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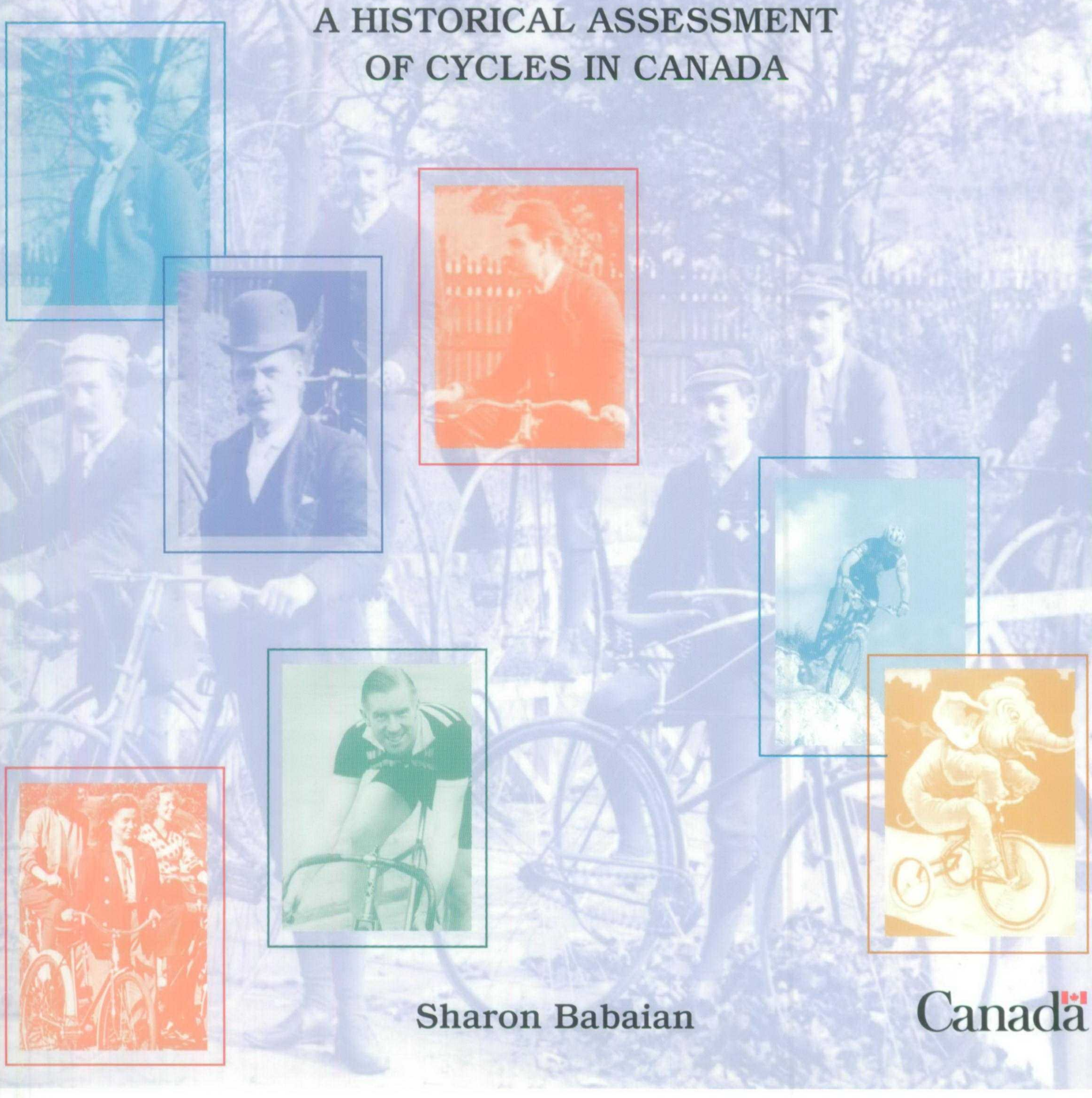
THE MOST BENEVOLENT MACHINE

A HISTORICAL ASSESSMENT OF CYCLES IN CANADA



Sharon Babaian

Canada

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The Most Benevolent Machine: A Historical Assessment of Cycles in Canada

Sharon Babaian

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Abstract

The cycle is a machine, but it is not just a machine. It is the basis of a popular recreational activity as well as a manufacturing industry in Canada. To understand its place in our society we must look at it from all these perspectives. Despite its apparent simplicity, the technological history of the cycle is a long and colourful one. It took mechanics and inventors almost 100 years of designing and building various types of human-propelled vehicles before they arrived at the safety bicycle. Between 1819 and 1885, they progressed from two-wheelers that were pushed along the ground to pedal-driven versions. To increase speed, they came up with the idea of the high-wheel or ordinary bicycle and to improve safety so that more people would ride, they designed a wide array of tricycles and a few adaptations of the ordinary. Finally they realized that the answer to speed and safety was the same — the pneumatic-tired safety bicycle. This new design was so popular that it changed the bicycle industry profoundly. In order to meet demand and compete with the companies that were being set up all around the world, cycle makers had to increase output and cut costs by automating their factories. In Canada, where cycle manufacturing began around 1895, these same forces were at work creating productive capacity and intense competition. The Canada Cycle and Motor Company (CCM) was created by the five largest makers in 1899 to try to control supply and reduce competition to an acceptable level. Though it failed to accomplish this, the company survived and went on to dominate Canadian cycle manufacturing into the 1970s. Its unfortunate demise in 1982, however, did not put an end to the Canadian industry, which continues to exist today, albeit in a significantly changed form. What keeps it going is, of course, the enduring popularity of cycling in Canada. From the great craze of the 1890s to the baby boom of the 1950s and the more recent ten-speed and mountain biking movements, millions of Canadians have enjoyed and continue to enjoy the pleasures and benefits of cycling.

Résumé

Le cycle est plus qu'une simple machine. Il est le fondement tant d'une activité de loisir populaire que d'une industrie manufacturière au Canada. Pour comprendre la place qu'il occupe dans notre société, il faut tenir compte de chacune de ces perspectives. Malgré sa simplicité apparente, l'histoire technique du cycle est longue et pittoresque. Les mécaniciens et les inventeurs ont mis près d'un siècle à concevoir et à construire divers types de véhicules à propulsion humaine avant d'en arriver à la bicyclette. Entre 1819 et 1885, ils passèrent de la draisienne aux versions à pédalier. Pour augmenter la vitesse, ils inventèrent le bicycle, ou grand bi ; pour accroître la sécurité et du même coup le nombre de cyclistes, ils produisirent une vaste gamme de tricycles et quelques adaptations du bicycle. Les inventeurs finirent par se rendre compte qu'il y avait une seule et même solution aux problèmes de la vitesse et de la sécurité : la bicyclette à pneumatiques. Ce nouveau concept fut tellement populaire qu'il révolutionna l'industrie de la bicyclette. Pour pouvoir suffire à la demande et faire concurrence aux entreprises qui voyaient le jour partout dans le monde, les fabricants de bicyclettes durent augmenter la production et réduire les frais en automatisant leurs usines. Au Canada, où on commença à fabriquer des bicyclettes vers 1895, les mêmes forces étaient en présence, ce qui donna lieu à une grande capacité de production et à une concurrence acharnée. La Canada Cycle and Motor Company (CCM) fut créée par les cinq principaux fabricants du pays en 1899 afin de tenter de maîtriser l'offre et de ramener la concurrence à un niveau acceptable. Même si elle n'y est pas parvenue, cette entreprise a survécu et a dominé la fabrication des bicyclettes au Canada jusqu'à la fin des années 1970. Sa disparition déplorable en 1982 n'a cependant pas mis fin à l'industrie canadienne, qui existe encore aujourd'hui, mais sous une tout autre forme. L'industrie doit sa survie à la popularité persistante du cyclisme au Canada. De l'engouement des années 1890 au baby-boom des années 1950, puis aux tendances plus récentes des vélos à dix vitesses et tout terrain, des millions de Canadiens et Canadiennes ont profité des avantages et des plaisirs de la bicyclette, et ils continuent encore de le faire aujourd'hui.

Foreword

A century ago, the bicycle was the object of intense, if not feverish, public interest. Today, the cycle in its various forms continues to hold our interest, both technically and socially. The bicycle is a superb example of a mature mode of transportation that has flourished in the face of newer and seemingly more dynamic technologies. It is a ubiquitous technology, as present on North American suburban streets as it is on the dirt roads of Third World nations.

While the development and adoption of bicycle technology has been the subject of considerable study, the Canadian side of this fascinating and enduring story has remained relatively unknown. Sharon Babaian's *The Most Benevolent Machine: A Historical Assessment of Cycles in Canada* is a significant contribution to the field and a notable attempt to address the traditionally disparate themes of the technical and social history of cycling. As a product of the National Museum of Science and Technology's ongoing research and publication program, her report will not only help to address current information needs, but will also stimulate further research into this fascinating aspect of Canadian technological and social history.

David W. Monaghan
Curator, Land Transportation
National Museum of Science and Technology

Avant-propos

Il y a un siècle, la bicyclette faisait l'objet d'un engouement général intense, voire fébrile. De nos jours, le cycle sous toutes ses formes retient encore notre attention, tant sur le plan technique que social. La bicyclette est le parfait exemple d'un moyen de transport évolué dont l'essor s'est poursuivi malgré l'apparition de techniques nouvelles et apparemment plus dynamiques. On la retrouve partout, des rues des banlieues d'Amérique du Nord aux routes de terre des pays du Tiers Monde.

Bien que l'évolution et l'adaptation de la bicyclette aient fait l'objet d'études poussées, le volet canadien de cette histoire passionnante et encore à suivre est peu connu. En signant *The Most Benevolent Machine: A Historical Assessment of Cycles in Canada*, Sharon Babaian apporte une contribution importante au domaine par cette remarquable tentative de traiter des thèmes traditionnellement distincts de l'histoire technique et de l'histoire sociale de la bicyclette. Paraissant dans le cadre du programme permanent de recherche et publication du Musée national des sciences et de la technologie, son rapport ne permet pas seulement de satisfaire aux besoins d'information actuels, il suscitera aussi d'autres recherches sur ce volet fascinant de l'histoire technique et sociale du Canada.

David W. Monaghan
Conservateur, Transports terrestres
Musée national des sciences et de la technologie

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A great many people had a hand in the completion of this work. Some are authors whose works helped me to understand the place of cycles and cycle manufacturing in the world of land-transportation technology. Others are public servants — librarians, clerks, communications officers — who only knew me as a voice over the telephone asking strange questions about bicycle-licence statistics, building permits, insurance maps and the like. I also talked to a number of people in the bicycle business, all of whom did their best to supply me with the technical and commercial information I needed. Though their contributions may not be immediately obvious, either to them or to readers, their assistance greatly enhanced my knowledge of cycles and cycling in Canada and helped me to fill in some major gaps in the narrative.

In addition to these anonymous research assistants, there are a few people who spent many hours of their time helping me and thus deserve specific mention. David Monaghan, the curator of Land Transportation, not only supervised my work but was also a reliable source of positive reinforcement, insight, good advice and humorous distraction. As well, he helped me find my way around the Shields Collection, a rich and at times overwhelming source of cycling information and imagery. In a similar vein, the library staff at the National Museum of Science and Technology, especially Anna Adamek, did a remarkable job of obtaining obscure research materials and always found a way to extend the loan periods for as long as I needed.

Outside the Museum, I received critical assistance from the Canadian Auto Workers (CAW) who put me in touch with Alec Gowen, a long time CCM employee. Mr. Gowen had a wealth of experience and information to share and, in the absence of any official company records, his input made it possible for me to begin to piece together the history of Canada's premier cycle maker. Also, two experts on the history of cycling, Dr. Glen Northcliffe and William Humber, gave my manuscript a thorough read, pointed out problems and provided many thoughtful suggestions for improvement. Any errors that remain in the text are, needless to say, entirely my own.

De nombreuses personnes m'ont aidée à mener ce travail à bien. Certaines sont les auteurs d'ouvrages qui m'ont permis de comprendre l'importance des cycles et de la fabrication des cycles dans l'univers des techniques de transports terrestres. D'autres sont des fonctionnaires (libraires, commis, agents et agentes de communication) pour qui je n'étais qu'une voix au téléphone, posant des questions insolites sur les statistiques de délivrance des permis de bicyclettes, les permis de construction, les cartes d'assurance et ainsi de suite. J'ai aussi consulté une foule de spécialistes du secteur de la bicyclette, qui se sont tous efforcés de me fournir les renseignements techniques et commerciaux dont j'avais besoin. Leur contribution n'est peut-être pas évidente à leurs yeux ou à ceux du public lecteur, mais leur aide a grandement élargi mes connaissances sur les cycles et le cyclisme au Canada, et m'a permis de combler des lacunes importantes dans le texte.

En plus de ces assistants et assistantes de recherche anonymes, quelques personnes ont consacré de nombreuses heures à m'aider et méritent donc que je les nomme. David Monaghan, le conservateur des Transports terrestres, a non seulement supervisé mon travail mais a été une source constante d'encouragements, d'éclaircissements, de conseils judicieux et d'humour. Il m'a également servi de guide dans la collection Shields, une source abondante et parfois écrasante de renseignements et d'images sur le cyclisme. Dans la même veine, les bibliothécaires du Musée national des sciences et de la technologie, en particulier Anna Adamek, ont accompli un travail hors pair pour obtenir des documents obscurs et trouvaient toujours le moyen d'allonger les périodes de prêt pour répondre à mes besoins.

En dehors du Musée, le Syndicat national de l'automobile, de l'aérospatiale, du transport et des autres travailleurs et travailleuses du Canada m'a fourni une aide précieuse en me mettant en contact avec Alec Gowen, à l'emploi de CCM durant de nombreuses années. M. Gowen avait une vaste expérience et une mine de renseignements à partager et, même s'il n'avait pas accès aux dossiers officiels de la société, il m'a permis de commencer à reconstituer l'histoire de ce grand

Finally, I owe a great debt of gratitude to Bob Caldwell who offered constant support and encouragement on the home front, especially in the final, frenetic stages of the work.

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Historian
National Museum of Science and Technology

fabricant canadien de bicyclettes. En outre, deux spécialistes de l'histoire du cyclisme, MM. Glen Northcliffe et William Humber, ont lu le manuscrit attentivement, ont relevé des problèmes et m'ont aimablement suggéré des améliorations. S'il subsiste des erreurs dans le texte, il va sans dire que j'en suis entièrement responsable.

Enfin, je remercie du fond du cœur Bob Caldwell, qui m'a constamment encouragée à la maison, surtout dans les dernières étapes frénétiques de mon travail.

Sharon Babaian
Historienne
Musée national des sciences et de la technologie

1. Introduction

The bicycle has been called "the most benevolent of machines."[1] It is a simple and efficient device that greatly enhances our ability to move while consuming a minimum of resources. By riding a bicycle instead of walking, a person uses one fifth less energy and becomes more efficient than any other animal or machine. This remarkable performance is the result of good design. The bicycle uses the body's most powerful muscles — the thigh muscles. The crank effectively converts the reciprocal action of the legs into a smooth rotary motion. The roller chain and ball bearings transmit this power efficiently to the rear driving wheel. The pneumatic tires minimize rolling resistance. Frequent improvements in construction materials and techniques, finally, have steadily reduced the overall weight of the bicycle making it even more efficient.[2]

This unique vehicle was not created quickly or easily. It took mechanics, inventors and builders working in several countries about 100 years to come up with the design of the modern safety bicycle. Beginning in the early 19th century, their experimentation with various forms of self-propelled vehicle produced the Draisienne, the velocipede, the high-wheeler and countless models of quadricycles and tricycles. Though none of these machines survived beyond the 1890s, their makers learned important lessons about how best to design and build a practical cycle. That experience was what made our modern, ultra-efficient machines possible.

Canadians have been riding cycles in one form or another for the past 125 years. A handful of people started out on imported or homemade velocipedes in the late 1860s. Hundreds of young Canadian men embraced the high-wheel bicycle after it was introduced here in the 1880s, helping to make cycling a familiar activity in communities across the country. With the introduction of the safety bicycle in the 1890s, cycling became an enormously popular and fashionable pastime in this country. Thousands of middle- and upper-class Canadians took up the "wheel" and began touring their communities and the nearby countryside at every opportunity. As a result of the safety bicycle's popularity, Canadian entrepreneurs began importing, making and distributing bicycles, establishing a manufacturing and retail industry that still exists today.

Like most fads, though, the bicycle craze came to an abrupt end only a few years after it began in Canada. By 1900, fashionable society had abandoned the bicycle and gone on to other things, eventually fixing its attention on the automobile. Yet, while it was no longer the centre of public attention, the bicycle did not disappear. Canadians continued to buy and use them for utilitarian purposes such as transportation to and from work and the delivery of goods, for cycle racing and, most importantly, for recreational riding. The Canada Cycle and Motor Company (CCM), formed in the last years of the boom, also survived after 1900 and went on to become the premier cycle manufacturer in the country. It built a complete range of products to supply the utility, sporting and leisure markets as well as making and selling millions of replacement parts for existing machines.

Since 1900, the bicycle has enjoyed a series of revivals. During the Depression of the 1930s and World War II it became a cheap, accessible and functional alternative to the automobile. In the 1950s, better-paid working Canadians with more leisure time discovered the pleasures of cycling. And, as their children grew up, they helped to fuel a sizeable boom in the domestic market. For the next 20 years, the bicycle increasingly came to be seen in North America as a vehicle for the young despite the fact the there was still a significant demand for adult vehicles. This image began to change in the 1970s when adult cycling again became a fashionable leisure-time activity. The oil embargo and concerns about the environment and physical fitness all contributed to this trend and it has continued into the 1990s. In recent years, Canadians have bought an unprecedented number of bicycles and more of them than ever before claim to use their vehicles on a regular basis.

Despite their enduring popularity in this country and around the world, cycles and cycling have not received much attention from historians or other writers. Partly, it seems that we are so familiar with the technology that we take its presence for granted. Also, Canadian historians tend to focus most of their attention on what are generally considered "serious" technologies, that is those that have had a profound and obvious impact on the development of the country. Viewed from this perspective, the bicycle does not seem to warrant much attention. On the other hand, the bicycle has survived and flourished for more than a century and given rise to an innovative international manufacturing industry. As well, its place in Canadian society, though not very conspicuous, is undeniable. The vast majority of Canadians have ridden a bicycle at some time in their lives and most of us know enough about how they work to do routine repairs. This is not something that can be said for many technologies, even familiar household ones.

The purpose of this historical assessment is to provide a general framework for the development and management of the Museum's cycle collection. It is based on the theme "the transformation of Canada" and the subthemes "Canadian context," "finding new ways," "how things work" and "people, science and technology." In constructing this framework, I have looked at cycles from several different but related perspectives. Chapters 2 and 3 are devoted to the technological development of the cycle. Chapter 2 deals with the early stages, beginning around 1817 with the Draisienne. It then looks at the role of amateur mechanics and builders in keeping the idea of human-propelled locomotion alive until the 1860s. The last two sections of this chapter tell the story of the first pedal-driven bicycles, the velocipede and the ordinary or high-wheeler. Chapter 3 focusses on the efforts of designers and builders after 1875 to make a safer cycle. These fall into three basic categories: tricycles (and other multi-wheeled vehicles), adaptations of the ordinary and, finally, the safety bicycle. The concluding section of this chapter outlines the most significant variations in cycle design since 1900 as well as some of the major advances in cycle components.

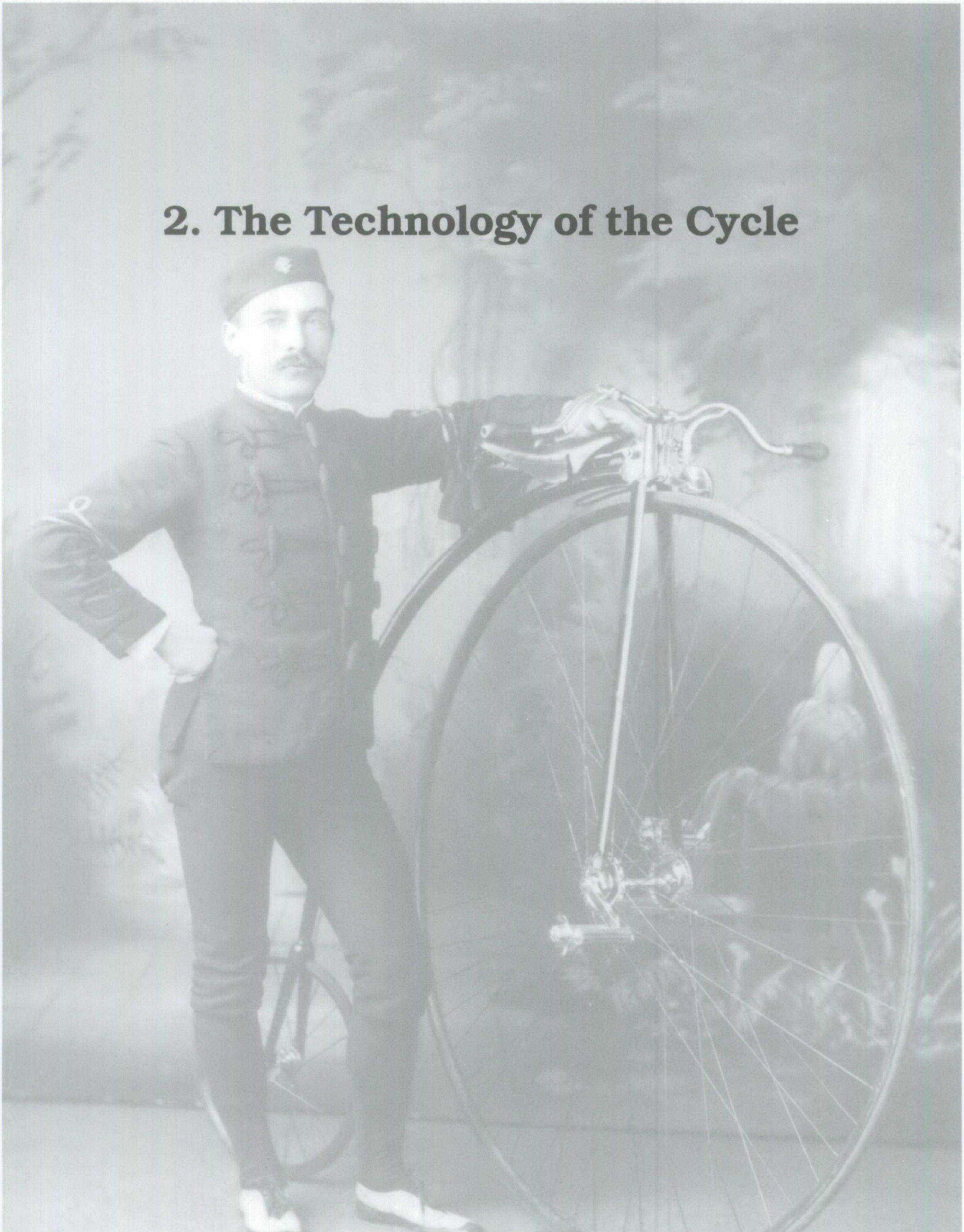
Chapters 4 and 5 focus on the cycle-manufacturing industry. The first concentrates on the international scene beginning with the big British and American makers of the 1890s. It describes how bicycles were made at this time and how these processes changed as a result of high demand and intense domestic and international competition. The focus then shifts to production techniques after 1900, when a steady stream of small incremental improvements in materials and processes made cycles lighter, faster, sturdier, safer and more comfortable to ride. This overview of the international industry provides the context for Chapter 5, which deals with the Canadian cycle industry. It begins around 1890 when the production of cycles first emerged as a viable industry. The first section focusses on the high-demand years of the boom when many companies were set up to manufacture, assemble and import cycles. Following this are two sections that deal mainly with the Canada Cycle and Motor Company. The first describes the formation of the company, its survival through the lean years and its emergence as the premier Canadian cycle maker. It also discusses the demise of CCM in the early 1980s. In the next section, the emphasis shifts to the kinds of bicycles made in Canada between 1900 and 1980. This discussion also centres on CCM and its products. The final section covers the period from the mid-1970s to the present. It outlines some of the major changes in the international cycle-manufacturing industry since the 1960s. It then highlights the activities of various small, medium and large Canadian cycle makers and places them in an international context.

The final chapter provides an overview of the role of the cycle and cycling in Canadian society. It begins by outlining the major trends in consumption based on production, import and sales statistics. The next two sections attempt to explain some of the factors that have contributed to the bicycle's popularity in Canada. The discussion initially focusses on its versatility as a tool for work and sport. It then moves on to the most common application of the bicycle — as a recreational device. Beginning in the 1890s, it describes the attributes that first made the bicycle appealing to Canadians and suggests that they are the same ones that have sustained and revived its popularity over the course of the last 100 years. The final brief section focusses on the role advertising has played and continues to play in promoting consumption of this device.

Notes

1. S.S. Wilson, "Bicycle Technology," *Scientific American*, vol. 228, no. 3 (March, 1973) p. 84.
2. Wilson, pp. 82–83.

2. The Technology of the Cycle



2. The Technology of the Cycle

By today's standards, cycle technology is remarkably simple. Though there are many different types, brand names, models and colours of cycles to choose from, they all have the same basic structure and operating principles. And unlike many modern technologies, we can actually see how cycles work. But for all its apparent simplicity, the bicycle as we know it today was not developed easily or quickly. Over a period of about 100 years, countless inventors, mechanics, designers and tinkerers tried their hand at building a practical human-propelled vehicle. Together, they produced an astonishing array of two-, three- and four-wheeled cycles. Many of these vehicles were one-of-a-kind devices, built for personal use or experimental purposes. Others were built in numbers and enjoyed some popularity and commercial success. A few proved to be of great and lasting importance to cycle design. Almost all of the makers and the vehicles they made, though, contributed something to the collective knowledge of how to build (and how not to build) a working cycle.

The First Cycles

> *Like most things worth the trouble of investigation, the origin of the modern Bicycle and Tricycle has given rise to much controversy, heated discussion, and wide divergence of opinion.*[3]

The many paths that led to the development of the modern cycle can be traced back as far as antiquity when human-propelled wheeled vehicles were designed and built. Most researchers, though, focus on a much later period, beginning in the late 18th or early 19th centuries. This is when the first bicycle-like devices were built and ridden. At that time, people travelled mainly by coach or other animal-drawn conveyance, on horseback or on foot. The demands of industrializing economies and the conduct of large-scale war put intense pressure on existing transportation and communications systems in Europe and encouraged technical innovation and change. During this period visionaries not only suggested the development of horseless carriages but also initiated a balloon craze and openly contemplated the possibility of "carrying people by air in steam-driven 'fiery Chariots'."[4] Schemes that might have seemed fantastic and even laughable in the 1790s — railways, for example — were well on their way to being realized by the 1820s. And the more inventors, mechanics and builders achieved, the more they and society believed was possible.

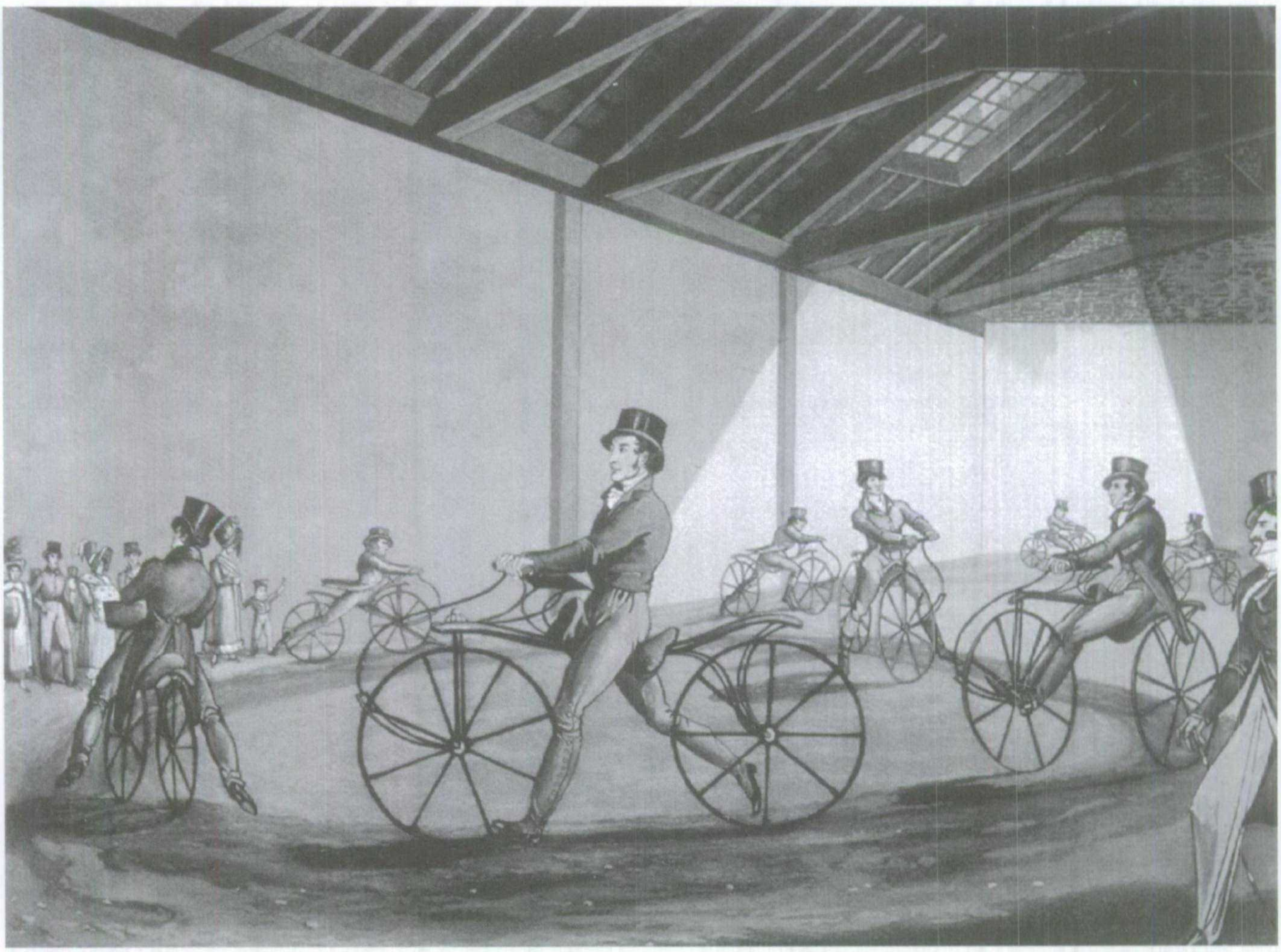
The first cycles were, at least in part, products of this technological enthusiasm. The period from the early 19th century until the mid-1860s is often considered only the "pre-history" of practical cycle development; many of the machines made during this era are routinely dismissed as unimportant or ignored altogether by modern writers. Yet this was, in reality, a time of intense and widespread experimentation in which inventors and builders grappled with the problems of human-powered transportation and came up with some remarkable solutions. To us, many of these solutions seem bizarre. Yet in creating these strange vehicles, inventors tested and established principles and processes that became the foundation of future advances in cycle design and construction.

According to some sources, a French aristocrat, the Comte de Sivrac, began the evolution of the modern cycle when he introduced the Célérifère to the world in 1791. This story, though, has been discredited by Jacques Seray, who did extensive research on the subject and found no evidence that this two-wheel vehicle ever existed.[5] Therefore, it seems that Karl von Drais of Sauerbrunn was the man responsible for giving the world its first bicycle-like vehicle. He built his machine between 1817 and 1818 to help him carry out his duties as Master of the Woods and Forests of the Grand Duke of Baden and introduced it in Paris where it soon became known as the Draisienne. It had two in-line wheels connected by a wooden frame. The rider sat astride the vehicle and pushed it along with his feet. A cushioned saddle and arm-rest gave him better purchase when striding along. Most importantly, Drais' vehicle had a steerable front wheel, making it a manageable and therefore practical device. And for those who doubted its viability, the baron was more than willing to demonstrate it. He proved to a sceptical public that a rider could in fact balance on two in-line wheels while propelling himself forward and steering the vehicle. Though embarrassing, messy or even dangerous spills were a constant hazard, Drais showed that experienced riders could travel over significant distances much more quickly than was possible on foot.[6]

The Draisienne was the first cycle to enjoy popularity beyond the immediate area where it was developed. The baron patented the vehicle in France and enthusiasts in that country as well as in Germany and Britain took it up. One English coach-maker, Denis Johnson, created, patented and sold his own form of the Draisienne, which he called "a pedestrian curricle or velocipede." The English people, though, were soon calling this vehicle the hobby-horse, after the children's toy, or the even more pejorative, dandy-horse, after the foppish class of men that tended to ride them. Compared to their continental cousins, hobby-horses were lighter and more finely constructed. The backbone and wheels were wood, reinforced with iron and linked by light iron supports. Also, the backbone was lower in the middle and so could accommodate larger wheels. These improvements were all based on three important principles set out in Johnson's 1818 patent — "...the lighter and more free from friction the whole can be made, and the larger the diameter of the wheels, the better and more expeditious the machine will be." These simple precepts were crucial to all cycle design and development until the 1870s, and the first two are still essential today.[7]

Whether it was called a hobby-horse, a Draisienne or the more generic velocipede, this type of cycle was commercially successful for about ten years in both Britain and France, where the upper classes adopted them as a sporting vehicle and leisure-time toy. Riding schools and clubs were opened, races were set up against coaches and velocipedists and parks began to fill up with these new steeds and their riders. A few people also used the hobby-horse for practical purposes. Doctors, vicars and postmen, for example, sometimes made their rounds in the countryside on these vehicles. As well, individual craftsmen, mechanics, artisans and workers saw great potential in this new fad — the potential to build and sell velocipedes and the potential to experiment with and improve on a promising technology.

When, by 1830, the high-society cycle craze faded, it was the practical users and builders who kept interest in velocipede development alive,



Johnson's Pedestrian Hobby-Horse Riding School, ca 1819. Dennis Johnson was a noted maker and promoter of the English version of the Draisienne, also known as the hobby-horse. (Source: NMST, Shields Collection cat. no. 871515) especially in Britain. They saw the need for an affordable, independent and efficient mode of transportation, particularly along local routes that railways did not serve. They also saw that the existing form of velocipede, the two-wheeled hobby-horse, had severe limitations. It was really only reliable on good, level roads in fair weather. Even then, "it bounced, and shook, and rattled and broke." A strong, young rider could overcome these difficulties but on bad or steep roads or in bad weather, even the best would find the going hard. And every rider risked injury or various degrees of "muscular strain due to the extraordinary action of the legs that was required to keep [the hobby-horse] moving." By far the most significant drawback of this type of vehicle, though, was that "it was not at all efficient in turning human energy into motion." The rider's leg strength "was completely misapplied" in an awkward, unnatural and strenuous movement that pushed the vehicle along rather than actually driving it.[8]

British enthusiasts focussed their attention on all these problems to varying degrees. But, from the mid-1820s to the late 1860s, their primary preoccupation became finding a more efficient method of propulsion for the velocipede. The search gradually led most builders to abandon two-wheeled designs in favour of the three- and four-wheeled ones that had never been fully pursued during the heyday of the hobby-horse. There were at least two reasons for this shift. At the time, many people were convinced that a vehicle with two in-line wheels could not be kept upright if the rider took both feet off the ground for any length of time. In this context, putting treadles or cranks and pedals on a hobby-horse seemed pointless. Also, two-wheeled velocipedes were small and narrow, making the addition of an elaborate driving system difficult at best. Tricycles and quadricycles, on the other hand, were larger, wider and much more stable and thus seemed to offer greater promise for the development of an effective method of propulsion.

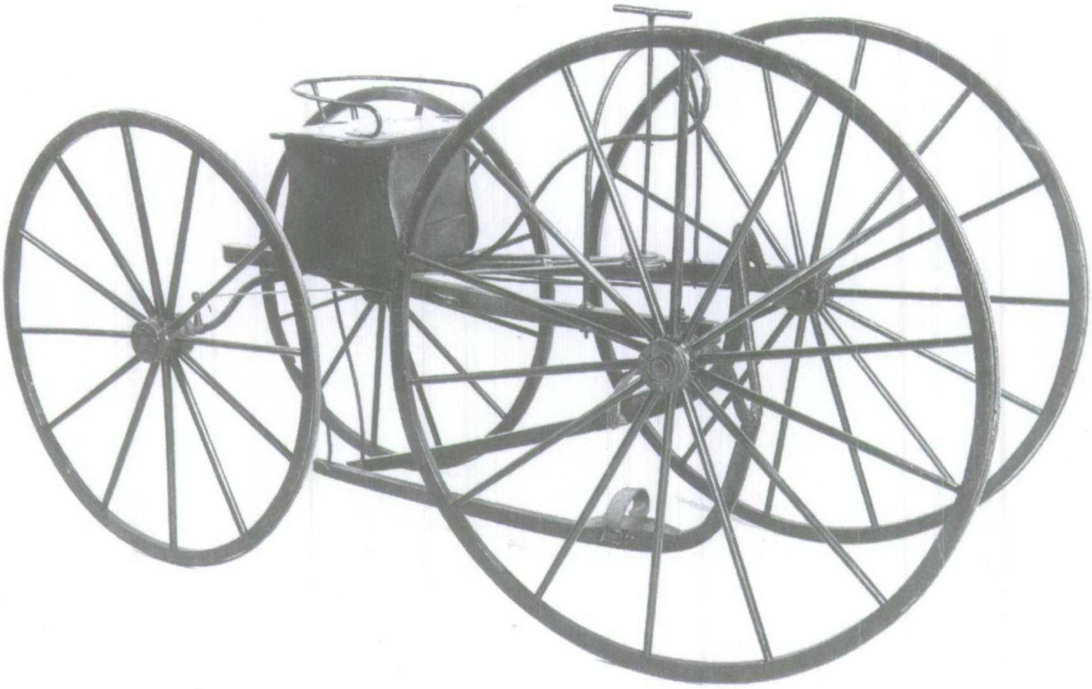
Many different multi-wheeled vehicles were proposed during this period by a small and scattered but active group of mechanically minded men. Some of these men corresponded and exchanged ideas, experiences and even designs through *The Mechanics' Magazine* after 1823.[9] It is clear from their letters that they believed that all proposals should be treated seriously, that few principles were beyond question and that they could (and for the good of society, should) perfect a self-propelled vehicle. Correspondents seemed to agree that some form of treadle or pedal and crank system was needed to propel the vehicle. But that was about all they agreed on. They routinely debated the relative merits of treadle and crank versus continuous rotary pedal movement, hand versus foot propulsion and front versus rear drive and steering. In 1843, one individual with foresight even pointed out "the need for some kind of differential to enable a four-wheeled rear-driven velocipede to take a corner without putting too much strain on the driving-axle."[10]

Unfortunately, because of their preoccupation with solving the propulsion problem, most of these velocipede enthusiasts lost sight of two other important design considerations: weight and simplicity. Almost all of the vehicles they built or proposed were heavy and mechanically complex, which reduced their utility and versatility and increased the cost of making and maintaining them. Though this did not prevent the builders themselves or their few devoted followers from using the machines and praising their great advantages for various types of travel, it did prevent these early velocipedes from becoming commercially viable.

It took the professional workmanship and entrepreneurial savvy of a Dover carpenter-turned-velocipede-builder to move the multi-wheeled cycle beyond the experimental realm and into the realm of manufacturing for the marketplace. Willard Sawyer probably began making velocipedes sometime in the 1840s because, in 1851, he had a highly refined quadricycle on display at the Great Exhibition in London. By the late 1850s his company offered a variety of models — tricycles, a six-passenger Sociable, a Lady's Carriage — including some with "hand-propeller"-assisted driving mechanisms. His basic design, though, seems to have been a four-wheeled vehicle propelled by a foot operated treadle and crank system. One of the finest examples of this formula was his Racer, which, at only 63 lb (28.5 kg), reflected both his exceptional engineering skills and the significant advances he had made in metal-and wood-working techniques.

Within the decade, Sawyer was by far the most renowned velocipede maker in Europe, building vehicles for such notables as the Prince of Wales, the Emperor of Russia, the Prince Imperial of France, the Crown Prince of Hanover and anyone else who could afford their princely price. Though by modern standards they were definitely large, heavy and awkward, when compared to what had come before, they were graceful and easy to use. Because of this, they won a loyal and enthusiastic following in certain segments of society and remained popular long after the first fully driveable bicycles became commercially available.[11]

While Sawyer was refining and manufacturing treadle-driven multi-wheeled velocipedes, another builder was attempting to apply the same system to the two-wheeled hobby-horse. As with the story of the Comte de Sivrac, there are many unanswered



Willard Sawyer Quadricycle, *ca 1852. Long after the eclipse of the hobby-horse and just before the introduction of the two-wheel velocipede, Sawyer was one of a small number of gifted mechanics who made a name and a living for himself designing, building and selling multi-wheel velocipedes. (Source: NMST, cat. no. 810203)*

questions surrounding the work of Kirkpatrick Macmillan, the man often credited with building the first driveable bicycle. According to most accounts, he built the vehicle in the blacksmith shop where he worked near Dumfries, Scotland, between 1839 and 1842. It was driven by a treadle and crank mechanism attached to the rear wheel (making it the first rear-driven bicycle) and was built of wood with iron strips around the wheels. The vehicle itself did not survive and we only know of it because of an 1842 newspaper account of an accident and court case involving Macmillan and his vehicle and because of the existence of two vehicles believed to be copies of his work.

Unfortunately, the reporter's story of Macmillan's accident and resulting fine describes a vehicle "driven with the hand by means of a crank" and the reference quoted is not the original newspaper article but a book published in 1946. Moreover, even if we can accept that the reporter was entirely mistaken about the way the vehicle worked, it is still unclear what connection Macmillan had with the two men, Gavin Dalzell and Thomas McCall, who are supposed to have copied his machine. Apart from the fact that they lived at the same time and in the same general area of Scotland (south of Glasgow and within 100 kms of one another), there seems to be no hard evidence that Dalzell and McCall ever actually saw Macmillan's velocipede or corresponded with him, or with each other for that matter.

All that can be said for certain is that Dalzell and McCall both made two-wheeled, treadle-driven velocipedes after 1840. Dalzell's machine, though mentioned in various secondary sources, is seldom described in any detail or pictured, despite the fact that it apparently still exists.[12] It is usually dated around 1845. McCall's work is documented both by correspondence in the *English Mechanic* in 1869 and by the existence of one of his cycles in the collection of the Science Museum in London. The author of the letters claimed that the improved McCall velocipede had a brake, "gun-metal bearings" as well as a treadle and crank driving mechanism that could be adjusted to suit different leg lengths. He also compared it favourably to the recently introduced French version of the two-wheeled velocipede, saying that it was as fast and yet "remarkably safe."[13] Despite the enthusiasm of the correspondent and the obvious advantages of this type of cycle (which were recognized some 20 years later) it was the French velocipede that took England, France and the US by storm in the late 1860s. Even the newly formed nation of Canada was not immune to its charms.

