important to economic life.[2] To oversimplify, it costs time and money to do a deal: but if deals are repeated (and become embedded in dense and stable social networks where actors come to know and trust each other), then deals cost a lot less to negotiate. For this reason, most economic transactions become socially embedded. Granovetter's use of the term "embedded" is evidently more specific than that of Polanyi.

In the decade since Granovetter's paper was published, the concept of embeddedness has been increasingly used by anthropologists, geographers and sociologists. However, the meaning attached to the term has shifted yet again, to emphasise the way local and regional cultures influence the way economies operate. To mention one example that relates to bicycle manufacturing—the armaments manufacturing industry long established in New England, in the Black Country, and in St. Etienne seems to have provided a favourable setting for early bicycle manufacturers. Culture in this sense is an umbrella term that includes the institutions that operate in such gun manufacturing regions, the various guilds and trade associations, the networks of artisans who specialise in casting, milling, rifling, and making gun stocks, the system of apprenticeship that reproduces particular skills in succeeding generations, and the trading practices used to distribute the final products to markets.

This notion of embeddedness helps us to understand the record of bicycle patents in Canada in several ways. First, the process was socially embedded, with patents registered in three waves. The third wave, which was by far the largest, corresponded with the bicycle craze of the mid-nineties, when a kind of herd instinct operated. This period of intense social interest in bicycling was accompanied by a flood of patents on improvements to the machine and its many accessories. Note that by 1900, the interests of movers and shakers in society had moved on to other things, so that, although more bicycles than ever before were in use in Canada, far fewer bicycle patents were registered. When the interests of trend setters in Canada moved on, so did the socially-embedded process of technological innovation.

Bicycle-related patents were also geographically embedded. Certain regions and towns, to be identified presently, accounted for a disproportionate number of patents. Other regions were scarcely involved at all in the development of the bicycle. In addition, certain established manufacturing activities nurtured the development of the bicycle more than others by fostering skills and know-how that were easily adapted to bicycle manufacture. The Canadian environment also influenced the innovation process, both through the abundance of suitable wood at low cost, and via the challenge of the long winters when

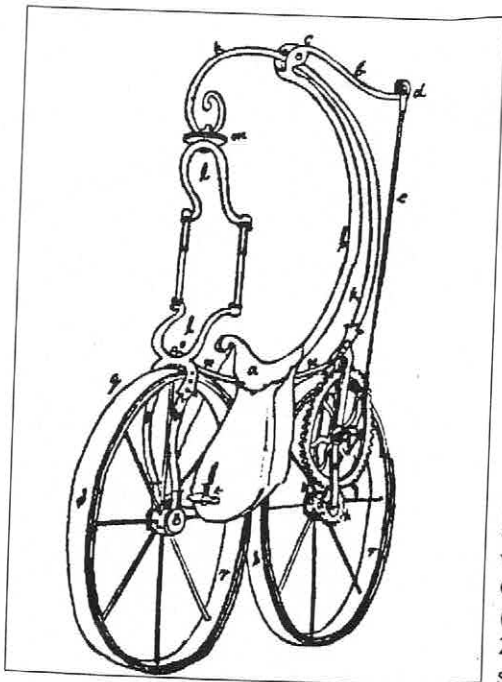
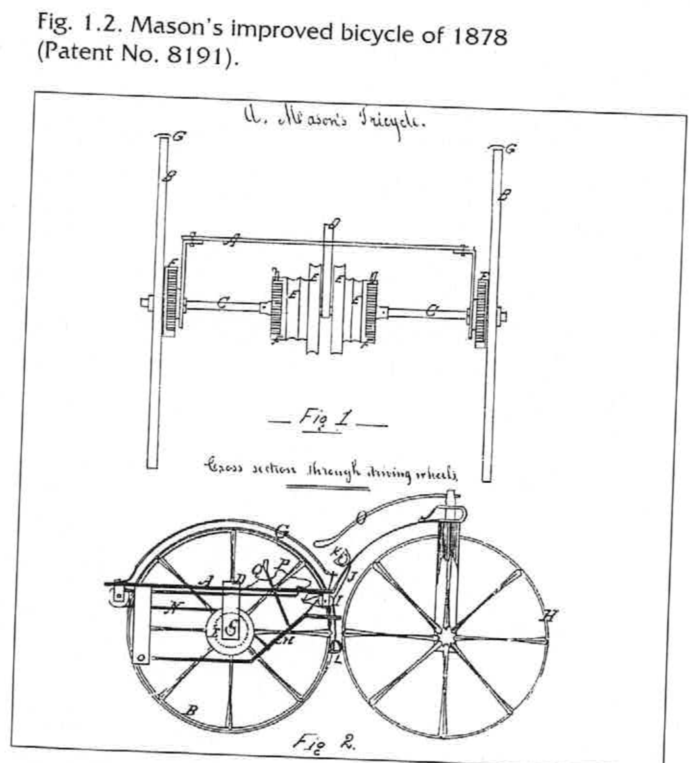


Fig. 1.1. Stimson's velocipede of October 1868 (Patent No. 2910, first series).

Fig. 1.2. Mason's improved bicycle of 1878 (Patent No. 8191).



Canadians were looking for new outdoor activities to amuse themselves. And finally, certain groups of people—whom we could label socially "avant-garde"—took an interest in improving the bicycle, while other groups took no interest at all. These facets of embeddedness are evidently interrelated. Collectively, they constitute elements of cultural embeddedness.

Three Waves of Bicycle-Related Patents in Canada

Canada was not one of the great sources of bicycle innovation; the most important developments occurred in France, Britain, and the United States. But in the industrial age, innovations spread rapidly. Thus even in somewhat peripheral countries, such as Australia, Canada, South Africa and New Zealand, consumers quite rapidly became aware of the velocipedes and bicycles that had become fashionable only shortly before in the main centres of innovation in Europe and the United States. The Canadian case is of interest partly because many of the patents registered in Canada were of foreign origin (reflecting an early tendency to globalization), and partly because there were a significant number of original Canadian contributions.

It took two years from the formation of the Canadian Confederation in 1867 before the new Dominion's legislators managed to pass the *Patent Act of 1869*; prior to that, Canadian patents were still registered and numbered under the old patent series of Lower and Upper Canada, dating back to June 1824. The new series, numbering from patent No. 1 of August 1869, at first applied to Canada's four original provinces, Nova Scotia, New Brunswick, Quebec and Ontario. Other provinces came under the aegis of this Act as they joined the Dominion.

Bicycle-related patents registered in Canada between 1868 and 1900 are recorded by year in Table 1. These data encapsulate the bicycle era, with the frequency of patents falling into three phases. The boneshaker caused the smallest flurry of interest, between 1868 and 1870. After that small ripple, virtually nothing happened until 1880, when a second small wave of patents was registered through the high bicycle era, tailing off at the end of the 1880s. Then, with the appearance of the safety bicycle, a third and vastly bigger surge of innovations occurred, peaking with 379 patents registered in 1897. Thereafter, interest declined rapidly, so that by 1900 only one fifth of the 1897 tally was registered. Thus there were three clear phases of interest, each bigger than the

Fig. 1.3. Bailey and Thorne's Improved Tricycle of 1883 (Patent No. 17,851).

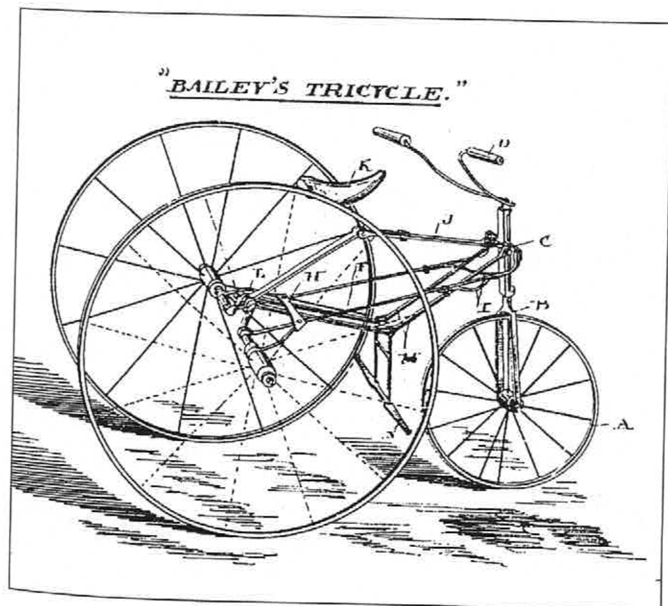
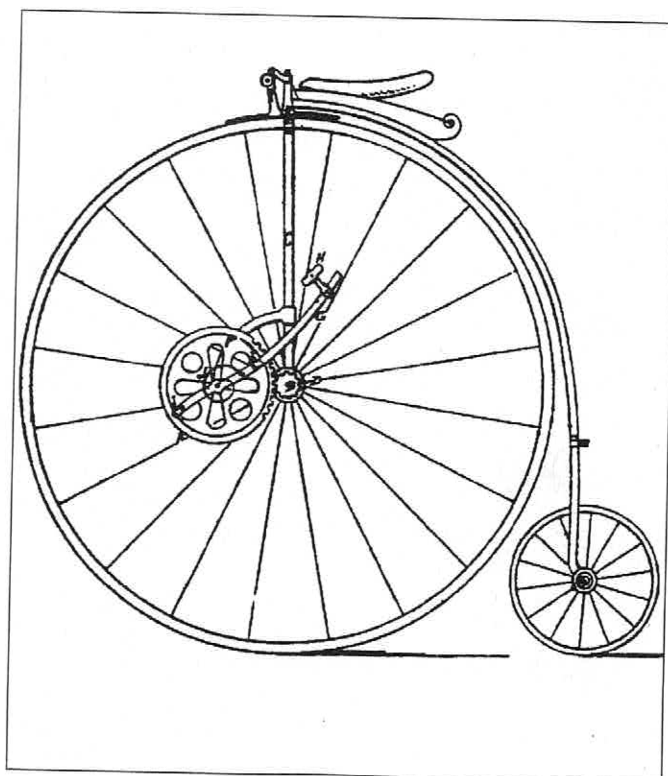


Fig. 1.4 Francis Rourk's geared highwheeler of 1888 (Patent No. 28,835).



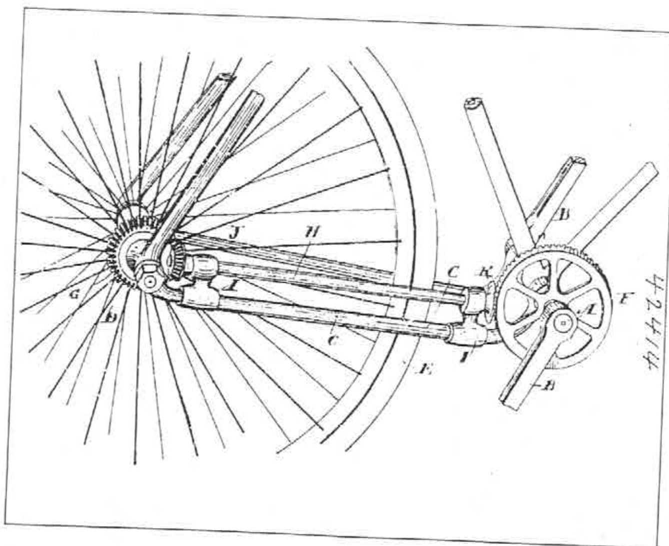
preceding one, broadly corresponding with the boneshaker, the highwheeler, and the safety bicycle.