The First Bicycles

The Velocipede or Boneshaker

The experimental vehicles of Macmillan, Dalzell and McCall are often called the first bicycles, and perhaps they were. The fact remains, however, that they had no discernible influence on the subsequent development of cycle technology because nobody in the emerging industry seemed to be aware of them. The same cannot be said for the work of Pierre Michaux and his sons. Like many small manufacturers of metal and woodwork, by about 1860, Michaux had branched out to include velocipedes among the products he made and repaired. In 1861 someone in his shop — one of his sons or a worker named Pierre Lallement, depending on which version of the story you believe — hit upon the idea of attaching pedals to the front wheel of an old Draisienne brought in for repair. The idea was not new; two Germans, Philipp Fischer and Karl Kech, had also adapted Draisiennes in this way. What was new, though, was what Michaux et Compagnie did with the idea. They built two experimental models, rode them, tinkered with them and rode them some more until they had what they believed was a marketable machine. They then began to make Velocipedes for sale, producing 142 machines in 1864 and more than 400 by 1865.[14]

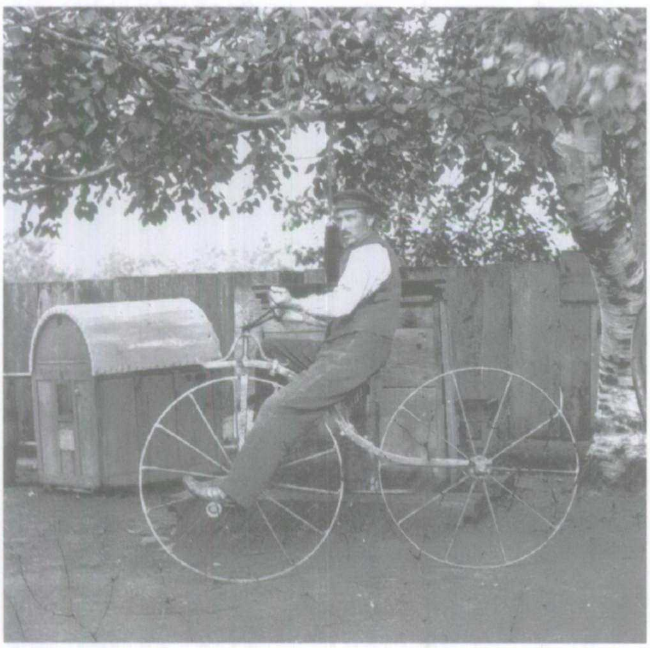
After the Michaux vélocipède was displayed at the Paris Exhibition in 1867 the craze began in earnest. The company built a new expanded facility employing some 300 workers and still could not supply enough vehicles to meet the demand. Other manufacturers entered the field to fill the gap: Pierre Lallement, Michaux's former employee who claimed to be the real inventor of the pedal-driven two-wheeler, Olivier Frères, M. Meyer, M. Tribout, Jules Truffault and M. Rouseau. In 1868, the first race was held at St-Cloud and the first long distance race took place the year after. The first cycling journal, *Le Vélocipède Illustré*, was published in France in 1869 and Paris played host to the first cycle trade show in November of that year.[15]

Like most Parisian fashions and fads, "velocipedomania" soon spread to other countries. By 1868 in the US, the new cycles were being imported and made domestically in significant numbers. Pickering and Davis, Mercer and Monod, Calvin Whitty, the Hanlon Brothers, the Wood Brothers, William P. Sargent and Company and the Kimball Brothers were all manufacturing and selling velocipedes in the north east. Most followed the basic Michaux formula but there were many improvements and changes made, so many in fact that the US Patent Office had trouble keeping up with submissions from individuals and companies.[16]

Cycle makers in a number of countries introduced the two-wheel velocipede in the mid-1860s and then made incremental changes to the design, materials and construction of their vehicles. This Michaux Velocipede, ca 1869, was a refined version of the company's original model, which did not have a diagonal backbone. (Source: NMST, cat. no. 810204)

The British, after a somewhat slower start, also took up the most recent version of the velocipede, which they christened the "boneshaker." Initially machines were imported from France and the US but, by early 1869, the Coventry Machinists Company was in full production filling orders from Britain and France. Before the end of the year there were at least ten velocipede makers in London, another ten in Wolverhampton and a couple of dozen more spread out over the rest of England. Enthusiasts published a growing number of journals and books, some of which provided instructions on how to build your own velocipede and offered advice on riding technique, maintenance and repair of the vehicle.[17]

What was the object of all this frenzied activity? There were two basic designs of two-wheeled velocipede. The first, which one writer has called the Lallement type, looked a lot like a hobby-horse with pedals and cranks attached to the front wheel. The second and, based on the numbers that survive, more common Michaux type, "combined the backbone and rear forks in one forging running diagonally from the front socket to the rear axle." Both types initially had solid, wrought iron backbones and wooden wheels, the front one larger than the rear one. Seats or saddles were supported on long and very pliable springs to absorb as much of the vibration and jarring as possible. Pedals at first were simple bobbins and then became flat with counterweights to keep them facing the right way. Many makers also made adjustable pedals to allow for different leg lengths. The most common form of steering arrangement was socket-type.[18]



John Taylor riding a hand-built wooden velocipede, said to be the first in Fredericton, New Brunswick, ca 1869. (Source: Provincial Archives of New Brunswick, P5-736. Photographer: George Taylor)

The velocipede's great popularity highlighted its design deficiencies. It was difficult to get on and off of and while in motion on roads, it was subject to a great deal of vibration and jarring. The pedals drove the front wheel directly, which meant that the amount of ground that could be covered with one revolution of the crank was limited by the size of the front wheel. Also, when coasting downhill, the pedals turned so quickly that most riders had to take their feet off them for comfort and safety. On loose surfaces, the wooden wheels, which were covered with iron strips, tended to slip and braking systems, either the simple backpedalling method or some form of spoon brake on the back wheel, were far from reliable. As with many cycle designs before and after, vehicle weight posed a problem for velocipede makers, most of whom could not get their vehicles much below 60 lb (27 kg). Finally, the position of the rider, seated between the two wheels, leaning back with legs angled forward to reach the pedals, was not very efficient. Every time the front wheel was turned more than a little, it rubbed up against the rider's legs, posing a nuisance to experienced riders and a real danger to the novice.

The widespread use that made these flaws so conspicuous also provided the impetus to improve the boneshaker since every significant modification became a potential source of profit for entrepreneurs, inventors and builders. Thus, over the course of only a few years, a large number of modifications and adaptations were made to the original designs. Some were quite successful. The Pickering velocipede, made in the US, was the first to use hydraulic tubing for the backbone, which lightened it considerably.[19] In 1869, W.F. Reynolds and J.A. Mays, builders of the Phantom, used light iron rods to reduce weight. They also were among the first to use wooden wheels with rubber tires and tensioned-wire spokes, which also reduced the weight of the machine. Many makers began to incorporate triangular pedals and adjustable slotted cranks on their vehicles. Similarly, mounting steps and leg rests for coasting became increasingly common. Some designers — Stassen, Reynolds and Mays, and others — also experimented with moving the rider forward to add weight to the force being applied to the pedals. Attempts were also made to spring mount the front wheel of some velocipedes to minimize jarring. Most of these improvements long outlasted this particular version of the bicycle.[20]

A few more ambitious inventors also attempted to address major problems like gear ratio and cornering. One builder tried to apply spur gears to the front wheel to make it revolve faster than the pedals, thereby improving the efficiency of the driving mechanism. Neither the gears nor the bearings available at the time were good enough to make the system work. An English engineering firm, Stassen & Company, offered a rear steering velocipede, which claimed to eliminate "the annoyance felt by all riders of having the front wheel grinding their legs at the slightest turn." The Reynolds and Mays Phantom also tried to address this problem. It was hinged at the centre so that when the front wheel turned, the rider's body turned with it. Both these bicycles, however, required strong and experienced hands to steer them effectively and neither were commercial successes.[21]

In any event, the drive to improve this type of two-wheeled velocipede was cut short in 1871 when "velocipedomania" ended in Europe and America. In France, it was crushed along with the cycle industry itself by the Franco-Prussian War of 1870-71 and, in the aftermath of defeat, the Communards' revolution in Paris. Americans, on the other hand, just seem to have lost interest in cycling by the end of 1871. The somewhat frenzied atmosphere subsided in Britain, too, but cycling and cycle development continued to flourish there within an enthusiastic sporting and club movement and an active manufacturing industry. By 1870, a new form of two-wheel velocipede had emerged and was beginning to replace the boneshaker in Britain.

The Ordinary

> *The Ordinary hasn't been properly explained in the past. It has been laughed at more than it should have been, and its real mechanical and social importance hidden behind a facade of patronizing sentimentality.*[22]

The lack of understanding of the cycle that is now known as the ordinary begins with the terminology that is often used to describe it. Besides the ordinary, this type of vehicle is often referred to as the "penny farthing," "high-wheeler," "high bicycle" and even "dangerous bicycle." Remarkably, none of these names were actually used during the heyday of this type of design. People in the 1870s called these vehicles "bicycles" or "wheels" because they were the dominant form of two-wheeled cycles at the time. The Michaux-type velocipede could still be seen from time to time but it was generally called a velocipede and the safety bicycle had not yet been introduced. When it was, the generic name "safety" was applied to it to distinguish it from the established form of bicycle. Once it had eclipsed its rival in popularity, it became known simply as the "bicycle," whereas its high-wheeled precursor began to be called the ordinary.[23]

From our current perspective, it is tempting to view the ordinary as a technological oddity and detour that delayed, until the 1880s, the full development of the rear driving bicycle, reputedly suggested by the work of Macmillan in 1839. This limited and skewed point of view, however, overlooks the important technical advances that grew out of the design and development of the ordinary-type cycle. It also diminishes the role it played in establishing cycling as a sport, a recreational pastime and, eventually, a practical means of transportation. As well, this interpretation of the ordinary oversimplifies and even distorts the complicated process of technological change.[24]

Far from being a technological detour, the high-wheeled bicycle of the 1870s and 1880s was a logical product of the technological capabilities (and limitations) of the day and the demands of cycling enthusiasts for a more efficient vehicle. Builders, many of whom were themselves avid cyclists, saw what we would call the low gear ratio of the two-wheeled velocipede as the main impediment to improved performance. In simple terms, gear ratio tells us how fast a particular cycle can go. It is measured by the distance that a cycle will travel with one complete turn of the pedals. When the pedals are directly attached to the hub of the front wheel, the gear ratio is the diameter of that wheel. The actual distance one revolution will carry the cycle is equal to the wheel's circumference. For example, a Michaux velocipede with a front wheel diameter of 35 inches (89 cm) has a gear ratio of 35 inches and can travel about 35×3.14 or 110 inches (280 cm) with one full turn of the pedals. To increase the gear ratio on a direct drive bicycle, therefore, the diameter of the front driving wheel must be increased.[25] On non-direct drive cycles, gear ratio can be increased by installing a gearing system that makes the wheels turn faster than the pedals.

This principle was understood before 1870 and some velocipede builders increased the size of the front wheels noticeably. The wood and wood-and-iron-shod wheels in general use at the time, though, were subject to high levels of vibration and jarring on most road surfaces. Because of this, it took a lot of power to propel and control the vehicle. The larger the wheels, the more power was required of the rider. As a result, builders found that it was not practical to increase wheel size beyond a certain point, about 48 inches (122 cm). All this changed after 1869 when the makers of the Phantom bicycle introduced rubber-shod iron wheels. Though rubber tires increased the level of rolling resistance of cycle wheels, they significantly reduced vibration and jar. With the smoother ride, less power was required to propel the cycle.[26] Because of this, "a larger driving-wheel could be driven with the same ease as the comparatively small driving wheel of the French bicycle." Makers also found that steady improvements in the quality of hub bearings and the development of the suspension or wire-spoked wheel (also introduced on the Phantom) made bicycles lighter and more free-running.[27]

The technological repercussions of the Phantom and its wheels were felt almost immediately. On 11 August 1870, James Starley and William Hillman patented the Ariel bicycle. Generally considered the first ordinary, in many ways it set the standard for this type of bicycle. It represented the first attempt to build "a light all-metal bicycle, and the first to have tension wheels [suspension] in which provision was made for tightening the spokes." The size of the rubber-tired wheels was conspicuously different from earlier cycles, with the front wheel about three and a half times larger than the rear one (50/14 inches [127/36 cm] in one early example). To make it possible for the rider to pedal this big wheel effectively, Starley and Hillman moved the seat forward until it was almost directly over the pedals. They then arranged for prospective buyers to order different sizes of front wheel to match the length of their legs. The Ariel also had a new type of steering head, centre or pivot steering, as opposed to the socket-type used on most boneshakers. Buyers had the option of a speed gear but this added cost and complexity (more power loss and more maintenance required) to the bicycle and did not become a standard feature of ordinary design. The Starley and Hillman Ariel weighed around 50 lb (22.5 kg) and was produced for almost ten years.[28]

Other bicycle makers were also actively pursuing high-wheel design and manufacture. In 1870-71, W.H.J. Grout introduced his Tension bicycle, which, like the Ariel, had a patented form of radial-spoked wheel that allowed for regular tightening and adjustment. Grout also offered different sizes of front wheel, ranging from 41 to 60 inches (104 to 155 cm) in diameter. The Coventry Machinists Company Limited began manufacturing its Spider model (later renamed the Gentleman's) around 1872. Before he left the company, Starley had influenced the development of this model, which was very similar to the Grout Tension but again had a slightly different method of adjusting the wheel spokes. Another notable early maker, John Keen, used his racing experience to develop bicycles that, according to one analyst, were models of elegant simplicity. In 1873, he introduced a spoon brake for the front wheel contrary to the established practice of using a rear wheel brake.[29]

This new style of bicycle had clear advantages over the old two-wheeler. With a higher gear ratio it was much faster and with the seat positioned directly over the pedals the rider could use his weight in addition to his muscle power to drive the bicycle. Even in the early years, as both distance and speed records were regularly set and broken, racing really came into its own with the ordinary. The ordinary's large front wheel made the ride much smoother than that of earlier cycles, not only because it passed over obstacles like stones more gradually than a small wheel but also because there was a greater distance between road and rider, which allowed the vibrations and jolts of rough surfaces to dissipate. As well, on a high-wheeled bicycle, the rider was well above most of the dust, dirt and water on the ground. This made it a much more practical touring vehicle for many enthusiasts. And by all accounts, ordinaries were handsome-looking vehicles with their fine, simple lines and a professional, finished look. They were particularly elegant when well ridden.

Bicycle designers were quick to recognize the positive attributes of a large front driving wheel, but they also understood from the start that it created new technical problems that had to be addressed.

Arthur Ashdown posing with his ordinary in Portage la Prairie, Manitoba, no date. (Source: NMST)

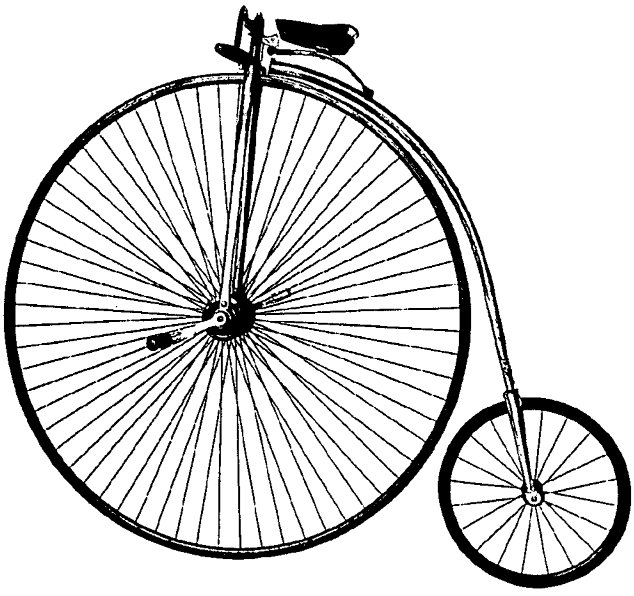
The single most critical challenge they faced was finding a reliable way to keep the wheels properly tensioned and "true" (correctly positioned, balanced or aligned). This was a particularly complicated process for the large driving wheel because the rider exerted two different types of pressure on it when in motion. First, the rider's weight placed pressure on the hubs of both wheels but especially on the front hub, above which he was directly seated. This load, applied to the centre of the wheel, was transmitted to the rim by the spokes, which, in the basic form first introduced on the Phantom, were able to resist tension (hence the use of the word "tension" to describe various types of wheels and bicycles at the time). By using the right number of spokes (calculated based on such factors as type of material used, its thickness and the size of the wheel) this load transmission could be accomplished with no "appreciable distortion of the rim." In other, more modern words, "tension applied to spokes enables the wheels to stay round and to withstand the pressures of weight and road shock."[30]

The second source of pressure on the front wheel was harder to contend with. The pedal cranks of ordinaries were attached directly to the front hub so that every time the rider pushed on the pedals, a driving force or torque was exerted on the hub. This caused the hub to turn, shifting the spokes from a radial to a slightly tangential position with respect to the hub. When the rider backpedalled to slow down or stop, the spokes moved back to the radial position. All of the early ordinary bicycles had tension wheels with radial spokes and all of them incorporated methods of counteracting the effects of the driving force on the wheel. On the Phantom, the first wire-spoked bicycle, Reynolds and Mays used moveable hub flanges to tighten the spokes. Starley and Hillman's Ariel had what they called Lever Tension wheels — radially spoked with a pair of levers attached to the hubs and rims. These "lever and tangent wires" were adjustable and not only allowed for the spokes to be moved and tightened but also were supposed to transfer some of the driving force of the pedals from the hub to the rim. True to its name, Grout's Tension bicycle also had a patented method of spoke adjustment. Grout's system involved individual adjustments to the radial spokes by means of nipples in the rim of the wheel. The Coventry Machinists Company offered a variation on Grout's system. Their Spider bicycle had adjustment nipples on the hub instead of the rim.[31] None of these forms of tension adjustment for spoked wheels proved to be the definitive solution to the pressures exerted on wheels by weight and torque, but they were effective enough to be widely adopted by cycle manufacturers around the world and lasted well into the 1880s. The makers who designed them also gained useful information by experimenting with different forms and configurations.[32]

Another major design problem posed by the increased size of the front driving wheel was additional weight. The suspension wheel had originally been introduced as a way to reduce weight, but with front wheels as much as two times larger than before, much of the weight saving was lost. To compensate for this, builders significantly reduced the size of the rear wheel. This helped but still left most machines weighing anywhere from 60 to 70 lb (27 to 32 kg), so makers continued to look for ways to lighten them. By 1878, their search began to show results. In that year, the Coventry Machinists Company introduced its Club model successor to the Gentleman's, which had succeeded the original Spider. Its frame was not solid but built of steel tubing, having been shown to be an effective structural member capable of resisting "tension or compression, bending, torsion or the combination of stresses that are exerted on the frame of a vehicle." Even the wheel rims were made hollow — often "formed of two U sections, one deeper than the other, brazed together" — to save on unnecessary weight. By 1884, this type of construction was the norm and, as a result, the weight range was reduced to less than 50 lb (22.5 kg) for road bicycles and around 20 lb (9 kg) for racing machines.[33]

Bicycle designers and builders understood that good wheel construction and reasonable weight alone could not guarantee that a vehicle would be either fast or reliable. Some attention also had to be paid to the place where the wheels met and carried the frame — that is, the hub bearings. As the rider pedals the wheels turn, creating mechanical friction in the hub. The power loss caused by this form of resistance to motion is not nearly as significant as rolling or wind resistance. Still, it can adversely affect overall performance by making a cycle less free-running than it might otherwise be. Good bearings, in other words, enhance a bicycle's ability to translate human energy efficiently into motion.[34]

Most of the first ordinaries had what are known as plain bearings, of which there were three basic types: plain, cone and parallel. Throughout most of the 1870s, builders seemed to prefer cone or parallel types. By 1879, though, ball and roller bearings were readily available and becoming more popular, particularly for the front driving wheel. In fact, while ball bearings were being adapted to and used in many different types of machinery, it has been suggested that more of the patents in the early period of ball-bearing development were aimed at the bicycle industry "than toward any other purpose."[35] In the 1880s, at the height of ordinary design and development, all these different types of bearings were still in use but the advantages of ball and rolling bearings were becoming increasingly apparent. In general, builders discovered that they were more



T. Fane and Company, Comet *model ordinary, ca 1887. Fane claimed to be one of the first manufacturers of bicycles in Canada, though it is more likely that he was assembling his products from imported, interchangeable parts. (Source: NMST, cat. no. 810208)*

tolerant of neglect — lack of lubrication, poor alignment. When a plain bearing is not well lubricated, "friction can increase manyfold." Equally important when dealing with a high gear ratio and direct drive transmission, ball bearings required a lower starting torque than plain bearings. As ball bearings were refined and perfected, these advantages became even more pronounced.[36]

Cycle companies made many other incremental changes in an attempt to improve the basic ordinary design of the 1870s. As cyclists found they could get more and more speed out of their mounts, the simple backpedalling method of braking was increasingly seen as inadequate. Various types of brake were adopted, most of which acted on the tire rather than the rim of the rear wheel. Starley's scissor action brake was a notable exception. After 1879, the front wheel brake introduced by Keen was generally adopted because it was more powerful.[37]

Another design consideration raised by the evolution of the high-wheel design was how to get on and off the vehicle and how to coast at speed. From the Ariel on, ordinaries needed some kind of mounting step to help riders push off, get a running start and then swing up into their saddles. As for the dismount, the step was not nearly as important as the learned technique of slowing to just the right speed before swinging one leg over the machine and then jumping down to the ground. For coasting down steep hills, most experienced riders took their feet off the rapidly revolving pedals. Some simply hung them over the handlebars. Others preferred to use foot rests and many makers included these on their bicycles, usually attached to the front forks.[38]

By 1880, the ordinary had reached the height of its technical and stylistic development in Britain and America. For the next ten or twelve years, most changes were purely cosmetic, aimed at offering a "new and improved" model every year. From the point of view of most serious bicyclists, there really was not a great deal of room for improvement. The direct-drive transmission was highly efficient and easy to maintain, the large wheel made riding on rough roads tolerable and the light weight and graceful lines made it both fast and attractive. Ordinary riders benefited from the steady improvement in the quality of rubber and design of tires and the gradual adoption of tangential spokes, but these were seen merely as enhancements to a successful formula.

Yet while this high-wheeled version of the bicycle was the ultimate vehicle to its devoted riders, makers and promoters, it was a difficult and dangerous machine to master. The vast majority of ordinary riders were young, athletic men who could meet the challenges of mounting, powering and dismounting from these tall cycles. Also, since the fastest mounts were those with the largest wheels, the longer the rider's legs were the more likely they were to excel. But even given a large number of tall riders, there were limits (about 60 inches or 152 cm) to how large the front wheel and therefore the gear ratio could be. All ordinaries had a high centre of gravity and so were unstable both laterally and from front to back. Riders had to pay close attention to maintaining their balance and avoiding obstructions on the road. Because they were perched directly above the pedals (and often more than 5 feet [1.5 m] above the ground), any sudden stop could throw them over the handlebars — called, among other things, a header or cropper — at the risk of serious injury. Special techniques were even developed for falling properly, in a way that would keep the rider clear of the handlebars, spokes and pedals. As well, riders had to contend with the additional strain put on their arms by having to drive and steer the big front wheel at the same time.[39]

The ordinary was clearly not a vehicle for the faint-hearted, middle-aged, non-athletic or overweight man, or for almost any woman. Manufacturers knew this and understood that it was not in their interests or the interests of cycling generally to exclude the vast majority of the population from enjoying the pleasures of this pastime. So, at the same time as they were perfecting the ordinary, most of them were also experimenting with, designing and manufacturing a variety of safer cycles to cater to the needs of a wider riding public. As a result of this work, during the late 1880s and the 1890s, the ordinary was gradually eclipsed and abandoned in favour of a more efficient and safer form of bicycle.

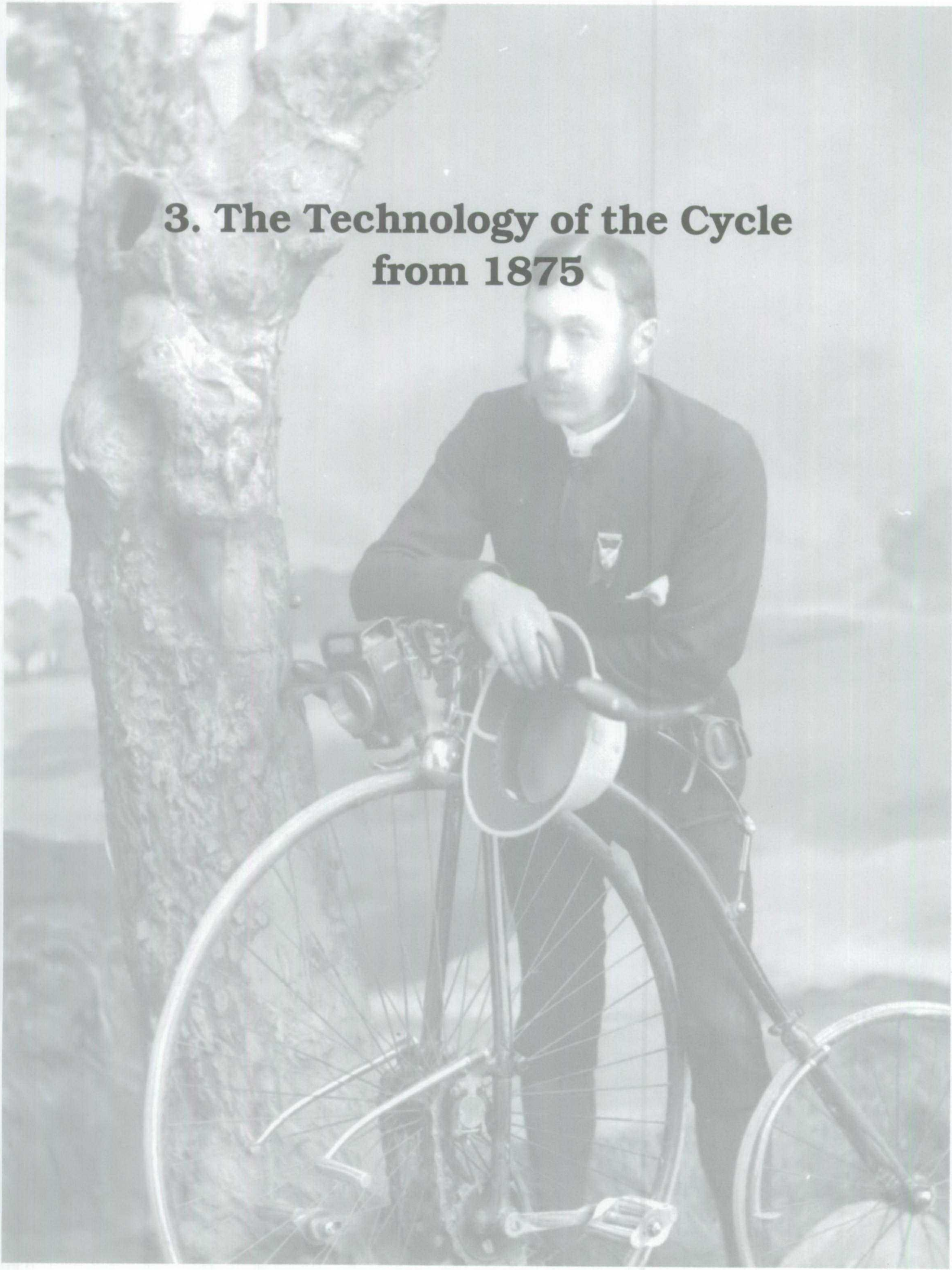
Notes

3. Charles *Spencer, Bicycles and Tricycles Past and Present* (New York: Griffith & Farran, 1883) p. 13.
4. Asa Briggs, *A Social History of England* (New York: The Viking Press, 1983) p. 208.
5. Writers who accept this story point to two contemporary prints, an 1804 play called *Les Vélocifères* and a newspaper report of races held in 1802 in Paris. According to Seray's research though, the vélocifères referred to in the latter two sources were not two-wheeled ones resembling bicycles but coaches built lightly for speed. The two prints, he argues, have been dated incorrectly. His etymological, technological and historical research is very convincing, particularly since he offers a plausible explanation of how and why the confusion began and was perpetuated. For a full account of his evidence and arguments, see, "No, Monsieur Baudry de Saunier! The True Origins of the Bicycle," *The Boneshaker*, volume 10, number 85 (Spring 1977) pp. 9–17. For two fairly representative accounts of the Sivrac story, see Andrew Ritchie, *King of the Road. An Illustrated History of Cycling* (London: Wildwood House Ltd, 1975) pp. 17–18 and C.F. Caunter, *The History and Development of Cycles, Part I, Historical Survey* (London: Her Majesty's Stationery Office, 1955) p. 2.
6. One account of the baron's travels is quoted repeatedly and at length in published sources — R. Ackermann *Repository of Arts, Literature, Commerce, Manufactures, Fashions and Politics* (London, 1819). The article compared the routes Drais took and the time it took him to make the same journey by foot or other means. It also mentions, among other things, the possibility of schools opening to instruct riders. Cited in Ritchie, pp. 18–20 and 26–27; Caunter, pp. 2–3.
7. Ritchie, pp 20–22; Caunter, pp. 3–4.
8. Ritchie, pp. 26 and 29.
9. The second issue of the magazine announced the invention of a "Self-moving Carriage" by a carpenter from Buckland, which had been examined and was found "to answer the purpose intended." *The Mechanics' Magazine*, vol. I, no. 2 (September 6, 1823) p. 30. In February 1824, a reader, E. Jamieson, submitted a design for a self-propelled carriage and asked for advice from readers on whether they thought it practical or not. There followed an exchange of letters between a correspondent and the original author regarding the design and construction of such vehicles. *The Mechanics' Magazine*, vol. I, no. 26 (February 21, 1824) p. 409; vol. II, no. 34 (April 17, 1824) pp. 81–82 and vol. II, no. 37 (May 8, 1824) p. 141.
10. Ritchie, pp. 31–33; Caunter, pp. 5–6; John Woodforde, *The Story of the Bicycle* (New York: Universe Books, 1970) pp. 12–16; A. Davis, *The Velocipede* (London: A. Davis, 1869) pp. 4–20. Davis and Ritchie both quote extensively from articles and correspondence in *The Mechanics' Magazine, The English Mechanic* and other sources from 1823 through to the 1860s regarding suggested designs for velocipedes or other pedomotive machines.
11. Ritchie, pp. 39–46; Caunter, pp. 5–6; C.F. Caunter, *Handbook of the Collection illustrating Cycles, Part II, Catalogue of Exhibits with Descriptive Notes* (London: Her Majesty's Stationery Office, 1958), pp. 3–5.
12. The one exception to this general tendency seems to be a photograph, caption and credit included in Ian Jones' *The Safety Bicycle* (Aylesbury, UK: Shire Publications Ltd, 1986). Unfortunately, Jones gives the reader no hint where the information in the caption and brief text references to Dalzell was originally found.
13. The letter can be found in *The English Mechanic*, vol. IX, no. 220 (June 11, 1869) p. 271 under the title "The Kilmarnock Bicycle." See also Ritchie, pp. 34–39; Caunter, *Part I*, p. 5; Woodforde, pp. 17–18; Frederick Alderson, *Bicycling. A History* (New York: Praeger, 1972) pp. 20–22.
14. Ritchie, pp. 54–57; Nick Clayton, *Early Bicycles* (Aylesbury, UK: Shire Publications Ltd., 1986) p. 7. Most sources repeat the same basic set of production figures relating to Michaux et Compagnie and the last one for 1868 refers to the number of workers employed rather than number of machines made. Ritchie claims that the 300 workers produced "about five velocipedes a day," while Clayton puts the number at "probably twelve machines per day."
15. Caunter, *Part I*, pp. 9–10; Ritchie, pp. 58–61 and 68.
16. Ritchie, pp. 61–63. Ritchie quotes several contemporary American sources on design and building activity in the US. Caunter also mentions some specific American advances in *Part I*, pp. 9 and 11. The most thorough and reliable source of information on activities in the US, however, is Norman Leslie Dunham, "The Bicycle Era in America," Ph.D. dissertation, Harvard University, 1957, see pp. 64–67 especially.
17. Caunter, *Part I*, pp. 10–12; Ritchie, pp. 67–70 and 74–76. David Herlihy has pointed out that it was not until 1869 that the Michaux company adopted the diagonal frame for its vehicles. See letter (21 February 1997) and attached documents on file with curator of land transportation.
18. Clayton, pp. 7–8; Caunter, *Part I*, pp. 8–10 and 14.
19. Dunham, p. 65.
20. Clayton, pp. 8–9; Caunter, *Part I*, pp. 9–11; Ritchie, pp. 71–76; H.W. Bartleet, *Bartleet's Bicycle Book* (London: Ed. J. Burrow & Co. Ltd., ca 1931) pp. 35–36 and Spencer, pp. 58–62.
21. Clayton, pp 9–11; Caunter, *Part I*, pp 13–14; Ritchie, pp. 75–76; Bartleet, pp. 35–36 and Spencer, pp. 58–62.
22. Ritchie, p. 80.
23. Ritchie, p. 80; J.L. Wood, *Cycles. A Short History* (Glasgow: Museum of Transport, 1970) p. 15; Clayton, p. 12. See, for example, terminology used on contemporary sources like Captain Crawley, ed., *Bicycling. Its Theory and Practice* (London: Ward, Lock, and Co., 1878) and the numerous contemporary quotations in Ritchie, pp. 79–99.
24. For a detailed and provocative discussion of the process of technological change in bicycle design and the ordinary's place in it see Wiebe E. Bijker, *Of Bicycles, Bakelites, and Bulbs. Toward a Theory of Sociotechnological Change* (Cambridge, MA: MIT Press, 1995) especially pp. 19–100. Because he was attempting to construct a systematic theory of technological

change. Bijker was primarily concerned with showing how the story of the bicycle supports his social construction of technology (SCOT) framework. His research into the actual historical development of the bicycle is limited and this, coupled with his unquestioning reliance on sources such as Woodforde, make me suspicious of his conclusions.

25. Caunter, *Part I*, p. 16; Ray Wolf, et al. (eds.), *Bicycling Magazine's Complete Guide to Bicycle Maintenance and Repair* (Emmaus, PA: Rodale Press, 1990) p. 279 and S.S. Wilson, p. 83.
26. Rolling resistance can be defined as "the resistance to the steady motion of the wheel caused by power absorption in the contacting surfaces of the wheel and the road, rail, or soil on which it rolls." Frank W. Whitt and David G. Wilson, *Bicycling Science* (Cambridge, MA: MIT Press, 1982) p. 107. According to Sharp, in general, "a soft substance like rubber will waste more work and therefore have a greater rolling resistance than a harder substance such as iron or steel." Archibald Sharp, *Bicycles and Tricycles* (Cambridge, MA: MIT Press, 1977) p. 83.
27. S.S. Wilson, p. 83; Sharp, p. 149 and J.L. Wood, p. 15.
28. Caunter, *Part II*, p. 66; Ritchie, p. 96; Caunter, *Part I*, p. 14; Clayton, p. 12.
29. Caunter, *Part II*, pp. 6–7; Caunter, *Part I*, pp. 14–15; Ritchie, pp. 94–95; Clayton, pp. 15–17 and Wood, pp. 15–16.
30. Sharp, p. 339 and Wolf, et al., p. 29.
31. Clayton, p. 11; Sharp, pp. 341–342; Ritchie, pp. 94–95 and Wilson, pp. 81, 83.
32. Though the first form of tangential spokes was patented by Starley in 1874, they were used on his tricycles and did not become common on bicycles until the late 1880s and 1890s. See, for example, Caunter, *Part II*, pp. 7–20 for technical descriptions of the Science Museum's collection of cycles from 1870 to 1900.
33. Clayton, p. 14; Wilson, p. 85; Wood, p. 16; Caunter, *Part II*, p. 10 and Caunter, *Part I*, pp. 16–17.
34. Whitt and Wilson, p. 140 and Sharp, pp. 250–256.
35. Whitt and Wilson, p. 145.
36. Ritchie, pp. 94, 99; Caunter, *Part I*, pp. 15, 21; Wood, p. 16 and Sharp, pp. 366–371.
37. Caunter, *Part I*, p. 22 and Clayton, p. 15.
38. Caunter, *Part I*, p. 22; Clayton, pp. 14–15. See also photograph in Ritchie, pp. 92–93 for a good idea of mounting technique.
39. Wood, pp. 16–17; Ritchie, pp. 99, 102, 122; Wilson, p. 83; Alderson, pp. 60–61.

3. The Technology of the Cycle from 1875



3. The Technology of the Cycle from 1875

By the mid-1870s, the basic design of the high-wheel bicycle was well established. While some makers were still busy refining it, others were already thinking about alternatives to the ordinary. Their motives were probably those of most inventors and innovators: they believed that the technology could and should be improved and they believed that they could make some money by contributing to that improvement. To achieve both these goals, they needed to make cycles that were safer and easier to ride than the ordinary without sacrificing too much speed and efficiency in the process. The pursuit of these objectives inspired them to create a vast array of new and imaginative cycle designs after 1875.

Finding Ways to Build Safer and Faster Cycles

The ordinary was the most popular cycle for about 15 years, but it was certainly not the only one. It preoccupied the attention of most mechanics and manufacturers during the early 1870s, but even during this period there were other kinds of cycles patented in the US, Britain and Europe.[40] These were overshadowed by the immense popularity and conspicuous public profile of the high-wheeled bicycle until that very popularity created a demand for cycles that were easier to ride. Cycle makers, always interested in expanding their sales, set out to supply this growing demand in a number of different ways. They reconsidered the possibilities of multi-wheeled cycles, particularly the tricycle, where Willard Sawyer's earlier innovative designs and commercial success stood as an example of what could be achieved in the field. They also began to explore ways of making a safer bicycle, based on both the existing high-wheel formula and on other, essentially new designs. In their quest for the perfect bicycle, they were able to take advantage of a large common store of knowledge, experience, skill and technical prowess gained from ten very active years of cycle development.

Tricycles[41]

Although in itself the tricycle pure and simple is considerably older than the bicycle, or two wheeled machine, it has until recently been so handicapped by faulty construction as to have been so far left behind and forgotten in comparison with its lesser confrère.[42]

Looking at the vehicles made by Willard Sawyer in the 1850s, "faulty construction" is not a description that leaps to mind. On the other hand, it is undeniably true that cycle makers in the mid-1870s had much improved engineering, and metal- and wood-working techniques, and had extensive practical knowledge of how to use materials such as rubber and steel tubing and how to make light, strong wheels. These were important advantages in designing and building viable tricycles especially since weight was often the most significant drawback of these vehicles. Builders and manufacturers, inspired by the growing demand for safe personal transportation, took these advantages and translated them into a vast array of new and improved tricycle designs, beginning in 1876 and continuing until the 1890s.

When the first new tricycles were introduced in 1876, it was obvious that they owed a great deal to earlier tricycle designs and to recent advances made in bicycle manufacturing. Both William Blood's Dublin tricycle and James Starley's Coventry Lever tricycle were driven by systems of rods and levers and were steered indirectly, in much the same way as many earlier multi-wheelers were. The influence of the ordinary was equally clear in the tubular frame of the Dublin and the rubber-tired suspension wheels of both vehicles. The size of the driving wheels of these tricycles, which were substantially larger than the other wheels, also reflected current bicycle design.[43]

Tricycle makers, however, very quickly moved beyond what they had learned and borrowed from existing tricycle and bicycle design. Sales of the Dublin and Coventry machines proved not only that there was a market for tricycles, but also that there was more than one way to build a successful tricycle. Thus in the late 1870s, cycle manufacturers began experimenting with new technologies, novel applications of existing technologies and alternative vehicle designs. Among other things, they tried out different wheel configurations, developed a variety of transmission and steering systems and patented various bearings and a new method of spoking wheels. In all, by the mid-1880s, they had produced literally hundreds of different models of tricycles.[44]

One of the most striking features of the many tricycles available after 1876 is the unusual and varied arrangement of their wheels. The Coventry Lever and its successors, the Coventry Rotary and

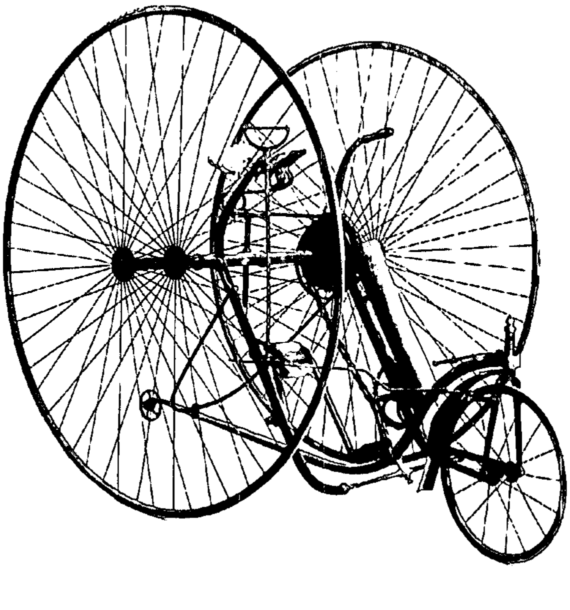
Rudge Rotary, had a single large driving wheel placed on one side of the rider and two much smaller in-line wheels on the other. On the Dublin, the large driving wheel was at the rear, with the two smaller wheels located in front. Other cycles had two large driving wheels and different makers placed them in the front or in the rear of the third, smaller wheel, depending on which they believed gave better overall performance. For many years, however, there was little agreement among either makers or users about which of these wheel arrangements was the best.[45]

To make their tricycles run, builders had a number of transmission methods or systems from which to choose. In 1882, Sturmey identified 50 different types of "driving gear" then available on specific makes and models. Lever systems, though inherited from an earlier generation of vehicles, were still being used by some builders. Singer & Company's Challenge tricycle and Butler's Omnicycle of 1879 were both propelled by levers and rods and there were at least six other such systems in use at the time. Other manufacturers used a series of interlocking gear wheels linking the pedals to the driving axle to transmit power from the rider to the machine. Bevel gear and driving band systems, though less common, were also available.[46]

By far the most common type of tricycle transmission after 1877 was continuous chain. The idea of chain drive transmission had been around for a number of years and had been applied in other fields. James Starley, who had used lever drive on his first tricycle in 1876, began experimenting with chains and decided that they provided a more elegant and efficient method of transmission. In 1877, he gave the cycling world its first continuous chain drive when he introduced his Salvoquadricycle. The following year he changed the design of the Coventry Lever tricycle to incorporate chain drive and renamed it the Coventry Rotary tricycle. Other makers were quick to follow Starley's lead and chain drive soon became the preferred method of transmission for tricycles. This trend was reinforced in 1880 when Hans Reynold patented a form of chain particularly well suited to cycles. His improved anti-friction bush and roller chain, based on work originally done by James Slater in 1864, has been in general use in the cycle industry since its introduction.[47]

In addition to different methods of transmission, there were also some specialized gearing features developed. These were mainly aimed at solving the problems of cornering and travelling over hilly terrain. Some makers built tricycles with two driving wheels for single or side-by-side (sociable) riders. Going around corners, the outside wheel needed to turn faster than the inside because it had to cover more ground. Because both wheels were connected to the axle, they could not revolve at different speeds and this made steering difficult. The problem was compounded when two riders operated a tricycle each driving a separate chain, especially if one rider was much stronger than the other. Then it became a challenge to steer the machine all the time, not just when cornering. The solution was found in 1877 when James Starley patented his balance gear — now known as a differential gear. He used it on the Salvo where two riders each controlled a driving wheel connected by chain drive to a set of pedals. The wheels had separate axles joined by a series of bevelled cog wheels that allowed them to turn at different rates all the time.

Starley's solution to the cornering problem, though the earliest and most famous, was not the only one. Between 1877 and 1882, tricycle makers incorporated 25 other forms of gearing that allowed driving wheels to turn at different rates. Eighteen of these involved clutch-type devices that released one wheel from the transmission when cornering. The remaining seven were differential-type gears that allowed both wheels to travel at their own rate all the time. Like chain drive transmission, the differential gear was not a new idea — it had already been applied to steam traction engines and other uses. This, though, was its first application to cycles (or vehicles of any kind) and it, too, quickly became standard for all tricycles driven by two wheels.[48]



Royal Salvo *tricycle, ca 1882. Starley first applied his famous balance gear or differential to this machine, which allowed the rear wheels to turn independent of one another. (Source: NMST, cat. no. 810229)*

Tricycle builders also worked out a number of gearing solutions to improve riding performance on hills. At first, makers tended to follow the bicycle formula, in which the gear ratio was determined by the size of the driving wheel or wheels, hence the inclusion of at least one large wheel in most designs. Tricycles, though, weighed significantly more than most high-wheel bicycles and so propelling them took substantially more power, especially when travelling over hills. At the same time, there was more space on most tricycle frames and this gave builders room to experiment with what were then called speed gears. These allowed machines to be geared "up" or "down," depending on the physical abilities of the rider and the type of terrain. For level ground, the device would generally be geared for speed; the driving wheel or wheels would turn more quickly than the pedals. On hills, the gear would be set for power and the pedals would outpace the driving wheel. Some speed gears also had what were called free-wheel devices that disengaged the pedals from the driving wheels so that the rider could coast. This was particularly useful going down hills when the pedals turned quickly. The major drawback of these devices was that they eliminated the backpedalling method of braking.

The Butler Omnicycle of 1879 was one of the first tricycles to include a speed gear. It was, according to one contemporary source, "one of the most peculiar and ingenious on the market." It had both "a mechanism for varying speed" and "a ratchet free-wheel device" that was probably a first in cycling. By 1882, there were at least six other speed-varying devices available and these appear to have enjoyed some commercial success. All but one of those reviewed in 1882 in *The Tricyclists' Indispensable Annual and Handbook* were still being used two years later. And makers had obviously been busy developing new forms of speed gears since there were 28 different ones reviewed in the 1884 edition of the *Handbook*. Of these, most offered two speeds but some boasted three, five and even ten different settings.[49]

Tricycle manufacturers applied and adapted a number of innovative steering systems for use on their vehicles. In part, their experimentation was made necessary by the variety of wheel configurations and seating arrangements they offered. It was also due to the lack of consensus among builders about what was the best way to build or, in this case, to steer, a tricycle. There was no consistency even among the first tricycles. The Dublin tricycle, a front steerer, could be controlled either directly by handle or indirectly by rack and pinion. Since the wheels were connected by a frame member, both turned at the same time. Starley's original Coventry Lever was steered directly by a tiller attached to the small front wheel. He soon changed it, though, to an indirect rack and pinion system involving both side wheels.

Within a few years there were several types of direct and indirect steering devices available on tricycles. Rack and pinion was the preferred method because it was relatively simple and could be very sensitive, but several makers used rack and rod and a few adopted the quadrant system. Most of these steering mechanisms could be adapted to work with either front, side or rear steering, though not all worked well with particular wheel configurations. For example, direct handlebar steering (bicycle steering) was difficult to reconcile with the open-fronted designs that were among the most popular and were essential for female riders. The same was true of models with two large steering and driving wheels in the front and those built for sociable riding. To some degree, this explains the apparent preference for indirect forms of steering, despite the fact that these often were more complicated than their direct counterparts that eventually became the accepted form for all cycles.[50]

Innovation in the tricycle field produced many other useful advances. Several manufacturers patented bearings, to be used on their own and other makers' vehicles. In 1878, Dan Rudge patented a type of ball bearing, which was used in the driving wheel of the Rudge Rotary around 1880 and which became one of two main types of ball bearing used in tricycle construction. The Singer tricycle of 1879 had hubs fitted with Challenge roller bearings as developed by G. Singer. Several other brands and types of bearings were also available to tricycle builders throughout the 1880s including those made by Bown, Palmer, Hillman and Burdess.[51]

A number of different brakes were also developed and adapted by the tricycle-building trade. Apart from the normal drill of backpedalling to brake, there were three main types used: tire, ground and hub. Tire brakes borrowed from bicycle design and were by far the most plentiful according to Sturmey's guide. He noted more than ten different makes, among them many spoon and roller types. There were far fewer ground or hub brakes from which to choose, though the latter were "the most effective and most generally-used class, especially with double-driving machines." As with transmission systems, the added weight and size of tricycles demanded greater attention to reliable braking methods and allowed room for experimentation with more elaborate devices.[52]

Finally, the tricycle and James Starley gave the suspension wheel it had borrowed from the bicycle back in a new and improved form. In 1876, Starley incorporated a new spoking system into his design for the Coventry Lever tricycle. Patented in 1874, it involved tangential as opposed to radial spokes: "the spokes are placed so as to be tangential to the hub in both the forward and backward direction, thus forming a series of triangles that brace the wheel against torque during either acceleration or braking." Though it took some time to refine this new technique, it was clearly a stronger and more reliable method of maintaining proper wheel tension. By 1884, tricycle and bicycle builders were beginning to recognize the merits of tangential spokes and this system gradually replaced all radial spoking as the industry standard. It remains the standard today for all types of cycles.[53]

The result of this intense development and manufacturing activity was a bewildering array of makes and models of tricycles. In 1877 and 1878 alone, 57 patents related to tricycles were awarded just in Britain, and the story was similar in the US and elsewhere. Coventry accounted for 20 different models as early as 1879 and within five years that number had risen to 120 made by some 20 builders. Not surprisingly, by 1883, tricycles actually outnumbered bicycles by 289 to 233 at the prestigious annual Stanley Bicycle Club Cycle Show in England.[54]

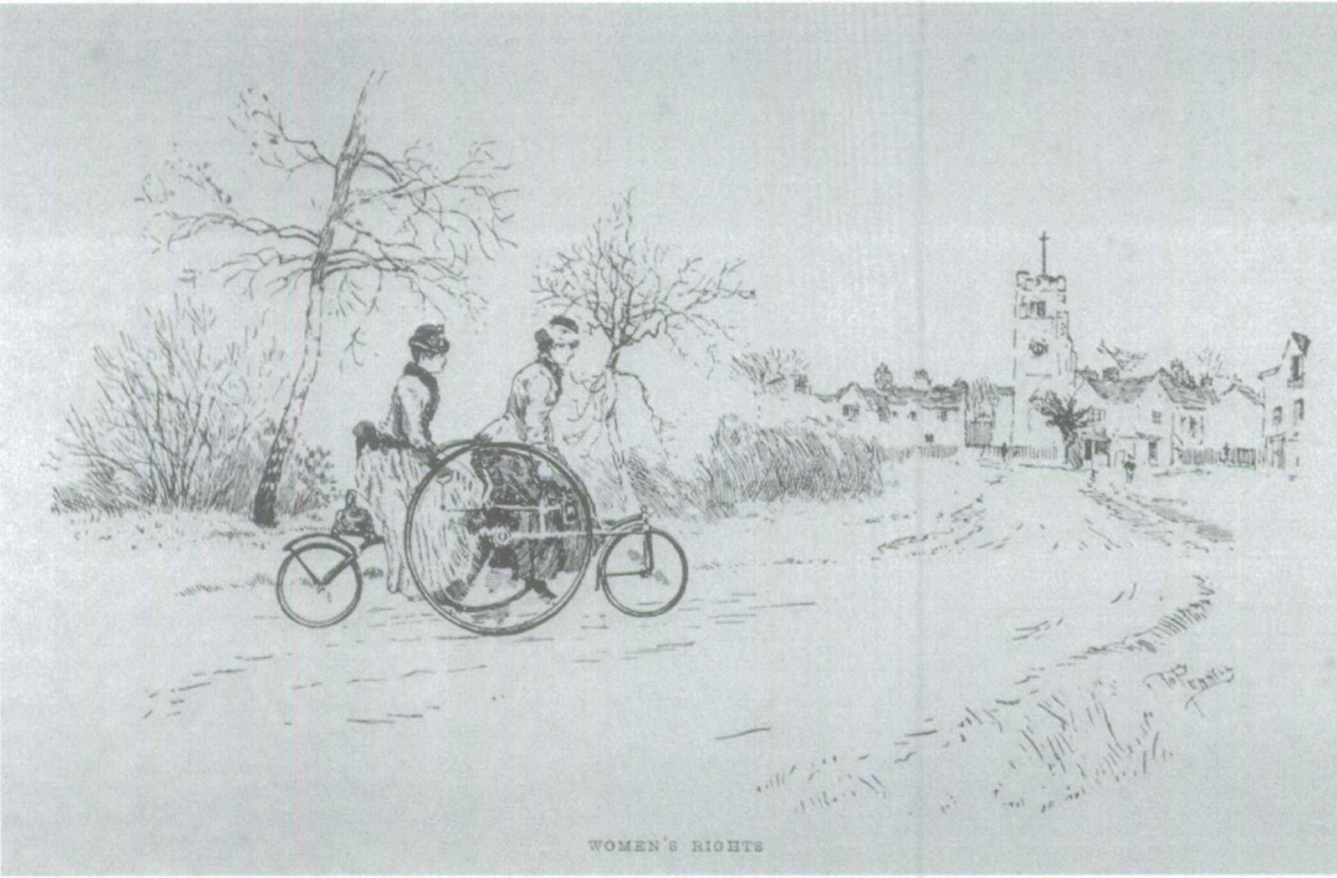
With all this variety, there was a tricycle to suit just about any taste or requirement. Each model had its supporters and each had definite strengths and weaknesses.[55] For example, the front-steering, front-driving Humber tricycle introduced in 1878 was well made, fast and good on inclines. Because of this it was very popular with the cycling public and many other companies copied the basic design and offered their versions for sale. Riders of this type of tricycle, though, had to learn how to control the two steering/driving wheels going downhill, when they could become unmanageable. Rear drivers, on the other hand, such as Starley's Royal Salvo (1880) and the later Humber Cripper (1884), were harder to get up the hills but were much more stable going down.[56]

There were similar trade-offs involved in choosing a steering system. Indirect forms of steering such as rack and pinion gave designers (and therefore consumers) the choice of front or rear steering and greater flexibility in the number and positioning of riders. It allowed for open-fronted models that could not only accommodate women's skirts but also made sociable or tandem seating possible and made it easier for riders to jump clear of the machine in the event of an accident. Indirect steering, however, was more complicated to operate and maintain than direct, bicycle-type steering such as that on the Humber. Some tricycles — the Quadrant (1882) and the Leicester (1881), for example — had bicycle-style handlebars controlling remote or indirect steering mechanisms. From a modern perspective, this would seem like a combination of the worst attributes of both designs, since handlebars limited steering and seating options without offering the benefits of a simple, direct method of control. Yet the Quadrant tricycle, named for its use of a quadrant steering mechanism, had its devoted adherents, as did the Leicester and other makes that had similarly hybrid steering systems.[57]

This process of constant experimentation and change in tricycle design did not just produce hundreds of different models after 1876. It also helped manufacturers decide which designs and features worked and which did not. Gradually they moved toward a standard formula for the tricycle. The outlines of that formula can be seen in the Leicester's single front steering wheel, the direct, handlebar steering of the Humber Cripper and the use of three equal-sized wheels on vehicles made by Dan Albone and Hillman, Herbert and Cooper in 1886. These, combined with dual rear drive by continuous chain and differential gearing, became the pattern for future tricycle development. It provided a reliable, versatile and efficient vehicle that most anyone could ride and that could also be easily adapted to commercial uses such as delivery of goods. Yet despite all the work that went into developing this form of vehicle and despite the real technological advances that were made in the course of that work, the tricycle faded from prominence almost as quickly as it had risen. By the early 1890s, the market for a safe, sturdy and dignified method of personal transportation was being filled by a vehicle that could do everything the tricycle could, and that cost less to own, operate and store.[58]

High-Wheel Variations

By 1878, the tricycle's popularity had proven beyond a doubt that there was a market for safer cycles. Some manufacturers decided to meet this demand on two levels. First, they spent a great deal of time, effort and money making tricycles. At the same time, they also began to tinker with the basic high-wheeled bicycle design in an effort to make it safer. The primary aim of all of these modifications was to move the rider back from above the front hub and closer to the ground. Between 1878 and the late 1880s, cycle builders came up with two basic methods of accomplishing this. Their first approach was to move the seat and rider back without altering the size of the front driving wheel. This meant that in order for the rider to reach the pedals, the pedals had to be put on levers that were pivoted on extensions from the sloping front forks. Two cycle makers named Beale and Straw introduced



One of hundreds of drawings from the 1880s and 1890s showing women cycling, in this case on a tandem quadricycle. Notice how the open design made it possible for them to operate the vehicle even though they were both wearing long, voluminous skirts. (Source: NMST, Shields Collection)

the first version of this type of levered ordinary in 1878. Their machine was called the Facile and once the rider became accustomed to the non-circular path of the pedals, it could be driven swiftly. Singer produced another, slightly different model of the levered bicycle the next year. Called the Xtraordinary, the Singer bicycle had pedals pivoted just below the handlebars but otherwise was much the same type of machine as the Facile. Both were definitely safer than standard bicycles and, along with tricycles, were very popular among the safety-conscious cycling public.[59]

By the mid-1880s, cycle makers had found another way to move riders back on the bicycle and closer to the ground. Instead of leaving the front wheel the same size and using levers to move the pedals, they reduced the size of the wheel so that the rider could still reach the pedals from behind the wheel. To compensate for the reduction in size and therefore gear ratio, they added a small gear and chain drive mechanism that "geared up" the driving wheel. The first cycle of this type, called the Kangaroo, was made by Hillman, Herbert and Cooper and introduced commercially in 1884. By the next season, "almost all the leading manufacturers" had copies of the Kangaroo on the market. The great strides made in chain and sprocket drives on tricycles paid off on this bicycle, which became popular for touring and also enjoyed great success on the race tracks. Kangaroo-type bicycles quickly took the market for safer bicycles away from the levered models, so much so that the company that made the Facile introduced its own geared version of the ordinary in 1887.

There were other, less influential attempts to redesign the ordinary. One, the Star, was especially popular in the US where it was produced. First patented in 1880, it was reworked and introduced by W.S. Kelly in 1885. It had lever-operated pedals to the large driving wheel like the Facile and Xtraordinary but there the similarity ended. The large wheel was at the rear of the bicycle with the seat positioned over it and the small one was in front. This kept the rider's weight over the back axle making it safer than the ordinary.[60]

The modified ordinary was in some ways a combination of technologies. Its basic form was that of the high-wheel bicycle but it used propulsion systems that

Ready for some serious riding, a uniformed and decorated Mr. Harrison posed with his well-equipped Kangaroo *bicycle, ca 1885. Note the mounting step, footrests, bell, pouch and lantern. (Source: National Archives of Canada, PA 32543)*

had been adapted and refined by tricycle makers. As a result it could offer the rider a vehicle that was both safer and more stable than an ordinary and lighter and more manageable than a tricycle. To many people, it must have seemed an ideal and enduring solution to the problem of how to build a safer bicycle. As it turned out, though, the modified ordinary was only a temporary answer, an intermediate stage in the development of a safer bicycle. The most that can be said for these types of bicycles was that, for a short period, they provided a lucrative commercial opportunity for certain makers and showed that two-wheelers could be made safer without sacrificing efficiency and versatility.

The Safety Bicycle

Even while tricycles and modified ordinaries were enjoying their greatest popularity from the late 1870s to the mid-1880s, makers and manufacturers continued to pursue other approaches to making safe, efficient bicycles. They borrowed heavily from existing and emerging technology, reshaped and rearranged it and developed some innovative designs during the late 1870s. These designs incorporated a chain drive to the rear wheel (as had been used successfully in many tricycle designs) and placed the rider between the two wheels, well back of the front steering wheel, in accordance with the same principles used in the popular Facile, Xtraordinary and Kangaroo bicycles. To accommodate this new configuration, makers reduced the size of the front wheel. These three basic attributes were the foundation of the modern safety bicycle.

The bicycle that came to be known as the safety was the product of many minds, workshops and factories. The technology and practical and theoretical knowledge that made it possible came from tricycle and bicycle makers as well as from people outside the industry. As with most other important cycle (and other technological) developments, several people claim to have invented, or at least introduced, the first safety bicycle. Some of these claims have validity but all of them must be qualified, either because there is no reliable evidence that the vehicle in question ever existed or because it lacked certain characteristic attributes of the safety bicycle form. In any event, what matters more than who was first is how designers and manufacturers took the first rudimentary safety types and reshaped and refined them into the modern bicycle that we still use today.

For the sake of clarity, we can divide the development of the safety bicycle into four stages. The first is essentially a non-commercial, prototype stage beginning in 1869 and ending with the commercial introduction of several safety models in 1884-85. Between 1885 and 1899 the basic design formula was established after extensive experimentation with different styles of frame and types of tires and steering. After 1900 most technological change — with a few notable exceptions — involved incremental improvements and refinements in designs and component parts. This is still largely the case today.[61]

As with the high-wheel bicycle and the tricycle, British cycle makers led the way in the technological development of the safety. With the exception of one rather tenuous French claim,[62] all the notable experimental vehicles were of British origin. Two of the earliest documented designs that bear some resemblance to the safety bicycle were submitted to the *English Mechanic* in 1869 by Thomas Wiseman and Frederick Shearing. Both pre-dated the introduction of the first high-wheel bicycle and were, in fact, attempts to improve on the Michaux velocipede. Like the McCall bicycle of the same period, they show how British mechanics were actively experimenting with new designs and seeking solutions for the flaws in existing vehicles. The

Shearing bicycle, in particular, had front steering and a continuous belt drive to the rear wheel, which is one reason historians tend to see it as a precursor to the safety. Yet for all its progressive attributes, this type of vehicle was completely eclipsed by the introduction of the ordinary. Of these designs, only McCall's was actually built and none of them appear to have had an appreciable impact on the eventual emergence of the modern safety bicycle.[63]

It took another ten years of cycle development and a strong demand for cycles that were more stable and easier to ride before the first manufacturer introduced a vehicle resembling the safety bicycle. In 1879, the Tangent and Coventry Tricycle Company offered a cycle called the Bicyclette for sale in Britain. Designed and patented by the company's manager, H.J. Lawson,[64] the Bicyclette combined and adapted some of the most successful design features of existing cycles. It was driven by a continuous chain to the rear wheel. The front fork was raked or angled back, away from the front hub, though to a much greater extent than in the modified ordinary designs of the time. This allowed the rider and pedals to be positioned between the two wheels instead of almost on top of the front one, a significant departure from established practice. Like most innovators, though, Lawson did not break completely with traditional form. His bicycle still looked a little like an ordinary with a front wheel nearly twice the size of the rear — 40 inches (1 m) and 24 inches (0.6 m) — and a single member main frame. The choice of wheel size combined with the position of the rider forced him to adopt an indirect, coupling-rod method of steering, similar to that used on many tricycles but not the most effective for steering a two-wheeler.

Lawson's Bicyclette received some publicity. It was shown at the Stanley Show in 1880 and an article published in the *Cyclist*, while commenting on its strange appearance, stated unequivocally that it was very safe to ride even over obstacles that would defeat any other cycle. Unfortunately, this testimonial and the curiosity of onlookers at the Stanley Show were not enough to make the Bicyclette a commercial success. It may have been that Lawson and his company were more interested in the increasingly lucrative tricycle market and thus did not actively promote the two-wheeler. It may also have been that the demand for safer cycles was being adequately met by the numerous tricycles and modified ordinaries already on the market. Perhaps the cycling public was just not ready to embrace yet another novel design when they had not exhausted all the possibilities of the existing ones. Whatever the reason, only a few Bicyclettes appear to have been made and sold and by 1881 it was dropped from the company catalogue.[65]

Despite this setback, the idea of a rear-driven safety did not fade away. It, along with other notions of how to improve the bicycle, continued to germinate in the minds of cycle makers and around 1884, began to bear fruit. In that year, the same one in which the Kangaroo was introduced, several manufacturers produced bicycles with chain-driven rear wheels. The models offered by the Birmingham Small Arms Company (B.S.A.) and J.K. Starley, nephew of James Starley, were both odd looking creations. Though they both had chain drive and more evenly sized wheels, neither represented a real improvement on Lawson's Bicyclette. Indeed, these bicycles contributed little to the development of the safety except perhaps by helping to demonstrate the inferiority of the indirect steering systems and non-raked or vertical front forks they both used.

The Humber and McCammon designs, however, definitely did represent advances on existing machines. Both still had unevenly sized wheels but the rear driving wheel was the larger of the two. More importantly, both had raked front forks and, for the first time on this type of bicycle, direct steering. As well, each of these models incorporated an innovative approach to frame design. The McCammon still used the single main member type of frame but curved it down from the steering head to hold the crank bracket and then back up over the rear wheel to support the seat and seat stays. This created an early form of drop frame suitable for women to ride. The Humber frame was even more novel. On this bicycle, the single member idea was rejected in favour of what is now called the diamond frame. In this type of frame, by far the most common even today, two main tubes run off the steering column, one across the top to the seat stays and one angled down to the crank bracket. A third tube, which runs from the crank bracket to the top tube and supports the seat, was not part of the original Humber or many other early diamond frame safety models.[66]

The second "crop" of safeties, introduced in 1885, reflected the fact that makers had learned a great deal from the successes and failures of 1884. For example, Starley and his partner Sutton, when making their second Rover, dispensed with the indirect steering and vertical front fork of the first, though they retained the single backbone style of frame and the larger front wheel. This second model enjoyed widespread publicity when Starley and Sutton organized a 100-mile (160-km) race especially for Rovers. They enticed (paid?) the top racers to take part and both the 50- (80-km) and 100-mile (160-km) records were broken. But the two makers did not stop experimenting at this point. Their third effort, remarkably, was also made in 1885 and its frame was similar to the 1884 Humber: a diamond form without the seat tube. Since its wheels were of equal size, a first in safety design, the actual shape of the frame looked much more like a modern-day frame than did the Humber with its tiny front wheel.[67]

With the benefit of hindsight, we know that the third version of the Starley and Sutton Rover was "the immediate ancestor of the present-day bicycle."[68] At the time, though, it was only the most widely known of several different versions of an evolving type identified by a long, low profile, same-sized wheels and a chain drive to the rear wheel. Makers, including Starley and Sutton, were not yet convinced that they had the right formula and continued to experiment to determine which design would give the best overall performance. One of their primary concerns was frame design. Because of its length, the safety frame was subject to different stresses and strains and had different weak points than the single backbone frame of the ordinary. The diamond shape used on the Humber and Rover was just one of several options makers tried to find the best combination of strength, simplicity and lightness. Other cycle builders adopted what was known as the cross-frame. This style of frame generally consisted of a main backbone member or tube reaching from the steering head to the rear wheel where it was forked to connect to the rear hub. Another tube ran vertically from the seat at the top to the crank bracket at the bottom, crossing the main tube in front of the rear wheel. In 1886 Dan Albone introduced what was probably the first cross-frame safety bicycle in Britain. The simplicity of the cross-frame design and this particular model's racing successes inspired other companies to produce similar bicycles, among them Rudge and Singer.[69]

Cycle manufacturers were also anxious to adapt this new type of bicycle for women. To do this required some rethinking of established two-wheeler design, which tended to require straddling the frame — something women in long skirts were not likely to attempt. Designers, therefore, had to find a way to open up the frame between the seat and the crank bracket and pedals. A workable approach was suggested by both the open-frame style of the McCammon safety of 1884 and the early cross-frames: run the main frame tube down from the steering head to the crank bracket (instead of across the top) to meet the rear forks and the vertical tube supporting the seat (which could also be braced by a pair of stays attached to the rear axle). This solution was used by Starley on his 1889 ladies' Rover and also by the Singer Company on their 1893 model. Another, more complicated design solution grew out of the diamond-type frame. Here, the top tube that normally ran from the steering head straight across to the seat was dropped to just

Starley Rover, *ca 1888. After producing two less successful safety designs, Starley introduced his third version of the Rover in 1886. Note the pivot hinge connecting the frame to the front fork. Makers soon abandoned this form of steering in favour of the now familiar socket system. (Source: NMST, cat. no. 810219)* above the main lower tube (now called the down tube). It joined and further braced the tube supporting the seat and crank bracket just above the pedals. This, like the diamond frame upon which it was based, proved to be the strongest and most versatile design for a ladies' safety bicycle and soon became the standard form in the industry.[70]

There were a variety of less orthodox and influential frame designs suggested during this experimental era. Some were never actually built and others were produced in such small numbers that few, if any, survive. One exception is the Dursley-Pederson bicycle patented in 1893 and produced beginning in 1895. This machine was built of lightweight steel tubes arranged in a fully triangulated form, using two tubes where most other frames would have had only one. The seat was strung hammock-style between two pairs of upright tubes. The makers also introduced a ladies' model, which had an open but still completely triangulated frame. The bicycles produced according to this design were noted for their "quality, strength, rigidity and lightness" and some were ridden for more than 50 years.[71]

During this period, makers also had to find ways to deal with two problems posed by the safety's small wheels. The first was gear ratio, which was relatively easy to solve. The size of the wheels (usually less than 30 inches [76 cm] in diameter) implied a low gear ratio — 30 × 3.14 inches (76 × 7.97 cm) travelled for one revolution of the pedals. But the safety bicycle was indirectly driven by a continuous chain, or sometimes a shaft transmission, into which gearing systems could be inserted to alter the ratio. With chain drive, a continuous roller-type chain is mounted on a pair of sprockets, one attached to the crank bracket and pedals and the other to the hub of the rear wheel. The front sprocket, also known as the chainring, turns as the rider pushes the pedals. The teeth of the chainring engage the chain and pull it and the rear sprocket or cog wheel around, thus turning the rear wheel. Tricycle manufacturers had already shown that by making the chainring significantly larger than the cog wheel, a cycle could be geared up so that the driving wheel turned more quickly than the pedals. For example, a bicycle with 28-inch (71-cm) wheels could be geared to the equivalent of a 50-inch (127-cm) driving wheel by using a precise formula for the number of teeth on each of the front and back sprockets. Bicycle designers found that this transmission system could be quite readily adapted to suit two-wheel machines.[72]

Though the continuous chain and sprocket method of transmission was simple, efficient and proven on tricycles, there were makers who were not prepared to accept it as the final answer. Some believed that shaft and bevel gears offered a more elegant and durable solution. Also used on tricycles, this system had the advantage of being completely enclosed, preventing dirt from getting into the system and sealing the grease and moving gears away from trouser legs and skirts. Cycle makers patented several forms of shaft drives in the late 1890s and used them on various models, usually in the deluxe price range. This form of bicycle transmission, though, did not survive much past the 1920s. Riders and manufacturers found that a shaft drive was no more efficient than the chain system and a good deal more difficult to remove and replace when repairing or changing tires.[73]

Also late in the 1890s, a few cycle manufacturers began to develop free-wheel systems for the safety bicycle. Like most of the bicycles and tricycles developed before it, the original safety formula was based on a fixed-gear system. This meant that when the wheels of the cycle were turning, so were the pedals and the riders' feet. Besides being an inconvenience, this system could be just plain dangerous when going downhill. At first, manufacturers dealt with the problem by providing foot rests so that riders could take their feet off the pedals and place them safely out of the way of the cycle's moving parts while coasting. Then, beginning in the 1880s, a number of tricycle makers began to incorporate what became known as free-wheel mechanisms, which disengaged the pedals from the transmission and allowed riders to keep their feet on the pedals at all times. In 1894, Linley and Biggs applied the same basic principle to the safety when they introduced the New Whippet bicycle, which, among other innovations, boasted a free-wheel device on the rear hub. This was probably one of the first of its kind and it was not until after the turn of the century that these devices became a standard feature on most bicycles.[74]

The second problem posed by the safety's small wheels was its uncomfortable ride. Compared to the ordinary, which was better able to absorb and dissipate the effects of, and was less prone to, jarring and jolting, the safety seemed to be subject to an inordinate amount of road shock and vibration. Well-sprung seats helped but certainly did not solve the problem. Some makers devised frames supported by springs in an attempt to improve the ride of the small-wheeled bicycle. The basic principle behind these spring frames was that shock-absorbing springs inserted in various places in the frame structure reduced the transmission of vibration from the tires to the frame and rider. Several different manufacturers produced spring-frame models, each with a different frame design and each incorporating various types of springs at critical points. The best known and one of the most successful models was the Whippet introduced in 1885. Others included the British Star first made by Guest and Barrow in 1887, the Cremorne, the B.S.A. and the Hall and Cooper, Kitchen & Company's Elland. Even some of the larger interests like Humber produced spring-frame models.

To some extent, the spring-frame solution was successful. The better-designed and built of these bicycles did provide a significantly smoother ride. However, these machines were more complicated and, therefore, more expensive to buy and maintain than other bicycles. As well, all spring frames were prone "to wear at the joints, to varying degrees, and what might have been an acceptable machine when new was not so when the joints became loose." This wear and loosening could cause any number of handling problems. For example, the Whippet's steering was "seriously affected by wear." As a result, the spring frame did not provide a satisfactory, long-term method of improving the comfort level of the safety.[75]

A Scot named John Boyd Dunlop gave the bicycling world a far more enduring solution to the problem of road shock and vibration when, in 1888, he revived the pneumatic tire. First patented by John William Thomson in 1845, the original air-filled rubber tire had found neither a maker nor a market, despite having been tested on a horse-drawn carriage and proven effective. Thomson's work was forgotten until the cycle manufacturing industry in Britain, Europe and America began the search for tires that could absorb more road shock and cushion the frame and rider.[76]

Since 1870, most cycle manufacturers had used some form of solid rubber tire on their vehicles. The quality and durability of these tires had been improved enormously over the years as makers experimented with and identified the best type of rubber to use and the most efficient designs. The safety, though, demonstrated that even the best solid rubber tire could not compensate for the reduction in wheel size. So the experimentation began again. Some cycle makers tried what were called cushion tires — solid rubber tires with a hollow core. Others adopted sprung wheels and rims of various kinds. Neither of these was very successful. Dunlop's pneumatic tires were first used on his son's tricycle but within a year they proved their worth on a Belfast racetrack. In May 1889, William Hume rode a pneumatic-tired safety to victory in four races. Though people could not resist commenting on the inelegant appearance of the fat, balloon-like tires, they also could not deny the day's results, especially since Hume was not considered a first-rate racer.

The sensation caused by Dunlop's tires at the racetrack gave him and his business associates the boost they needed to become commercially viable. This, in turn, prompted them to improve and refine their product to make sure it lived up to the expectations they had created. In the first few years of commercial production there were still significant problems with the pneumatic tire. It was not nearly as durable as solid tires and it was hard to remove for repair or replacement. A reliable valve had yet to be devised and, like most new inventions, it was expensive. Most of these weaknesses were systematically addressed after 1890. Cycle manufacturers, meanwhile, had quickly embraced the new tire because, even with its deficiencies, it improved shock absorption to such an extent that it justified any modifications that had to be made in fork width and rims. By 1892, almost all manufacturers were using pneumatic tires on their vehicles, including the last of the ordinaries, tricycles and modified ordinaries.[77]

With the introduction and widespread adoption of the pneumatic tire, the basic form of the modern safety bicycle was more or less complete. Manufacturers continued to make adjustments and refinements to the design. For example, by the 1890s, virtually all builders were using tangential rather than radial spokes[78] on their wheels and most had abandoned centre-pivot steering in favour of the socket-type systems still in use today. They also began to concentrate more of their innovative energies on adding or improving certain critical components such as brakes and gearing systems. Many of the major advances in these areas (and their actual application in bicycle design and production) came after the turn of the century, but their beginnings were evident in the 1890s.

Cycle Developments after 1900

But one notable fact stands out like a shining light. The basic design of a good, strong, efficient bicycle has not been improved on since the eighteen-nineties.[79]

In an era of computer-assisted design and space-age metals and plastics, it is tempting to believe that today's cycles are dramatically different from and better than those of 100 years ago. They are not. The reasons for this technological stability are fairly obvious. The bicycle is an incredibly simple and efficient machine. This made it an enormously popular and profitable vehicle in the 1890s and helped to maintain its role up to the present day. When the cycle trade was booming, manufacturers saw little reason to tamper with a successful formula. When the boom collapsed and prices plummeted, they were even less inclined to invest time and money in risky experiments.

Raleigh women's bicycle, called the Canadian, *with hand brakes and Sturmey-Archer 3-speed gear, ca 1952. This cycle is typical of the fully equipped, high-quality British-built products imported to Canada in increasing numbers after World War II. (Source: NMST, cat. no. 880660)*

This is not to say, however, that there have not been any advances in cycle design in the 20th century. On the contrary, designers, manufacturers and enthusiasts have made many incremental improvements that have enhanced the durability, versatility and performance of cycles. First, they created a number of specialized variations on the basic safety design. Second, they developed a wide range of increasingly sophisticated components.

Design Variations

Though the cosmetic appearance of the bicycle has changed a great deal over the decades, there have been very few significant, lasting design changes, and only one really radical departure from conventional bicycle form.[80] Moreover, all but one of these innovations originated outside the mainstream manufacturing industry and the world cycling establishment, which by 1920 were already quite conservative in outlook and in approach to design. Fortunately, the bicycle is still a simple enough device that amateur mechanics and small makers, like their 19th century counterparts, can do much of their own research, development and fabrication work. Since 1900, small makers have been the main source of design innovation in the industry.

The most unorthodox innovation in cycle design was the Recumbent. In the late 1890s and early 1900s, several builders designed vehicles that moved riders back from the front wheel in a semi-recumbent position, which lowered their centre of gravity. In 1914, Peugeot produced the first commercial version of the Recumbent and, after World War I, French makers introduced racing Recumbents know as Velocars. These were built so that riders could lie on their backs and use both their leg and back muscles to turn the pedals, which were located at or near the front of the vehicle. This position gave these cycles and their riders a lower and more aerodynamic profile. Velocars had a long wheelbase and a tiller for steering, not unlike those used on some tricycles in the 1880s. To anyone familiar with the standard, diamond-frame safety bicycle, they were very odd-looking vehicles, but they were also very fast. In 1933, when François Faure beat the then-world champion and broke existing track records riding a Velocar, the French racing authorities were forced to admit that the vehicle was superior in many ways to an upright cycle. Foreseeing the upheaval that such a dramatically new cycle would cause in the established industry, not to mention the racing fraternity, they declared that it was not a bicycle. Demonstrating technological narrow-mindedness and snobbery of the highest order, the international cycling community agreed.[81]

Recumbent enthusiasts, though, refused to give up. Like the amateur mechanics of the early 19th century, they believed that to find the most efficient means of human propulsion, builders had to remain open to all options and ideas. Since the 1930s, they have built, designed and tested many more versions of the Recumbent bicycle.

Unrecognized and ostracized by traditional cycling organizations around the world, they formed their own organization — the International Human-Powered Vehicle Association. The IHPVA acts as an umbrella group for all kinds of activities relating to Recumbent and other unconventional vehicles. Members include university professors and their students, engineers, builders, cyclists and others who share their knowledge of and enthusiasm for these remarkable machines. The group organizes yearly races to test the capabilities of members' latest designs.[82]

A much less dramatic yet equally persistent design innovation was introduced at the turn of the century. Military authorities had for some time seen the potential of the bicycle for moving troops who would otherwise have to walk or wait for transport. But they wanted it to be made more portable. To meet this requirement, British maker B.S.A. designed a bicycle that looked almost exactly like a conventional safety but that had a hinged frame that meant it could be folded and carried more easily. The company produced the first version for use in the South African War (1899–1902). The same basic model was used in World War I and a lighter version was issued to troops during World War II. In theory, paratroopers and soldiers exploiting the successes of an amphibious assault would use the folding bicycle for critical mobility. Canadian troops were photographed on D-Day carrying folding bicycles with them on the landing craft. They were not very useful in this role though, and it is safe to say that, except for the routine transportation of soldiers around military camps and of workers to and from factories, bicycles did not play a very important role in the Allied war effort.[83]

Despite its apparent failure as a form of military transportation, the folding bicycle did not disappear after 1945. The idea of portability is an attractive one and the folding bike resurfaced in the mid-1970s, this time in a small-wheeled version aimed at commuters and travellers. With only one

Bicycle-equipped Canadian infantry troops from the Stormont, Dundas and Glengarry Highlanders prepare to land in Normandy, June 1944. Their purpose-built folding cycles were opened to full size in this photograph. (Source: National Archives of Canada, PA 133757) oversized main frame tube, small wheels and extended seat tube, these folding cycles could, at first glance, easily be mistaken for children's bikes. But the strange frame shape was what made it possible to fold them down to a size that would fit handily in automobile trunks, on luggage racks of trains and on sailing and other recreational boats. At the same time, these were serious cycles that incorporated the latest materials, components and construction techniques and that provided reliable transportation in a variety of environments. In the 1990s, the folding cycle has become known as the travel bike. There are a variety available, from very basic, utilitarian models to more sophisticated ones with prices exceeding $1000.[84]

The small-wheel version of the folding bicycle owed a lot to an earlier design. In the late 1950s, Alex Moulton, an independent engineer, set out to develop a bicycle that would suit the needs of urban riders who wanted a vehicle that was stable, was easy to ride and could carry more luggage than a conventional model yet be easily stowed in the trunk of a car. He determined that, in order to carry more and be truly portable, the vehicle would have to have much smaller wheels than a regular cycle. Since smaller wheels meant more vibration and energy loss, some kind of suspension system would be required to make its ride comfortable. Moulton put all these attributes together using an unconventional frame configuration that looked something like a cross-frame. Though it was not as efficient as a traditional diamond frame safety, the Moulton small wheel was such a commercial success in Britain that Raleigh, which had rejected the design when Moulton offered it to the company in 1959, began to make their own version. Raleigh eventually bought Moulton and continued to make small-wheel bicycles until 1974, by which time about 250 000 of them had been sold, mainly in Britain. Currently, there is a travel bicycle carrying the Moulton name.[85]

The next significant change in cycle design came at the end of the 1960s and seems to have originated in California. Bicycle Moto-Cross, or BMX, began with kids using their bikes like motorcycles, racing over rough, obstacle strewn dirt tracks, jumping over moguls and skidding around corners. According to at least one source, it did not take long for amateur mechanics, including riders' fathers, to begin changing conventional bicycles to meet the special needs of the sport. For example, BMXers wanted small-framed bikes (something like younger children might ride), with higher bottom brackets to allow greater clearance over obstacles. They also discovered that wide, knobby tires and upright, braced handlebars were a must. By the mid-70s a few entrepreneurs had set up small manufacturing works like Redline, GT, Diamond Back — the first two founded by "BMX dads" — to produce BMX cycles. Around the same time, Yamaha, the Japanese motorcycle maker, introduced its Moto-Bike, which had twin shock absorbers in the rear. Other established companies tried to break into this lucrative new field once it became clear that it was not just another fad, but, unlike other areas of cycle manufacture, "the big names in BMX racing continued to be smaller companies like Redline and GT."[86]

Around the time that BMX was becoming widely known and established as a sport, a new kind of cycling and a new kind of cycle was born, also in California. The parents of the mountain or all-terrain bike were "grown-ups," sort of, and at first their bikes were nothing more than old one-speed clunkers or cruisers from the 1930s. These people searched fields, barns and shops all over the region looking for the ideal specimen — preferably a Schwinn bicycle with a heavily built frame, lots of clearance between the bottom bracket and the ground, wide motorcycle-style handlebars and reliable coaster brakes. They would then put new wide, knobby tires on them and take to the mountain roads, tracks and trails of Marin County, north of San Francisco.

Around 1976, a small band of these off-road enthusiasts began racing down a fire road, now called Repack Hill, and their experiences there spawned a series of new innovations. Some added derailleur gears and refurbished old drum brakes; others installed longer pedal cranks. Still not entirely satisfied with the vehicles, at least two of the mountain bikers — Joe Breeze and Tom Ritchie — began to design and build cycles specifically for off-road riding. This was no small undertaking because the level of standardization in the bicycle industry was high and many of the parts they needed were simply not available. For example, they wanted stronger, stiffer frames with steeper head angles and straighter forks than conventional road bicycles, but there were no lugs available that could accommodate the wider tubes and unconventional angles they desired. As a result, they adopted lugless forms of brazing or welding to build their frames.[87] Unhappy with the choice of handlebars available, Ritchie developed the "one-piece, triangulated handlebar," which is now considered standard equipment on all-terrain bikes. Thanks to the BMX movement, they and other early builders were able to obtain wide rims made of aluminum, which were better in wet conditions, and high quality tires to match.[88]

By the early 1980s, the manufacture of all-terrain bikes was no longer a small offshoot of the main industry in the US; it was becoming an industry all by itself. As sales took off, people began to talk about yet another bicycle boom and more and more makers entered the field. The rate of innovation and change also increased dramatically. Sturdier fork styles, powerful cantilever brakes and stronger steering systems were among the first major improvements. Soon, though, the industry was trying more radical experiments — with frame geometry, index shifting and hydraulic suspension systems, to name just a few. By 1985, *Bicycling* magazine was warning prospective buyers: "there are so many different models available that it is often difficult to know how to choose. Unless you are already quite knowledgeable about bikes and bike components, it is a good idea for you to get help."[89]

The mountain bike movement is still going strong and the popularity of these sturdy, shock-absorbing cycles for urban commuting has given rise to a subspecies known as the commuter or city bike. A slightly "dressed down" version of the true off-road vehicle, the city bike generally has smoother and perhaps slightly narrower tires, a shorter, more comfortable reach to the handlebars and fewer gears. To protect the rider's clothing, they often have fenders, mud flaps and chain guards. Some makers and dealers also make a winter or all-season version with an enclosed multi-speed coaster brake and a sealed bottom bracket, both of which prevent snow and slush from penetrating and damaging these critical areas.[90]

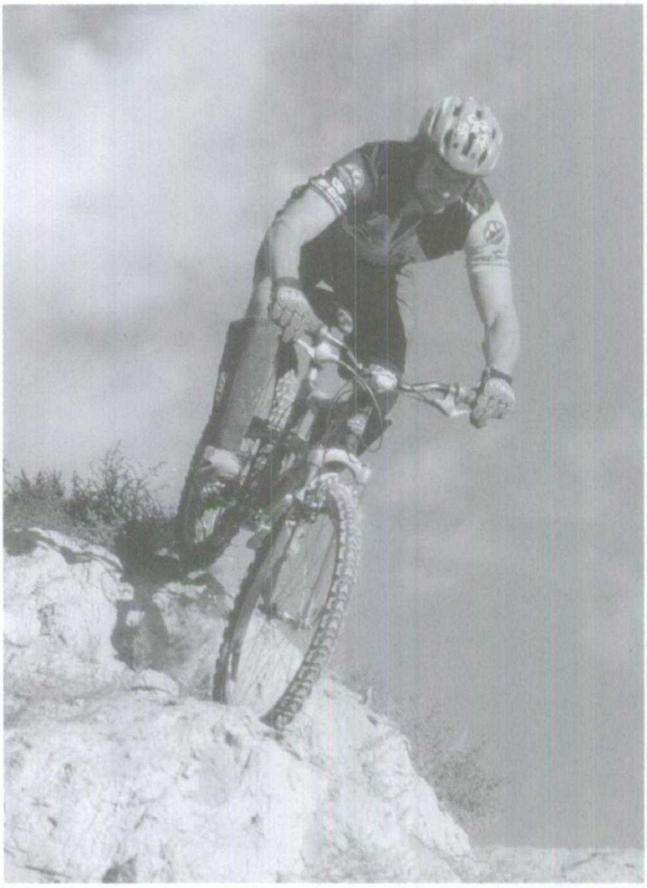
Components

Bicycles are made up of many components and groups of components. Needless to say, makers have refined and improved all of these since 1900. Some advances have been more significant than others. Gearing and braking systems are two of the most critical areas of development.