The country of origin of these patents is also revealing. At first they were exclusively Canadian, since inventors were required to live in Canada for twelve months before applying. This residency requirement was removed in 1872—thereafter patents could be registered by citizens of any country. During Canada's high bicycle period, from 1880 to 1890, a total of 55 patents were registered, of which only eight (15 percent) originated in Canada. High bicycles were not manufactured in Canada, so there was little interest among manufacturers in advancing this technology.[3] Seventy percent of the patents in the high bicycle phase originated in the United States. Up to the mid 1890s, most of the registered inventors were individuals rather than corporations, although a number of these inventors either worked with or for the big bicycle manufacturers, including Lucius D. Copeland, who patented his steam tricycle in Ottawa in 1888, and William S. Kelly (sic) of Smithville, New Jersey, who patented the improved ratchet system used on the Star bicycle in 1886. In the last part of the period, corporations are specifically identified somewhat more frequently.

During the third phase, from 1891 to 1900, a number of Canadian firms began to manufacture safety bicycles, and a substantial stream of Canadian bicycle inventions was registered: in most years, between a quarter and a third of the patents were of Canadian origin. About half of the remaining patents originated in the U.S., and all other countries pale in comparison. A handful of British patents were registered in Ottawa, including several by John Boyd Dunlop, and Edward C.F. Otto, but most European inventors did not bother to register their ideas in Canada, which was seen to be a minor and distant market. It is of interest, however, that quite a number of Australian and New Zealand patents were registered in Canada during the 1890s; bicycling had become popular in these dominions, as it had in Canada, and several local manufacturers began production in Australia.[4] In addition, a few Canadian bicycle manufacturers, notably Massey-Harris and The Goold (Red Bird) Bicycle Company of Brantford, developed a significant market in Australia during this period.[5] The year 1897 marked the peak of inventive activity; indeed this one year alone accounted from almost a quarter of all the Canadian bicycle-related patents recorded between 1868 and 1900. After 1897, there was a sharp decline in bicycle-related patents as the interest of the leisure class in cycling waned rapidly. Such an historical clustering of patents reflects the social embeddedness of invention and innovation.

There is no denying that the pioneers of cycling, including Baron von Drais, Pierre Lallement, James Starley, and their ilk, were social as well as technical leaders. It seems very likely that such pioneers needed to be somewhat iconoclastic loners in order to pursue single-mindedly their idiosyncratic visions in the face of considerable scepticism and some ridicule from other segments of society. But in later years the great majority of inventors belonged to a very different crowd, who were clearly surfing a popular wave.

Fig. 1.5. Henry Cutler's shaft-drive bicycle of 1893 (Patent No. 42,414).



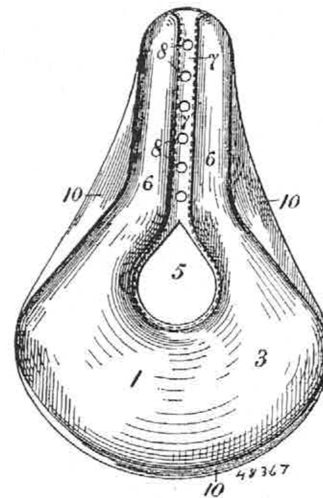


Fig. 1.6. Banes and Cleland pneumatic saddle of 1895 (Patent No. 48,367).

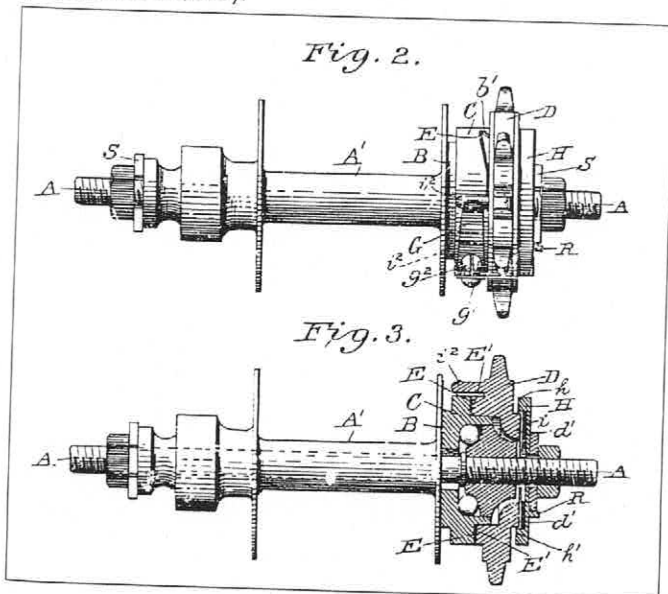
Thus the peaks of innovation waves reflect the flow of popular taste and fashion.

Being the year when patent activity peaked, 1897 is also a good year to illustrate the global geography of Canadian-registered patents. Ninety, or 24%, of the 1897 patents were of Canadian origin, compared to 202 (or 53%) that were American. The remaining 87 patents came from other countries including 36 from England, three each from Scotland and Ireland, 11 from Germany, an astonishing 19 and 10 from Australia and New Zealand, respectively, and one each from Austria, Belgium, South Africa, the Netherlands, and Switzerland. Clearly, the bicycle boom was not a local matter but a wave that swept the industrialized world.

These patents have their own geography, its most remarkable feature being the extraordinary degree of concentration of inventive activity in Ontario. Of a total of 275 Canadian-based patents, 221 (80%) originated in Ontario. The other provinces trailed far behind, with 26 from Quebec, six each from New Brunswick and Nova Scotia, one from Prince Edward Island, two from the North West Territories (which at that time included Alberta, Saskatchewan, and parts of what are now Manitoba), two from Manitoba and eleven from British Columbia. It is important to remember that the geography of Canada changed rapidly during the bicycle age. In 1868, the West was still largely the domain of indigenous Canadians and fur traders, and parts of Southern Ontario had yet to be opened up for settlement. By 1900, Vancouver was a thriving city, the Prairies were under the plough, the Yukon had experienced a gold rush, and the trans-Continental railway was a reality. It is no surprise, then, that the first bicycle patents originating in territory west of Ontario were registered only in 1896.

The contrast in the number of bicycle patents originating in Montreal and Toronto says a great deal about the different economic roles of these two cities. At that time, Montreal was by far Canada's largest city and Toronto a mere upstart,[6] yet Toronto accounted for 90 bicycle patents, Montreal only 14. The patent count for smaller Ontario towns, including Hamilton with 14, Brantford 11, Ottawa 10, London 6, and Guelph and Woodstock 5, is also revealing. At its roots, this contrast in innovative activity is connected with the differing economic cultures of Quebec and Ontario. Montreal's strength lay in commercial and financial capital, linked strongly with Canada's resource industries and transportation, while its industrial capital was sectorally concentrated in textiles, clothing, footwear, and similar consumer durables. Montreal was Canada's great mercantile city, and its leading port. Ontario's newer industrial and financial capital was focused more on heavy manufacturing—steel, agricultural and industrial machinery and other engineering and technical industries. Nowhere else in Canada was a comparable manufacturing base taking shape.

Fig. 1.7. Dr. K. Perry Doolittle's bicycle hub brake of 1986 (Patent No. 53,808).



Aspects of Embeddedness in Canadian Bicycle Innovation

As interest in the bicycle diffused across the industrialised world during the last third of the nineteenth

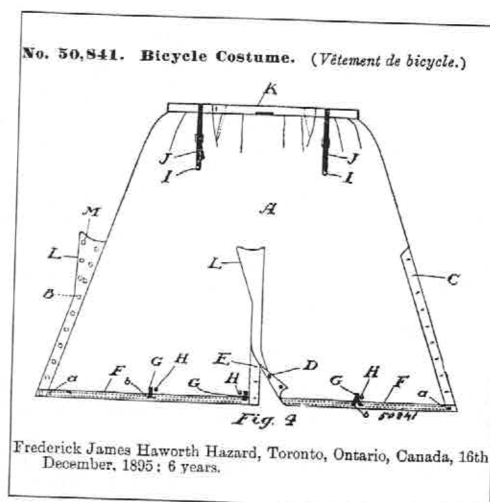


Fig. 1.8. Frederick Hazard's "bicycling costume for women which may be worn either as a skirt, bloomers, or a divided skirt" of 1895 (Patent No. 50,841).

century, in each country the machine was embedded in different ways that incorporated assorted local understandings and uses of the bicycle. Chapter 4 of Jim Fitzpatrick's book *The Bicycle and the Bush*, entitled "Environment and Adaptation," is particularly good on the adaptation of the bicycle to conditions and uses in the Australian outback. The detailed record of home-grown patents registered at the Canadian Patent Office indicates that a similar process was underway in Canada. Thus the main elements in the sequence of technological evolution of the bicycle—the boneshaker, the high wheeler, the safety bicycle, and so on—all appear in proper order. But Canadians also managed to add their own variations. This section begins with an overview of the main types of Canadian invention being patented during each of the three waves, illustrating the story with a few of the most interesting innovations.

The First Wave: 1868–1879

The initial wave of Canadian patents consisted of improvements to the velocipede and to the tricycle, plus (as early as 1869) an ice bicycle. Compared to the third wave, there was a very low level of innovative activity, mainly because the velocipede was not manufactured in Canadian factories, although a few were made by artisans. Two examples capture the main innovative thrust of the period.

The very first bicycle patent submitted in Canada—Stimson's velocipede (Fig. 1.1)—was dated 24 October 1868 (No. 2910 First Series). It was the creation of a medical doctor, James Stimson, who resided in St. George, near Brantford, Ontario. His velocipede had no pedals: the rider rocked backwards and forwards in the seat, and this activated a spring and lever mechanism overhead which in turn drove the sprocket wheel attached to the rear wheel. It must have seemed rather like riding a camel. Despite being Canada's first bicycle patent, this submission did not come from nowhere. Newspaper reports about the velocipede in the summer of 1868 aroused considerable interest, as did the first appearance of the machine on Canadian streets. Stimson must have thought about the design of the velocipede and presumably felt he could do better. As a doctor, he could afford to have a working model made, and living near Brantford, he had access to the skills and technology used by the local agricultural machinery industry.

Mason's improved tricycle (Fig. 1.2) of 1878 (No. 8191) has its roots in nineteenth century industrial machinery. Allen Mason was a "mechanician" in the small saw milling and furniture-making town of Paisley in Bruce County, Ontario, working on a daily basis with the drive shafts, pulleys, levers and ratchets on which his improvement was based. The diagram Mason submitted is not very informative, but it seems that the rider stood between the two rear wheels of a tricycle with his feet attached to driving stirrups,

Fig. 1.9. John Boyle's Bicycle Training Machine of 1897 (Patent No. 54,723).

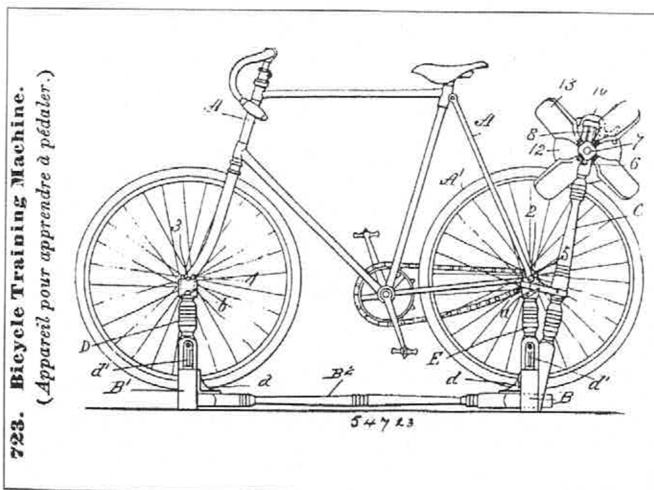
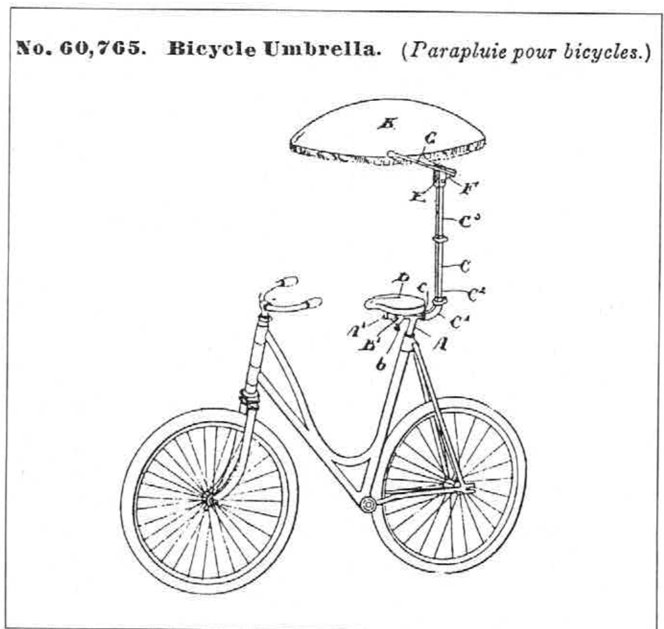