Today, gearing mechanisms and brakes are considered absolutely essential cycle components, but at the turn of the century, makers were only beginning to recognize their importance. Most safeties were built with one-speed, fixed gear systems, which meant that they had only one gear ratio and that when the wheels were turning so were the pedals and the rider's feet. To brake, the rider put backward pressure on the pedals. Some models also had plunger or shoe brakes on the front wheel, which were activated by turning a lever on the handlebars. This system, much the same as that used on high-wheelers, was simple and therefore easy to build and to repair, but it did not allow riders much flexibility when they were travelling over difficult terrain.

To free cyclists from this rather rigid formula, makers began to experiment with free-wheels — mechanisms that release the rear wheel from its connection to the cranks when you stop pedalling — and gearing systems. Though some of these were patented as early as the 1880s, the first commercially successful ones came shortly after 1900. In 1902, Sturmey-Archer introduced its three-speed hub gear, which became the prototype for most of the hub gears that followed it. Based on a single epicyclic gear train enclosed in steel shell, it provided variations 25% above and 20% below the normal drive setting, yet was small and light. It also had a built-in free-wheel mechanism. In later versions, such as the Tri-Coaster (1908) and K types (1918), the increased range of variations reinforced the reputation and popularity of this type and brand of speed gear. Other hub gears were developed by makers in Britain, the US and elsewhere around the same time and some sold quite well.

A second form of gearing system was developed in France around 1909. Derailleur gears are external to the hub and operate by lifting and moving the chain across a range of different sized cogs. Though this system required more maintenance than the



A high-performance all-terrain or mountain bicycle, ca 1997, built by the Rocky Mountain Bicycle Company Limited of Delta, British Columbia. In addition to the compact, sturdy frame and wide, rugged tires typical of most off-road cycles, this model also has full suspension. (Source: Rocky Mountain Bicycles Limited) internal hub gear, its principle of operation was so simple that it could be easily repaired. Moreover, in theory, all the rider had to do to increase the range of gearing was add more cogs. Though practical reality was a little more difficult, it was not long before the makers of derailleur systems were offering multi-speed versions. In 1935, Cyclo produced a six-speed model with two chainwheels and three cogs mounted on a free-wheel hub. By 1950, ten-speed derailleurs (two chainwheels, five cogs) were available.

For many years, hub gears were the choice of virtually all British and North American makers for their multi-speed models, while most French and many other European builders preferred the derailleur system. Hub gear makers tried to keep pace with the expanding capabilities of derailleur gears — in 1938 Sturmey-Archer introduced a four-speed model of its famous hub with wide, medium and close ratio versions — and did for a number of years. But gradually British and North American cyclists and cycle makers discovered the advantages of the derailleur system. Beginning in 1950, racing bikes were equipped with this type of gearing and within 20 years, the general cycling public was demanding ten-speed bicycles. At the time, derailleurs were by far the most effective, not to mention the most popular, way to deliver this range of gearing.[91]

In recent years, the hub gear has made a noticeable comeback. There are two reasons for this. Because it is completely sealed, and thus protected from the elements, makers of all-season commuter models prefer it to the derailleur system, which is far more susceptible to deterioration from the build-up of dust, dirt, snow and slush. Also, component makers have steadily improved the range and efficiency of hub gears in order to compete with derailleur types. They are now available in up to 12-speed models and are small, light and reliable. As a result, more and more makers are trying them out on commuter cycles and other models.[92]

Component makers have also improved the mechanism used to shift derailleur gears and now offer more options for type and location than ever before. Derailleurs are connected by cables to shift levers at the front of the bike where the rider can reach them. On road bikes, makers place the shifters on the down tube just below the rider, on the handlebar stem, just in front of the rider or at the ends of the handlebars. Mountain bikers, who like to keep both hands on the bars at all times, persuaded makers to place gear levers on the tops of the handlebars near enough to their hands to be shifted by the thumbs only. Many three-speed bikes have a similar form of thumb shifter. The most recent development in shifters is the combined brake and gear shifter. There are both road and mountain bike versions of this system in which the gear levers are underneath or opposite the brake levers and can be activated while the rider's hands remain in control of the brake levers and handlebars.[93]

There are three different types of shifters: friction, ratchet-style and index. Friction systems are the oldest and for a long time were the most common. But since 1987 they have been displaced by the other two types. Friction shifters require the rider to move the lever slightly in one direction until the derailleur moves the chain to the next cog. Riders have to get to know their bikes in order to judge how much to move the lever on each shift. Index shifters, though, click into pre-set positions that correspond to each cog, so there is no judgement involved. Ratcheting shifters are similar to friction types but can be moved more easily backward than simple friction levers. By far the majority of shift levers in use today, on both expensive and inexpensive cycles, are the index type, though many cyclists bemoan the fact that all the skill is being taken out of cycling.[94]

During the same period, component makers began to focus more attention on improving bicycle brakes. When free-wheels became standard equipment shortly after the turn of the century, new methods of braking had to be devised to take the place of backpedalling. Four different types were developed: internally expanding hub, coaster hub, disk and rim. The first three types all act on the hubs of the bicycle. The internally expanding variety was produced and used by several makers including Sturmey-Archer, who built their version of it into their coaster hub speed gears. The brake mechanism was activated by backpedalling. This type of brake was very common in Britain where hub gear systems were popular and was especially prized for heavy or fast models that needed high braking capacity. Though they fell out of favour when the ten-speed came along, they enjoyed a minor revival in the early 1980s, perhaps as a result of demands by mountain bikers for stronger brakes.

Coaster hub brakes, such as that patented by the New Departure Bell Company in 1898 and 1900, were used mainly on one-speed cycles. Like the internally expanding brake, they combine the free-wheel and brake system in the rear hub and are activated by backpedalling. Until the late 1960s, the coaster brake was by far the most common used in North America, since most cycles were one-speeds. They are still used today, but mainly on children's or juveniles' models where simplicity of operation is crucial.

Disk brakes for bicycles are a much more recent development. Component and cycle makers including

Shimano, Phil Wood and Bridgestone produced them in the mid-1970s, claiming that these brakes, which are operated by hand levers and cables, were effective in both wet and dry weather and provided high-capacity braking action. Though both Shimano and Bridgestone stopped making them by 1990, a recent issue of a cycling magazine published photographs of two new types of disk brake. One is made by Spinergy and is being developed to use with its downhill wheel set, and the other, again from Shimano, is part of a research and development project in which the company is testing various forms of disk and internal hub brakes.[95]

The most popular form of brake today is the rim brake. In this type of brake, the rider presses hand levers connected by cable to two pairs of metal arms, fastened above the wheels. Rubber pads attached to the metal arms are pushed against both wheel rims. Rim brakes have been around in one form or another since the 1890s or earlier. They were available on high-quality British touring models from 1900 and were commonly used on road-racing bikes from about the 1920s. Their popularity rose with the use of multiple gearing systems.

Over the years, many different styles of rim brakes have been developed, but most were variations on three main types: centre-pull, side-pull and cantilever brakes. In North America, the first rim brakes introduced by cycle makers after World War II were side-pulls but, starting in the late 50s, these were displaced by the centre-pull designs that were self-centring and had greater mechanical advantage than their rivals. During the ten-speed craze of the 1970s, new side-pull styles were introduced that incorporated many of the superior features of centre-pulls. Today, along with cantilevers, side-pulls are the most common form of rim brake on high-grade cycles.

Cantilever brakes have a similar action to centre-pulls but have shorter, stiffer arms that are attached directly to the forks and stays of the cycle. Because of this arm design and method of mounting, cantilevers have the greatest mechanical advantage of any rim brake. Although they have been around since at least 1929, their use was limited to heavy vehicles like tandems and loaded touring bikes that needed a lot of braking power. When mountain bike makers began looking for rim brakes that would stand up to steep descents and rough terrain, cantilevers were a natural choice.[96]

There have been countless other incremental advances in the design and development of components. Wheels, for example, were once made with steel or wooden rims, with a standard number of steel spokes (there were small differences from country to country) and a standard hub design (again with minor variations). Today most bikes have either aluminum (for higher-grade makes) or steel (for inexpensive models) rims. But serious cyclists can also choose from the latest aerodynamically designed and wind-tunnel tested rims and wheels, including "deep-dish" and "V-rim" carbon-fibre rims, "tri-spoke," disk and other moulded "spokeless" wheels. Some of these designs have the radial spokes that were abandoned by cycle makers in the 1890s in favour of tangential spokes. BMX bicycles also have specialized wheels that look like motorcycle wheels with only a few large moulded "spokes." They can be made of substances like glass-reinforced nylon, Kevlar and carbon fibre. Hubs also come in a variety of shapes and sizes — large-flange for stiffer wheels, small for more flexible ones, quick release, sealed and unsealed.[97]

Component and bicycle manufacturers in recent years have also rediscovered suspension systems. For many makers, the introduction of the pneumatic tire around 1890 eliminated the need to incorporate shock-absorbing springs in their cycle frames. The idea enjoyed a brief revival just after the turn of the century when several companies designed and built cycles with sprung forks — CCM called their model a Cushion Frame. But when suspended frames failed to revive the sagging market for cycles, this feature was abandoned. The industry did not begin to look seriously at suspension systems again until Moulton incorporated one on his small-wheel cycle. It was the emergence and astonishing growth of BMX and mountain bike demand in the late 1970s and early 1980s that really revived interest in increasing the cycle's capacity to absorb shocks. Within a few years various types of suspensions had been developed. The three most common are rubber bumpers, springs and hydraulics, each of which has its strengths and weaknesses, proponents and detractors. To add to the confusion, makers now also offer cyclists front and full suspension vehicles. In the latter form both the forks and the rear triangle have independent suspension systems.[98]

It took cycle-makers just under 100 years to work out the design for the "perfect" bicycle. They spent the next century refining and improving it by building specialized variations on the design and adding more versatile components to it. But this was not their only preoccupation after 1890. They also focussed an increasing amount of attention and innovative energy on finding new ways to produce more and better bicycles. This is the subject of the next chapter.

Notes

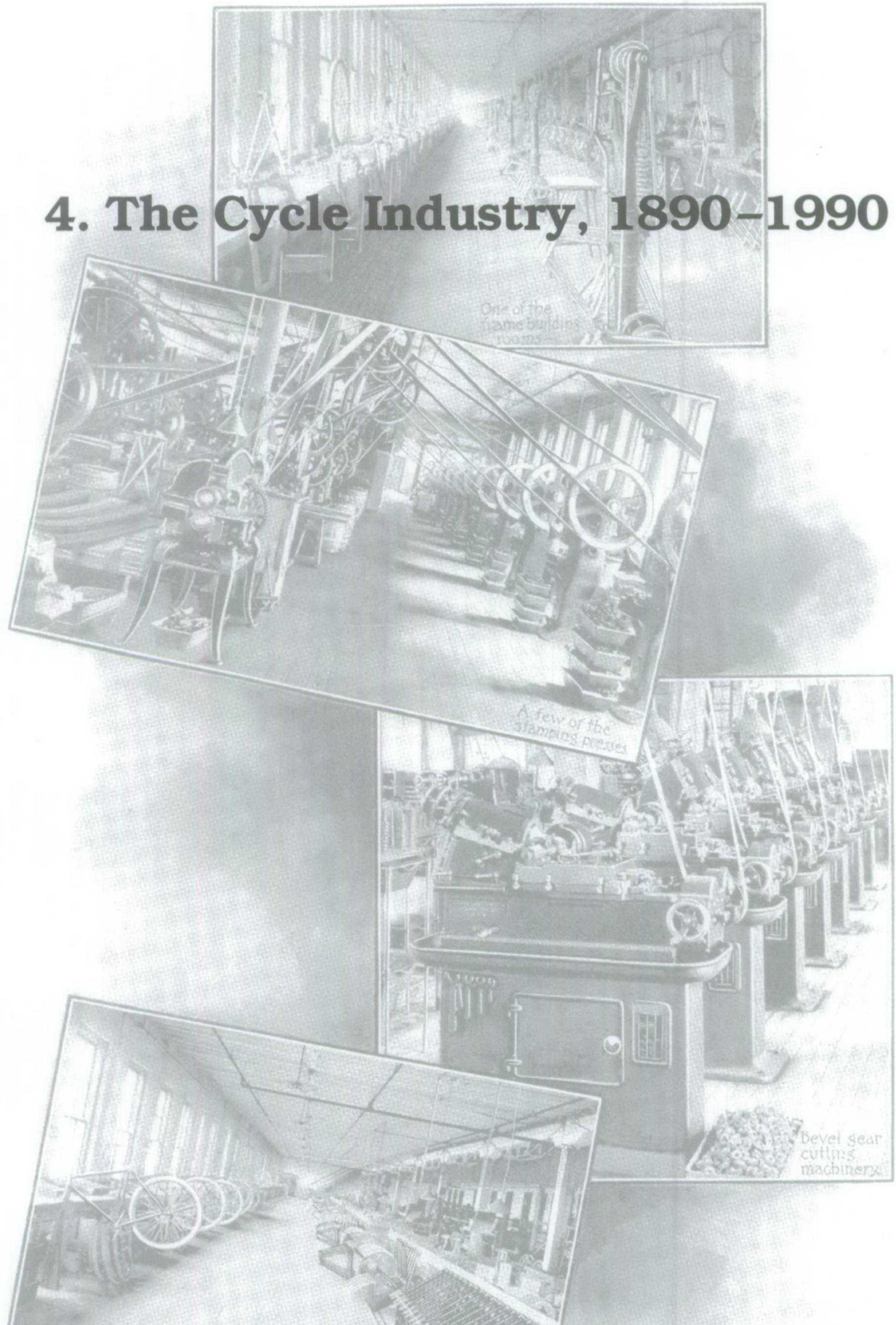
40. See, for example, *Allen's Digest of United States Patents, Digest of Cycles or Velocipedes with Attachments, Patented in the United States 1789-1892* and the British publication *Patents for Inventions, Abridgements to Specifications, Class 136, Velocipedes, Period — A.D. 1867-76* (London: Patent Office, 1904).
41. Though tricycles were not the only non-bicycle types of cycle made after 1875, they were by far the most common and absorbed most of the design and manufacturing energy of the industry. Most sources acknowledge that a few quadricycles were made and marketed during this period. Some were actually tricycles that could be converted to quadricycles for various purposes. The Otto dicycle is another, more unusual vehicle that historians frequently mention. Though much sought after by collectors, it had little or no commercial impact and was of minor significance to the development of cycle design. See Caunter, *Part I*, pp. 26, 31–32.
42. Henry Sturmey, *The Tricyclists' Indispensable Annual and Handbook, A Guide to the Pastime, & Complete Cyclopaedia on the Subject* (Coventry: Iliffe & Son, 1882) p. 5.
43. Wood, pp. 23–24; Caunter, *Part I*, p. 27; Caunter, *Part II*, p. 8; Sharp, p. 166; Clayton, p. 21; Ritchie, p. 104.
44. See Henry Sturmey, *Handbook*, 1882. In the second edition of this guide, Sturmey commented on the fact that the first edition had sold out after only three weeks, much to his great surprise and delight. In it he provides full descriptions "of upwards of 200 Machines" (see list of Contents, p. 3) along with a lot of other useful technical and practical information for the potential buyer and the committed rider. The fourth edition, Henry Sturmey, *The Tricyclists' Indispensable Annual and Handbook, A Guide to the Pastime, & Complete Cyclopaedia of the Subject* (Coventry: Iliffe & Son, 1884) describes and illustrates "some 350 different varieties of tricycle," (see list of Contents, p. 3) and Ritchie, pp. 114–115.
45. See, for example, any of the many photographs or drawings in Caunter, Clayton, Ritchie, Sharp, Wood or Sturmey.
46. Sturmey, *Handbook*, 1882, pp. 50–56.
47. Ritchie, p. 107; Caunter, *Part I*, p. 42; Clayton, p. 42; Wilson, p. 86; Sturmey, *Handbook*, 1882, pp. 52–53; Sturmey, *Handbook*, 1884, pp. 95–98.
48. Wood, pp. 24–25; Clayton, pp. 21–22; Ritchie, pp. 107–108; Wilson, p. 85; Sharp, pp. 169–170; Caunter, *Part I*, p. 27; Sturmey, *Handbook*, 1882, pp. 56–65; Sturmey, Handbook, 1884, pp. 104–118.
49. Sturmey, *Handbook*, 1882, pp. 65–69; Sturmey, *Handbook*, 1884, pp. 119–133; Caunter, *Part II*, p. 11.
50. Caunter, *Part I*, pp. 27–31; Caunter, *Part II*, pp. 8–16; Sturmey, *Handbook*, 1882, pp. 47–50; Sturmey, *Handbook*, 1884, pp. 83–91; Clayton, pp. 21–22; Ritchie, pp. 107, 115; Wood, pp. 24–26; Sharp, pp. 166–172.
51. Caunter, *Part II*, pp. 10, 12; Sturmey, *Handbook*, 1882, pp. 24–33; Sturmey, *Handbook*, 1884, pp. 34–43.
52. Sturmey, *Handbook*, 1882, pp. 69–73; Sturmey, *Handbook*, 1884, pp. 133–142.
53. Wilson, p. 83; Clayton, p. 21; Wood, p. 24; Sharp, pp. 166–167; Caunter, *Part I*, p. 27; Caunter, *Part II*, p. 9; Sturmey, *Handbook*, 1884, pp. 27–28. Though patented in 1874 and first used commercially in 1876, the tangential spoke was not mentioned in the second edition of Sturmey's guide to tricycles. Also, it seems that although Starley used this new system on his first commercial tricycle, he did not use it on several of the early successors to the Coventry Lever. See, for example, the detailed descriptions of Starley-designed vehicles in both the 1882 and 1884 Sturmey guides and in Caunter, *Part II*, pp. 8–16.
54. Wood, pp. 25–26; Ritchie, p. 108; Sturmey, *Handbook*, 1884, pp. 175–177. Sturmey's description is only of the British tricycle trade but this is where most of the innovation took place.
55. One disadvantage that plagued all tricycles was size. These vehicles were not easy to store or transport. Makers responded to this problem by building collapsible or folding machines. Though smaller, these were more complicated and costly and still took up more space and were more awkward to handle than a bicycle. Ritchie, pp. 115–116.
56. Ritchie, pp. 115–116; Clayton, p. 22; Wood, p. 26; Caunter, *Part II*, pp. 9, 11.
57. Wood, pp. 25–26; Caunter, *Part I*, pp. 28–30; Clayton, pp. 22–23.
58. Caunter, *Part I*, p. 31; Wood, pp. 26–27; Clayton, p. 23; Ritchie, pp. 115, 118–119.
59. Clayton, p. 18; Caunter, *Part II*, pp. 8–14; Caunter, *Part I*, pp. 17–20; Wood, pp. 17–18; Ritchie, pp. 125–129 Though usually one of the most reliable sources, Ritchie makes an error in his description of the Facile and Xtraordinary when he claims that they used smaller front wheels that were geared up. According to every other technical description I have read these bicycles were not geared up.
60. Clayton, pp. 18–20; Caunter, *Part II*, pp. 9–10, 14; Caunter, *Part I*, pp. 18–20; Wood, p. 18; Ritchie, pp. 127–129; Wilson, pp. 84–85 and Dunham, pp. 188–189.
61. The chronological divisions I have used here loosely follow those used by Caunter, Wood and Jones, among others.
62. The claim, repeated in various sources, is that Meyer, a French velocipede maker, built a rear wheel chain-driven bicycle following the design of André Guilmet in 1868. There is no concrete evidence of this vehicle's existence — no drawings or full technical descriptions. L. Baudry de Saunier, who did everything he could to establish the importance of France's contribution to the cycle industry, makes no mention of the vehicle in his detailed survey of cycling published in 1892, though he did accept and promote the Comte de Sivrac's priority over Drais. See L. Baudry de Saunier, *Histoire de la Locomotion Terrestre* (Paris: 1936). For an account of the Meyer story see Caunter, *Part I*, pp. 33–34.
63. Ritchie, pp. 122–124 (text, photos and captions); Jones, pp. 4–7; Wood, p. 19; Clayton, p. 23; Caunter, *Part I*, pp. 34–35; Caunter, *Part II*, pp. 7–10; Thomas Wiseman's letter and drawing appear in *The English Mechanic*, vol. IX, no. 225 (July 16, 1869) p. 386. He describes his bicycle as "something like the 'Kilmarnock Bicycle'," a reference to the McCall vehicle mentioned in a letter to *The English Mechanic*, vol. IX, no. 200 (June 11, 1869) p. 271. A description and drawing of Frederick Shearing's machine appeared in *The English Mechanic*, vol. IX, no. 227 (June 30, 1869) p. 424 under the title "The 'Norfolk' Bicycle."
64. In 1876, Lawson patented and built a bicycle driven by treadles connected to the rear wheel. It looked a lot like McCall's two-wheeler, though much more finely made. Lawson also claimed to have designed an even earlier version of a rear-driven bicycle using a continuous chain and same-sized wheels. Though this story is often repeated as fact, the only evidence that the cycle ever existed is Lawson's own account of the vehicle and

its use, given to the Science Museum after the development of the safety. There are far too many unanswered questions about this bicycle for the story to be considered plausible. Why, for example, was this design abandoned in favour of the much less sophisticated treadle-driven one? Why was it not patented as the other Lawson vehicles were? How did the experience with this design influence the development of the Bicyclette? For a description of a drawing based on the information Lawson gave the Science Museum see Caunter, *Part II*, p. 7.

65. Jones, pp. 6–7 (photo and caption); Wood, pp. 19–20; Clayton, pp. 23–24 (photos and captions); Ritchie, pp. 124–125 (photos and captions); Caunter, *Part I*, p. 34; Caunter, *Part II*, pp. 10–11.
66. Jones, p. 7 (photo and caption); Wood, p. 20; Ritchie, p. 129 (photos and captions); Clayton, pp. 23–24 (centre photo and caption); Caunter, *Part I*, p. 35 and photo on Plate VII; Caunter, *Part II*, pp. 13–14.
67. Ritchie, pp. 129–130; Clayton, pp. 23–25; Caunter, *Part I*, pp. 34–35; Jones, pp. 6–8 including photos and captions; Caunter, *Part II*, pp. 10, 13–15; Wood, pp. 20–21.
68. Wood, p. 21.
69. Wood, p. 21; Caunter, *Part I*, pp. 35–36; Clayton, p. 25 (text and top photo caption); Jones, pp. 8 (centre photo caption), 10; Ritchie, pp. 130–132 (photo and caption). See S.S. Wilson, p. 85 for a discussion of the stresses and strains placed on bicycle frames.
70. Jones, p. 11 (centre and bottom photo captions); Clayton, p. 25 (bottom photo caption); Caunter, *Part II*, pp. 18–19, 21; Ritchie, p. 155.
71. Jones, p. 24 (text and photo caption); Wood, p. 33; Caunter, *Part I*, p. 45; Ritchie, p. 166, p. 170 (photo); S.S. Wilson, p. 85. On this same page Wilson also provides a useful explanation of the principles of tubular construction and triangulation.
72. For examples of actual gear ratios on pre-1900 safeties see Caunter, *Part II*, pp. 14–20. For a thorough technical discussion of the principles behind modern gearing systems and the "Gear Inch Chart" see Chapter 16 of Ray Wolf, et al.
73. Wood, p. 33; Jones, p. 22; Caunter, *Part I*, pp. 37–38; Caunter, *Part II*, pp. 19–22, 33.
74. Ritchie, p. 140; Caunter, *Part II*, p. 33; Caunter, *Part I*, p. 37; S.S. Wilson, p. 90.
75. Whitt and Wilson, pp. 131–133; Sharp, pp. 295–297; Wood, p. 22; Clayton, pp. 25–26; Ritchie, p. 131; Jones, p. 10; Caunter, *Part I*, p. 37 (photo Plate X); Caunter, *Part II*, p. 19.
76. Dunlop's 1888 patent was invalidated in 1890 when Thomson's priority was established. By this time, though, the company was well established. Eric Tompkins, *The History of the Pneumatic Tyre* (Suffolk: Eastland Press, 1981), pp. 12–13. The pneumatic tire was also developed independently in France by André and Edouard Michelin in 1892. Caunter, *Part I*, p. 39.
77. Eric Tompkins, pp. 1–20; Caunter, *Part I*, p. 39; Wood, p. 22; Ritchie, pp. 131–132; Wilson, p. 87.
78. See subsection on tricycles for a description of tangent spokes.
79. Ritchie, p. 166.
80. I am defining design in a narrow sense here. I discuss changes that were intended to enhance or extend the capabilities of the safety bicycle, but not stylistic ones, like the motorbike or chopper designs, that only enhanced the looks and popular appeal of cycles.
81. Whitt and Wilson, pp. 22–26 and Jay Pridmore and Jim Hurd, *The American Bicycle* (Osceola, WI: Motorbooks International Publishers and Wholesalers, 1995) pp. 178–179. See also Caunter, *Part I*, p. 54.
82. Pridmore and Hurd, pp. 179–185; Whitt and Wilson, p. 26 and James McGurn, *On Your Bicycle* (New York: Facts on File Publications, 1987) pp. 168–169.
83. Caunter, *Part I*, pp. 46, 54. Bianchi also produced a folding bike for the Italian army in 1909. Antonio Pinghelli for ANCMA, "Italy," *American Bicyclist and Motorcyclist*, 100th Anniversary Issue, vol. 100, no. 12 (December 1979) p. 293. According to Pridmore, various US makers revived the idea of the folding bicycle during World War II but little or nothing came of it Pridmore, p. 128.
84. Whitt and Wilson, pp. 269–270; Derek Roberts, *The Invention of Bicycles and Motorcycles* (London: Usborne Publishing Limited, 1975) p. 32 and Alan Coté, "1996 Buyers' Guide," p. 36. The bottom half of the page assesses travel bikes, the most expensive of which is priced at US$5500. For a Canadian version of the folding bicycles, see Canada Cycle and Motor Company Limited, *CCM*, 1974, p. 17. CCM's bike was called the Fold-up and was a three-speed with coaster and hand brakes.
85. Whitt and Wilson, p. 134; McGurn, pp. 165–166; Ritchie, p. 167; Roberts, p. 32 and Alan Coté, p. 36.
86. Pridmore and Hurd, pp. 164–168 and McGurn, p. 169. For an indication of how popular and lucrative a sport BMX had become by 1979, look at some of the advertisements in *American Bicyclist and Motorcyclist* (1979) pp. 10, 64, 123, 273, 311, 322–323. On page 261 there are also some dates relating to BMX and its rise to popularity.
87. These building processes are dealt with in some detail in the next chapter.
88. Pridmore and Hurd, pp. 168–178; *Bicycling* Magazine's, *All-Terrain Bikes* (Emmaus, Pennsylvania: Rodale Press, 1985) pp. 4–25 and McGurn, pp. 169–171.
89. Pridmore and Hurd, pp. 175–178 and *Bicycling* magazine's, *All-Terrain Bikes*, p. 27.
90. *Bicycling* magazine's, *All-Terrain Bikes*, pp. 41–45; Pridmore, p. 178, (see also p. 179 photo and caption) and telephone interviews with Peter Haggerty and Doug Gableman of the Bike Stop, Ottawa, Ontario, conducted between January and September, 1996. The Bike Stop makes its winter commuter by taking a basic frame and adding a seven-speed Sachs coaster hub, sealed bottom bracket and a partial chain guard to it. According the Haggerty, the store considered using a fully enclosed chain system similar to those that were once standard equipment on British bicycles, but found that they did not fit properly with the frame and other components. Perhaps if demand for this type of cycle grows, parts makers will begin to produce components specifically to meet these needs.
91. Caunter, *Part I*, pp. 40–41, 47–48, 57–58 and *Part II*, pp. 40–41; Whitt and Wilson, pp. 21–22 and Roberts, p. 30.
92. Interviews with Peter Haggerty and Doug Gableman. According to Gableman, Sachs, a German component maker, now offers a very impressive 12-speed coaster hub, which the Bike Stop plans to use on it latest commuter model.
93. Wolf, et al., pp. 135–137. See *Bicycle Guide* (October, 1996) for an indication of how common combined or integrated shift/brake levers are becoming on high-performance cycles. Almost all the cycles reviewed in this issue seem to sport this latest gear shift technology.
94. Wolf, et al., pp. 135–137; *Bicycling* magazine's, *All-Terrain Bikes*, p. 40 and Bridgestone Cycle (USA), Inc., *The 1992 Bridgestone Bicycle Catalogue*, pp. 8–9. The Bridgestone people admit to being "extremists" in their anti-index shifting stand but I doubt they are alone.

95. Whitt and Wilson, pp. 191–193; Wolf, et al., p. 199; Caunter, *Part I*, pp. 49–50 and *Part II*, pp. 55–56 and Marcus Horeak, "Cactus Cup Spy Photos," *Pedal*, vol. 10, no. 3, (May 1996) p. 8.
96. Wolf, et al., pp. 200–201; Caunter, *Part II*, pp. 56–57 and Whitt and Wilson, p. 191.
97. Sean Scott, "What Goes Around...Comes Around, Aero Wheels," *Pedal*, vol. 10, no. 4 (June 1996) pp. 51–53. This article describes and reviews several of the latest (and extremely expensive) aerodynamic wheels. Caunter, *Part I*, p. 41. I have taken the lack of discussion of different wheel types in this 1958 publication as an indication that few notable changes took place before the 1960s. Other sources mention wheels and hubs but do not discuss the evolution of different types include: Wolf, et al., pp. 29, 68–70 and Whitt and Wilson, p. 257.
98. Bridgestone Cycle (USA) Inc., 1992, p. 10. For descriptions and photos of cycles with front and full suspension, see Sean Scott, "A Class Act," and Kevin Mackinnon, "No Compromises," *Pedal*, vol. 10, no. 3 (May 1996) pp. 54, 57.

4. The Cycle Industry, 1890–1990



4. The Cycle Industry, 1890–1990

The safety bicycle boom of the 1890s and its immediate aftermath brought major changes to the way bicycles were built. With the basic diamond-frame design firmly established and demand increasing by leaps and bounds, manufacturers became increasingly concerned with technological innovations in the factory that would streamline production, augment output and reduce costs. The British industry, because it was the first, set the standards for production, and makers in other nations initially turned to Britain to learn how to make quality cycles. American manufacturers, pressured by higher labour costs, high demand and very intense domestic competition, were forced to make significant changes in the production process. These soon spread to other countries like Britain, especially after the boom ended in the late 1890s. There, the companies that survived the collapse found that upgrading production technology could help keep costs down without sacrificing quality thus enabling them to compete for both domestic and international markets.

This chapter is divided into three sections. The first deals primarily with the British cycle industry as it emerged in the late 19th century. It outlines the basic materials and processes used to make cycles in Britain, identifies some of the problem areas and places the British industry in an international context. The second section focusses on the rise of American cycle manufacturers, the new approach to production that they developed and the way that approach influenced makers elsewhere. The final section highlights some of the major production developments in the cycle industry since 1900.

Building Cycles the British Way

At the time that the safety bicycle was introduced, Britain led the world in the design and manufacture of cycles, parts and the machine tools needed to make them.[99] That lead was reinforced between 1885 and the early 1890s by the efforts of British builders to refine and standardize the basic diamond frame and its components including, of course, the pneumatic tire. The British approach to production therefore dominated the industry in the early years of the safety craze. It was characterized by several basic principles: standardization of overall design and parts making interchangeability possible, use of high-quality materials and skilled production workers, development of specialized tools and equipment and commitment to quality control. With the exception of standardization and interchangeability, these principles had, for the most part, governed the manufacture of British high-wheel cycles and tricycles in the 1870s and 1880s. The result was a high-grade, although expensive, product respected the world over for quality of design, materials and construction.

Making safety bicycles in the 1890s was a labour intensive process. The safety was much more complicated than the high-wheel bicycle. On average, it consisted of about 300 major components made up of some 1500 individual parts. Most ordinaries had far fewer than 100. The safety chain alone had over 500 pieces and there were usually around 250 balls contained in a safety's numerous bearings. Then there were the sprockets or chainwheels and an additional axle and bearings and its housing, the bottom bracket or crank hanger, none of which were found on the ordinary. Finally, the safety frame needed double the amount of tubing and required many more and much stronger joints to support its elongated form.[100]

As a consequence of the relative complexity of the safety, a major turn-of-the-century cycle works[101] generally included a large and well-organized supplies or stores area; a machine and tool shop; milling and drilling rooms; blacksmith, forge, and brazing shops; a series of machining stations; wheel and frame assembly areas; and enamelling, plating and polishing facilities. To support these functions, factories had to have large supplies of power, heat and water, as well as administrative offices and some basic services for their employees. Like most manufacturers, cycle makers also had to connect their factories to established transportation routes in order to insure a steady flow of incoming materials and outgoing products. Even more important, they had to staff a large number and wide variety of jobs — from highly skilled machinists to unskilled sorters and packers — in the most cost effective way, and organize these employees and their work in such a way that the factory functioned as a cohesive and productive enterprise.

Early safety bicycles, with the exception of the tires and saddles, were made almost entirely of steel. Frames, including the steering column, handlebars, front fork and seat and chain stays were generally made of cold-drawn, seamless, steel tubing of different gauges and diameters. Most

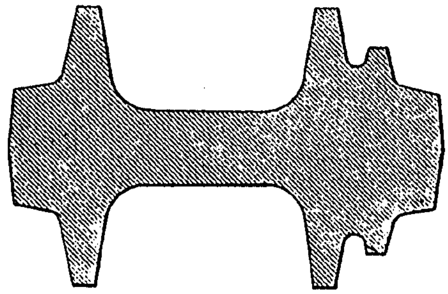


Fig. 1 —Hub Forging.

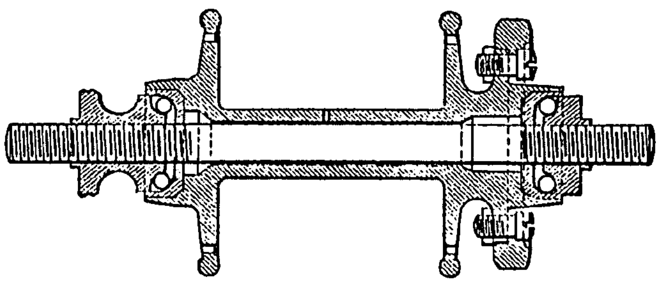


Fig 2.—Hub Finished.

Diagram showing a wheel hub in rough and then final form, complete with axle and ball bearings. To achieve the first step, solid steel blanks had to be heated and forged into shape. Then, skilled machinists drilled, bored and lathed away much of the original steel until the final product met exacting standards of precision, lightness and durability. Source: The Iron Age *June 2, 1892, p. 1070)*

manufacturers made wheel rims out of rolled sheet steel (though North American companies also used wood), and joint brackets or lugs, cranks, chainwheels, axles, bearings and hubs of forged steel. Drawn-steel rods were used to make spokes for the wheels and the hundreds of pieces used to build the chain were cut from solid steel, as were the countless screws, nuts, bolts, rivets and other bits of hardware. Some makers used cast, malleable iron for the lugs, particularly the complex bottom bracket.[102]

Manufacturers had to assemble a wide array of machines and other equipment to turn the steel tubing, sheet steel and solid bars, rods and wire into the many different parts needed to make a bicycle. Some of the components formed from solid steel, the hubs for example, were complicated and required several operations to complete. The rough shape of the hub was created either by simple lathing of a round steel bar or by drop forging, that is, stamping a heated piece of steel between weighted dies several times. Once this was done, workers used finishing lathes, milling machines and drills to give the hub its precise shape, including hollowing out the centre to take the axle, shaping and smoothing recesses in the ends for the ball bearings and drilling or boring spoke holes in the flanges. The lugs (seat, top and bottom tubes), brackets (steering and bottom), crowns (front fork) and bridges (rear fork and stays) used to join the sections of tube that made up the frame, though simpler shapes, also required both forging or casting and machining. So did the fork and stay ends — the places where the frame met and was connected to the hubs. Of all these pieces, the bottom bracket was, by all accounts, "the most difficult forging made," because it had to be very strong, because of its irregular shape (it had to accommodate four tube ends as well as the crank axle) and because most of the metal had to be bored out to make it hollow and light. This is why some makers chose to cast the bracket out of molten iron instead.[103]

The axles or spindles on which the wheels, pedals and sprockets or chain-wheels turned as well as the sprockets themselves were forged and machined from solid steel, but workers used a different set of machines to rough out and to finish these pieces. The chainwheels in particular required a lot of cutting. Workers used a stamping machine or hammer to cut the excess steel out of the centre of the wheel and a milling cutter to make the teeth to catch the chain. In all this work, a high level of precision, insured by constant measurement with special gauges, was demanded both of the operators and the tools they used.

Other specialized equipment was needed to make the chain and wheels and to join all the pieces together, clean and finish them. Workers used a gang saw to make the chain blanks and then stamped out the links. A drill, punch and riveting machine were used to put them together. Wheel makers had to have an apparatus that could roll steel into a U shaped rim, form it into a circle and then weld or braze the ends into place. Rims also had to be drilled to take the spoke nipples. Other workers cut the spokes and stamped or machined threads into them. Wheel assembly was mainly a manual task but the people who did it depended on special jigs or frames to hold the rim and hub in place while they added and adjusted the spokes one by one.

To make the lengths of steel tube and lugs into a solid frame required steel presses, drilling equipment, a variety of jigs and blacksmith and brazing stations. The backstay tubes (connecting the bottom bracket to the rear hub) had to be heated and bent slightly to allow enough clearance for the back wheel. This was done in a screw press. A smith working with hand tools, an anvil and a wire pattern shaped the handlebars from larger gauge tubing that was heated to make it malleable. For the main frame, workers following templates drilled holes in the lugs and pre-cut tube sections and then joined the sections using pegs to hold them in place. Brazers then heated the tube using a gas flame, poured a mixture of borax (flux) and brass (spelter) over the tubes and when it liquefied, guided it into and all around the joints. The process was repeated on every lug, including the complicated bottom bracket with its four-tube join, and also on the fork and stay ends. Like the precision machining that preceded it, brazing required a highly skilled worker; overheating weakened the steel and underheating resulted in imperfect joints. An experienced brazer knew just how much heat to apply. Most safety bicycles had about 18 brazed connections.[104]

After brazing, the frames had to be filed and sand-blasted before receiving multiple coats of enamel (usually 3 to 4), each baked on in large ovens. They were then polished and trued, that is measured for straightness and straightened if necessary. Each of these operations involved machinery either designed or adapted for use in bicycle factories. Wheels also had to be trued and adjusted using special tools. Some companies also had special equipment to check the strength and operation of chains. Parts such as cranks and chainwheels were often nickel plated so many factories had electrochemical plating facilities.

Once the subassembly and inspection of major components was completed, the main frame, front fork, handlebars, wheels, driving gear and seat were sent to the final assembly area. Here, workers put them together using purpose-built jigs to hold the various pieces while they inserted, adjusted and tightened the last screws and bolts. The bicycles were then wrapped — in Britain, often by women — packed, sorted and prepared for shipment to various retail outlets and individual clients.

Despite the obvious complexities of bicycle making, in the early 1890s, hundreds of companies believed they could profit by trying to supply the growing demand for the vehicles. Many manufacturing sectors were hit hard by "the general downward movement of prices and profits" that had taken place since 1873 and the years between 1893 and 1896 were particularly bad for certain key industries.[105] But the depression had no appreciable impact on the bicycle business. By 1895, it was booming, stimulating "a cycle company promotion mania, large investment expenditures by cycle-manufacturing firms, and an inflow of new enterprises into the industry, some of them coming from technologically associated trades on sewing-machine and arms and ammunition making."[106] In just four years, the number of makers of complete cycles in four of the leading centres of cycle manufacturing had risen to 774 from the 1893 total of 199. There were many more companies making parts that, because of the emphasis placed on standardization and interchangeability in the industry, could be sold to almost any maker or assembly operation. As well, British machine-tool companies took advantage of industry expansion to make and market a whole range of specialized tools needed to make and assemble parts.

In Europe and North America, the situation was similar. By the mid-90s, various small arms and sewing machine companies had joined the handful of existing cycle makers in Germany and France. Already well aware of "the absolute necessity of perfect accuracy and interchangeability" in the manufacture of parts, these firms also had the foresight to purchase the very latest and best machine tools from American, English, German and French makers. The number of American cycle manufacturers also grew dramatically. In 1890 there were 27 firms listed as producing bicycles in the US. Within six years, the industry had expanded to include 250 factories and by 1897 there were more than 500, over half of which made in excess of 500 cycles per year.[107] Many American makers, like their European counterparts, came from sewing machine and armoury operations and some carried this business on while producing cycles. Others came from areas like furniture, clock, toy, carriage and wagon manufacturing. In the mid-west, farm-implement makers, who were especially hard hit by the depression, also entered the bicycle business bringing a different set of skills with them.[108]

Initially, British makers of bicycles, parts and the machine tools needed to produce them were able to take advantage of their substantial head start in knowledge, skill and plant capacity to dominate the industry. Most manufacturers in Europe and North America could not produce enough cycles to meet domestic demand and thus imported large numbers of complete vehicles from Britain. Those they did build domestically often included a significant proportion of British-made parts, especially steel tubing. As a result, the value of British exports of cycles and parts more than doubled from £915 856 in 1892 to £1 855 614 in 1896.[109]

Britain's dominance of the world cycle market did not last. Demand increased so rapidly in the US, Canada, Australia and Western Europe that British parts and cycle companies simply could not keep up. As early as 1891, some observers reported an acute shortage of steel tubing, a critical component that, up to this time, came almost exclusively from Britain's highly developed steel industry.[110] Individuals involved in the export business also complained that, with demand far exceeding supply, British makers were giving preference to home orders at the expense of foreign ones, and were using what some considered an unfair pricing system. These shortcomings, along with the introduction of higher tariffs on imported cycles and parts in both Europe and North America, fed the already expanding domestic industries there. It encouraged many firms to make more of their own parts, or at least find more reliable suppliers, and to increase production any way they could to meet demand.[111]

These trends were particularly pronounced in the US. Sheltered by the *McKinley Act*-tariffs after 1890, cycle and parts makers and suppliers set out to feed Americans' seemingly insatiable appetite for safety bicycles by extending the capabilities of their operations and expanding production. Some big firms, like Pope's Columbia and Hartford companies, began making their own seamless steel tubing. Other makers turned to one of the growing number of American suppliers of this essential commodity, thus breaking the stranglehold that British tube producers had over the US market. The machine-tool industry also began to cater more to the cycle trade, working with makers to design appropriate equipment for forging, machining, drilling, lathing, assembling and finishing the many precision parts of a safety bicycle. The product of these parts and processes was "a distinctive design of bicycle well able to compete with the British makes in price," and apparently well suited to the tastes of many American cyclists. By 1895, US imports of British cycles and parts had fallen from a value of £255 466 in 1892 to £162 702. Two years later they stood at £24 308.[112]

In addition to supplying a burgeoning domestic market, the American cycle industry also began to establish an international presence. When British exports to France and Germany declined in the mid-1890s, US companies picked up some of the business not taken over by domestic producers. More importantly, they began to sell their products to Britain itself, which took 33.9% of total US cycle exports in 1896-97. By comparison, Germany took 14.6%, Canada 10.5%, Australasia 9.9% and France 3.7%. The total value of US exports that year was $7 005 323, a 269.1% increase over the previous fiscal year. By 1898, American companies accounted for 37.9% of world exports of cycles and parts, while Britain's share of the market fell to 25.7%.[113]

The Production Revolution

Many factors contributed to this dramatic shift in the relative positions of the British and American industries. At the time, some British observers blamed unfair trading practices. American makers, they said, used protective tariffs to build an industry and then began flooding the market with their cheap, poorly made products. There is no doubt that having a large, protected market to serve stimulated massive increases in cycle production in the US. But the Americans were certainly not alone in adopting this strategy to protect their new industries. Many European countries (not to mention Canada) pursued a similar approach in an attempt to catch up with Britain's advanced level of industrial development. However, the suggestion that American makers in the mid-1890s were dumping cycles and parts on the international market at prices below the domestic level is not very convincing. As one economic historian pointed out, demand for cycles exceeded supply at that time and any profit-motivated maker would have been inclined to set prices well *above* market value. The fact that American prices were lower than British did, to a certain extent, reflect the lower quality of workmanship and material found in many US products. This was, however, by no means true of the many higher-grade cycles available from US makers such as Overman, Pope, and Gormully and Jeffery. Despite the attention these builders lavished on their vehicles,[114] they were still cheaper than comparable British makes.[115]

To understand the rise of the US cycle industry, we have to look beyond tariffs and quality of output and focus on the overall approach of American makers to cycle production. Though this industry, like many others, originated in Britain, competitors in other countries were able to buy and soon learned to use, adapt and improve the basic tools needed to make safety bicycles.[116] Protective tariffs definitely helped them to establish domestic manufacturing capabilities but those capabilities were then shaped — enhanced or sometimes undermined — by the particular domestic economic circumstances that prevailed at the time. In the late 19th century, US manufacturers were faced with one overwhelming fact that affected their approach to production: labour was in short supply and skilled labour was especially scarce. Manufacturers, therefore, had to pay higher wages than their British and European competitors. This forced them to find ways to reduce the number of workers needed to make cycles, to get more from the workers they did employ and to identify savings in other areas of production. At the same time, the high cost of labour meant that many more people in the US had "relatively high average incomes," which meant the domestic market for consumer goods was potentially much bigger than in Britain or Europe, where the tendency was to produce "elaborate and expensive goods" for the few who could afford them. This encouraged American cycle makers to offer a range of products, some of which were inexpensive enough to be within reach of the masses. Selling in quantity, they believed, would more than compensate for lower prices and profit margins.[117] Thus, while Pope charged as much as $100 for a Columbia in 1896, his Hartford cycles could be bought for as little as $50. Western Wheel Works offered products that ranged in price from $40 to $75 in its 1896 catalogue. One of the most expensive US models available around this time seems to have been Overman's Victor Racer at $150. By comparison, the Raleigh Cycle Company advertised prices of between $150 and $200 in its 1893 US catalogue.[118]

To make more cycles, more cost effectively than their competitors at home and abroad, American manufacturers adopted three main strategies. First, they automated as many manual tasks as they could. Second, they paid great attention to the organization of work within their factories, particularly complex, labour-intensive jobs, and tried to devise better ways of getting these jobs done, a process that eventually became known as "scientific management."[119] Finally, they developed production methods aimed at reducing the cost of materials and machine time.

Beginning in the early 1890s, ongoing and increasing automation seems to have been a constant feature of the American cycle industry. Companies routinely boasted in their trade literature about the marvellous automatic machines they had developed and were applying to the job, making their parts stronger or lighter or more precise or better looking or all of the above. While these things may all have been true, the most important, though seldom mentioned, benefit of automation was cost reduction. Automatic machines could either replace expensive workers (partly or entirely) or enable them to produce more. At Western Wheel Works in Chicago, the machine room was filled with more than 175 separate machines including ganged drill presses (4–6 to a gang) that could be operated by only one man. Their "automatic machine room" (which was separate from the "machine room") contained all the equipment needed to make "[c]ones, spoke nipples, nuts, screws, chain rivets, chain screws, saddle post rails and bolts, etc.," yet was operated by only a foreman and four assistants. Both Western and the Pope-owned companies, Columbia and Hartford, had automatic chain-making systems to reduce the time and effort required to make and assemble the 500 tiny components of each chain. The sidepieces, centre blocks and rivets were cut out of different types of steel by automatic machines and after being gauged, tested, drilled and tempered were put together and riveted, also automatically. Both companies also tested the fully assembled product to insure that it was strong and ran smoothly.[120]

Automation alone, however, cannot fully explain the success of the US industry. While some major British companies like Humber prided themselves on not using automatic machinery,[121] many smaller and some large firms were clearly following the American example. In 1895, Leechman described a British cycle works, which included, among other things, machines for drilling spoke holes in rims and hubs, screw machines that needed only to be fed material by workers, a milling cutter that worked on "about a dozen chain wheels at once," and a spoke-threading machine simple enough to be operated by a boy.[122] An article published in the same year in the British periodical *Cycle Manufacturer* named some specific instances of firms buying and using the most advanced forms of American tools where "one workman is able to attend to two or three machines instead of being confined just to one tool as in days gone by."[123]

There were definite limits to what tasks could be accomplished effectively by automatic machinery. Pope's "automatic" chain-making system required two manual operations at the end to complete the chain: the rivet ends had to be spun down individually and the chain had to be straightened by hammering. Gormully and Jeffery developed their own automatic rim-polishing machine, yet even with six of these working ten hours a day, the output was only 50 rims.[124] Moreover, some of the most crucial and time- and labour-consuming tasks — assembly and finishing — did not lend themselves to automation. Brazing the frame together and building wheels demanded the careful and constant attention of skilled workers working for the most part with jigs and simple hand tools. Polishing, enamelling and plating required repetitive operations with long waiting periods in between.

Since the automation of devices and processes could not solve these troublesome production problems, many US makers looked for ways to organize work in these (and all other) areas more efficiently. One commonly used approach was to divide complicated operations into a series of smaller, less complicated ones.[125] Pope's machining department was made up of several subdepartments, each responsible for a major component like the crank assembly or the hubs. Wheel assembly had its own separate department consisting of four basic stages — attaching the spokes to the hub and rim, truing, soldering and, finally, grinding the spoke ends down. Frame brazing was also carefully organized. Each brazer specialized in one of the 30 joints that had to be secured.

American companies, especially those with large factories, also had to pay attention to material flows. To be effective, Pope's 30 brazers had to be well supplied with frames to work on, while completed ones had to be removed promptly; the workers who transferred them to the next station had to file off the excess spelter while it was still hot to minimize later finishing work. Since each joint took at most 90 seconds, the flow of people and materials had to be precisely coordinated.[126] Similarly, at the Western Wheel Works factory in Chicago, where it took 27 successive pressing operations to make one crank hanger bracket, a small army of pressmen sat at their benches while runners kept them supplied with parts and removed others to the annealing room.[127]

Another method commonly used by cycle makers in the US to increase efficiency was piecework. Workers in most factories were paid not by the hour or the day but by how many "pieces" — parts or processes — they worked on or completed in a set period of time. According to owners, this method of payment gave workers an incentive to produce more as opposed to just putting in their time. Even manufacturers like Pope, who prided themselves on the high quality of their products, used this system of payment for most workers. At the Columbia and Hartford works, however, brazers were paid by the day to make sure that the proper care was taken in carrying out this critical operation.[128]

Like automation, though, scientific management could only do so much to improve productivity in cycle factories. The Hartford Cycle Company, for example, "often fell behind on its frame filing,"[129] and, in general, many of the efforts made at improving efficiency at Pope's factories were viewed by the managers as unsuccessful. At the Stearns Manufacturing Company, a much smaller maker than Pope or Western, 250 men were employed to assemble and braze 5000 frames per year in 1896.[130] To increase output would probably have required additional staff and equipment, which was essentially the British solution to production bottlenecks.[131]

To make up for the costs of processes that could not be automated or managed more efficiently, American manufacturers looked for savings in materials and machine time. In 1895, British observers at Pope's factories "reported that their tube-annealing techniques were superior to those employed in Britain, and that their brazing systems were cleaner and weakened the cycle tubing less."

Liquid brazing also seems to have been an American development. An anti-flux substance was developed by the Joseph Dixon Crucible Company that prevented spelter from sticking to the frame where it was not needed. Thus the whole pre-assembled and pegged frame could be dipped into molten spelter and all the joints brazed at once instead of one at a time. This process reduced both the amount spelter used and the labour and time required to work it into the joint and clean it off the rest of the frame.[132]

Even more radical than Pope's method of working with tubing were the metal-working techniques adopted and promoted by the Western Wheel Works. Pope and many other cycle companies that followed what has been called the New England-armoury tradition of metal work were firm believers in working from solid pieces of steel, preferably forged, and removing metal from them with machine tools until they took on the precise shape required for lugs, hubs, cranks and other components.[133] The managers of Western, on the other hand, used sheet-steel stampings or pressings in many of their products. They claimed to have originated the application of this method to bicycle construction in 1890 when they produced a stamped-bearing bushing or cup. By 1895, Western Wheel Works was using "stamped connections, such as the upper and lower head lugs, saddle post clamp, rear fork end connections, reinforcements" as well as a unique stamped sprocket or chainwheel. Two years later, they introduced what their catalogue called a "work of art" — their stamped-steel bottom bracket, which took 27 "different operations" to make and which, when finished, was "without a seam or joint." They also made their hubs from steel tubing and stampings, brazed together and finished in a lathe.[134]

After seven years of "experimenting, testing, and perfecting this method of construction," Western believed it had developed "the most advanced and perfect forms" and even went so far as to argue that its sheet-steel components were "superior in every way to forgings."[135] Though it is unlikely that these pressed components were physically superior to forgings,[136] they almost certainly were superior from a production point of view. First, they used much less steel than those worked from solid where up to 80% of the metal was machined out and discarded.[137] And, even with the many pressings required to make complex pieces like the crank bracket, machine time was probably significantly less than that required to lathe, bore, drill and finish a forged piece. Finally, stamped components were not as heavy as most forgings or castings and this allowed Western more flexibility in design. They could offer lighter models, add special features or just focus less attention on reducing weight elsewhere in their bicycles.

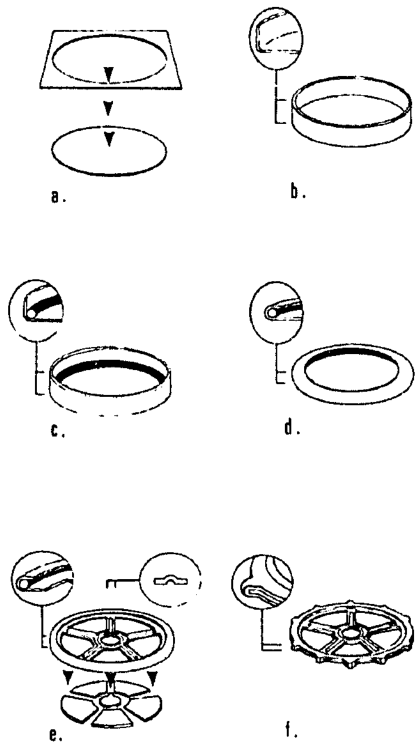


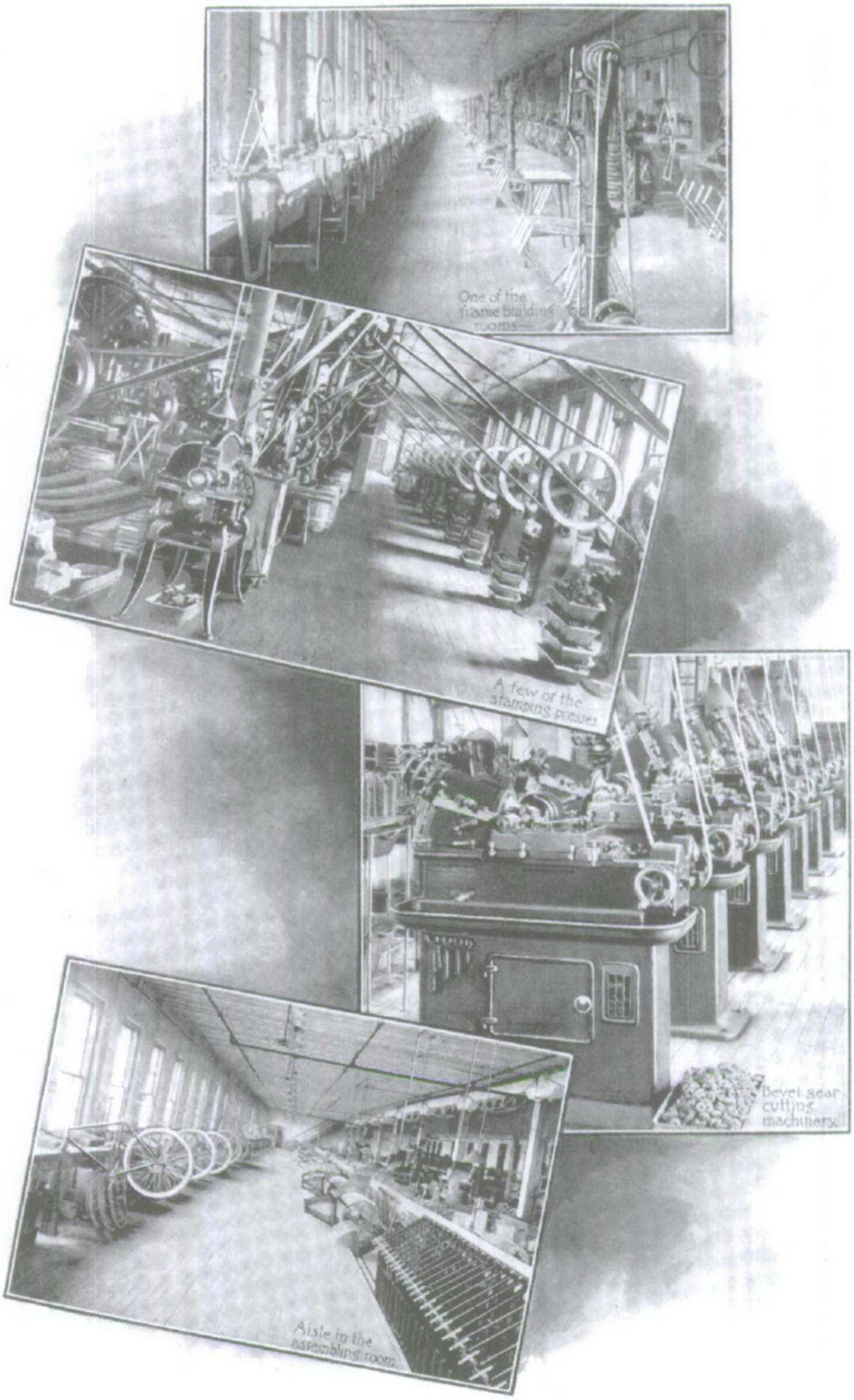
Diagram showing how a sprocket or chainwheel was pressed from sheet steel in the 1890s. These techniques were adopted by Western Wheel Works to limit the amount of time-consuming forging and machining required to make bicycles. (Source: David A. Hounshell, From the American System to Mass Production, *Baltimore, MD: The Johns Hopkins University Press, 1984, p. 213)*

Combined with "a large number of automatic machines capable of finishing over 325,000 small parts daily," and an elaborate supply system that kept every press operator busy with work, Western's sheet-steel manufacturing methods enabled them "to complete 1000 bicycles in a working day of ten hours." By 1896, they were the largest cycle manufacturer in the US, outproducing Pope by some 10 000 vehicles. Meanwhile, other American makers, including Pope, tried to maintain or increase their shares of the market by continuing to automate, reorganize and innovate, further augmenting the industry's already enormous productive capacity. In 1895, Pope and Western Wheel Works claimed to have made and sold nearly 120 000 bicycles. By 1898, Western was making 100 000 by itself.[138] Total US output at its height in the mid-1890s was estimated at 1 200 000 units.[139] By comparison, Raleigh, which claimed to be the largest British maker, produced 30 000 per year in 1896. Humber boasted of being able to produce a complete cycle every 40 seconds, but it took several factories, each with a separate set of tools and equipment, and some 7000 employees to accomplish this. Western had just one large works and a staff of 2500 and still made more cycles.[140]

Western's success forced other cycle makers on both sides of the Atlantic to reconsider their production techniques. In the US, by 1895, it was becoming clear that advanced stamping techniques could produce strong, reliable and lightweight lugs, crank hangers and hubs. Moreover, the cost savings could be significant. Even Pope, who had long criticized and dismissed sheet-steel work as inferior, began to adopt pressed components. His factories first began to use pressed lugs, but soon, Columbias and Hartfords had pressed-steel bottom brackets and "barrel hubs" formed from heavy steel tubing and press work. Other companies followed Pope's lead and the process was accelerated by the dramatic decline in domestic bicycle demand and the resulting price cuts that began late in 1897. Makers were forced to entertain the notion that, while stampings might not be as strong as forgings or machined parts, they were clearly strong enough for the purpose of building bicycles.[141]

Faced with intensifying American competition after the boom ended and "the desertion of wealthy British customers as cycling went out of society fashion," British cycle makers also had to reassess their longstanding "high-price/high quality policy." As a result of these pressures, a few firms, led by Rudge-Whitworth, started to implement cost- and price-cutting measures. They reluctantly reduced the number and quality of accessories on their cycles as well as the amount of inspection and testing their products received. This, in combination with falling prices for tubing and other critical components, allowed for a gradual reduction in prices. More important, British manufacturers increased the level of automation in their plants — both tire- and chain-making became more capital intensive and, thus, steadily less costly — and reorganized and divided up work to allow them to employ fewer skilled workers and to accommodate shifts and piecework. Equally critical was their adoption of processes that saved materials and machine time. Following the American example, Raleigh began liquid-brazing its frames and using pressed sheet-steel lugs at the joints. Soon, pressed steel was being used for brackets, cones, chainwheels and pedals, saving British manufacturers a significant amount of money.[142]

As a result of this approach to production and ongoing competition at home and abroad, British cycle prices declined steadily after 1898. Makers, however, were still able to maintain their well-known commitment to quality at a level above that of most American and European builders and also managed to add new features like free-wheels, rim brakes and speed gears to their vehicles without adding significantly to their cost. They could thus offer customers a product that stood up well against



Collage of factory images from the Western Wheel Works catalogue of 1897. Many companies highlighted their factories and production techniques in their catalogues as a way of demonstrating the technical superiority of their bicycles. (Source: NMST, Western Wheel Works, Crescent Bicycles 1899) its competition both in quality and price and by so doing began to reclaim some of the domestic and export markets they had lost.[143]

British cycle makers were helped by the fact that, by 1899, the US industry was in an acute state of crisis, with far too many companies capable of making far more units than either the saturated domestic or evaporating international markets could absorb. Several rounds of deep price cutting that saw the cost of some models reduced by more than 50% in one season failed to solve the problem. Though a number of companies did go bankrupt or got out of the business, there was still too much capacity and too many cycles on the market. In an attempt to control supply and bring an end to the price war, several big firms — among them Pope Manufacturing, H.A. Lozier, Gormully and Jeffery and Western Wheel Works — and a variety of smaller ones, combined to form the American Bicycle Company (ABC) in May 1899. Almost immediately, the bicycle trust began to close factories and dealerships and continued to cut prices and advertising budgets. It also initiated a series of patent suits to solidify its control over the market. But the ABC was never as powerful as either its critics or its managers claimed. Weighed down with serious capital liabilities, plagued by confusion and inconsistency at the highest levels of management and with its finances in disarray, the trust struggled on for three years before going into receivership. Pope took over the remnants of the company and reorganized it as the Pope Manufacturing Company. Other US companies remained in the cycle trade, but by 1900 the Americans no longer led the world in cycle manufacturing.[144]

By the turn of the century, the leadership role was slowly shifting back to Britain, with its "leaner and meaner" industry. By 1906, according to one cycle maker, no other trade in the country had "such up-to-date machinery and factory methods as the cycle trade." But these advances had come at a cost. The number of cycle firms had "steadily diminished" since 1900, leaving a handful of large firms like Raleigh, Humber and Rudge-Whitworth to dominate the market for cheap, popular machines. These makers could afford the high initial costs of the latest automatic machinery and could produce sufficient quantities to make such capital investments worthwhile despite the low prices they charged for their products. What remained of the demand for very high-grade vehicles was increasingly handled by "relatively small specialist makers" who could still take the time to customize their vehicles.[145]

Production Advances since 1900

Production techniques and organization continued to evolve in the 20th century but we know very little about when and how these changes occurred. What little evidence we do have suggests that the most significant innovations came after World War II and led to greater automation of processes such as plating and wheel assembly. In more recent years, some large makers have begun to apply the advances made in computer-controlled machinery and robotics to such traditionally labour-intensive tasks as frame assembly, cleaning and painting.[146] As in the late 19th century, these advances in manufacturing technology and organization have led to increases in efficiency, productive capacity and competition.

Apart from these broad general trends, most of what we know about the changes in cycle building in the last 90 years relates to very specific improvements in materials and fabrication processes. Since the turn of the 20th century, manufacturers have produced a small but steady stream of innovations in these areas that have gradually made cycles lighter, faster, sturdier, safer and more comfortable to ride. This section will focus on these technological advances.

Materials

Cycle makers have long been preoccupied with reducing the weight of their vehicles which, after all, are propelled solely by human power. The challenge has always been to accomplish this without undermining the cycle's strength and durability. Innovators have focussed much of their attention on the frame — most of a cycle's weight. Seamless steel tubing became the industry standard soon after its introduction in the late 1870s because it represented such a huge improvement over solid steel or iron rods. Within 20 years, however, tubing manufacturers were searching for ways to improve upon it. The first major breakthrough actually came before the end of the century. In 1897, A.M. Reynolds and J.T. Hewitt patented a process for making variable gauge tubing. Integral butt-ended tubes were made thicker and stronger (heavier gauge) at the ends where the frame joints were formed and where most of the stress occurred. The middle sections of the tubes were much thinner. Cycles built of this tubing were substantially lighter than those made of constant gauge tubes, and yet were strong enough to withstand normal use. Manufacturers also discovered that butted tubing is more resilient than straight-gauge and thus absorbs more road shock, providing a better ride. For many years, butted tubing was used only for deluxe models, like racers, because of its cost. Gradually, though, it has become fairly common on

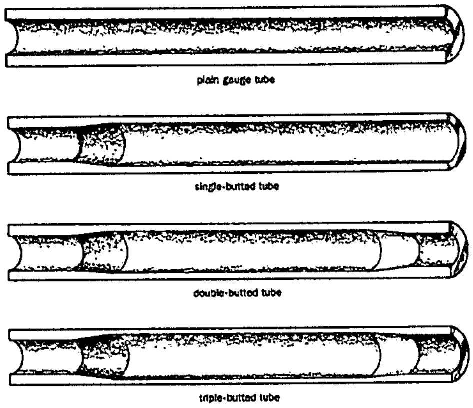


Diagram showing the various types of butted bicycle tubing. Butting allows tube makers to add strength where it is most needed while reducing the thickness and therefore the weight of tubing in other, less stress-prone parts of the frame. (Wolf, Ray et al., eds., Bicycling Magazine's Complete Guide to Bicycle Maintenance and Repair, *Emmaus, PA: Rodale Press, 1990, p. 20. Artist: Sally Onopa)*

higher-grade cycles and makers can now build their frames out of single-, double-, triple- or quadruple-butted tubes — tubes with anywhere from two to four different thicknesses along their length.[147]

The quest for lighter frames also led manufacturers to investigate new materials that could be used to build them. One of the very first attempts was probably Albert Pope's introduction of nickel-steel tubing around 1897. According to Pope, his company's metallurgical research demonstrated that 5% nickel steel was so much stronger than either 0.5% or 0.25% carbon steel, and that frame tubes made of it could be substantially thinner and still stand up to the hardest use. Pope Manufacturing apparently was the only company at the time to use this material and its higher cost no doubt reduced its appeal to both the maker and his customers when the bicycle boom ended and prices collapsed.[148]

It was not until the mid-1930s that the search for better frame material resumed and two advances of enduring importance were made. In 1935, the British tube makers Reynolds and Accles & Pollock each introduced a new type of steel-alloy tubing. Reynolds 531 was manganese-molybdenum steel, which had a tensile strength of 68 tons per square inch (psi; 937 720 kPa). Accles & Pollock's product was a chrome-molybdenum steel rated at 50 tons psi (689 500 kPa). Sample main frame tubes had thicknesses measured in hundredths of inches (0.085 to 0.094 inches; 0.216 cm to 0.238 cm) at their thickest butted points. According to one 1996 source, Reynolds 531 became "the benchmark tubeset for high-performance bicycles for the next 50 years."[149] In 1976 the company introduced a heat-treated version of manganese-molybdenum tubing, called Reynolds 753, and has recently (1996) begun to make a new "heavily alloyed steel" set — Reynolds 853, which it claims is actually strengthened by the heat of brazing or welding.[150] Chrome-molybdenum has enjoyed a similarly good reputation among makers and is perhaps the most commonly used alloy in the bicycle industry today. As with butted tubing, the use of alloy framing material was limited to expensive racing and other special-purpose cycles until the ten-speed craze of the 1970s encouraged cyclists to look for lighter vehicles.

The next major advances in frame material came after the World War II and were largely the results of aviation, space and military research and development — fields where lightness, durability and strength were absolutely essential. It was natural for cycle makers to be interested in the work being done with materials such as aluminum, carbon fibre, titanium and something called metal matrix. As early as 1953, a German company produced a die-cast aluminum cross-frame that weighed only 5.25 lb (2.38 kg), making it possible to build "a touring bike without accessories with a weight of 25 lb [11 kg]." [151] In addition to being very light, aluminum alloys are also very durable and corrosion resistant. As well, aluminum can be alloyed with many different substances allowing it to be worked using a variety of manufacturing processes. By the late 1970s, these attributes had prompted a number of large and small makers to build aluminum frames. Today, it is one of four or five primary choices for building high-grade bicycles.[152]

Titanium and carbon fibre were later arrivals on the cycling scene. The manufacturers of these materials worked mainly in military and space-related production until the late 1970s and early 1980s. Defence budget cuts prompted many of them to branch out and find new applications for these very specialized and expensive substances. Bicycle-frame construction seemed a promising field because of the industry's seemingly endless preoccupation with finding the perfect combination of lightness and strength. Titanium frames are among the lightest and strongest built and have the added advantage of not being susceptible to rust or corrosion. Carbon frames are made of fibres cemented into shape by some kind of plastic. They can be moulded into one-piece frames or into tubes that are then put together with adhesive and lugs. Either way, they are also extremely light and, because of the plastic content, good shock absorbers.[153] Both titanium and carbon-fibre frames are very expensive and seem to appeal mainly to technophile types who love anything new and have the money to buy it and to serious cyclists who believe that shaving a few hundred grams off the weight of their frame will allow them to shave fractions of seconds off their race times.

Since the 1930s, cycle makers have also looked for ways to lighten other parts of the vehicle. Though individual parts such as hubs, rims, handlebars and stems, chainrings, cranks and brakes account for much less weight than the frame, taken as a group, they can add a significant amount of weight to a cycle. Moreover, the stress on most of these parts was much less than that on the main frame structure and thus, builders reasoned, there was no need for them to be made of the same strong but relatively heavy steel used for frames. In the 1930s, several makers began to experiment with aluminum alloys — two common trade names were Hiduminium and Duralumin — producing handlebars, stems, rims and hubs. Like lightweight frame material, these were used almost exclusively for racing cycles in the early years because there was not much demand for ultralight models for any other purpose.[154]

Beginning in the late 1960s and early 1970s, the cycle industry began to produce a much larger range of lightweight components. By this time they had a variety of materials with which to work. Because it is so adaptable, aluminum is among the most popular component materials (makers were still using Duralumin in 1979). In various alloy forms it can be cast, forged, machined and moulded to meet any number of specialized requirements from free-wheels to cranks and brakes. Most good rims are now made of aluminum because, in addition to being lighter than steel, it provides better braking in wet conditions.[155]

Components that take a lot of wear, like axles and cogs (sprockets), are generally made of steel or titanium, both harder than aluminum. For example, both Shimano and Campagnolo have recently introduced their latest component sets. In both cases the large cogs are made of titanium and the smaller ones are made of steel. This combination balances weight savings with cost savings, since an all-titanium cog set, though lighter, would be much more expensive. Campagnolo's set also offers a titanium rear axle. Both titanium and steel alloy are used for some of the same components that are often built out of aluminum, such as handlebar stems. Carbon is less common as a component material but is currently being used to make rims and pedals.[156]

The level of weight reduction that can be attained by using the latest light alloy components, though, is minimal when compared to overall vehicle weight; both Shimano and Campagnolo claim that their new component sets are 500 grams lighter than previous versions. As a result, both the earliest lightweight components and the latest computer-designed ones appeal mainly to racers and other very enthusiastic riders. And while it is true that most good cycles now use a minimum of plain old tempered steel, a good many inexpensive ones used by thousands of children and casual riders in the west and millions of less affluent riders in places like China are still made largely out of steel.

Processes

In addition to advances in materials, and in part because of them, cycle builders also developed new processes and techniques for making cycle frames and components. Their work evolved from the basic processes established in the 1890s and centred on finding ways to put together and finish frames more effectively and to produce more precise, durable and lighter parts and components. All but a few of these innovations came after 1945.

The first major improvement in frame-building techniques came in the 1950s when silver brazing was introduced and adopted by most of the industry. Until this time, the vast majority of cycle makers had used brass to secure frame tubes into lugged joints. Brass melts at about 925°C, so brazers had to work quickly in order to limit heat damage to the steel tubes and lugs. Silver alloys, however, melted at a lower temperature (630°C) and so the frame members were much less susceptible to heat damage. Makers found that joints made using silver were just as strong as brass ones. As a result silver brazing quickly became the standard method for steel and alloy tube joinery. It is still used today on many types of both mass-produced and hand-built cycles.[157]

Another form of brazing, which has probably been used by some cycle makers since the 1890s, has re-emerged in recent years. Fillet brazing is a lugless form of brazing in which molten brass or silver is built up around the junction of two tubes to form a solid mass when it cools. Though it requires much more brazing material than a lugged joint, the finished product, once filed down and painted, has an elegant, seamless look to it. To do a good job of fillet brazing, however, as opposed to making and covering "mistakes with putty and paint" requires great skill and, thus, does not seem to lend itself to mass production. The technique is used today primarily by hand-builders.[158]

In the late 1970s and early 1980s, changes in the design of cycles and the materials used to build them gave rise to what is now probably the most common method of making cycle frames. Tungsten inert gas welding (TIG welding) is a lugless technique that uses extremely high temperatures to form joints. Unlike brazing, where only the spelter or filler metal melts, in TIG welding the tubes themselves are melted together and some filler metal is added so that the liquefied tube metal can "flow into the joint without reducing the wall thickness of a tube." The process takes place at temperatures higher than 1538°C and so much less specialized and expensive spelter metal can be used.[159]

TIG welding was first applied to cycle building shortly after the emergence of the mountain or all-terrain bike. Designers wanted to use larger tubing and new frame angles to adapt the basic safety design to off-road environments. At the time, lugs were built in a series of standard shapes and sizes, few of which could accommodate these new requirements. TIG welding provided mountain bike manufacturers with an infinitely more flexible technique for making strong joints. The absence of lugs also made the frames lighter. This technique quickly spread to other areas of the cycle industry, including mass production plants where robots instead of highly skilled (and highly paid) workers carry out the work. Many small, specialized makers of road and racing bikes also use TIG welding.[160]

One more method of frame building is worth noting. Carbon-fibre frames cannot be brazed or welded the way metal frames are. Instead, carbon fibre is either made into tubes that are bonded together with very strong adhesive or formed into moulded one-piece frames that have no joints. Of those builders that use carbon tubes, some make lugged and bonded connections, while others simply bond the joints. One-piece frames are generally made by arranging sheets of carbon fibre in a carefully planned pattern that imparts strength to the material and then moulding them together using heat and pressure to form a solid member. There are several variations on this basic process.[161]

Cycle manufacturers have also made some notable advances in frame finishing. In the late 40s Raleigh adopted a new pre-enamelling process called bonderizing, which rust-proofed the cleaned, unfinished frame and improved the adhesion of the paint to the steel.[162] Thirty years later, some makers began to use powder coating or dry painting systems, which promised still better adhesion and "greater chip- and abrasion-resistance." British Columbia's Rocky Mountain Bicycle Company recently installed such a system and, according to one observer, it provides "a thin finish, pleasing to the eye and difficult to chip or scratch."[163] Other makers continue to use liquid painting systems that can be adapted to suit very small or very large scale operations. In the case of mass producers, the process has been automated and computerized to make what was once a highly labour-intensive and slow job much more efficient. In these larger operations, electrostatic systems are often used to enhance application and some, like Myata, have installed a special drying apparatus as well.[164]

Advances in parts and component making have largely been the result of two factors. After World War II, cycle builders, along with many other manufacturers, had a much larger variety of metals and alloys from which to choose and they had access to ever more refined metal-working techniques. Whereas cycle makers in the 1890s could only use steel or iron, their successors have access to countless aluminum alloys as well as to steel and titanium-based metals. These metals are still worked using the basic processes of casting, forging and stamping or pressing, but there are a number of versions of these methods that allow makers to decide how to balance strength, lightness, appearance and cost. For example, cold-forged parts can be made of very strong aluminum alloys whereas hot-forged and cast parts must use materials that are not as strong. Forging generally takes more time than casting and thus forged parts are the most expensive. They also tend to be "thinner, lighter, stronger, [and] more accurately made" than their cast equivalents. Hot-forged parts, which are not the same as those made in the 1890s, are slightly less strong and less costly than cold-forged ones. Makers who decide to cast some of their parts can choose one of several processes. Gravity-casting seems to be considered the best method, though melt-forging (actually a form of casting) also produces reliable alloy products that are much more affordable than forged ones yet noticeably lighter than straight steel.[165] Another form of casting, investment casting, is used to make most lugs because it is a much less labour intensive process than forming them out of sheet steel.[166]

The bicycle industry has also benefited from continual advances in machine-tool technology. In general, most machining work is focussed on the same critical parts as before: hubs, axles, chain-wheels and cogs. The difference is in the level of precision and the speed with which the work can now be done. For high-performance cycles in particular, metal must be carefully carved away to reduce weight and provide the minute clearances required for aerodynamic performance. Steel components such as cogs or lugs often end up looking like pieces of lace because so much of metal has been removed, but designers and engineers have calculated exactly how much they can take away without undermining the structure.[167] Inexpensive cycles, of course, rely much less on high-level engineering but their overall quality has certainly improved as a result of the widespread use of precision machining tools and techniques.

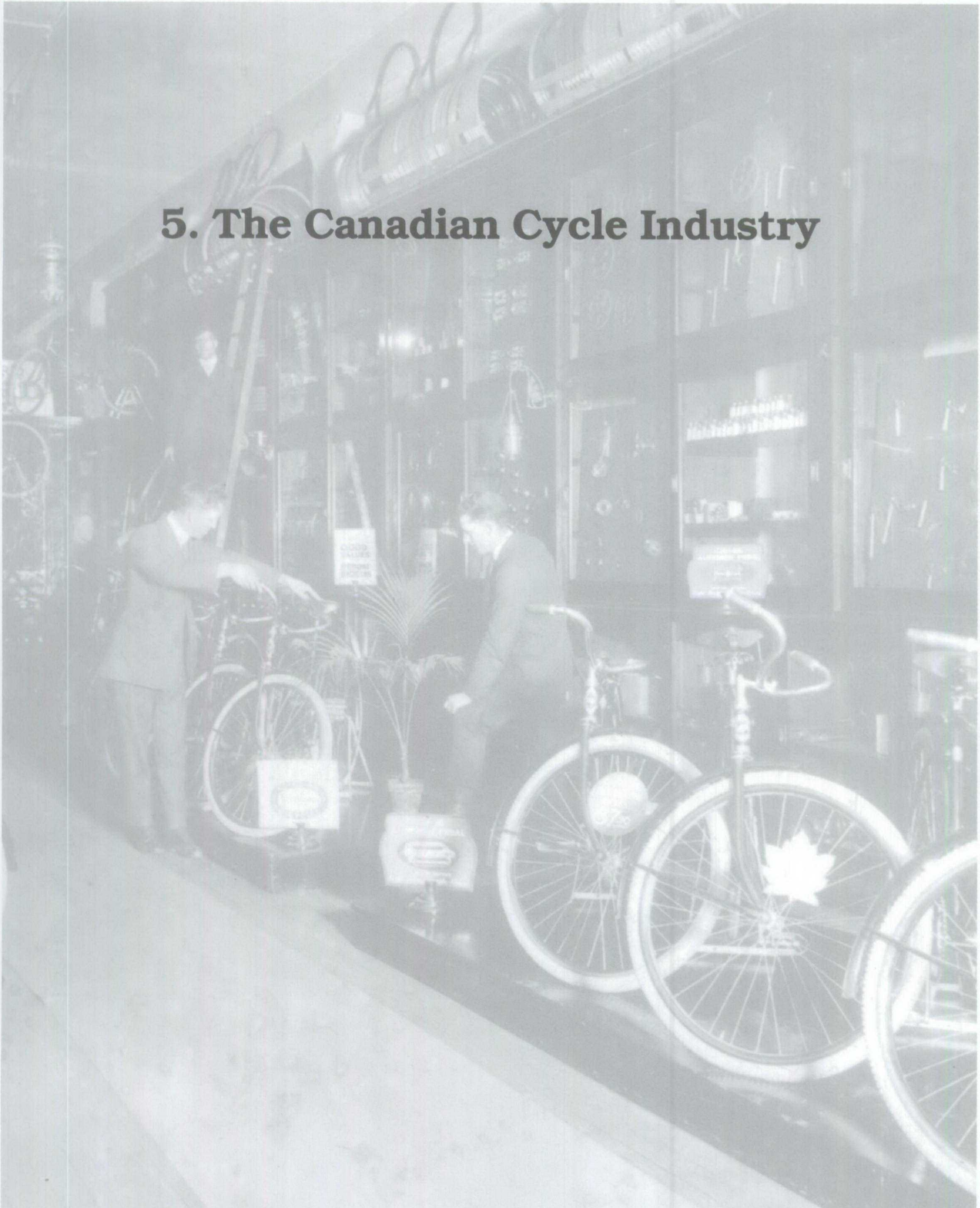
Notes

99. For further information on the role of machine-making in British industry see Hobsbawm, *Industry and Empire. An Economic History of Britain since 1750* (London: Weidenfeld and Nicolson, 1968), p. 147.
100. David A. Hounshell, *From the American System to Mass Production 1800–1932. The Development of Manufacturing Technology in the United States* (Baltimore, MD: The Johns Hopkins University Press, 1984) pp. 201–202 and Caunter, *Part I*, p. 43.
101. This outline of some of the major processes involved in building safety bicycles is based primarily on three contemporary sources. "Making a Bicycle," *Iron Age*, June 2, 1892, pp. 1070–1072; G. Douglas Leechman, "How a Bicycle is Built," *The Cycle Magazine*, vol. 1, no. 1 (November 1895), pp. 37–44 and Archibald Williams, *How It Is Built* (London: Thomas Nelson and Sons, n.d.) Chapter XXI, "Cycle-Building," pp. 325–344.
102. Sources differ on the types of lugs preferred by British makers. Two contemporary sources describe representative factories in Britain and suggested that forged and machined steel lugs were the rule except for the bottom bracket. See Leechman, p. 41 and Williams, pp. 326, 332. Other general sources seem to suggest that by the late 90s at least, malleable iron castings were also being used for all lugs. See Caunter, *Part I*, pp. 44–45 and A.E. Harrison, "The Competitiveness of the British Cycle Industry, 1890–1914," *The Economic History Review*, second series, vol. 22, nos. 1, 2, 3, 1969, p. 298. Yet another source, A.J. Wallis-Tayler, *Modern Cycles, A Practical Handbook on Their Construction and Repair* (London: Crosby Lockwood and Son, 1897), claimed that the type of lug used differed according to the "quality of the cycle — viz. malleable castings for cheap, low quality machines, forged stampings for those of a somewhat superior make, and finally, pieces stamped from sheet metal and moulded to the required shape by means of special tools in a powerful press for machines of the higher grades." p. 247.
103. Humber & Company used castings for all their lugs. They claimed that "the special combination of materials used," and the processes by which they were formed and finished made them "superior to the finest steel forgings." Humber & Company Limited, *Humber Cycles*, 1897, p. 15.
104. According the Hounshell, Pope's factories had 30 brazing stations, one for each joint. See pp. 205–206.
105. R.K. Webb, *Modern England, From the 18th Century to the Present* (New York: Dodd, Mead & Company, 1975) pp. 373–374 and Martha Moore Trescott, "The Bicycle, a Technical Precursor of the Automobile," *Business and Economic History*, 5 (1976), 2nd series, p. 57.
106. Harrison, p. 288.
107. Dunham, p. 468.
108. Trescott discusses the special skills and methods used by implement manufacturers to fashion the steel parts of their machines and suggests how this might have influenced their approach to cycle making when they entered the field. See pp. 64–68, in particular.
109. Harrison, p. 288.
110. According to Hobsbawm, steel production had been "revolutionized by the invention of the Bessemer converter in 1850, the open-hearth process in the 1860s, and the basic process in the late 1870s." See pp. 94–95. As a result of these developments, by the 1890s, the steel industry was producing more grades and types of steel and a greater variety of products than ever before.
111. Harrison, pp. 289–291.
112. Harrison, pp. 290–291.
113. Harrison, p. 291.
114. Pope was particularly devoted to building the very best bicycles. He established a testing department that, among other things, analyzed and experimented with different types of steel and other materials trying to find ways to strengthen and lighten existing designs. Hounshell, p. 208. See also Pope Mfg. Company, *Columbia and Hartford Bicycles*, 1896 and 1897.
115. Harrison, pp. 290–293.
116. Webb, pp. 374–375.
117. Hobsbawm, p. 148.
118. Pope Mfg. Company, 1896, pp. 6–28; Western Wheel Works, *Crescent Bicycles*, 1896; Overman Wheel Company, *Victor Bicycles*, 1894, p. 17 and The Raleigh Cycle Company Limited, *Preliminary 1893 Catalogue*.
119. The scientific management movement started by Frederick W. Taylor originated in the US steel industry where he was employed until 1893. Though it is hard to say whether his time and motion studies had any specific impact on the bicycle business, it is interesting to speculate since his ideas became widely known just at the time that the cycle makers were struggling to increase production and become more efficient. *Chambers Biographical Dictionary*, 5th ed. (1990), s.v. "Taylor, Frederick Winslow."
120. Western Wheel Works, *Crescent Bicycles*, 1897, n.p., and Hounshell, p. 205. This Western catalogue contains a very useful, 16-page description the company's Chicago works including photographs.
121. Harrison, p. 296.
122. Leechman, pp. 39, 40, 44.
123. Quoted in Harrison, p. 295.
124. Hounshell, pp. 205, 369, note 62 and Western Wheel Works, 1897, n.p.
125. This, along with automation, was a hallmark of the evolving system of mass production. See Hobsbawm, pp. 146–148.
126. Hounshell, pp. 205–206.
127. Western Wheel Works, 1897, n.p., and Hounshell, p. 211.
128. Harrison, p. 298 and Hounshell, p. 206. Many British companies maintained that "excellence of workmanship" could only be achieved "by strictly tabooing all piece-work." Humber & Company Limited, 1897, p. 15.
129. Hounshell, p. 369, endnote 58. Hounshell bases this assertion on references he found in a series of letters exchanged between managers of the Hartford works in 1891 and 1892.
130. Hounshell, pp. 205–206.
131. Webb, pp. 377–378.
132. Harrison, pp. 295, 298; Caunter, *Part I*, p. 49 and Hounshell, p. 206.