Fig. 1.10. Pentelow and Weston's Bicycle Umbrella of 1898 (Patent No. 60,765).



while his hands pulled on two levers which drove the tricycle using a ratchet mechanism, so that "every pound of human weight, in combination with human muscular force ... was used." The machine had a split rear axle, with each side controlled by a separate ratchet, and two gears, a low gear for hill climbing, and a higher gear for speeding.

The Second Wave: 1880–1890

Like the first wave, this was a period marked by a low level of domestic innovation, whereas non-Canadians, including Edward Otto, Lucius Copeland, and John B. Dunlop, were active in registering patents in Ottawa. Most of the patents registered during this phase by Canadians relate to velocipedes and tricycles, where solid construction took precedence over speed. The first Canadian submission that used technology related to the ordinary bicycle was Robinson's tandem ordinary of 1884.[7] Two machines are selected from this second wave for illustrative purposes.

Bailey and Thorne's Improved Tricycle (Fig. 1.3) of 1883 (No. 17,851) had its origin in Patterson, now one of the ghost towns of Ontario. But in 1883, Patterson was a thriving community where a large agricultural implements manufacturer, Peter Patterson & Bros., made the decision to diversify its product range into tricycles. The essence of Bailey's patent was a bent rear axle driven by stirrups attached to a jointed frame. This innovation illustrates how technology moved between related industries—in this case between agricultural machinery and bicycles.[8] It seems likely that this tricycle entered into limited commercial production.

A geared highwheeler patented in 1888 (No. 28,835) was the brainchild of Francis Rourk of London, Ontario (Fig. 1.4). To activate this highwheeler the rider depressed a lever which turned the large sprocket wheel about a quarter of a revolution, driving the bicycle forward. Pawls fitted to the axle sprocket allow the spring loaded lever to recover for another stroke. Placing the lever behind the front axle reduced the likelihood of a header, so this bicycle was a safety highwheeler, its closest relative being the Springfield Roadster. London, Ontario, was a city with a diverse manufacturing base, and one of the most active cycling communities in Ontario during the 1880s. In short, both the interest and the know-how were locally available to Francis Rourk, although the machine was not commercially produced.

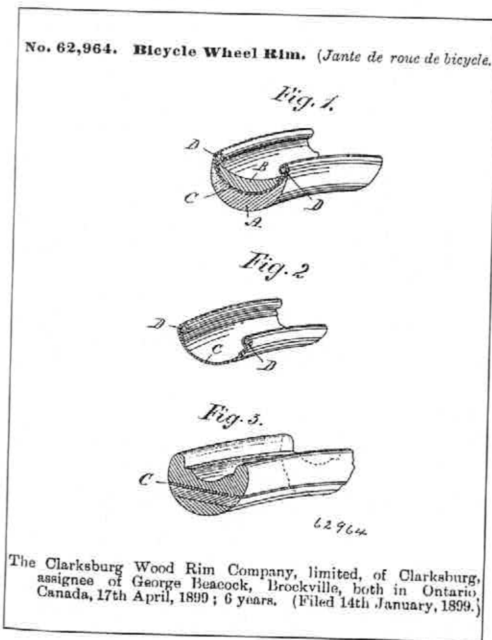


Fig. 1.11. Clarksburg Wood Rim Company's rims with laminated strips of rawhide, patented in 1899 (Patent No. 62,964).

The Third Wave: 1891–1900

During this wave, a considerable number of Canadian firms began to manufacture bicycles. A few were created specifically with this objective, but the majority were engaged in related activities such as manufacturing agricultural machinery, clocks, prams and carriages; they began to manufacture bicycles in the hope of adding a profitable new line to their business. Previously noted innovation themes such as ice velocipedes and tricycles continued to appear in the patent books during the third wave, but many of the patents concern two important new thrusts, the first being improvements to the safety bicycle, and the second—particularly after 1895—being bicycle accessories.

Improvements to the Safety Bicycle

In 1891, the safety bicycle was still a ponderous machine with (mainly) solid rubber tyres, thick-walled tubing, and heavy spokes and rims. In the years that followed, numerous improvements were made to the safety bicycle so that, by the end of the decade, a much lighter and more flexible machine was available with thin-wall tubing, pneumatic tyres and finer spokes, often set in light wooden rims. Hub and coaster brakes were replacing plunger brakes, and lighter roller chains were superseding heavier block

chains. The bicycle became a light, fast, and robust machine.

Also in this period, newly-established Canadian bicycle manufacturers began to register patents. In 1891 the Goold Bicycle Company of Brantford registered a patent on a safety bicycle, and thereafter Thomas Fane and Charles Lavender (of the Comet Bicycle Company in Toronto), Peter Gendron (of the Gendron Bicycle Company in Toronto), Albert P. Jones (of the Toronto Cycle Company), Henry Cutler (of the Wanderer Cycle Company), the Massey-Harris Bicycle Company, the Clarksburg Wood Rim Company, and the Welland Vale Manufacturing Company all submitted one or more patents based on their improvements to the safety bicycle.

During the first half of the decade, many of the innovations were mechanical in character, including various drive mechanisms and gears, flywheels, cranks, pedals, a shaft drive, plus sociable and tandem bicycles. By mid-decade, attachments to the bicycle—saddles, handlebars, mudguards, carriers, pumps, brakes, and chains—became more prominent. There was also something of an obsession with the search for a puncture-proof pneumatic tyre.

Synopses of three interesting innovations will give some idea of the range of contributions made by Canadians during this phase.

Henry Cutler's shaft drive bicycle (Fig. 1.5) of 1893 (No. 42,414), which was based on a bevelled gear shaft drive, was patented shortly after the Metropole shaft drive bicycle appeared in France, and five years before the Pope Manufacturing Company launched its successful range of chainless bicycles in the U.S. As a manufacturer in Toronto, Cutler had access to a wide range of technical expertise. Cutler's patent is important in that he introduced gearing to this bicycle by fitting two driving wheels of different size. Its inventor evidently lacked the resources to produce and market it. The most successful chainless bicycle, the Columbia, came quite late but it was superbly promoted by the Pope Manufacturing Company.

Banes and Cleland, two Toronto-based mechanics, patented a pneumatic saddle (Fig. 1.6) in 1895 (No. 48,367). A forerunner of the modern "gel" saddle, this invention had some merit, and may have been marketed. It reflected a concern for comfort, especially amongst women riders, as the safety bicycle boom took off. At the time it was widely considered unwise—for anatomical reasons—for a woman to use the kind of saddle found on men's bicycles, hence there was considerable social pressure to come up with a more comfortable alternative.

Dr. Doolittle sounds like a character out a musical comedy, but Dr. K. Perry Doolittle was a physician living in Toronto fascinated with things mechanical (later he went on to experiment with the automobile in Ontario). His patents on the bicycle hub brake (Fig. 1.7) of 1896 (No. 53,808) and 1898 (No. 59,540) were commercially produced. Pedalling backward engaged a clutch which shifted the brake mechanism sideways, which in turn engaged a friction disk. Similar back-pedal brakes, but with a lever arm attached to the chain stay, became very popular a few years later. The illustration shows the rear hub and sprocket, and a cut away of the brake mechanism. It was used quite widely on Canadian bicycles, and a few still turn up on old bicycles.

Missing from this list is the invention that arguably ranks as the single most important bicycle-related invention originating in Canada—Thomas Willson's Carbide Lamp of 1896. The reason for this is quite simple—he never patented this invention in Canada. Born in Woodstock, Ontario in 1860, Willson grew up in the industrial city of Hamilton where he began experimenting with electricity and chemistry, and by 1880 had developed early forms of arc lighting.[9] He moved to the United States in the mid 1880s to work

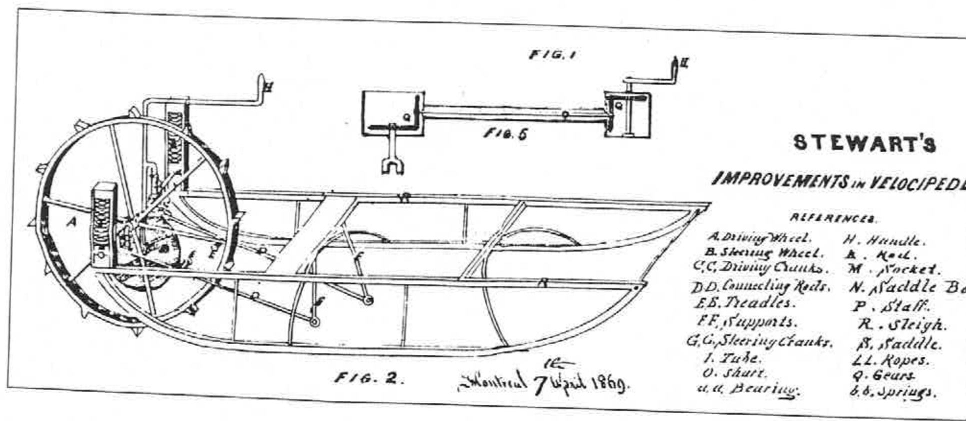


Fig. 1.12. Charles Hamilton Stewart's ice velocipede of 1869 (Patent No. 3241).

on electrical processes for making aluminium. In 1892, while trying to develop a cheap calcium process, he serendipitiously developed the water-on-calcium carbide process, making the domestic and commercial production of acetylene gas feasible. Calcium carbide was subsequently used for lighting bicycles, marine buoys, and headlights on early automobiles. It was also the precursor to the invention, in 1903, of the oxy-acetylene welding torch. Willson returned to Canada in 1896 where he opened Canada's first carbide factory at Merritton, near St. Catharines, Ontario. From this date through to the 1930s, carbide lamps were widely used by bicyclists.

Accessories

It was only during the latter years of the decade that inventors turned to developing bicycle accessories such as bicycle stands, locks, toe clips, footrests, shoes, umbrellas, and parcel carriers. By this time the much improved bicycle had achieved widespread social acceptance, hence the market began to shift from the machine itself to its "add-ons." The various accessories patented were intended to add "style" to the pastime, especially amongst the monied classes, who could best afford the various accessories. The three accessories listed below give some idea of where innovative activities shifted towards the end of the bicycle boom.