133. For a discussion of New England armoury practice as it applies to cycle making, see Hounshell, pp. 192–208.
134. Western Wheel Works, 1897, n.p., and Hounshell, pp. 210–211. In their 1899 catalogue, Western stated that it took no fewer than "sixty distinct operations" to form their crank hanger (formerly called a bottom bracket) from cold drawn sheet steel. Western Wheel Works, *Crescent Bicycles*, 1899, n.p., included in "Some Crescent Features" section.
135. Western Wheel Works, 1897, n.p.
136. From a technical point of view, forging is generally considered "the best method that has been found for developing the greatest strength and toughness from steel, bronze, brass, copper, aluminum, and magnesium." Stampings, on the other hand, cost less, especially when made in quantity. Arthur C. Ansley, *Manufacturing Methods and Processes*, 2nd edition (Philadelphia: Chilton Book Company, 1968) pp. 70, 108.
137. Hounshell, p. 210.
138. Hounshell, p. 202 and Western Wheel Works, 1899. The catalogue has no page numbers but near the end there is a page headed "Where Crescent Bicycles are Made," that includes both a "Chronological History" and a list of "Annual Sales of Crescents," as well as some other useful information regarding the company.
139. Dunham, p. 468.
140. Woodforde, p. 167; Humber & Company Limited, 1897, p. 36 and Western Wheel Works, 1899, n.p., included in "Where Crescent Bicycles are Made," section. Humber's Coventry works — one of its three British factories — had 25 large stoves in its enamelling department. Humber & Company Limited, 1897, p. 30. Western had only ten but with a capacity of 700 frames per day. Western Wheel Works, 1897, n.p.
141. Hounshell, p. 212.
142. Harrison, pp. 295–298. See also Caunter, *Part II*, p. 20, where the author states that, on its all steel model of ca 1900, Raleigh replaced heavy castings with "light sheet steel pressings which provided adequate strength with lower overall weight." This bicycle, he claimed, was a prototype of "the form of construction now generally used by the modern bicycle." Though the author did not mention it, at the time that British makers adopted this type of construction, it had already been in use for nearly a decade in the American industry.
143. Harrison, p. 299–301.
144. "The Trust & The Bust," *American Bicyclist and Motorcyclist*, pp. 173–174 and Harrison, pp. 299–300. Accounts differ on how many companies amalgamated to form the American Bicycle Company and, according to the *American Bicyclist and Motorcyclist* article, the trust's own information "varied from week to week." Most estimates seem to put the number between 42 and 48. See Harrison, p. 299 and William Humber, *Freewheeling. The Story of Bicycling in Canada* (Erin, Ontario: The Boston Mills Press, 1986) p. 55.
145. Harrison, pp. 300–303. See in particular footnotes 2 and 4, p. 300 and Caunter, *Part I*, pp. 43–44.
146. Some of the changes in production technology are discussed in Chapter 5, which deals with the Canadian cycle industry and CCM. See also advertisements for production equipment, in this case wheels, in *American Bicyclist and Motorcyclist*, pp. 225, 240.
147. Wolf, et al., p. 20; Caunter, *Part I*, p. 49 and Bridgestone Cycle (U.S.A.) Inc., *The 1994 Bicycle Catalogue from Bridgestone*, pp. 20–22.
148. Pope Mfg. Company, 1897, n.p.
149. Mark Riedy, "The New Steel," *Bicycle Guide*, (April 1996) p. 39 and Caunter, *Part II*, pp. 26–27.
150. Riedy, pp. 39–40.
151. Caunter, *Part I*, p. 55. According to Caunter, before the turn of the century, a builder had tried to make a one-piece cast frame out of aluminum alloy but existing materials and methods made it impractical to produce such vehicles in any quantity. See p. 41.
152. Coté, "1996 Buyer's Guide," *Bicycle Guide* (March 1996) pp. 24–49. This article includes a large number of highly rated (and highly priced) aluminum cycles. Aluminum models are also highlighted in one of four special sections (p. 46) devoted to different frame materials. The others are steel (which gets the largest section), titanium and carbon. See also Bridgestone Cycle (U.S.A.) Inc., 1994, p. 56.
153. Coté, pp. 25, 47–48. According to the glossary that accompanies this article, metal matrix is "a material that has been reinforced...with small particulates of another. The particulate is distributed throughout the material but not dissolved (which would make it an alloy)." See p. 49. This does not appear to be a very common frame-making material based on the contents of this article and other current cycling literature.
154. Caunter, *Part II*, pp. 51–52. Caunter points out that both the Duralumin and Airlite D.S. hubs of the mid-1930s were intended exclusively for racing cycles.
155. Much of the information included in this section on component materials comes from magazine advertisements and notices. Several ads in the *American Bicyclist and Motorcyclist* refer to aluminum and Duralumin parts. See for example pp. 6–7, 238, 301, 302, 313, 326. In Bridgestone's 1994 catalogue, aluminum rims are standard equipment on most models.
156. See Garrett Lai, "New for '97," *Bicycle Guide* (October 1996) pp. 32–35, for information on titanium/steel cog sets. See *American Bicyclist and Motorcyclist*, pp. 36, 177, 197, 334, 336 for related component ads and see "Corrections," *Pedal*, vol. 10, no. 5 (July 1996) p. 5 for information on carbon-fibre rims.
157. Caunter, *Part I*, p. 56; Alan Coté, "Brazing and Welding, How It Works," *Bicycle Guide* (April 1996) pp. 31–32 and see also section on CCM's plant upgrades in chapter 5.
158. Coté, "Brazing and Welding, How It Works," pp. 32–33 and Bridgestone Cycle (U.S.A.) Inc., 1992, p. 44. It may be that this type of brazing was used to form the so-called "flush" joints advertised by various makers around the turn of the century but it is impossible to say for certain without more information. See, for example, CCM advertisements in *Massey-Harris Illustrated*, vol. V, no. 2 (March–April 1901). The Massey-Harris ad lists "New Flush Joints" as one of several new features, while the Cleveland one boasts of "New Style Frame Construction."
159. Coté, "Brazing and Welding, How It Works," pp. 31–36.
160. Bridgestone Cycle (U.S.A.) Inc., 1992, p. 44; Coté, "Brazing and Welding, How It Works," pp. 35–36; Pierre Bouchard, "China's 'CBC'," *Pedal*, vol. 10, no. 4 (June 1996) p. 20–21 and Patrick Brethour, "Bike Makers Face Uphill Climb," *Globe and Mail*, 6 August 1996.
161. Coté, "1996 Buyer's Guide," p. 48.
162. Caunter, *Part II*, p. 24. In Canada, CCM adopted the bonderizing process in the early 50s. See next chapter for details and references.
163. The Bicycle Association of Great Britain Ltd., "Great Britain," *American Bicyclist and Motorcyclist*, p. 341 and Joan Jones, "Race It or Take It, Rocky Mountain Blizzard," *Pedal*, vol. 10, no. 4 (June 1996) p. 49.
164. Bouchard, p. 21 and Myata advertisement in *American Bicyclist and Motorcyclist*, p. 207. See also any number of the profiles of small makers included in every issue of *Bicycle Guide*.

165. Bridgestone Cycle (U.S.A.) Inc., 1992, pp. 42–43.
166. Bridgestone Cycle (U.S.A.) Inc., 1994, pp. 18–19. Ironically, stamped lugs had been at the centre of the drive towards automation and mass production in the industry before the turn of the century. At that time many quality-conscious makers considered them cheap looking and not sufficiently strong. Now they are considered a labour-intensive luxury that only a handful can afford.
167. This information is a synthesis of various articles and cycle reviews in *Bicycle Guide* and *Pedal*. In particular, Garret Lai's "New for '97" article on the latest Shimano and Campagnolo components sets was very useful.

5. The Canadian Cycle Industry



5. The Canadian Cycle Industry

As with so many other Canadian industries, the history of cycle manufacturing in this country is difficult to trace. Except for a brief period of intense activity in the 1890s, there have been few Canadian manufacturers of note, and, like the majority of businesses, they either left no useful records of their activities or refuse to make those records available to historians. Consequently, there is little primary evidence relating directly to Canadian cycle companies and how they made their products. In many instances we cannot even say for sure that a given company was actually manufacturing its cycles, as opposed to merely assembling them from parts made elsewhere.[168] Even in the case of Canada's premier cycle maker, CCM, reliable information on factory workers and the machinery, materials and processes used to build bicycles is very hard to find. The same is true of commercial information that might help us to understand the company's approach to production, and its strengths and weaknesses.

Nevertheless, it is still possible to piece together at least a partial story of bicycle making in Canada by looking at a combination of trade literature and production statistics for the industry as a whole. For the boom years, there is a fair bit of information about several companies. Most of it is promotional — either catalogues or brief articles and trade notices in *Cycling* and *The Canadian Wheelman* — but it offers some insight into the major events and trends and the overall level of activity in the industry during this crucial period. Most of what we know about cycle making in Canada after 1900 comes from CCM sources. CCM was never the only manufacturer in Canada, but because of its size, stature and longevity, many examples of its cycles and a substantial quantity of its trade literature have survived. Although this material cannot give us a coherent or complete picture of how cycle design and production evolved in this country, it can at least provide an outline of the primary developments that took place within the industry from the 1920s to the 1970s.

This chapter is divided into four sections. The first looks at the early years of the Canadian cycle industry, focussing on how it evolved and the impact developments in Britain and the US had on it. The second section is a short business history of CCM, from its formation in 1899 and gradual rise to dominance to its decline and eventual fall in 1982. Section three, concentrates on how Canadian cycles were made after 1900, highlighting some of the most important technological and design innovations introduced to the Canadian market, mainly by CCM. Finally, the chapter concludes with a look at the Canadian and international industries since the 1970s.

The Canadian Cycle Industry to 1900

There have been cycles in what is now Canada since at least the days of the velocipede. The first Canadian cycles were imported from the US, Britain and Europe or built by amateur mechanics and small local manufacturing concerns. The work of these pioneer builders is poorly documented and none of their vehicles seem to have survived.[169] With the commercial success of the ordinary in Britain in the 1870s and in the US in the following decade, Canadian manufacturers began to look a little more seriously at the possibility of making and selling cycles. At least two companies, both based in Ontario, are known to have built high-wheel cycles: Semmens, Ghent and Company of Burlington and Thomas Fane and Company of Toronto. Semmens began making cycles around 1882, while Fane seems to have entered the field in 1884.[170] Given the limited manufacturing capabilities existing in Ontario at the time and the easy availability of essentially interchangeable parts, it seems likely that they imported most of the necessary parts, assembled the cycles using some basic metal-working machinery and techniques and sold them as their own products.

This was probably also true of two other relatively early entrants into cycle manufacturing — Goold and Gendron — both of which seem to have been in the business before 1890. Formed in 1888, the Goold Bicycle Company was an offshoot of Goold, Shapely and Muir Company Limited, a general hardware dealer, importer and manufacturer of household and farm implements, based in Brantford, Ontario. The company is said to have moved from importing cycles in the early 1880s to making their own by 1887.[171] Gendron Manufacturing Company Limited was incorporated in Ontario in 1887 but, according to patent records, had an American parent company based in Toledo, Ohio. Both seem to have been active in the bicycle business by 1890.[172] Besides bicycles, the Canadian firm also made baby carriages, furniture, children's carts and wagons, and sleighs and other related products.[173] Again, despite the names and claims of these companies, it is not at all clear that they were actually manufacturing a substantial proportion of the products they were selling. Since "Canadian industry was still very much in its infancy," basic materials and components such as steel tubing, bearings, rims and tires were not available from domestic suppliers. But they were relatively cheap and easy to obtain from the much more developed manufacturing sectors of Britain and the US, as were complete cycles.[174] As the demand for safety bicycles grew after 1890, more and more parts and cycles were imported and sold to Canadians.

This situation changed dramatically once Canadians began to recognize the potential of this emerging sector. Although the bicycle boom took a little longer to reach Canada, by 1895 there was no doubt that it had arrived. Toronto alone had some 90 bicycle shops, which claimed to be selling 18 000 machines per year. Bicycle dealers were springing up all over the country to supply the growing demand — in hardware, drug and sporting goods stores as well as in less obvious places like opticians' offices and insurance agencies.[175] Hard hit by two of the severest years of the depression, Ontario manufacturers welcomed the opportunity to enter a prosperous new field. The federal government, for its part, was anxious to encourage the development of such a high value-added sector since the manufacturers had promised to provide jobs, to augment and diversify the nation's manufacturing capabilities and to generate a great deal of related industrial and commercial activity, all at a time when the economic outlook was generally dismal. To help secure the budding industry's glowing prospects, the federal government raised the tariff on bicycles and parts in 1895, making it even more attractive for entrepreneurs to build factories.[176]

Canadians responded by setting up numerous cycle-building enterprises between 1895 and 1897 and by equipping many of them to manufacture rather than merely assemble the vehicles. Most of these were in Ontario, where the bulk of Canada's manufacturing capacity and population were based. Some were already established manufacturers, like Welland Vale of St. Catharines, the Canadian Typographic Company and Massey-Harris, that saw diversification as way to insure prosperity in bad times. Massey-Harris, for example, had watched its agricultural implement sales drop about 23% between 1892 and 1895. To try to mitigate these losses, its owners began two new lines of work: they bought a carriage company and they built and equipped a cycle factory.[177] Welland Vale produced steel goods such as axes, saws and harvesting tools and was probably also suffering losses as a result of the depression.[178] Other companies and individuals, often with fewer resources and less manufacturing experience, set up cycle works. Many had backgrounds in carriage-, wood- and metal-work or owned small foundries or machine shops. Some, like Henderson's of Goderich and Toronto-based McCready, made cycles, parts and accessories almost exclusively, while others carried on other manufacturing activities. The Kingston Vehicle Company and James Lochrie began making bicycles in 1895 but also offered other transportation-related products such as wagons, sleighs and carts. Hyslop, another Toronto firm, made its own cycles as well as importing and selling Western Wheel Works' products.

The increased tariff not only encouraged Canadians to enter the field, it also prompted existing "makers," like Goold and Gendron, to upgrade their works and add new machinery that allowed them to make more of their own parts and reduce their dependence on increasingly expensive imported materials. As well, it became more attractive for American makers to set up shop in Canada to avoid the tariff barrier. At least one major company, H.A. Lozier, began producing cycles in its well-equipped Toronto Junction factory in 1895. Another US-based firm, Iver Johnson, also apparently considered building a Canadian branch plant and entered into negotiations with the town of Carleton Place near Ottawa in 1896.[179]

Though documentation is sketchy, it has been estimated that there were about 25 cycle manufacturers in Canada by 1898.[180] Several of these had already expanded, were in the process of expanding or were actively considering it. A Goold advertisement of 1896 announced that the makers of Brantford Red Birds had "found it impossible during '95 to fill [their] orders, although [they] had doubled the capacity of [their] factory for the season's work." To remedy this situation they claimed to have "doubled" their capacity a second time.[181] The same magazine made note of Massey-Harris's new factory, which was upgraded further in 1899.[182] Lozier stated that the 228 men working in its Toronto plant in 1895 could produce 50 cycles per day. By 1897, their ads claimed a capacity of some 350 vehicles.[183] Gendron, by its own account, was also very busy, declaring that it had sold more bicycles in Toronto in 1896 than "any three or four bicycle concerns," and was planning to upgrade its facilities in 1899.[184] In addition to enlarging and improving plants and increasing capacity, many firms had already developed extensive networks of sales representatives and agents. Lozier had agents handling its Cleveland and other products from Victoria to Halifax. Massey-Harris was similarly well represented and McCready and others regularly advertised for agents willing to take their products on in under- or unrepresented areas of the country.[185]

Truing frames and wheels in the Massey-Harris bicycle factory, ca 1898. Massey, like the Pope companies whose patents and processes it used, prided itself on the special care it took in making, testing and inspecting its products. (Source: NMST)

As the cycle-making sector grew, it also spawned or promoted a variety of supporting enterprises. Canadian cycling and cycle-related publications of the 1890s are filled with advertisements from, among others, makers of tires, wood rims and chains. As with many of the cycle makers, it is hard to tell for certain whether companies like McKinnon Dash & Hardware Company, the Canada Cycle Wood Rim Company and the Canadian Tire Company were actually manufacturing their products, assembling them or simply acting as agents and jobbers for US and British companies. Whatever the case, these were local suppliers providing essential support to a domestic industry that would otherwise have had to buy critical materials and components from more distant manufacturers. For example, T.W. Van Tuyl of Petrolia was one of many entrepreneurs who sought out suppliers in Britain and the US of such things as tubing (pre-cut and ready for brazing), frames, handlebars, hubs, basic machine tools like bench drills and specialized bicycle-making equipment like wheel balancers and spoke grips.[186] Being able to choose from a variety of the best products was especially important for small makers who often could not afford to deal directly in foreign countries. Similarly, Canadian cyclists whose vehicles needed to be maintained or repaired generally did not need to look too far for assistance. By the late 1890s, enterprising individuals had set up repair shops virtually across the country, though by far the highest concentration was in Ontario. These and countless other cycle-related businesses along with the wholesale and retail sales networks and the factories themselves, made the bicycle much more than just a social phenomenon. It was fast becoming an important source of economic prosperity, providing many good jobs, both skilled and unskilled, much commercial activity and enhancing and diversifying Canada's manufacturing capabilities.

The burgeoning Canadian cycle industry had a lot in common with the much larger US industry. It was subject to many of the same pressures that influenced developments there, notably high demand, intense competition and relatively high labour costs. Canadian makers, like their counterparts south of the border, searched for ways to produce more cycles, more cheaply to supply the rapidly rising domestic demand that was increasingly being supplied by foreign companies. With the heightening of the tariff barrier by the federal government, automation came to be seen by many companies as an attractive and sensible option, despite the high initial cost of the equipment, most of which had to be imported.[187] Though detailed information is scarce, we do know that some of the major firms began automating and improving their factories within a few years of opening. Lozier described its upgrades in 1898.

> *[Our plant now has] new and modern punch presses, drill presses, automatics, sprocket machines, lathes, millers, filing stands, brazing stands, enamelling ovens, etc., etc.... which fully doubles the capacity of last season. A new sand blast plant has been added for removing spelter from frames, which greatly increases safety and prolongs the life of the bicycle, doing away with the usual method of acid pickling which eats the steel tube and renders it dangerous, also prevents rust, which destroys the enamel.*
>
> *The plant has been in full operation since August 1st, and thousands of bicycles have been constructed three months ahead of last season, and we are now in a position to positively guarantee most prompt attention to every want of dealers and riders, and intend making this a feature of our business.*[188]

According to a notice in the same issue of the magazine, these renovations, which cost over $18 000, "nearly doubled" the company's capacity and made it possible for them to offer "no less than twenty-three different lines."[189] The next year, in an article that reads much like an advertisement, *The Canadian Wheelman* stated that "no firm deserves more credit for bringing out new ideas in bicycle construction than H.A. Lozier." The author goes on to outline some of the many new and improved features and components of the latest Cleveland bicycles, including its pressed steel hubs, which passed "through six powerful presses" before going on to be threaded, drilled and ground.[190]

Not to be outdone, Massey-Harris and Welland Vale upgraded their facilities by, among other things, installing immersion brazing systems. According to one account of the Welland Vale factory, their system dispensed with "the old method of using a gas flame" and replaced it with a new method whereby each "joint [was] dipped into a vessel of melted brass and by this means the fluid penetrate[d] the smallest possible crevice; and as the frame [was] allowed to remain in the liquid until the tubing attain[ed] a proper heat, the two metals [we]re so thoroughly fused into each other that such a thing as an imperfect joint [was] simply impossible."[191] Massey-Harris, in its 1899 catalogue, boasted that its cycles were "built with the most up-to-date machinery, and expert machinists — not the product of an amateur's experimenting." Their new brazing equipment was among their latest acquisitions and, they claimed, produced "a perfect soldering and great strength and rigidity in the whole machine."[192]

On the subject of the organization and management of work within Canadian factories, the trade literature and few secondary sources are virtually silent. For example, while Massey-Harris catalogues made a point of mentioning the expertise and experience of their workforce, they gave no indication of how the primary tasks were set up and divided, how the workers were deployed to carry them out or how they were paid. Given the price of skilled labour in Canada and the strong American influences in three of the biggest factories — Massey-Harris, Gendron and Lozier — it seems likely that scientific management practices had some impact here and that piecework payment was a common form of remuneration.

Canadian makers also seem to have been affected by American techniques for saving materials and machine time. Even before Lozier adopted pressed hubs in 1899, *Cycling* reprinted an article from a Buffalo, New York, paper that advised novice bicycle buyers "that connections of sheet steel are stronger than drop-forgings, as the tough surface of the steel, which gives tensile strength, is retained in this method of manufacture."[193] Also, most Canadian makers seem to have adopted the so-called barrel hub, which, according to Hounshell, was made in part of pressed sheet-steel. This is born out by the careful wording of many ads and catalogues, which emphasized that the cones and cases of hubs and crank hangers were made of forged, hardened and machined steel. Similarly, the fact that certain manufacturers stressed the superiority of forged components over other "cheaper" forms (which usually meant pressed parts) suggests that sheet-steel parts or cycles made using them were not only available but were seen as a serious competitor. For example, *The Canadian Wheelman* included at least two articles that praised the greater strength and precision of forged steel components — lugs, bottom brackets, hub cones — over weaker and cheaper pressed ones.[194] As well, Massey-Harris catalogues, following the example set by Pope Manufacturing whose patents and processes they used, promoted forged and machined parts over "any of the cheaper substitutes in use."[195] Still other makers adopted the flush joint, doing away with lugs altogether and making the frame seamless in appearance. Though reinforcement had to be added internally to support the joint, these makers still saved the significant amount of material and machine time needed to make lugs.[196]

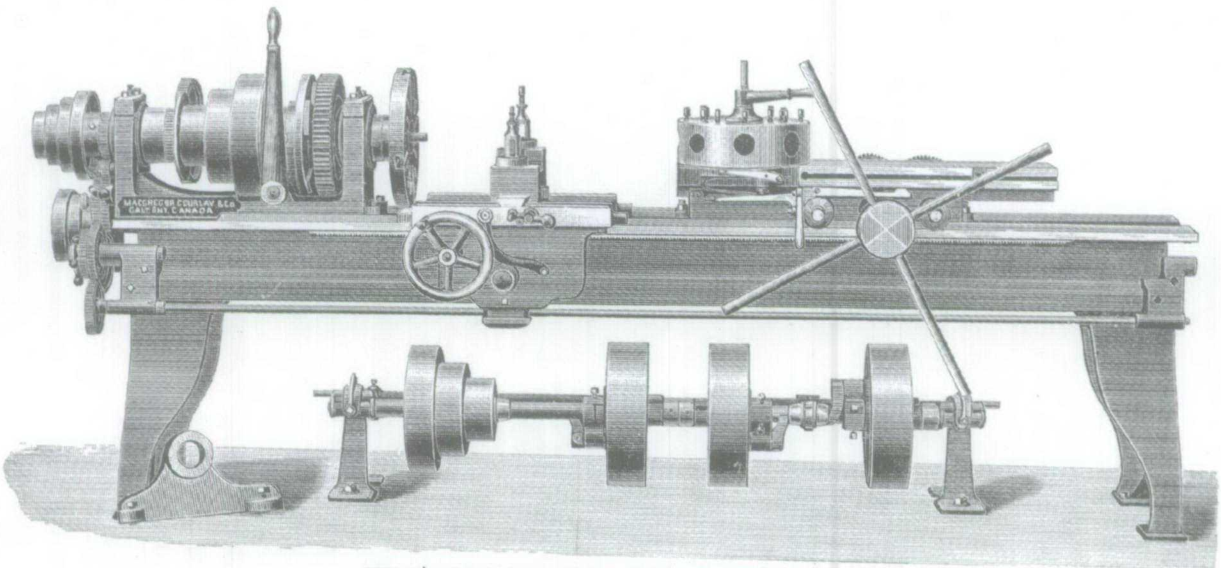
Whatever techniques they were using, Canadian cycle manufacturers were soon producing a significant number of vehicles. One estimate suggests that something like 100 000 bicycles were made and sold in Canada between 1896 and 1900. The five companies that eventually formed the Canada

Cycle and Motor Company produced 38 500 cycles in 1898 and employed some 1700 workers. Their combined profits between 1896 and 1899 totalled over $800 000.[197] Though dwarfed by the mammoth US production figures and profits for this period, if true, these were still impressive numbers for a nation with a population of around 5 000 000 (of which only 1 500 000 lived in urban areas),[198] a limited manufacturing capacity and no steel or machine-tool industry to speak of when the industry was established.[199]

Despite the impressive performance and continued development of the Canadian cycle industry between 1895 and 1900, there were signs of trouble as early as 1897. In that year, the booming American industry hit its peak and began to slow down. Facing a marked decline in domestic sales, US makers tried to compensate by selling more products in foreign markets. Canada was one very convenient destination for their excess production. At the same time British demand was slowing down and manufacturers there were beginning to cut prices in response to intense competition from the US. Their products were generally more expensive than American ones and perhaps not as well suited to Canadian tastes and requirements.[200] As prices fell, however, these high-quality vehicles were bound to become more attractive to Canadian consumers. Thus while demand remained strong in Canada for longer than it did in the US or Britain, makers here increasingly felt the pressure of competition from these cycle-making giants.

With domestic productive capacity still growing, the Canadian market became more and more competitive. Throughout the 1890s, Canadian makers approached pricing and sales in much the same way that their main US competitors did. Few domestically made models were priced over $100 and many fell into the $75 to $85 range. Those companies that made higher priced models usually offered more reasonably priced mounts as well. Massey-Harris, for example, made only a few models of its own, which generally sold for $85 — the same price as the highest grade of Hartford cycle made by Pope. They did, however, carry a cheaper line of vehicles made by another company.[201] In 1897, Lozier advertised prices of between $75 and $100 for five models, while McCready offered adult models for $65 to $100, a racer for $110, tandems for $150 and juveniles for $45 and $47.[202] Yet even with this range of products, Canadian makers still had to contend with competition from a variety of cheaper makes, both foreign and domestic. Thus, as early as October 1897 *The Canadian Wheelman* was reporting that, according to three of the largest dealers in the trade, the state of the bicycle business was "not very encouraging." It seemed likely that "large stocks of 1897 wheels" would be left unsold and would have to be offered "at bargain counter prices [the] next season."[203]

This brief, negative notice was contradicted by manufacturers' continued claims that they were having difficulty keeping up with demand. Yet while their ads implored dealers to get their orders in



THE M'GREGOR, GOURLAY CO., LTD.,—20 INCH TURRET LATHE.

A 20-inch (50-cm) turret lathe or screw machine, a tool used extensively by cycle manufacturers. By January 1897, when this article appeared in The Canadian Engineer, *demand for these and other machine tools was rising due to the rapid growth of a Canadian cycle industry. (Source:* The Canadian Engineer, *vol. IV, no. 9, January 1897, p. 269)* early for next season, all were acutely aware of the pressure to reduce prices and some actually began to do so. In 1898, Lozier offered 23 different styles at $40 to $90 for bicycles and $110 for tandems.[204] W. Mann & Company, though probably more an assembler than a maker, reduced its 1897 prices of between $60 and $85 to between $35 and $60 in 1898.[205] Massey-Harris, meanwhile, did not lower its prices but felt compelled to defend them against public expectations of reductions. These expectations, the company argued, were unreasonable because "a truly high-grade wheel cannot be made and sold for forty or fifty dollars any more than a solid gold watch with a high-class jewelled movement can be bought for the price of a plated one with machine-made works."[206] The following year it changed its approach, no doubt in light of management's realization that the bicycle craze had "to some extent died down in the larger cities," leaving the bicycle trade in an "unsatisfactory condition."[207] Its 1899 catalogue acknowledged that prices in general needed to come down because so many makers had inflated them when the boom began. Massey-Harris, on the other hand, had offered a reasonable price from the first and thus did not have to offer drastic reductions.[208] And they were not the only company that began to feel compelled to justify their prices to the public. As market pressure intensified with the rapid decline of American domestic demand, this type of explanation became a very common feature of the advertisements and catalogues produced by cycle makers in Canada and abroad.

The Canada Cycle and Motor Company

Intense competition brought major changes to the Canadian cycle industry. As demand for cycles continued to weaken, Canadian makers began to realize that improving production methods, materials and organization would not provide the cost savings they needed to reduce prices *and* preserve their profit margins. There were simply too many cycles being made and greater efficiency in the factory only meant that the situation would be made worse. What was needed, according to the five largest makers, was a way to bring order to the chaotic Canadian market by controlling the supply of cycles. To carry out this task, they established the Canada Cycle and Motor Company in 1899. It eventually became the dominant force in the Canadian cycle manufacturing industry.

CCM was created by merging the cycle-making facilities of the five leading Canadian manufacturers — Massey-Harris, Lozier, Gendron, Welland Vale and Goold. Together, these companies accounted for approximately 85% of domestic cycle production. The primary goal of the men behind the merger (not all of whom were in the cycle business) was to reduce production and competition, thereby allowing prices to be maintained at the highest possible levels, even in the face of declining demand. They also planned to use the financial resources raised by selling $2 000 000 worth of stock in the company to modernize their cycle plants and equip a factory to manufacture automobiles. Another $4 000 000 in stock was held by the members of the syndicate in payment for the assets they brought to the company.[209] The formation of the American bicycle trust earlier in 1899 and its plan to set up a Canadian branch plant certainly influenced the timing of the Canadian move, but so did the recent successes of Canadian financiers in promoting railway and utility company mergers on the stock market.[210]

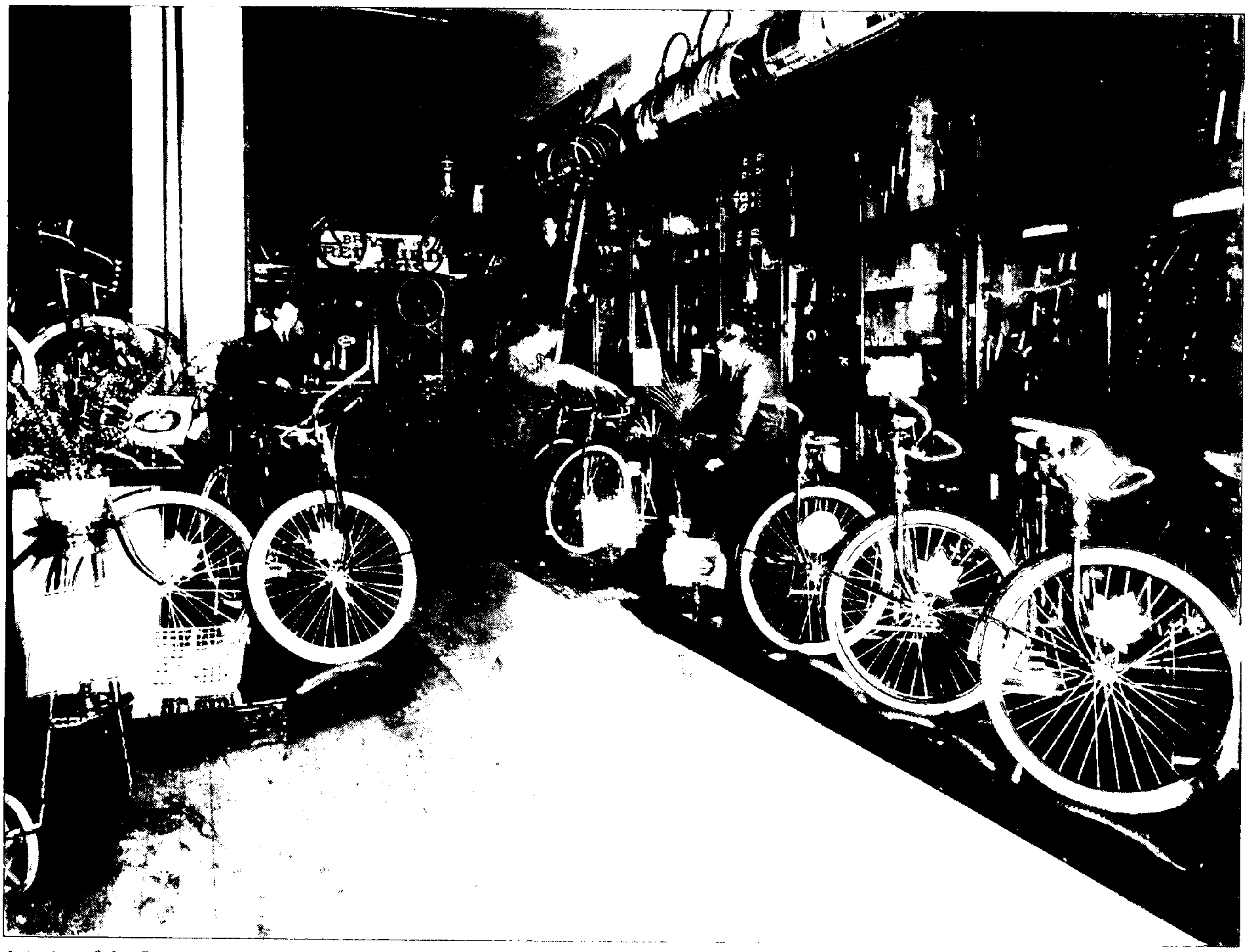
Critics complained that CCM was unfairly curtailing competition and suggested that factories would be closed and jobs lost as a result of the merger.[211] Supporters denied these charges and claimed that the cycle maker was in fact protecting Canadian jobs and manufacturing capacity. The merger, they argued, created a big and well-capitalized company able to make cycles more efficiently than minor concerns because it could afford to acquire all the latest production technology. Such a company would be better placed to face the stiff competition coming from both British and US firms, thereby preserving the domestic industry. As well, a major enterprise like CCM could help "lead Canada's transportation revolution by building automobiles," something a small manufacturer could not hope to accomplish efficiently.[212]

Boom markets always foster high expectations for the future. Unfortunately, the grand plans of CCM's creators and promoters, like those of so many before and after them, proved totally unrealistic. The Canadian bicycle market collapsed with spectacular speed after 1899, when CCM's production reached its height. The following year, it fell by 27.3% and, in 1901, an additional 66%. The company tried to console itself and placate its stockholders by depicting the losses as a temporary slump made worse by very wet weather in April and May of 1901. But the next year, this hopeful scenario disappeared in a cloud of public scandal as CCM stockholders revolted against legally questionable and blatantly self-interested financial management decisions made by the company's directors. With sales still declining and an obsolete inventory left over from the previous two disastrous seasons, litigation with its stockholders was the last thing the company needed. In September 1902, CCM recorded a loss of $159 000 and soon after began a drastic reorganization of the company, which saw capital stock reduced to $600 000. Branch offices in Montreal, Saint John, Winnipeg and Vancouver were closed. The factories at St. Catharines and Brantford were shut down and production, on a much reduced scale, was concentrated in the former Lozier plant at Toronto Junction, fulfilling the worst fears of CCM's early critics.[213]

A leaner and humbler CCM emerged from this near disaster. For the next several years the owners pursued a cautious commercial strategy based on the assumption that the bicycle craze was well and truly over.[214] Thus, when the market recovered a little by 1904, the company welcomed the improvement but continued to develop and promote other products like skates (introduced in 1905) and automobiles. It also focussed increasingly on supplying replacement parts for the many thousands of cycles Canadians had bought during the boom years. These products, along with a booming economy and the demise of the American Bicycle Company by 1903, helped CCM survive until 1911 when bicycle sales finally stabilized and began a steady climb.[215]

By the time that World War I broke out, CCM's owners were once again allowing themselves the luxury of optimism. The centrepiece of their long-range plan was a new factory, the design of which was based on "studies of leading American and British bicycle factories." Equipped with all the latest tools and machinery for making bicycles, parts, accessories and skates, the new 110 000-square-foot (10 219-m^2) plant at Weston (just outside Toronto) was opened in 1917. Despite the war, business was so good that within two years an additional 35 000 square feet (3251 m^2) of space had to be added.[216]

From this time until the late 1960s, CCM grew and prospered. Even the Depression years were far from disastrous for the company though, if industry-wide figures are any indication, both production and employment fell significantly between 1930 and 1933.[217] By 1937, production had recovered to such an extent that the company's



Interior of the Premier Cycle Shop in Calgary, Alberta, 1913. CCM cycles and parts are prominently displayed in this shot. (Source: Glenbow Archives, Calgary, Alberta. NA-2718-1) directors decided to add another 20 000 square feet (1858 m^2), beginning almost a decade of regular expansions (1940–42, 1943, 1945 and 1946) of the plant and its capacity to make bicycles, as well as a number of war-related products.[218]

After 1945, CCM faced a number of challenges. The company's workers, many of them veterans, fought hard for and won the right to unionize. Local 28, United Auto Workers, was certified in January 1947 after an acrimonious campaign in which the company resorted to firings and other forms of intimidation to convince employees to oppose the union. In the immediate post-war period, many Canadian businesses had to cope with newly militant workers organizing to demand fair compensation for their wartime sacrifices and more control over their working lives.[219] According to at least two sources though, CCM found it more difficult than most companies to accept the existence and role of the union in their factory. This attitude set the tone for labour-management relations in the short- and long-term.[220] Negotiations for the first contract went to conciliation and, when the company rejected the conciliation board's majority report, ended in a two-week strike. In late 1951, after eight months of fruitless negotiations, Local 28 again walked out, this time for more than two and a half months in the dead of winter. There was a third strike in 1966 that lasted about a month and then there was relative labour peace until the fourth and final strike of 1982. But even when peace prevailed, relations between the company and its workers seem, for the most part, to have remained mistrustful, strained and unfriendly.[221]

In addition to labour strife, CCM also had to adjust to a newly competitive bicycle industry. At the beginning of the war, there were just five cycle manufacturers in Canada — CCM and four others, one of which, Standard Cycle Products Limited, was probably owned outright by CCM.[222] By 1947, the Dominion Bureau of Statistics recorded 9 makers and two years later the list had grown to include 13 companies. Two factors contributed to the expansion of the industry: excess manufacturing capacity developed to supply wartime needs and a sharp rise in demand for consumer goods of all kinds after the war. Though information on the companies listed by the Dominion Bureau of Statistics is sketchy, it seems likely that some of them had been set up to serve wartime manufacturing needs and, once the war was over, needed to redirect their productive capacity. At the same time, Canadians were freed from the constraints of rationing, wage controls and other forms of regulation and wanted to buy new things, including cycles. In 1946, the seven domestic makers increased production by over 10 000 and still could not meet demand. As a result, imports rose from 3316 to 21 629. The next year Canadian manufacturers made 90 644 cycles, about 5000 more than in 1946 and foreign imports rose to a new high of 51 912. After nearly 50 years, the bicycle business once again looked like a good place to be.[223]

While demand was high, by 1949 the profitability of the industry was, according to CCM, being threatened by the monetary policies of the British and Canadian governments. Huge debts incurred during the war caused a series of exchange crises in the late 1940s forcing the British to devalue the pound and the Canadian government to conserve its supply of US dollars. Essential materials purchased south of the border were automatically 10% more expensive, while bicycles imported from the UK became significantly less expensive. In the opinion of the president of CCM, G.S. Braden, this amounted to "the most serious crisis" in the history of the industry.[224]

In fact, the situation was not nearly as bad as Braden wanted his employees to believe.[225] For all the challenges that faced the company, it was still in an extremely strong position. It had the largest and probably the most up-to-date plant in the industry. Its managers, workers and dealers knew more about making and selling cycles than any of their Canadian competitors and it had established trademarks that gave its products visibility and status in the marketplace. Also, while it complained about the unionization of its workforce, it benefited from the fact that Canadian workers were generally better paid and had more leisure time as a result of collective bargaining and, thus, were more likely to buy bicycles than their non-unionized contemporaries. Finally, high post-war demand for consumer goods hardly had time to slow down before the baby boom greatly expanded the market for children's and juvenile cycles, an area in which CCM already had immense experience.