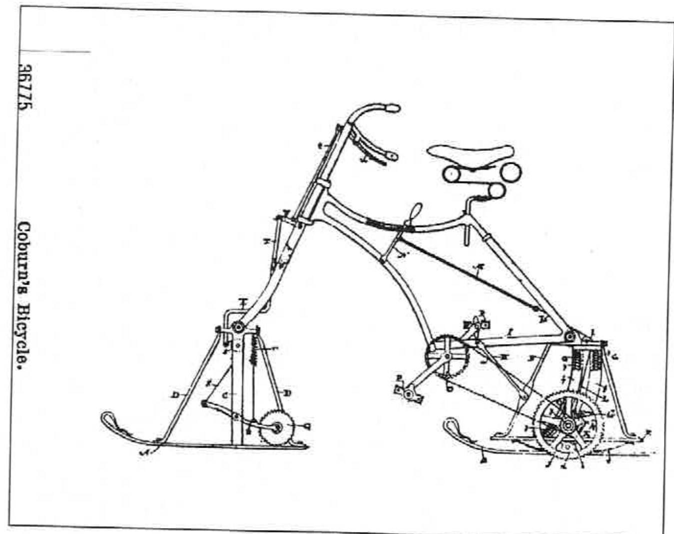
Frederick Hazard, yet another Toronto based inventor, patented "a bicycling costume for women which may be worn either as a skirt, bloomers, or a divided skirt and which may be quickly changed from any one to any other" in 1895 (No. 50,841). The illustration (Fig. 1.8) shows the whole garment opened out. If it was worn as bloomers, the tapes (G) were pulled up to gather the bottom of the legs. Quite clearly, the interests of women bicyclists had risen in the consciousness of inventors by the mid-1890s. But equally, this patent reflects the thrust of social modernity, especially with respect to "rational dress" in women's clothing.

Boyle's Bicycle Training Machine of 1897 (No. 54,723) was the creation of John Boyle of Orillia, in Ontario (Fig.1.9). A century later, Canadian bicyclists may be found on winter nights in their basements furiously pedalling bicycles mounted on rollers, driving a fan for friction and to stop themselves overheating. Plus ça change … Serious riders, especially during Canada's long winters, wanted some means of keeping fit, and getting into shape in spring ready for the summer touring and racing season.

In the late Victorian era, white middle class women sought to avoid bright sunlight so as to keep their skin a light as possible, so it was logical enough that someone would think of attaching a sunshade to a bicycle. Pentelow and Weston's Bicycle Umbrella of 1898 (No. 60,765) was an answer to this need (Fig. 1.10). Unfortunately, even a light breeze would have sent this parasol flying, and it would only be effective when the sun was directly overhead since there was a limited range of adjustment. Social norms therefore inspired this invention, just as they did with sun-block lotions a century later.

In conclusion, it is noteworthy that bicycle-related invention was not exclusively a male activity in the late nineteenth century. A small proportion of the bicycle patents of Canadian origin, about one in twenty, had a woman's name attached it. Some of these inventions were for accessories such as bicycling boots, an umbrella, and training wheels, but a larger number were for the bicycle itself, including Susan Fleming's gear drive, Ysobel Western's pneumatic tyre, and Mary Ellen Annand's mudguard. Of particular interest is Agnes Jardine who, with Marmaduke Matthews and Alexander Jardine, registered a series of patents for bicycle pedals, pedal-grips, spindles and bearings.[11] Quite clearly, a small number of women was engaged in the quest for mechanical modernity, and no longer conforming with the gender stereotyping of the Victorian age.

Fig. 1.13. Walter Coburn's ice velocipede of 1891.



Wooden Bicycles and the Ice Velocipede

These three waves of inventive enthusiasm for things bicycle-related did not pass by without having a distinctive Canadian patina added to them. Two areas stand out as distinctive: ice bicycles and wooden bicycles. But then, Canada lacks neither wood nor ice, and has frequently been referred to both as the "green north" and as the "blue north."

Southern Canada in the late nineteenth century had some of the finest hardwood forests on earth, forests that were being rapidly cleared to make way for agriculture. Superb timber was being cut and sold at bargain basement prices, while other settlers simply burned trees that woodworkers today would value highly. Not surprisingly, Canadian bicycle manufacturers turned their attention to ways in which they could make use of cheap wood. Soon thereafter bicycles with wooden frames, wooden handlebars, and wooden rims appeared for sale; this was in addition to the more widespread use of wood for skirt guards around chains and wheels.

The wheels of the boneshaker were normally made of wood, as were the wheels of some artisan-made highwheelers. But it was in the age of the pneumatic-tyre safety that the most interesting uses of wood are found. Wooden rims, made of maple, ash, or beech, became popular because they were light, cheap, and quite strong, though they were prone to warping if they became damp. A number of Canadian inventors patented variations on wooden rims, including the Clarksburg Wood Rim Company which laminated strips of rawhide into wooden hoops (No. 62,964) in 1899 (Fig.1.11). Wooden handlebars also found favour in some quarters, mainly because they were light, although were not very strong. Most interesting are a number of wood-frame bicycles, including that registered in 1897 by Charles Lavender and Thomas Fane, owners of the Comet Cycle Company of Toronto. The frame consisted of pairs of wooden stays held in place by steel brackets; only the head tube, bottom bracket, forks and drop-outs were made of steel.[12]

The idea of riding velocipedes and other bicycles on ice seems to have dawned on northern riders quite early, and is mentioned in "Velox's" velocipede book (1869, pp. 111–2). Canadians shared this interest with other residents of the Blue North who wanted to add some spice to life during the long winter; ice velocipede patents registered at Ottawa came from Wisconsin, Minnesota, Michigan, and New York, as well as Canada. The earliest Canadian ice velocipede

Table 1.1
Number of bicycle-related patents registered in Canada 1868–1900.

	Total Number Registered	Patens of Canadian Origin	Patents of U.S. Origin	Patents from other countries
1868	1	1	0	0
1869	4	4	0	0
1870	1	1	0	0
1871	0	0	0	0
1872	0	0	0	0
1873	0	0	0	0
1874	0	0	0	0
1875	0	0	0	0
1876	1	0	1	0
1877	0	0	0	0
1878	1	1	0	0
1879	0	0	0	0
1880	4	0	2	2
1881	9	2	3	4
1882	3	1	2	0
1883	6	1	5	0
1884	5	1	3	1
1885	6	0	6	0
1886	6	1	5	0
1887	5	0	4	1
1888	5	1	4	0
1889	1	0	1	0
1890	5	1	3	1
1891	8	4	3	1
1892	14	5	7	2
1893	23	8	14	1
1894	35	15	16	4
1895	69	24	40	5
1896	181	48	92	41
1897	379	90	202	87
1898	156	40	72	44
1899	108	12	79	17
1900	76	14	52	10
TOTAL	1112	275	616	221

patent was registered in 1869 (No. 3241), and thereafter they came at frequent intervals. In total, at least 30 versions of ice velocipedes, ice creepers and bicycle sleds were recorded. The idea certainly caught the public imagination, and several illustrations appeared in Canadian magazines.

Three examples of the ice-bicycle will illustrate the enthusiasm with which this vehicle was developed. The first is the snow velocipede of Charles Hamilton Stewart of Montreal (Fig. 1.12), registered in 1869 (No. 3241). Stewart describes himself as a "manufacturer of velocipedes," and may therefore be the first Canadian bicycle manufacturer. The driving wheel on the front of his sledge might work on hard packed snow or ice, but would likely be ineffective in deeper snow. Rather different in appearance was Walter Coburn's invention of 1891 (Fig. 1.13) which consisted of attachments that adapted a hard-tyre safety to run on ice. These attachments could be removed in spring and the wheels reattached to return the bicycle to regular road use. Coburn lived in Toronto which, by Canadian standards, has a mild winter. However, Charles Casselman lived in Muskoka, which lies squarely in Ontario's snow belt, so the idea for his snow velocipede of 1899 may have germinated during the long Muskoka winter. It bore a number of similarities to Coburn's machine.

The development of ice velocipedes is far more important than might seem at first glance. These early machines were rather impractical and slow: for example, Day's ice "creeper" (No. 6374) was driven by an Archimedes-type screw which could not have crawled faster than one mile an hour, flat out. But they were the direct precursors to the snowmobile. As Canadian inventors sought to make their ice velocipedes go faster, they hit upon the same idea that developers of the motor bicycle did; they attached an engine and the result was one of Canada's more dubious gifts to the modern world, the skidoo or snowmobile. The modern snowmobile, which has become a major Canadian manufacturing industry, is a direct descendent of these ice bicycles.

Conclusion

The conclusion to be drawn from the record of patents relating to Canadian bicycles, and particularly to wooden bicycles and ice velocipedes, is that they were embedded not only in a social and cultural sense, but also in a very explicitly historical and geographical way. The patents came in waves that followed the rise and fall of interest, within Canadian society, in the bicycle. The patents were highly concentrated in time, and also geographically: far more patents came from southern Ontario than any other region, almost certainly because Ontario's manufacturing base was better equipped to make bicycles and accessories. The environment also had a direct impact through the availability of cheap and abundant raw materials, and by the impossibility of normal cycling during the long months of winter. Canada's vast forests and its cold winters both influenced bicycle design. Note that these tendencies are not uniquely Canadian—similar tendencies were evident in the northern states of the United States, but they do seem to have been more central to the project of cycling in Canada.

Clearly, the record of bicycle patents in Canada between 1868 and 1900 is not vastly different from that of other industrialised countries during the same period. But neither is it identical—there is a series of nuances that are attributed to the fact that Canadian patents were embedded, in the broadest sense, in Canadian culture and environment. The principal conclusion is that the evolution of the bicycle was not purely a technical progression, but also an act of social construction embedded in local culture. Full development of this theme would require systematic case histories of individual patents—something that would be difficult a century after the event—but the fragmentary evidence presented here is seen to provide strong evidence that geographical embeddeness is vital to the evolution of technology.

Endnotes

Notes to Introduction

1 I acknowledge, with thanks, the help given by Ronald Miller in sifting through the records of the Canadian Patent Office in Hull, Quebec.

2 See, for example, Philip Crang "Cultural turns and the (re-constitution of economic geography" in Roger Lee and Jane Wills, editors, *Geographies of Economies*, London: Arnold, 1997, pp. 3–15.

Notes to Text Body

1 Karl Polanyi "The economy as instituted process" in Karl Polanyi et al, editors, *Trade and Market in the Early Empire* New York: Free Press, 1955 pp. 243–270.

2 Mark Granovetter "Economic action and social structure: the problem of embeddedness," *American Journal of Sociology*, Vol.91 (1985) pp. 481–510.

3 There are several surviving Canadian blacksmith-made highwheelers, but no factory-made machines. The exception is a small number of manufactured high-bicycles with the name T. Fane of Toronto, makers of Comet Cycles, but it seems probable that these machines were manufactured outside Canada, and subsequently had the Fane name-plate attached.

4 Jim Fitzpatrick's book, *The Bicycle and the Bush*, Melbourne: Oxford University Press,1980, provides a revealing account of the importance of bicycles in Australia, and echoes the argument made here that they were briefly of greater significance than is generally credited.

5 Fitzpatrick, 1980, p. 36.

6 In 1871 the population of Montreal was 107,255 compared to 56,092 for Toronto. By 1891, these figures were 216,650 for Montreal and 181,220 for Toronto.

7 This tandem is similar to Rucker and Winterschladen's U.S. patent (No. 3628) which Adams (1996, p.118) dates to 1883, so this may be a pirated idea rather than an independent invention, in which case it shows the importance of imitation.

8 The same is true of Massey-Harris, Canada's largest agricultural machinery manufacturer, which also became a major bicycle fabricator in the 1890s.

9 Dee J.J. Brown, *Ideas in Exile,* Toronto: McClelland and Stewart, 1965; and Carole Precious, *Thomas "Carbide" Willson*, Toronto: Fitzhenry and Whiteside, 1980.

(Editor's note: There is no note No. 10.)

11 Marmaduke Matthews, a landscape painter, was an interesting figure in Ontario society at that time. He developed Wychwood Park, one of Toronto's most exclusive housing developments, and he fostered Canadian art through the Royal Canadian Academy and the Ontario Society of Artists, in addition to his bicycle experiments (Wilton, 1992).

12 These wooden frame bicycles were very flexible and whippy to ride; indeed this was their main drawback.