So even while the industry as a whole contracted after 1950, Canada's premier maker did remarkably well. (By 1956 there were again only five cycle manufacturers listed by the Dominion Bureau of Statistics and production had just climbed back to around 100 000 from a low of 71 000 in 1954.) In 1950, CCM's parent company, Russell Industries, recorded a net profit equalling $2.31 a share, an increase of $0.27 over 1949, and announced that it intended to buy John Bertram and Sons, a machine-tool maker based in Dundas, Ontario. The same year, the company established sales representatives in a number of distant locations including China, Mexico, Argentina, Hong Kong, the Dominican Republic, Sweden and Germany. By the end of the decade, with only four companies manufacturing cycles in Canada, production reached a new high of 134 987. It is safe to assume that the largest portion of this output came from CCM, still by far the industry's dominant maker. Based in large part on this performance, the company renovated and retooled the Weston plant. Upgrades continued up to 1960 and the company remained profitable into the 1970s.[226]

In the mid-1970s CCM began to stumble and by 1982 it had collapsed. Many factors contributed to its demise. Some, like economic instability, high interest rates and the level of foreign competition[227] were largely beyond its control. Others, such as declining product quality, abandonment of a long-established and successful marketing policy, poor union-management relations and failure to modernize the Weston plant, were the result of decisions made by CCM's owners. Based on the evidence available, internal problems began in the late 1960s when the company was absorbed into larger and more ambitious corporate conglomerates. Levy Industries, which purchased CCM's parent, Russell Industries, in 1962, was a complex of manufacturing concerns. Seaway-Multi Corporation Limited, however, had been in the hotel business until it purchased Levy in 1968 as part of an aggressive expansionary drive into a number of new fields, including manufacturing.

Convinced that the market for leisure-time products held huge growth potential, Seaway had big plans for CCM, including new lines of leisure equipment and a new state-of-the-art factory, twice the size of the Weston facility, to be located near Stouffville, Ontario. Unfortunately, the conglomerate had taken on too many interests too quickly and the new factory, along with other development schemes, never made it off the drawing board. More significantly, control of Seaway reverted to the Levy brothers in 1970, but only after an ugly corporate battle with Seaway's other directors. Less than 18 months later, the Levys decided to sell Seaway but changed their minds at the last minute, landing them in the middle of yet another messy legal action.[228]

While all these power struggles were going on, the cycle business was changing dramatically, as the ten-speed, environmental and health concerns and the energy crisis revived interest in the bicycle. Despite the owners' apparent preference for building empires instead of bicycles, CCM initially kept pace with these changes by introducing "a tough, popular-priced racing bike called the Targa," that, by 1973-74, had won them a good share of the booming Canadian market. But with every boom comes increased competition and this one was no exception. The number of Canadian makers and foreign imports grew, as they had in the 1890s. Many of the imported cycles were cheap models — from $10 to $50 — originating in Taiwan and Eastern Europe and these found a ready market in Canada.[229]

As intense as it was, foreign competition alone did not bring Canada's premier cycle maker to its knees. During this same period, CCM's owners made several decisions that lacked foresight and undermined the good reputation of their products, making it difficult, if not impossible, for them to hold on to or expand their share of the market. Buoyed by the success of the Targa and booming demand generally, the company stepped up production to the point where, according to employees, quality control could no longer be maintained. Workers were being asked to make more and more bicycles using equipment that was badly outdated and constantly in need of repair.[230] It did not take long for the quality of CCM bicycles to deteriorate noticeably.

To market this big new inventory, CCM turned to department stores that promised large-volume sales in exchange for special low prices. The small retailers that had been the backbone of the company's sales network for over 70 years could still carry the products but had to pay higher prices for them and thus could not compete with major companies like Eaton's. Combined with declining quality and slow deliveries, this pricing policy alienated most of the company's loyal dealers for good. For buyers, the new policy meant that service was not necessarily provided at the place of purchase, another longstanding and popular tradition with established makers and one maintained by firms such as Raleigh.[231]

In addition to angering its loyal retailers, this new mass marketing scheme also cost CCM a great deal of money, money that could have been spent upgrading the antiquated Weston plant. The directors seemed intent on taking as much profit as they could from the boom market, perhaps hoping that, if it succeeded, the strategy would supply the funds to retool and renovate down the road. But it did not succeed. CCM could not sell its output because the market for higher-priced cycles had peaked and because buyers quickly became aware of the deficiencies of the new CCM products. Even their slick advertising and well-known trademarks could not sell shoddy products to increasingly sophisticated consumers.

By 1976, instead of profits at year-end, losses had become the norm at CCM. The company brought in a new management team to find out what had gone wrong and they immediately took steps to control and repair the damage. They began talks with the union,[232] cut production, re-established quality controls, laid off over 400 workers (from all plants) and began to research and develop new products. With several years of losses built up and a $6 million fire at the St Jean, Quebec, plant, though, these measures were not enough. CCM also needed major support from the federal government in the form of higher tariffs on imported cycles and multi-million dollar loan guarantees to keep it afloat. At stake were more than 1500 jobs and a high-profile Canadian company and the government definitely wanted to help. After investigating import trends,[233] the government imposed anti-dumping charges on Taiwanese products in 1977. At the same time, it entered into lengthy negotiations with CCM to come up with a viable restructuring plan, part of which involved the sale of both divisions of the company to new owners.[234]

With the restructuring plan, new owners and guarantees totalling $10.4 million and an additional $4.9 million in direct government funding in place, CCM began the long climb back to profitability. Early signs were encouraging; the company sold about 250 000 bicycles in 1977. By 1981 managers were boasting that sales had more than doubled over the previous three years, reaching over $70 million for the year ending 30 September. Losses, though, continued to mount and in 1982 the company went looking for more money. To encourage confidence in the company's profitability and make it more appealing to investors, the managers asked the workforce to take what amounted to a 34% pay cut. They refused and went on strike in the summer, eventually winning small wage increases, but most never went back to work. CCM was placed in receivership in October 1982 and after a three-month search for a refinancing package, was declared bankrupt in January 1983.[235]

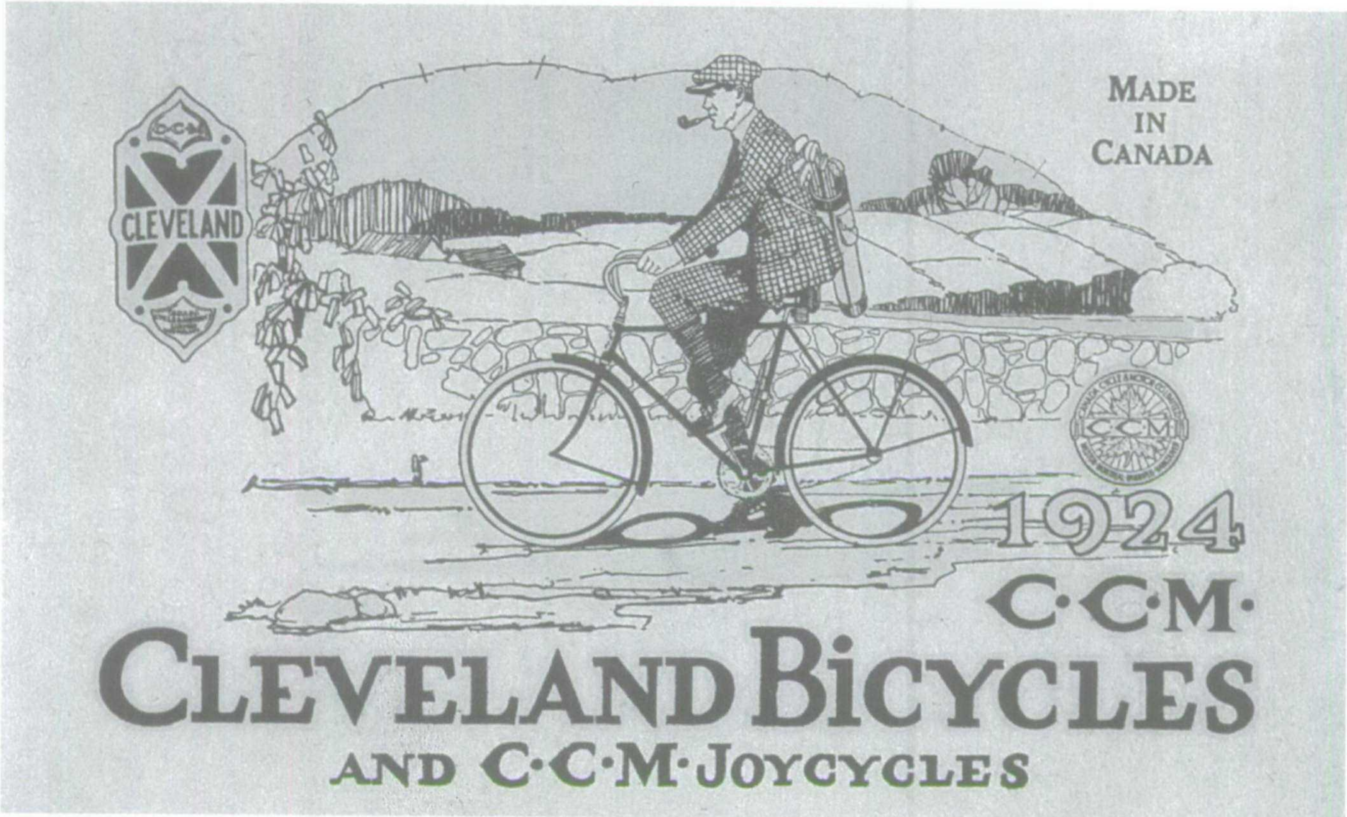
The company owed many people, including Canadian taxpayers, money — its debts totalled $54 869 033.33 — but only the secured creditors, that is the Royal Bank of Canada, got any (they received partial payment from the sale of the company's remaining assets to Procycle for $8 million). The Canadian government received none of the $17 million it had contributed. The people who suffered most, however, were the former and current employees. Largely shut out of the bankruptcy discussions, it took nearly two years for the workers to find out that the company had failed to pay into their pension fund for the two and a half years before its demise, in blatant contravention of Ontario law. As a result, the fund was short more than $2 million and employees and pensioners were told they would either get a reduced pension or, in the case of those with less than ten years' service, none at all. For those who had been employees at the time of the bankruptcy there was no severance package and they had to look for new jobs in the middle of a serious recession. The pension debacle raised serious public concerns about pension funds and how they are regulated and protected in the event of bankruptcies, which at the time were all too common. The one positive outcome of the whole CCM tragedy was stronger legal protection for other Ontario workers' pensions.[236]

Making Canadian Cycles, 1900–1980

In some ways, bicycle making did not change a great deal after 1900. It was still a labour-intensive process involving much cutting, drilling, machining and shaping of steel. The basic steps were still the same, including the time-consuming work of assembling wheels, and brazing, assembling and finishing frames, which remained largely manual jobs. Most improvements seem to have been made in the machinery and processes used to carry out these steps and even these changes took place gradually. For example, in a series of photographs taken at the CCM plant in the 1930s, it is hard to find obvious differences from a well-equipped facility of the 1890s. The newer plant seemed more spacious and well-organized than many earlier ones but, with the exception of the enamelling, steel-treating and automatic machinery departments, each tool, station or machine was operated by one person — wheels were assembled and frames trued one-at-a-time by a worker using a manual device, parts were inspected and measured for precision by women using simple gauges and later polished singly or in small groups at a series of finishing stations.[237] The company, of course, claimed that there had been significant advances made in the precision of the parts they produced and in the overall quality of their bicycles since (and as a result of) World War I.[238]

By the end of the 30s, CCM had adopted at least two new processes in its bicycle operation. Probably following the British industry's lead, they introduced chromium plating for the bright parts of their cycles such as hubs and cranks. This process, which involved electroplating components with a coat of nickel and then one of chromium, provided a much more durable and rust-resistant finish than simple nickel-plating.[239] Around the same time, the company expanded the factory, added steel-grit blasting equipment for cleaning the frames and forks of their cycles, and improved enamelling ovens and automatic screw machinery. In 1940, a new engineering department was established along with the first machinery in Canada to make steel rims, which up to this time had been bought from outside suppliers.[240]

It was in the years immediately following World War II, however, that the most substantial changes



Cover of a CCM bicycle catalogue from 1924, highlighting the Cleveland *label that belonged to Gendron before the merger of 1899. (Source: NMST, Canada Cycle and Motor Company* Cleveland Bicycles and CCM Joycycles 1924*)*

were made to the Weston plant. During the war, CCM had been given war contracts "of a highly technical nature" by the government. According to the company's official history, management decided that the best way to fill these was "to develop new manufacturing methods, skills and processes" instead of just "expanding plant and facilities." As a result of this decision, the company gained new expertise and, immediately after the war, set about applying it to making bicycles. They completely redesigned the plant layout "to permit the use of straight-line production methods," and installed the latest high-speed automatic machinery. This equipment was clearly more sophisticated than that shown in the earlier photographs. One screw machine, punch press or turret lathe operated by one worker could turn out many more pieces in much less time, and with a minimum of supervision. And the automatic chromium-plating system, with its conveyor, tanks and separate generator, looked nothing like the plating plant of the 1930s with its open tanks and manual delivery system. As always, assembly and finishing remained largely immune to the effects of automation. Brazing, truing and assembling frames were manual operations though cleaning and enamelling were more automated than before. Wheel assembly, truing, decorative painting and final assembly of the complete cycle were also done without the aid of any very sophisticated machines.[241]

Changes continued into the 50s, in spite of some instability in the cycle market. By 1952, CCM had adopted low-temperature silver brazing, which produced a lighter and stronger joint and weakened the tubing less. The company claimed that this process, called "resilobrazing," was exclusively theirs, but silver brazing was being used by makers in Britain as early as 1950.[242] Around the same time, the company equipped the Weston plant to apply a new type of finish to its cycles. Called bonderite or bonderized enamel, this finish required an elaborate series of carefully timed and temperature-controlled rinses and treatments of frames and forks prior to enamelling. The end result was improved adhesion of the enamel to the steel tubing and superior resistance to rust and corrosion. By 1955, the company had also installed a special device to true wheels, again claiming it as an exclusive CCM invention. Built by Bertram and Sons according to CCM's specifications, it took a strung wheel (rim, hub and spokes) and automatically tightened all the spokes at once to an even tension. Workers still had to do a quick hand truing to insure precise alignment but they no longer had to tighten each spoke individually with air guns.[243]

Between 1955 and 1959, the owners undertook what may have been the last major renovation of the building and inside plant. According to Humber and Rush, the changes arose from the need to accommodate a new, state-of-the-art Ransberg enamelling system. This fully automated machinery helped to speed up the process of finishing cycles considerably. The extent of the changes made at this time was significant based on a comparison of the insurance map completed in February 1955 and Alec Gowen's hand-drawn diagram and photograph of the plant showing the additional floor space and new layout of machinery.[244] Though some sources suggest that further improvements were made throughout the 1960s and into the 1970s, Alec Gowen remembers only minor changes and upgrades for the most part. And given the general consensus that the Weston plant was antiquated by the mid-1970s, it seems unlikely that there had been a major retooling or renovation effort during the previous ten years. Production technology in the era before robotics and computer-controlled assembly lines did not evolve that quickly.[245]

Until the 1970s, CCM had taken great pride in its well-equipped plant, which was a symbol of its long-term dedication to "the constant improvement of its bicycles." Even in its darkest (at least until its collapse) hour after the first great bicycle boom collapsed, the company felt it had "to maintain its own drafting, research and engineering divisions," despite the enormous cost of doing so. It was these divisions that came up with and implemented new designs and special features for CCM cycles.[246]

From what we know of their work, these engineers and designers were not great innovators. According to Canadian patent records, for example, 10 patents relating to cycles were awarded to CCM, all between 1923 and 1959. Of these, only one was for a complete bicycle, the 1936 Flyte (Canadian patent no. 358849). The others were for components such as coaster brakes, pedals, axles and bottom brackets. For the most part, Canadian cycle makers seemed content to follow developments elsewhere and then pick and choose which new features to adopt.[247]

This conservative approach is understandable. The basic form of the diamond-frame safety had been around since the 1880s and by the mid-1890s had been refined to the point where no really radical improvements were necessary. So after 1900, most bicycle patents were for materials or components. When the Canadian industry was first established, everything had to be imported, either from the US or Britain, and, even after domestic makers had established themselves, many continued to look to these countries for the latest trends in cycle building. This approach was reinforced when the domestic bicycle market collapsed and the remaining companies focussed most, if not all, of their energy and resources on survival. They could not afford to invest much money in research and development. Thus, though CCM added features such as coaster brakes, cushion frames and flush joints during the first years of the 20th century, these had all been introduced elsewhere previously and so were not risky innovations.[248]

Once the bicycle business began to grow again, CCM maintained its relatively cautious attitude towards change. Its policy seems to have been based on the belief that to be profitable in the small Canadian market, it had to make good, sturdy, reliable bicycles in styles and sizes to cater to as many users as possible. The core of its product line was a fairly basic type of bicycle with a few standard features, a selection of frame sizes and colours with lots of accessories and upgraded equipment available by special order. In 1918, for example, CCM's basic model was the Roadster. Dealers could order it in men's or ladies' models, with different frame sizes, grade A or grade B equipment, and bearing one of four labels — Massey, Red Bird, Perfect or Cleveland. There was a small selection of enamel colours available as well. Standard equipment included coaster brakes, wooden rims fitted with double-tube Dunlop tires (guaranteed for 12 months) and mud guards (and chain and skirt guards on ladies' models). CCM's 1920 and 1921 catalogues offered a similar range of models and features.[249]

In 1931, CCM offered 15 models, ten of which followed the same basic pattern as the Roadster. The designers had made a few cosmetic changes — a different shape of handlebars and a curved top tube on men's models — but the only significant improvement was the inclusion of steel rims as standard equipment. By 1940, there was a larger variety of models, including some that incorporated the latest American design feature, balloon tires. Standard equipment remained essentially the same though the Sturmey-Archer Tri-Coaster Brake, a 3-speed hub gear, could be installed on any CCM cycle for an extra charge. Similarly, dealers and buyers could order calliper hand brakes. These had to be imported from England.[250]

Though rare in the 40s, speed gears and hand brakes became increasingly common on Canadian-made bicycles in the 1950s. CCM's 1950 version of the Sports Roadster came with one of four different types of hubs — coaster brake, fixed and free-wheel, three-speed hub or three-speed Cyclo derailleur gear. The latter three came with hand brakes. By 1954, the company was carrying 4 and 5-speed Benelux derailleur systems and by 1958, it offered at least eight different types of speed gears. Of the 43 models offered to dealers in 1963, 20 of them came with three-speed gears as standard equipment and, three years later, the company built two ten-speed models. By 1977, dealers could chose from around 14 multi-geared cycles, most of them five- and ten-speed models.[251]

Another notable improvement in CCM's basic cycle models during this period involved weight. Until the 1950s, North American bicycles were heavier than British and European ones. Across the Atlantic, where the cycle was seen as a serious form of adult transportation, riders demanded cycles that, in spite of being fully equipped, were light and sturdy. Here though, since most North American adults were only recreational cyclists, makers and riders cared less about extra weight than they did about comfort and stability, which the heavier models certainly delivered. As a result, most minimally equipped Canadian bikes weighed substantially more than a fully-loaded British one.[252]

By the 1950s, though, makers in Canada and the US had begun to see the virtue in lightness. Their belated awakening was probably caused in part by the sharp rise in British imports after the war.[253] North American cyclists clearly liked this type of vehicle and so makers here decided to produce their own versions of it. CCM's 1952 catalogue clearly reflects the movement towards lighter cycles. The men's Sports Roadster, for example, appeared in its new lightweight incarnation, weighing in at 31.5 to 35.25 lb (14.28 to 15.99 kg), depending on which frame size and gearing system was included. The ladies' model weighed between 32.5 and 36 lb (14.74 to 16.32 kg). The Standard Roadster for men weighed between 37.5 and 37.75 lb (17.01 to 17.12 kg). Moreover, the weight of each cycle was displayed prominently along with the other information relating to each adult model, something that had not been included in catalogues up to this time. As well, this catalogue contained a whole page of what it called racing hubs made of special alloy steel, Duralumin and Hiduminium and with hollowed axles. Most of these alloy hubs were imported, but CCM did make its own lightweight steel hubs. The trend toward lightweight design continued into the 60s and 70s and was reinforced by the introduction of ten-speed bicycles based on European racing/touring models.[254]

CCM, like most large manufacturers, knew that catering to the adult cycle market was not nearly enough to keep it going. It also focussed its attention on other groups in society that might want a relatively cheap and easy-to-use method of transportation. It designed and made special-purpose vehicles such as heavy-duty bicycles for tradesmen and shopkeepers. Dating from before World War I, most catalogues carried at least one model of this type. The 1937 Delivery model, for example, looked much the same as its earlier precursors, with a strong tubular carrier structure supported by the frame rather than just the handlebars, special wide tires and matching mud guards with double braces holding them in place. Unlike older versions of this vehicle, though, the frame of the 1937 model was made of chromol tubing to reduce its overall weight. Schwinn took credit for introducing "the first practical factory built delivery bicycle," to Americans in 1939 and, though it had some features that CCM's model did not, it certainly was not nearly as original an idea as the advertisements claimed.[255]

Another obvious market was children. As early as 1916, CCM offered smaller versions of many of its basic adult models. In the early years, the only discernible difference in the catalogue descriptions was the size of the frames and wheels. For example, the Massey Juveniles model for either boys or girls had a 16-inch (40-cm) frame, as opposed to 20-, 22-, 24- and 26-inch (50-, 55-, 60- and 66-cm) frames for men and women. As pictured in the catalogue, the girl's bike, except for a few minor equipment details, appears to have been an exact replica of the ladies' vehicle above it. CCM continued this approach of making small versions of adult bicycles for their younger customers into the 1960s.[256]

CCM also made racing bicycles from the 1920s until the 1970s, even though the potential for sales was limited. The company had sound promotional and technological reasons for pursuing this line of cycle manufacture. Cycle companies had long used racing as a way of promoting their products, of showing the cycling public just how expertly they were designed and crafted. Racing was also an excellent way to test out new features, materials and designs. In spite of these benefits, not many makers in North America were interested in building racing cycles — in the US, Schwinn claimed to have reintroduced American-built racers in the mid-1930s — so CCM was very much a pioneer in the field. And if national and international championships are any indication, their Flyer was a huge success.[257]

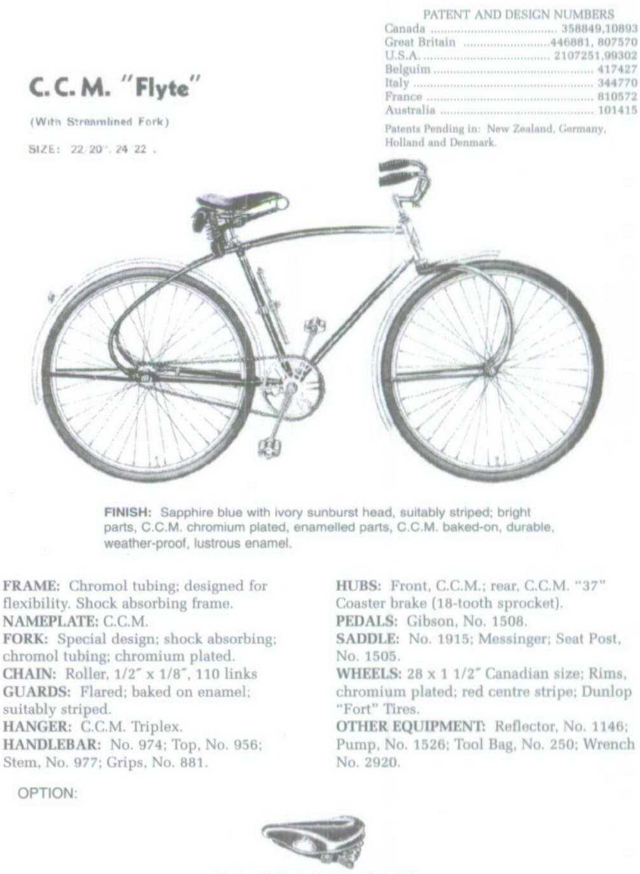
From time to time, despite its generally conservative approach to cycle making, CCM did incorporate interesting innovations into its products. Some of these were serious attempts to build better bicycles. The most radical departure from traditional cycle design was the CCM Flyte, a streamline-styled adult model introduced in 1936. Covered by a series of international patents, this bicycle had a curved front fork made of chromol tubing, as well as curved seat stays at the rear. Though this design probably owed something to the latest American design craze led by Schwinn's 1934 Aerocycle, it

William "Torchy" Peden, one of Canada's most distinguished racers aboard his CCM Flyer, *ca 1930. The company used Peden and other famous racers to promote its products to racers and casual cyclists alike. It also sponsored numerous racing events. (Source: NMST)*

was much less a flamboyant marketing ploy and a more honest attempt to produce a more flexible, shock-absorbing frame. CCM also produced a model with a standard fork and chromium-plated truss called Flyte 8. Neither of these models was successful — the one with curved fork was particularly difficult to steer — though they remained in the catalogue until at least 1940.[258]

Other innovations, though less dramatic, proved to be of lasting importance. Speed gears and lighter frame designs, which CCM began offering in the 1950s, greatly enhanced the usefulness of bicycles for practical transportation purposes. Also, because of its interest in racing cycles, the company experimented with different types of tubing. CCM built its 1927 Flyer, for example, out of butt-ended tubing and the 1931 version out of what it called "double butted aeroplane seamless steel tubing." An obvious advertising ploy, the use of the word aeroplane was probably intended to suggest modernity, lightness and speed. CCM also used newly developed steel-alloy tubing, which it referred to as either chromol or simply alloy tubing. The Flyte, the Custom Built Professional Racer and the Delivery models were among the first, if not *the* first, North American cycles to be made with this lighter tubing. The name chromol suggests that they were using Accles and Pollock's chrome molybdenum, which makes sense since they had been buying tubing from this company since about 1911. Apart from alloy frame material, the racing model also had special hubs made with aluminum shells and swaged spokes for lightness and could be ordered in short or regular frame design for different types of racing.[259] Until quite recently, both butted and alloy tubing were reserved for racing, custom-built and other very expensive models.

CCM also introduced Canadians to some new cycle styles. These did not offer improved technology but were essentially aimed at making bikes more appealing to consumers. The Motorbike model was first introduced around 1918 (eight years after it had proven its popularity in the US) and had long, wide handlebars, two top tubes and, on later models, chromium-plated fork trusses. All these extra stylistic flourishes added weight to an already heavy



CCM's Flyte *bicycle of 1938. One of the company's few truly innovative designs, the* Flyte *was protected by Canadian and international patents. It was not a commercial success and the company removed it from their catalogues after only a few years. (Source: NMST, Canada Cycle and Motor Company,* CCM Bicycles *1938)* machine. The construction made it look more like a motorcycle and since this was the aim, the extra weight was not considered a problem. It seems to have been a fairly popular model in both adult and juvenile versions and remained a fixture in the annual catalogues until the 1960s.[260]

Another design feature that CCM adopted from American makers, who had apparently borrowed it from the German industry, was the balloon tire. According to Schwinn, they introduced balloon tires in the 1930s to improve the overall quality of bicycle tires, which was notoriously poor in the US, and to add an interesting and marketable feature to its emerging automobile-inspired designs. CCM's balloon-tired bicycles were far more conventionally styled. In 1940 they offered men's, ladies' and Motorbike models with 2-inch (5-cm) tires, but none were specifically built for children and, apart from the tires, there were few differences between these vehicles and the regular roadster models. Like the Motorbike style, balloon-tired bicycles were a regular feature in CCM catalogues until the 1960s.[261]

Around 1966, CCM began making yet another American-style cycle, this time one aimed exclusively at youngsters. Generically known as the chopper, probably because of its resemblance to Harley Davidson motorcycles, this model had extended forks, high-rise handlebars, smaller than standard wheels, and a long narrow saddle called a banana seat. Some models had smaller front wheels, hand brakes and gears, usually controlled by a stick shift on the top tube. A few, like the 1974 CCM Marauder, had innovative frame designs, in this case called "wedge" style. This type of cycle, which was probably introduced by Schwinn in the early 60s, was enormously popular, especially with boys despite (or perhaps because of) the fact that it was unsafe and inefficient to ride.[262]

At least one European design became popular in Canada in the 1960s and 1970s and has remained popular to this day. The multi-speed touring cycle with drop handlebars, derailleur gearing, narrow tires and light construction was based on road-racing bikes that had long been familiar to enthusiasts around the world. With the increasing availability of high-quality, lightweight precision parts like gear sets, hubs, cranks and frames, it became practical for non-specialist makers to put together relatively high-grade ten-speed bikes for the burgeoning market. For CCM, it meant that more and more of the parts they used were imported — names like Shimano and Sun Tour appeared often in the specifications for its 1977 multi-speed models — a trend that no doubt would have continued had the company survived beyond 1982.[263]

Canadian Makers and the "New" Cycle Industry

The cycle industry, like manufacturing generally, has changed enormously in the last 30 years. In the late 1960s and the 1970s Western industrialized nations that had built viable manufacturing sectors began to lose ground to developing nations where wages were low and worker benefits and legal rights were virtually non-existent. At the same time, many manufacturers in the West also failed to keep pace with manufacturing innovations —time-, labour- and material-saving production technology. By the end of the 70s, the cycle industry was just one of many ill-equipped to compete with the low-priced foreign products that began flooding its once secure domestic market.

The market for cycles also evolved rapidly after 1970. The ten-speed craze and BMX and mountain bike movements not only ushered in a whole new range of designs, components, materials and processes; they also created new groups of sophisticated consumers. These people demanded purpose-built bikes with very specialized equipment, which were designed and built primarily by firms that do little other than research, develop and market high-grade components. Even the majority of cycle buyers, who were generally less discerning than serious cyclists, often wanted bikes that at least looked like the latest high-tech dream machine, even if they cost a great deal less. Intense international competition has made it difficult, if not impossible, for any one maker to meet all of these demands effectively. By the 1980s, companies like CCM and the American giant Schwinn (which had once prided themselves on making a bike for everybody — from toddlers to professional racers — and making them with parts and components produced in their own factories or at least purchased from domestic producers), were a thing of the past.[264]

As a consequence of these and other factors, the cycle industry has taken on a new character. The dominant players are now mainly companies based in places like Japan, Taiwan, China and South Korea. Though some of these makers produce complete machines, they generally do not make the components that go with them. Most of what they build is aimed at export markets in the West and these manufacturers do not seem to make or market their own brands of cycles. Instead, they make products to order for other makers, assemblers, wholesalers and retailers. Customers can buy finished or unfinished main frames, frames and forks, or complete cycles. They can specify everything from the type, size and configuration of tubing, to which, if any, component sets they want. The China Bicycle Company (CBC), for example, is the largest exporter of bicycles in China and is currently capable of making 1500 units per day. While the majority of these are probably aimed at the popular market, the CBC also makes cycles for such well-known and respected makers as Specialized and Diamond Back.[265]

The components industry is also dominated by a few major manufacturers. The largest component maker is Japan's Shimano, which, though established in the 1920s, rose to prominence in the 1970s by supplying an increasingly large proportion of the derailleur systems used on ten-speed bikes around the world. Based on this success, it expanded into complete component sets and now manufactures its goods in several countries. Other well-known names include Campagnolo, an Italian company known for supplying the makers of fine European racing and touring bikes, Sachs, a German maker of high-quality components, Simplex, an early French maker of derailleur systems and Sun Tour, the brand name of Japan's Maeda Industries, another long-established maker of derailleurs and related components. Together, these components manufacturers produce millions of parts every year, with a wide price and performance range. Both Shimano and Campagnolo, for example, make some of the latest precision-designed and engineered components for racing and other high-grade cycles. But both companies also produce the much less elaborate and less expensive sets commonly found on popularly priced multi-speed machines. Most of the big components firms have, since the early 1980s, also developed lines of components specifically tailored to BMX, mountain bikes and other variants of the safety bicycle.[266]

In addition to these big manufacturers of cycles and components, there are numerous small- and medium-sized makers worldwide. Though it is difficult to say for certain, most of these builders do not seem to make their own parts or components and some do even not assemble their own frames. This allows them to buy the necessary pieces from a variety of outside producers who either specialize in a particular type of component or offer the best prices, depending on whether the company's priority is building a high-performance machine or a popularly priced bike. Many of these companies got their start during the early years of the BMX and mountain bike movements, when established makers did not respond quickly enough to the specialized requirements of these new sports. Though some, particularly mountain bike makers, expanded rapidly as a result of the huge and lasting popularity of their products, the successful ones seem to have remained specialists and have not branched out or tried to compete in other fields. Other companies are attempting to follow in the footsteps of the traditional "generalist" makers and by automating their factories (following the Taiwanese and Chinese examples), by copying the latest and most successful designs from around the world and by acting as makers and distributors for well-known foreign companies. The same pattern seems to hold true for smaller components manufacturers, some of whom have specialized in a limited number of pieces and others who make a variety of machined metal products, including a few bicycle components.

A third category of cycle makers is firmly within the artisanal tradition of the early mechanics and builders. Custom builders have always existed and continue to thrive today. Despite substantial technological advances in cycle production, bicycle parts are still essentially interchangeable. And with the large number of specialty parts and component makers in the field, builders can easily tailor each bike to meet the specific measurements, weight requirements and performance needs of the client. Many racers turn to these custom-builders to make their cycles; they can be relied on to adjust and refine their designs over time. These sorts of workshops where makers use delicately carved lugs and do all their brazing, welding, finishing and painting by hand are a far cry from the huge factories of the far east. In today's economy, none of these artisans are likely to make a lot of money building cycles. Yet the traditional skills they maintain and nurture not only provide a link with the bicycle's colourful past, but also remind us that these very practical and fast vehicles can also be works of art.[267]

The post-1970 cycle industry in Canada clearly reflects these trends and developments. The industry is largely made up of two types of makers: specialists who range from small custom builders to mid-size factory-based operations and larger, mass-market producers who employ many workers and produce a wide range of products. According to Anita Rush's research on the Canadian cycle industry, the vast majority of specialist makers began work between the early 1970s and the early 1980s to serve the booming markets for ten-speed racing and touring bikes and mountain bikes. The smaller specialist makers, of which there are about ten, all had strong connections to cycling before they entered the industry, either as racers and enthusiasts or through the retail, mail order and repair trade. Like small makers elsewhere in the world, they tend to make their frames from high-grade imported tubing and lugs and complete their machines with the very best components, again usually made outside of Canada.

The oldest of Canada's small cycle manufacturers is probably Bicycle Sport Limited of Toronto, which was founded by English enthusiasts John Palmer and Mike Barry around 1970. They began making their Mariposa cycles in a basement workshop using European frames and other high-grade parts. The business flourished and in 1979-80 they decided to start making their own frames, installing the necessary equipment to build and paint them. By 1984, they were producing about 100 bicycles per year, in single, tandem and special pull-apart models.[268]

Cycles Marinoni of Laval, Quebec, was established in 1975 by Giuseppe Marinoni, a former racer. Though mainly a frame builder — he makes about 1500 per year — he also offers complete bikes using Shimano and Campagnolo components to complete the package. Although he does not spend a lot of time and money promoting his products, they have a good reputation among cycle racing and touring enthusiasts. They can be found in a variety of Canadian cycle stores that specialize in high-performance machines.[269]

Makers that came to the craft via the retail, mail order and repair trades include Canadian Bicycle Specialists (CBS) and Carleton Recreational Equipment, both of Vancouver. These companies have been designing and custom-building frames since about 1981. The CBS operation is a combination of high-tech aids like computer-assisted design and a program that calculates exact mitre angles for tubing sections and traditional methods like "hand-crafted brazing and finishing." Within two years, their cycles were so successful that they got out of the retail and mail order business to focus on building. Information on Carleton is a little less reliable and less complete but it seems that they, too, custom-build racing and touring cycles, under the brand name Talbot, to precise specifications using high-grade imported parts and materials.[270]

In Ontario and Quebec, several retailers got into the business of making cycles during this period. Dave's Bicycle Repair of Newmarket, Ontario, claims to have designed and built the first Canadian BMX racing frame in 1982 based on "ideas about racing, nurtured by observation, study and testing." The next year, Cycle Bertrand, a Hull, Quebec, retailer, set up a subsidiary called Fabricycle Ltée to custom-build cycles for its store. As with other small makers, only the frames were made in-house. The components were all purchased from suppliers. Two Ottawa bicycle shops have also dabbled in the cycle-making business. Both Ottawa Bikeway and The Bike Stop have customized off-the-shelf models by adding special components to produce vehicles that can function more effectively in winter weather. Both have had or are in the process of having custom designs built for them. Bikeway, which went bankrupt in 1996, was known for catering to winter riders, the elderly, handicapped people, as well as avid road and off-road cyclists. The Bike Stop has followed much the same approach and its latest venture is a basic Roadster-style bicycle with a drop frame for less athletic, older and more timid riders. Based on the Roadster bikes of the 1930s and 1940s but made of light alloy and equipped with superior components, the designers hope that this vehicle will appeal to the growing number ageing baby boomers. It will be built in Taiwan where the designers have found a factory willing to adapt their production facilities to the unique frame style of this bike.[271]

The second group of specialist cycle builders is much smaller. Looking at Rush's work and a combination of other sources, there seem to be just three or four makers that qualify for this group — Sekine Canada Limited of Rivers, Manitoba, Cambio Rino Inc. of Mississauga, Ontario, Norco of Vancouver and Langley, British Columbia, and the Rocky Mountain Bicycle Company Ltd. of Delta, British Columbia. Like small makers, they tend to be wholly or mainly dependent on imported materials to build their high-quality products. Sekine Industries Limited of Japan set up a Canadian plant in rural Manitoba around 1972, which essentially built cycles according to designs developed by its parent company using mostly imported parts and components. In 1977, the company's 80 employees produced 50 000 bicycles and were hoping to benefit from the newly imposed tariffs on cycles imported from Taiwan and South Korea. Sekine was also looking for ways to increase the Canadian content of their cycles — they already used domestically made spokes, brake cables and some seat posts — and to reduce their reliance on increasingly expensive Japanese components. Despite a generally optimistic outlook, the Canadian branch of the company folded in 1983. According to Humber, the company wanted to begin making its own frames but found this impractical when the government lowered the tariff on imported bicycles in 1975. The saturation of the market for ten-speeds that contributed to CCM's failure may also have affected Sekine's profitability.[272]

Cambio Rino Inc. began building "high-end" bicycles in 1981 at its 80 000-square-foot (7432 m^2) plant in Mississauga. According to at least one source, all of the assembly but only some of the manufacturing was done there. It is not entirely clear from this source whether assembly meant building the frames, finishing pre-built frames or just adding components to completed frames. Though the company is not listed in the Canadian Trade Index or in current Toronto telephone books, Rush cites several published references to the company and its products and found it listed in telephone directories for 1983 and 1984 as "manufacturers of bicycles, parts and frames."[273]

Norco, located in Vancouver and Langley, British Columbia, is a mid-size Canadian maker. When it was initially set up in 1964 as Northern Cycle Ltd. it was only a distributor of cycles. In 1977, around the time that the federal government imposed tariffs on many cycle products imported from Asia, Norco decided to get into the manufacturing business. Since that time the company has produced over 500 000 bicycles and 2 000 000 wheels and especially prides itself on its "leading-edge mountain bike designs," its top quality production line equipment and overhead conveyors that insure "fast, efficient, quality manufacturing," and its "World Class (Holland Mechanics) wheel lacing and robotic wheel truing machinery." Like most specialist companies, Norco buys many of its high-end parts and components from makers around the world and puts them together to complement what they call their "hard-core 'Canadian' designs." With the continuing popularity of the mountain bike and the positive reviews its products have received from biking magazines, the company seems to be thriving, though like other specialist makers Norco may suffer if the government raises tariffs on imported parts.[274]

Another mid-size specialist company is the Rocky Mountain Bicycle Company Ltd. of Delta, British Columbia. It was set up in 1981 to serve the burgeoning market for high-performance mountain bikes. Like Cambio Rino, it combines some manufacturing work with what is primarily an assembly operation. In a 1996 article in *Pedal*, Joan Jones described the company's new facility where high-quality alloy frames imported from Taiwan are "checked for alignment, spot-welded if necessary, and sanded to perfection before entering Rocky Mountain's new powder-coating area." Though her description then focussed on one particular model of bike, it confirmed the company's reliance on various imported components to complete its bikes. Rocky Mountain does however get some of its critical components — handlebars, stems, cranks, headsets — from Race Face, a separate company "located in the same facility." Known for the quality and innovative engineering of their bikes, Rocky Mountain has grown with the popularity of the mountain bike. In 1995, it sold 15 000 bikes; 40% of which were exported to 14 different countries. Though they projected a 20% increase in sales in 1996, there may be trouble on the horizon as Canada's mass-market makers seek an extension of existing tariffs on cycle imports like the frames used by Rocky Mountain.[275]

Canada currently has three mass-market cycle makers, which, in 1995, had a commanding 76% share of the domestic market. These companies — Raleigh Industries of Canada Ltd. (a wholly-owned subsidiary of Britain's Raleigh Industries Ltd.), Groupe Procycle Inc. and Victoria Precision Inc. — all have their production facilities in Quebec. Like the generalist cycle makers of an earlier era, they each produce a full line of adult, juvenile and children's cycles and they make, finish and paint their own frames. They do not, however, make their own parts or components and, while they do try to buy from domestic (North American) suppliers wherever possible, most of their products have a more than negligible proportion of foreign content.

Raleigh has had a long and distinguished history in the cycle business dating back to the 1880s in Britain. Though its cycles have been available in Canada for over a century, the company only began manufacturing here in 1972 when they took over the Lines Brothers metal toy-making facility in Waterloo, Quebec. In 1995 the company claimed 28% of the domestic market with its wide selection of products and prides itself on being a "family bicycle company." They currently offer about 40 different cycles under their own brand names, which vary in price from $199 to $1100 for adult vehicles. Wherever possible, Raleigh tries to use North American materials and parts and still maintains its traditional policy of selling through independent dealers. The company also makes private-label vehicles for other sellers. Though employment and production levels vary on both a yearly and seasonal basis, the company employs between 200 and 400 workers who make 300 000 to 400 000 units annually.[276]

Victoria Precision Inc. began life in 1941 doing machine- and metal-work related to the war. After the war, it branched out into civilian production and, by 1953, was listed by the Dominion Bureau of Statistics as a cycle manufacturer. Though a 1972 article about Canadian bicycle makers described the company as a distributor of imported cycles, they now make cycles at their Montreal-area facility. Like Raleigh, Victoria Precision builds its own frames and assembles its cycles using both domestic and foreign components. They make a full range of models including children's tricycles, BMX, mountain and touring bicycles. It currently produces about 200 000 vehicles per year and in 1995 their share of the domestic market was 25%.[277]

Canada's third mass-market cycle manufacturer is Groupe Procycle Inc. of St-Georges-de-Beauce, Quebec. Established in 1981, Procycle acquired the assets of CCM in 1982 but, like Victoria Precision, it apparently did not initially manufacture its own products. By the mid-80s it was making "mostly low-end private-label bikes for major retailers such as Canadian Tire Corp. of Toronto and was hit hard by the sharp drop in popularity of 10-speed racing bikes." Losing money, Procycle's owners decided to change their approach. In the late 1980s and early 1990s they upgraded both their plant and their products. They also purchased the "international rights to make and distribute bikes under France's Peugeot and Look trademarks." Around the same time, the company developed a new frame sizing system based on the assumption the vast majority of the population can be accommodated using "just three reconfigured standard unisex frame sizes." This so-called "integrated sizing system" was intended to allow the company and its retailers to maintain much smaller inventories and to standardize parts. In its new, updated form, Procycle has become a major force in the Canadian cycle industry, supplying 23% of the Canadian market. The company also exports its products — about 10% of its 1995 sales were to the US — and is actively working to sell more of its cycles abroad.[278]

Despite their recent successes, all three of these cycle manufacturers face serious challenges in the years ahead. Foreign competition is still a major problem, especially where lower priced cycles are concerned. As in the 1890s, the boom market of the late 1980s and early 1990s encouraged expansion of the industry worldwide. Low wage, high-capacity producers in China and Taiwan had, by 1992, reduced the Canadian market share of the big three domestic makers to 37%. Like CCM in the late 1970s, they turned to the government for help in the form of higher duties on products from these countries. At the same time, they upgraded their facilities to reduce costs and improve the quality of their products and Raleigh and Procycle have placed increasing emphasis on export markets. As a result, by 1995, the three Canadian companies had improved their competitive position in the domestic market. Currently, they are lobbying for an extension of the tariff protection and for cycles from Thailand to be included in the legislation since makers in this country have emerged as a significant new source of low-priced products. But companies like Rocky Mountain, which depend on Taiwanese products, are opposed to any such extension. Meanwhile, all these enterprises must deal with the fact that the latest bicycle boom appears to be ending. This will mean that worldwide productive capacity will far outstrip demand, which, as before, will lead to more intense competition and then probably rationalization and greater corporate concentration. Who knows, we may even see another Canadian cycle industry merger like the one that created CCM.[279]

Notes

168. The same is true of the modern "industry" in Canada, where both large and small makers seldom manufacture complete cycles. Companies that cater to the large popular market generally import most of their parts or complete cycles from low-wage countries because it is much cheaper than making them here. Other firms that concentrate on supplying the specialist and custom-built demand need high-quality precision parts that are often made by only a handful of manufacturers around the world.
169. Dorothy Leurs claims that John Turner, an ironmonger and machinist, began making cycles in Toronto around 1860 and that an example survived and is preserved at David Willson's Sharon Temple in Sharon, Ontario. Dorothy Leurs, "Ride a Cock-horse," *The York Pioneer*, Annual Report (Toronto: The York Pioneer Historical Society, 1964) p. 70.
170. What little information is available on these two firms can be found in Anita Rush's "Directory of Canadian Manufacturers of Bicycles, Bicycle Parts and Bicycle Accessories, 1880–1984." For Fane see pp. 122–123, 189–190. For Semmens, Ghent & Company, see p. 390.
171. Rick Mannen, "A Fine Old Canadian Company: The Goold, Shapely & Muir Co. Ltd.," *Canadian Antique Power*, vol. 3 (September/October 1995) pp. 10–12.
172. The Canadian patent office's published records show Peter Gendron of Toledo, Ohio, as the original source of Gendron's first recorded cycle patent. See Canadian patent no. 33,628, 8 February 1890. According to the Canadian patent search (for the companies that formed CCM) done for the Museum by Brian Reynolds, Gendron registered 13 patents for cycle-related devices between 1890 and 1900. John Boyd Dunlop and the Dunlop Pneumatic Tire Company accounted for 11 and Massey-Harris had two, both dated 1897. All but the last two of these represent Canadian rights to existing foreign patents rather than original inventions. To be awarded Canadian patent rights, non-residents or their representatives simply had to manufacture the patented item in Canada within two years of applying for patent protection. Glen Williams, *Not For Export* (Toronto: McClelland and Stewart, 1983) p. 23.
173. Rush, pp. 199–201.
174. Merrill Denison, *CCM Good Sports. The Story of the First Fifty Years* (privately published, 1949) pp. 20–21.
175. Humber, pp. 50–51.
176. Denison in his history of CCM quotes the 1890 tariffs as having been 35% on items costing more than $100, 20% plus $15 on items costing between $50 and $100 and 20% plus $10 on items costing less than $50. It is unclear where he got this information and my attempts to confirm it and find out the extent of the 1895 increase through the National Library were thwarted by the failure of staff to respond to my repeated inquiries.
177. Merrill Denison, *Harvest Triumphant. The Story of Massey-Harris* (Toronto: McClelland and Stewart Limited, 1948) pp. 138, 152–153.
178. Basic information on Welland Vale can be found in Anita Rush's research notes held by the curator of land transportation.
179. See alphabetic listings in Rush for details on all of the companies named here except Massey-Harris, Welland Vale, Goold and Lozier.
180. It is not clear how many of these firms had fully equipped factories that allowed them to make most of their own parts.

181. Brantford Red Birds for 1896 advertisement, *Cycling*, vol. VII, no. 7 (February 27, 1896) inside cover.
182. "Massey Wheel a Certainty," *Cycling*, vol. VII, no. 7 (February 27, 1896) p. 185. Massey-Harris Company Limited, *Massey-Harris Bicycles*, 1899, n.p.
183. The first set of figures were reported in "Trade Gossip," *Cycling*, vol. VII, no. 7 (February 27, 1896) p. 196. The second comes from a large two-page advertisement in *The Canadian Wheelman*, vol. XIV, no. 10 (April 5, 1897) n.p.
184. Rush, p. 201.
185. Glance through any issue of *The Canadian Wheelman* or *Cycling* for example to find ads looking for agents or naming agents located across the country.
186. See advertisement in *Cycling*, vol. VII, no. 7 (February 27, 1896) facing page 192.
187. According to some estimates, Americans supplied 80% to 85% of the Canadian market for capital goods like machine tools between 1885 and 1900. Glen Williams, p. 25.
188. "Public Opinion a Mighty Force," Lozier advertisement in *The Canadian Wheelman*, vol. XV, no. 24 (November 3, 1898) n.p.
189. Miscellaneous trade notices, *The Canadian Wheelman*, vol. XV, no. 24 (November 3, 1898, n.p.
190. "The World's Greatest Bicycle," *The Canadian Wheelman*, vol. XVI, no. 6 (February 2, 1899) n.p.
191. "The Trade," *The Canadian Wheelman*, vol. XVI, no. 2 (December 1, 1898) n.p.
192. Massey-Harris Company Limited, *Massey-Harris Bicycles*, 1899, n.ps.
193. "Hints to the Novice Buyer," *Cycling*, vol. VII, no. 7 (February 27, 1896) n.p.
194. "Sculptors in Steel," *The Canadian Wheelman*, vol. XIV, no. 9 (March 15, 1897) n.p., and "The Trade," A Walk Through the Welland Vale Company's Factory, *The Canadian Wheelman*, vol. XVI, no. 2 (December 1, 1898) n.p.
195. Massey-Harris Company Limited, *The Massey-Harris Wheel*, 1896, n.p., see section entitled "Construction" following specific cycle descriptions.
196. "Canada's First Cycle Show," *The Canadian Wheelman*, vol. XIV, no. 9 (March 15, 1897) n.p. See item on E.C. Stearns & Co. See also The McCready Company Limited, *The McCready Bicycles*, 1897. This company claimed that its lap-forged joints were superior to "the flush joint which is being introduced into some makes of wheels," n.p.
197. Denison, p. 23 and Humber, p. 55. Unfortunately, neither of these authors indicated the source or sources of the statistics they provide.
198. In 1891, Canada's total population was 4 833 239. City or town dwellers numbered 1 537 098. F.H. Leahy (ed.), *Historical Statistics of Canada*, second edition (Ottawa: Department of Supply and Services, 1983) Table A67–69.
199. From what I can tell, much of the steel used by Canadian makers was imported from the US or Britain. Certainly all of the steel tubing came from foreign sources and the size of the Canadian market (unlike the American) never really made it worthwhile to produce tubing here, especially given the fact that cold-drawing was a relatively new and complicated process at the time. As for machine tools, the vast majority were imported from the US, though by 1897, at least one Canadian firm, MacGregor, Gourlay Company Limited, were manufacturing a turret lathe or screw machine in different sizes and with optional automatic feed. This type of lathe was one of the most common pieces of equipment used in the making of cycles. "Bicycle Machine Tools," *Canadian Engineer*, vol. 4, no. 9 (January 1897) pp. 269–270. Based on the general tendencies within Canadian manufacturing, it is probable that even domestically made tools like the MacGregor, Gourlay turret lathe were not designed or developed here but merely built based on patents that originated in the US. Glen Williams, pp. 22–29.
200. According to Harrison, the British lost the Canadian market almost completely to American makers because they refused to cater to Canadian demands for "a cycle free of gear-cases and other weighty accessories." p. 294. This seems to be supported by the advertisements in *The Canadian Wheelman* and *Cycling*, where US companies and their products are well-represented while British makers, with the possible exceptions of Humber and Raleigh, hardly appear at all. British steel tube manufacturers, on the other hand, are mentioned more often.
201. Massey-Harris Company Limited, *The Massey-Harris Wheel*, 1896, n.p., and "Canada's First Cycle Show," n.p., under heading "The Massey-Harris Co."
202. We Build Bicycles Exclusively. Lozier advertisement in *The Canadian Wheelman*, vol. XIV, no. 10 (April 5, 1897) n.p., and The R.A. McCready Company Limited, *The McCready Bicycles*, 1897, n.p.
203. "Trade Notes," *The Canadian Wheelman*, vol. XIV, no. 23 (October 18, 1897) n.p.
204. The Banner Cleveland Year, Lozier advertisement, *The Canadian Wheelman*, vol. XV, no. 24 (November 3, 1898) n.p.
205. See advertisements in *The Canadian Wheelman*, vol. XIV, no. 9 (March 15, 1897) and vol. XVI, no. 2 (December 1, 1898) n.p.
206. Massey-Harris Company Limited, *Massey-Harris Bicycles*, 1898, n.p.
207. President's Address to the Shareholders of Massey-Harris Co. Limited, 16th February 1899, p. 6 (photocopy), Ontario Agricultural Museum.
208. Massey-Harris Company Limited, *Massey-Harris Bicycles*, 1899, n.p.
209. Rush, p. 74.
210. Michael Bliss, *Northern Enterprise Five Centuries of Canadian Business* (Toronto: McClelland and Stewart, 1987) p. 337. According to Bliss, these men went looking for new investment opportunities in industries that seemed ready for rationalization and an injection of new capital.
211. Humber, p. 55.
212. Bliss, p. 337.
213. Denison, *CCM*, pp. 26–30; Rush, p. 74 and Humber, p. 58. While Denison carefully avoids any serious discussion of the financial mismanagement and litigation, Rush gives a fair bit of detail on this checkered period of the company's history. Her main source is the *Monetary Times*.
214. Denison stated that during these early years the company was in such dire financial straits that sometimes payrolls were hard to meet, salesmen worked without salaries, and shareholders "voluntarily turned over their stock as bank security for advances made the company." Denison, *CCM*, p. 28. The word "voluntarily" is, I think, open to some interpretation given the fact that these shareholders stood to lose their entire investment if the company was allowed to collapse.
215. Sales of the Russell automobile were also very good, so much so that overall production was doubled in 1910. In 1911, as the auto business took on greater importance, CCM became a division of the newly formed Russell Motor Car Company. This lasted until 1915 when the auto company was sold to Willys-Overland after two

very bad years brought on by production problems and economic recession. Hugh Durnford and Glen Baechler, *Cars of Canada* (Toronto: McClelland and Stewart Limited, 1973) pp. 84–97.

216. Denison, p. 37 and Canada Cycle and Motor Company, *Bicycle Accessories*, 1920, p. 2.

217. The Dominion Bureau of Statistics published an annual report on the Canadian cycle industry between 1926 and 1960. According to their statistics, output dropped from $1 962 947 in 1930 to a low of $712 624 in 1933. Employment fell from an average of 456 workers to 236 in the same period. Canada, Dominion Bureau of Statistics, Mining, Metallurgical and Chemical Branch, *The Bicycle Manufacturing Industry in Canada*, annual, 1926–1960. For a summary of some of the information collected in these reports, see Rush, pp. 162–175.

218. Denison, pp. 37–39.

219. See Bliss, pp. 455–456 for a brief discussion of post-war unionization and business reaction to it.

220. Humber, p. 60 and interview with Alec Gowen, former CCM worker and union activist. Mr. Gowen recalled that G.S. Braden (president from 1941), who had known him and his family for some time, would always greet him in a friendly manner whenever they met in the factory. After unionization he hardly spoke to him again except on official business.

221. For a detailed account of relations from the union's perspective see W. Devine, *The First Thirty Years. A History of UAW Amalgamated Local 28. 1947–1977* (Toronto: Local 28, United Auto Workers, 1977).

222. G.S. Braden was the president of Standard Cycle Products from 1947–1958. He was also president of CCM from 1942–1958. Rush, pp. 72, 403.

223. Dominion Bureau of Statistics, 1953, pp. C-4, C-6. These published tables include a wide variety of data on the industry including overall domestic production and number and value of imports. Unfortunately the import information is not specific to country of origin.

224. Desmond Morton, *A Short History of Canada* (Edmonton: Hurtig Publishers Limited, 1983) p. 210; Jay Pridmore and Jim Hurd, p. 133; J.M. Bumsted, *The Peoples of Canada. A Post-Confederation History* (Toronto: Oxford University Press, 1992) p. 277 and G.S. Braden, letter to employees, September 20, 1949, from private files of Alec Gowen.

225. The union believed that Braden's dire warnings were intended to frighten its members as they approached the next round of bargaining. There is some evidence to support this claim. In August 1949 the company had cut production and warned of possible layoffs because it had a stockpile of unsold cycles. Within a month it was claiming that it could not make enough vehicles to meet demand. See W. Devine, p. 14 and Braden letter. Also, the threat posed by government exchange policy seems to have been exaggerated. Far from increasing, imports actually fell dramatically (from 51 402 to 29 352) in 1949, while domestic production rose to a new high of 130 413. See Dominion Bureau of Statistics, 1953, pp. C-3, C-4.

226. Devine, pp. 16, 40, 42; Rush, p. 77 and Humber, p. 59. Both Rush and Humber suggest that major upgrades were undertaken by the company in the 60s and 70s. This assertion is based on a letter to the editor of *Bicycling News Canada* from M.A. Daly, in the fall of 1983, who stated that major upgrades were undertaken into the 1970s. But since the letter-writer gets some facts wrong and oversimplifies others, I am not convinced that this document is a reliable source of information especially since newspaper and other accounts of CCM's troubles in the late 70s invariable comment on the antiquated state of the Weston plant. See Alec Gowen's clipping files.

227. "In the 1960s and 1970s North America's strength in key areas of manufacturing began eroding. The slippage was twofold. Traditional labour-intensive production tended to locate in developing countries where low wages gave significant competitive advantage. At the same time, leadership in manufacturing innovation, particularly the development of high technology products and factory automation came increasingly from abroad.... From the point of view of North American producers, the source of the imports did not matter so much as the fact that wave after wave of them poured into domestic markets, flooding over the sandbars and seawalls of tariff and non-tariff protection." Bliss, p. 562.

228. Devine, pp. 39–40. Most of the information on Seaway-Multicorp comes from newspaper clippings in Alec Gowen's files. They were taken primarily from the Toronto *Star* and, though many have no precise dates, they were published between April and September of 1969. Information on the aborted 1971 sale of Levy to Security Capital Corporation comes from Devine and a Toronto *Star* article, "Rejection of takeover brings $115 million suit against Levy firms," from 14 April 1972.

229. Legge, "CCM: Goodbye to All That," *Bicycling News Canada* (Summer 1983) p. 30; Gordon Legge, "CCM takes the comeback trail," Toronto *Star*, 13 August 1977 and Canada, Department of Industry, Trade and Commerce, Import Analysis Division, *Bicycles*, March 1977.

230. The January 1982 volume of the union newsletter, "Local 28 UAW News," included a poem by Phyllis Waddell that described the poor state of the machinery at Weston. It read, in part, "With ole CCM/ In such bad repair/ You'd think that good tradesmen/ We just couldn't spare// The paint line for instance/ Is now running fine/ Those guys have remade it/ One part at a time// The rims on the rim line/ Now swing round the bend/ When not long ago/ They just fell off the end."

231. Humber, p. 59; Legge, "CCM takes the comeback trail," and "CCM: Goodbye to All That." Raleigh's dealer policy became an issue in CCM's proposal to buy the company in the summer of 1982. See "Raleigh breaks off talks with CCM, pledges tough fight in market," Jim Rennie's *Sports Letter*, vol. 6, no. 27, 5 July 1982.

232. According to several sources, talking with the union was a radically new idea at CCM. Until this crisis, communication was almost exclusively limited to collective bargaining and grievance discussions — both adversarial in character. Unfortunately, 30 years of mistrust could not be reversed in five years and so, despite the financial problems of the company, the union refused to accept wage cuts and went on strike in the summer of 1982. Humber, p. 60 and Legge, "CCM takes the comeback trail." Devine's history of Local 28 chronicles the first 30 years of the bargaining unit and only once mentions "some improvement in management-union relations." Devine, p. 44.

233. The results of this investigation can be found in Department of Industry, Trade and Commerce, March 1977.

234. Legge, "CCM takes the comeback trail," and Carey French, "Levy to sell troubled bicycle unit despite campaign on efficiency," clipping from unknown newspaper, 3 March 1978 in Alec Gowen's clipping files. Though the Levys denied it in this article and elsewhere, many believed that the federal government refused to get involved in

the bailout as long as they owned the company. The union was the only group that openly accused the Levy brothers of profit-gouging during their tenure as owners (and this after the company was declared bankrupt), but similar charges are now heard anytime the collapse of CCM is mentioned. See for example UAW spokesman Robert Nickerson's letter to Premier Davis, 10 January 1983 in Alec Gowen's files.

235. Rush, p. 78 and "CCM: Goodbye to All That." CCM was not alone in its distress. The late 70s and early 80s were dark years for many high profile Canadian manufacturers. High interest rates and foreign competition were major problems but so was the dominant corporate mentality that stressed ambitious expansion and making fast money, often at the expense of making quality products. Not long after CCM's demise, Massey-Ferguson, successor to Massey-Harris, received a massive government bailout in an attempt to save it from bankruptcy. It, or what little was left of it, survived but under a new name and with a US address. Bliss, pp. 457–458.
236. Alec Gowen's files contain copies of newspaper articles and correspondence with the trustees dealing with the pension scandal and the political reverberations it caused in Ontario and across the country.
237. Compare the photographs in CCM's 1931 or 1934 catalogues with the images in the 1897 Western Wheel Works or Humber catalogues. The similarities are remarkable.
238. Canada Cycle and Motor Company, *Bicycle Accessories*, 1924, "Making High-Grade Canadian Bicycles for 25 Years," p. 10. Because CCM changed the titles of their catalogues a great deal over the years, from this point forward I will use the generic title *CCM* and the year only.
239. Caunter, *Part I*, pp. 49–53 and Canada Cycle and Motor Company, *CCM*, 1937. For a detailed description of the company's process see "Enamelling and Finishing the CCM Bicycle," *Vim*, vol. 39, no. 1 (1952) pp. 7–8.
240. Canada Cycle and Motor Company, *CCM*, 1939, n.p., and Denison, pp. 37–38.
241. Denison, pp. 58–59 and "A Collection of Photographic Views of the Plant."
242. Caunter, *Part II*, p. 56.
243. A promotional poster for CCM's Cyco models for 1955 highlights both the resilobrazing and wheel equipment. Information on the bonderized finished comes from "Enamelling and Finishing the CCM Bicycle," pp. 9–10 and that relating to how the wheel-truing machine worked came from a telephone interview with Alec Gowen, 22 August 1996.
244. Underwriters' Survey Bureau, Limited, *Insurance Plan of the City of Toronto*, Volume 17, partially revised May 1961, plan dated April 1955, sheet 1771. The CCM map was not among those revised. Alec Gowen's hand drawn map, though clearly not to scale, nevertheless contains enough detail to highlight the major changes that took place around 1959.
245. Rush, p. 77; Humber, p. 59; M.A. Daly, letter to the editor of *Bicycling News Canada* and telephone interview with Alec Gowen, 22 August 1996. Also, according to building permits issued by the city of York, the only renovations undertaken after 1960 involved converting a coal bunker to house an oil tank, turning a garage into a storage area, and repairing the paint ovens, penthouse and roof. The last permit was issued in 1988 for demolition of the factory and construction of a fire hall. Telephone interview with clerk at the civic offices of the City of York, January 1996.
246. Denison, p. 29.
247. See Brian Reynolds' research files held by the curator of land transportation.
248. See Denison, p. 29 and miscellaneous CCM advertisements in journals like *Massey-Harris Illustrated* and *Cycling* between 1900 to 1903, in research files of the Museum.
249. Canada Cycle and Motor Company Limited, *CCM*, 1918; *CCM*, 1920; and *CCM*, 1921. The first few pages of these early catalogues were generally devoted to cycles while the majority of the remaining 20 or more pages were usually taken up with accessories.
250. Canada Cycle and Motor Company Limited, *CCM*, 1931, pp. 8–15; Canada Cycle and Motor Company Limited, *CCM*, 1940, pp. 6–24A, 33. CCM had offered the Sturmey-Archer Tricoaster in a much earlier catalogue, ca 1915, but does not seem to have carried it consistently until this later period. Canada Cycle and Motor Company Limited, *CCM*, ca 1915, p.15. Also the company offered a calliper hand brake (rear wheel only) on its Road Racer model for 1934. Canada Cycle and Motor Company Limited, *CCM*, 1934, p. 12.
251. Canada Cycle and Motor Company Limited, *CCM*, 1950, p. 15; Canada Cycle and Motor Company Limited, *CCM*, 1954, p. 17; Canada Cycle and Motor Company Limited, *CCM*, 1958, p. 33; Canada Cycle and Motor Company Limited, *CCM*, 1963, p. IFC; Canada Cycle and Motor Company Limited, *CCM*, 1966, p. IFC and Canada Cycle and Motor Company, *CCM*, 1977, pp. 18–19.
252. Caunter, *Part I*, p. 55 and Pridmore, pp. 123, 128.
253. Although the import statistics collected by the Dominion Bureau of Statistics do not specify country of origin, it seems likely that British cycles made up a significant portion of the imported products. This was certainly true in the US at the time (see Pridmore, p. 128) and CCM's criticism of federal government exchange policy arose from concern about British rather than American imports. Also, two articles published in the *Financial Post* in 1962 and 1963 confirm that Britain was the main source of cycles imported to Canada. See Chapter 6, footnote 284 for full references.
254. Canada Cycle and Motor Company Limited, *CCM*, 1952, pp. 13–14, 51–52.
255. Canada Cycle and Motor Company Limited, *CCM*, 1931, p. 14; *CCM*, 1934, p. 16; *CCM*, 1937, p. 10; *CCM*, 1940, p. 17 and Arnold, Schwinn & Company, *50 Years of Schwinn-Built Bicycles* (Chicago: Arnold Schwinn & Company, 1945) pp. 68–69.
256. Canada Cycle and Motor Company Limited, *CCM*, 1916, p. 4.
257. Humber, p. 59. See also Canada Cycle and Motor Company catalogues from 1921 and 1927 for detailed descriptions of the early racing models. From this time on, most catalogues display at least one or two specially designed racers.
258. Canada Cycle and Motor Company Limited, *CCM*, 1937; *CCM*, 1940 and Pridmore, pp. 104, 117.
259. Canada Cycle and Motor Company Limited, *CCM*, 1927; *CCM*, 1931; *CCM*, 1937; *CCM*, 1940, pp. 17–18 and Denison, third page of section at rear of book entitled, "Excerpts From Letters Received From Some Of Our Business Associates."
260. Pridmore, p. 98 and Canada Cycle and Motor Company Limited, *CCM*, 1921, p. 16. See also any number of catalogues from this date until the early 1960s for further stylistic developments in this design.
261. Pridmore, p. 113; Arnold, Schwinn & Company, pp. 57–59 and Canada Cycle and Motor Company Limited, *CCM*, 1940, pp. 8–23.

262. Canada Cycle and Motor Company Limited, *CCM*, 1974, pp. 24–25 and Pridmore, pp. 160–164.
263. Canada Cycle and Motor Company Limited, *CCM*, 1977, pp. 18–19. See also catalogues throughout the late 1960s and the 1970s for an indication of how the multi-speed grew in popularity and how CCM developed its versions of this type of cycle.
264. In the late 1970s, the Schwinn Bicycle Company fell prey to many of the same problems that brought CCM down — ageing plant, labour unrest and unpopular products. Though it managed to hold out ten years longer than CCM, in 1992 it too filed for bankruptcy. The Schwinn name is carried on by a new, reorganized company, Schwinn Bicycles & Fitness, Inc. Peter Nye, "Schwinn, the family business that kept U.S. cycling rolling," *Bicycle Guide* (November 1995) pp. 24–28.
265. Bouchard, "China's 'CBC'," pp. 20–21 and Trade Winds, "Taiwan," *American Bicyclist and Motorcyclist*, pp. 297–298. When this article was written in 1979, Taiwan was the source of 53% of American cycle imports. In Canada, the value of Taiwanese imports rose a staggering 156% between 1971 and 1977. See Industry, Trade and Commerce, "Bicycles," p. 8. According to McGurn, in 1987 China was producing 32 million bicycles per year and increasing production at an annual rate of 45%. McGurn, p. 192.
266. This information on components has been gleaned from a variety of sources. Among the most important are advertisements in *American Cyclist and Motorcyclist* and numerous cycle reviews in *Bicycle Guide* and *Pedal*. See also Japan Bicycle Promotion Institute, "Japan," *American Bicyclist and Motorcyclist*, pp. 295–296, 342–343 and Douglas Cunningham, "This year we're buying more bicycles than cars," *Financial Post*, 26 August 1972, p. 13.
267. Again, this information comes mainly from cycle review articles in *Bicycle Guide* and *Pedal*, where the products of both medium-sized and small specialist builders are often profiled and evaluated.
268. Rush, pp. 42–43. Though Bicycle Sport Limited is no longer listed in the metro Toronto telephone directory, a custom-builder called Bicycle Specialities advertises the Mariposa name in the 1996 directory.
269. Rush, pp. 138–139 and Alan Coté, "Marinoni Squadra, A Cheapskate for the Peloton," *Bicycle Guide* (June 1996) pp. 22–25. See also Rush, p. 188.
270. Rush, p. 85 for Canadian Bicycle Specialists and p. 109 for Carleton Recreational Equipment.
271. Rush, p. 150 for Dave's Bicycle Repair, p. 188 for Fabricycle Ltée and p. 334 for Ottawa Bikeway. Information on Bike Stop's involvement in cycle building comes from telephone interviews with Peter Haggerty and Doug Gableman.
272. "The Sekine Story," included as part of acquisition proposal by D. Monaghan dated 31/01/96; French, n.p., Cunningham, p. 13 and Humber, p. 63.
273. Rush, p. 67 and the *Canadian Trade Index*, "Bicycles" (Ottawa: The Canadian Manufacturers Association, 1970–1995).
274. Norco, "Norco Performance Bikes Company Profile," no date and Norco web site at www.norco.com. See also Patrick Brethour, "Bike makers face uphill climb," Toronto *Globe and Mail*, 6 August 1996, n.p.
275. Jones, p. 49; Robert Williamson, "Bike maker rides rebound," Toronto *Globe and Mail*, 2 February 1996, p. B8 and Brethour, n.p., As it turned out, rather than fighting the mass-market makers, Rocky Mountain joined one of them. In July 1997, Procycle Group bought the British Columbia maker, which "will continue to operate independently" and to concentrate on "manufacturing the world's best mountain bikes for sale across Canada and around the world." *Ottawa Citizen*, 5 July 1997.
276. Brethour, n.p.; Cunningham, p. 13 and telephone interview with Ron Hansen, vice-president of sales, marketing and distribution, Raleigh Industries of Canada Ltd., 3 October 1996. According to the Brethour article, Raleigh has recently installed robot welders to save labour and enhance the quality of their frames.
277. Cunningham, p. 13; Brethour, n.p. and telephone interview with J. St. Amour of Victoria Precision Inc., 3 October 1996.
278. Rush, p. 355; Barrie McKenna, "Procycle gains Peugeot, Look," Toronto *Globe and Mail*, no date, ca 1990, p. B11, from Alec Gowen's files and Brethour, n.p. The sources are a little contradictory on what Procycle was doing in the early years. Rush quotes a 1984 *Canadian Business* article as stating that the company produced "domestically assembled bicycles." The McKenna article mentions that Procycle got its start in the early 1970s in a former Japanese assembly plant near its current location but the *Canadian Trade Index* does not list Procycle as a bicycle maker until 1981. Procycle produces and distributes under a number of labels including CCM and Orynx. The latter vehicles are high-performance types that retail for around $1700. See Kevin Mackinnon, "Solid & Smooth," *Pedal*, vol. 10, no. 7 (September 1996) p. 40 for a review of the Orynx 4000S.
279. Brethour, n.p. and interview with Doug Gableman. As an indication of the enormous productive capacity of the industry, the China Bicycle Company plans to add three more assembly lines to its current factory which will allow it to produce 2.5 million cycles per year. Bouchard, pp. 20–21. In July 1997 Procycle bought the Rocky Mountain Bicycle Company Ltd., thereby increasing its share of the Canadian market, augmenting its level of exports and adding a well-known and respected brand to its product list. *Ottawa Citizen*, 5 July 1997.

6. "A Significant Minority": Canadians and the Bicycle

6. "A Significant Minority": Canadians and the Bicycle

Over the past century, the bicycle has become a familiar fixture in the lives of Canadians. Most of us, with the exception of those who grew up in remote communities without roads or passable trails, learned how to ride as children and have at one time or another owned or purchased a bicycle. In 1991, Canadians bought an estimated 1.3 million cycles. Surveys taken then also showed that just over half of all households in the country had at least one adult-sized bicycle and that about 44% of the population cycled at least once a year.[280] And each of us can provide anecdotal evidence from our own daily experience that confirms the pervasiveness of the bicycle in Canadian society.

Despite its enduring presence in our lives, few of us consider the bicycle an essential technology, one that we would find it difficult to do without. In part, this is because the great distances between communities in many regions and the climate in much of the country make cycling a less than practical means of transportation for all but the very fit, well equipped and determined. These same factors have combined with our fixation on speed — since the 19th century we seem to have accepted the notion that faster is always better — to create an outlook that favours motorized transport. From the way we plan and build our cities and towns to the way we assign status to various forms of transportation, the bicycle is simply not taken seriously.

Even with these significant factors working against it, the bicycle has persisted in Canada for over a century and, at times, has actually flourished. Makers, sellers and users have continued to develop and modify the basic safety form and have regularly incorporated improvements in materials, designs and components to enhance its performance. Why has this 100-year-old technology thrived? What has made it so attractive to so many Canadians over the years? There are many possible answers to these questions but it seems clear that, at the most basic level, the bicycle has survived and prospered because it is a useful and versatile tool.

This chapter is divided into four parts. The first section provides an overview of the statistics and other evidence relating to bicycle consumption in Canada since the 1890s. This is followed by a discussion of the use of the bicycle in Canada for utility and sporting purposes. A third section examines the history of recreational applications beginning with the safety craze of the 1890s when the cycle's most popular attributes first became evident. The final section looks at the role of advertising in promoting and selling cycles in the 1890s.

Canadian Cycle Consumption

Although Canadians have been cycling since around the time of confederation, there is little concrete evidence indicating who owned bicycles and for what purposes they were used. Bicycles were licenced in many, if not most, urban communities across Canada for a number of decades. By the 1970s, however, this practice was ending and the records appear to have been destroyed.[281] While the federal government has collected statistics on bicycles as household goods in recent years, there seem to be few data relating to the period before 1970. Canadian historians, for their part, have largely ignored the bicycle, except perhaps as a symbol of the "gay 90s" and as the personal transportation precursor of the automobile. Those writers who have shown interest in the topic focus almost exclusively on the safety craze of the 1890s. Only one writer, Bill Humber, has bothered to carry the story into the 1980s but his efforts are aimed mainly at chronicling the story of cycle racing in Canada. Moreover, all of these writers tend to approach their subject from a sentimental perspective and often use questionable sources uncritically. They also fail to provide traceable evidence for many of the assertions they make.[282]

Thus, in order to make any useful generalizations about the number of cycles Canadians have bought and the way they use them, we must rely on a patchwork of primary and secondary sources as well as anecdotal evidence. Industry production and import figures provide a general indication of national consumption, while the contents of cycle catalogues indicate which models were successful in the marketplace at different times in our history. In some instances, catalogues also reveal consistent use by specific groups. Along with a few post-1980 data on use, these sources can at least help to sketch some broad national trends. More specific information about why people acquired bicycles comes from personal accounts or reminiscences of tours, races and other cycle-related activities. Predictably, most of these were written in the 1890s when cycling was a fashionable novelty and magazine and book publishers could not seem to get enough stories of adventure and exhilaration on two wheels.

Canadians first began buying bicycles in large numbers in the 1890s. Although there are no reliable figures from this early period, it is clear from the rapid expansion of the industry and retail trade that consumption was high. According to one estimate, the five major makers that eventually formed CCM accounted for about 85% of domestic production. They allegedly produced 38 500 cycles in 1898, which means that the industry as a whole made approximately 45 000 units that year alone. There were also a large number of imported products entering the Canadian market throughout the boom. In 1892, for example, Britain exported £48 975 ($244 875) worth of cycles and parts to Canada, about 5.5% of their total exports. In 1896-97, Canada imported approximately $735 559 worth of American bicycles and parts and 1897-98, $616 187. Unfortunately there are no unit figures accompanying these values, but if we place the average price of an 1897-98 cycle at $100, it would mean that in 1898 more than 50 000 vehicles were available to Canadian consumers. This level of production indicates a healthy demand, at least over the previous season.[283]

By 1900, the first Canadian cycle craze was over.[284] Demand plummeted and factories closed. While makers and dealers worried that this might be the end of the bicycle business, it was really only the predictable end of the most recent fad. No longer the fashionable thing to do, cycling lost its place at the centre of public attention; the automobile soon replaced it in the hearts and minds of technophiles, sophisticates and other trendsetters. But the bicycle did not go away. Even during the first ten to 15 years of the new century, when demand was at its weakest, Canadians were buying bicycles and replacement parts, so they must have still been riding. By World War I, the Canadian industry, led by CCM, was steadily increasing its production, presumably in response to demand. Though there have been some setbacks, during the Depression (1930–1932) and World War II (1942–1944), for example, the market continued to grow.[285] Between 1920 and 1934, Canadian cycle manufacturers produced over 330 000 cycles. Of these, 88% were men's vehicles and the remaining 12% were machines for women and children.[286]

In the years following World War II, both domestic production and the number of imports rose dramatically. Canadian makers produced just 66 108 units in 1944 and imports numbered only 120. Four years later, domestic production reached a new high of 124 717. Demand was so high, however, that 51 402 bicycles were imported to meet it. In 1959 when the Dominion Bureau of Statistics stopped collecting data on the Canadian cycle industry, Canadian makers reached their highest level of production to date, manufacturing some 134 987 units. Imports also hit an all time high of 141 339, most of which came from Britain (whose makers had a well-deserved reputation for building high-quality, fully-equipped bicycles). In the 50s and early 60s, Canadians also favoured bikes made in the Netherlands, West Germany, Japan and Poland. During this period, imported bikes represented about one half of all sales in Canada.[287]

Canadians continued to buy both domestic and imported cycles through the 1970s, 1980s and 1990s. In the 70s it was the ten-speed that caught the imagination of Canadians — to the point where in 1972, industry analysts were predicting that cycle sales would reach 1 000 000, exceeding sales of passenger cars by about 100 000. CCM, the only domestic maker at the time, believed that they could control about 45% of the market. As it turned out, there were over 1 000 000 cycles imported in 1972. If CCM's sales were anywhere near their estimate, then just under 2 000 000 cycles were offered for sale that year alone. During this boom, Canadians began to buy an increasing number of Japanese, Taiwanese and Eastern European vehicles, mostly in the lower price range. According to data collected in March 1977, 89.5% of imports fell into the $10 to $49 range and 73% were priced between $10 and $39. At the same time, Canadian consumption of higher priced British and Western European machines began to decline. In 1976, of 853 000 imports, 664 000 came from Taiwan, Japan, Poland and Czechoslovakia. The remaining 189 000 originated in France, the UK, the US and miscellaneous other countries. By way of comparison, in 1977 Canada's largest domestic maker, CCM, sold about 250 000 cycles, while Sekine Canada, a branch of a Japanese company produced (assembled?) about 50 000.[288]

Although this cycle boom petered out in the late 1970s (and took CCM with it), Canadians continued to show great interest in the bicycle. According statistics compiled by the Canadian Cycling Association, bicycle ownership has increased steadily since 1982 when some 47.2% of Canadian households — about 3.9 million — claimed at least one adult bicycle. By 1992, the number had grown to 5.2 million households out of a total of 10 million. While the number of households grew about 21%, the number reporting ownership of a bicycle increased by 32%. Overall, more than half of Canadian households owned an adult bike in 1992. The association also stated that there were some 2 111 000 households that owned two cycles and 846 000 that reported ownership of 3 or more, for an estimated total of 8 969 000 cycles in 5.166 million Canadian households. By province, Alberta had the highest percentage of cycle-owning households at 59.1, Quebec, Saskatchewan and Manitoba followed at 56.4%, 54.6% and 53.3% respectively. The other provinces, including Ontario, fell below the national average of 51.4%, but all were above 30%.[289]

In addition to ownership of cycles, we also know a little about how many and what types of cycles Canadians bought between 1984 and 1990. From 1984, when they purchased 1.45 million cycles worth about $229 000 000 until 1991, Canadians bought over 10.5 million machines at a cost in excess of $2 200 000 000. Based on these figures, the average price ranged from a low of about $158 in 1984 to a high of $244 in 1990. As for the type of cycles consumers favoured, in 1990-91, 62% of the bikes purchased in Canada were mountain or all-terrain models. Of the remaining 38%, children's cycles accounted for 18%, hybrids, 10%, city bikes, 5%, racing models 3% and BMX types just 2%. Recently, the demand for cycles in Canada has slowed, leading many in the industry to worry about the future. Yet while oversupply and excess productive capacity may cause problems in the short term, as they did at the turn of the 20th century, after 100 years of using the bicycle, Canadians do not seem the least bit inclined to give it up.[290]

The Cycle as a Utility and Sporting Vehicle

So what exactly are Canadians doing with all the bicycles they own? Like cyclists around the world, they use them for three basic purposes: transportation,[291] sport and recreation. Though we cannot make any specific or definitive claims covering the entire 130-year history of cycling in this country, it is clear that most Canadians cycle for recreation. It is also clear that commuting and sporting cyclists, though far fewer in number, have been a constant and, at times, conspicuous feature of the cycling scene in Canada since at least the 1880s.

The bicycle has never been a significant method of working transportation in Canada. In the early years, the cycle was, by all accounts, faster than walking and cheaper to own and maintain than a horse and, in theory, it allowed its rider to travel according to his or her own schedule and route. The reality, though, was not nearly as appealing. To begin with, the price of a new bicycle, whether a boneshaker, an ordinary or a safety, was well beyond the means of many working- and lower-middle-class Canadians until after World War II. For those who could afford a vehicle, they soon found that the limited number and poor state of roads and trails precluded riding in many areas. When inclement weather was added to the mix, even good roads could become impassable and dangerous. Though streets in urban communities tended to be more reliable, cyclists then, as now, had to compete with much larger and more numerous conveyances like wagons and carriages, the drivers of which often showed little tolerance for this new form of transportation. And, with the exception of the west coast, winter weather made travel by bicycle impractical for all but the hardiest souls.

In more recent times, though the number of roads is much greater and their quality much higher, the competition for space has intensified. Cycles are still not accepted as legitimate vehicles by many motorists who crowd or ignore them, or by city councils and employers who are often reluctant to plan and build infrastructure and facilities for bicycle commuters. In addition to these and many other man-made obstacles, commuting cyclists will always have to contend with the problems posed by our notorious Canadian winters. On the prairies there is the hard, dry snow, driving winds and bitter cold. Over much of southern Ontario, Quebec and the Maritimes winter means lots of heavy, wet snow, freezing rain and piles of road salt. These are not conditions that encourage most Canadians to depend on a bicycle to get them to and from work. As well, bicycles are essentially single-person vehicles and thus not very convenient for a variety of commuters, from car-poolers to parents who take children to day-care or school before going to work.[292]

Clearly the bicycle has serious limitations as a method of transportation for many Canadians. Yet, despite these limitations it has been used for various transportation purposes since the 1890s and is still being used today. The bicycle has long been employed as a delivery and working vehicle. In some cases, large concerns like telegraph companies bought fleets of purpose-built machines to equip delivery boys. In others, individual business owners bought a bike and hired someone to delivery groceries or other goods. CCM began making a specially designed Delivery model around 1918 and continued to offer this type of bicycle into the 1950s. These vehicles were built to adult proportions only and when fully loaded would have been heavy and hard to drive and control. This seems to suggest that the stereotypical view of boys as the main users of delivery bicycles is perhaps not entirely accurate in the Canadian context. In more recent years, urban courier companies have revived the tradition of bicycle delivery. Their radio-equipped riders speed around the central business districts of major cities in all seasons carrying letters and small parcels in their packs. Not only can they pick their way through traffic and other obstacles that slow automobile-based couriers down, but they are better able (and generally very willing) to disobey inconvenient traffic regulations and to take liberties with the rules of the road.[293]

There is little evidence relating to other working applications of the bicycle — as a police vehicle or by country doctors or ministers — in Canada. According to Humber, Massey-Harris supplied its Silver Ribbon bicycles to the police force of Wellington, New Zealand, in the 1890s and the city of Ottawa bought several bicycles for its police force in 1896 to help its officers cover more territory on their rounds. Apart from this, though, there does not seem to be any information showing that Canadian law-enforcement agencies used this form of transportation to any significant extent.[294] Today, some Canadian police forces have adopted the bicycle to make officers on foot patrol more mobile and to allow them to patrol areas cars can not go (cycle paths, pedestrian malls, etc.) or where traffic is very congested. There are cycle-mounted police in cities like Toronto and Ottawa and even the RCMP has started to use bicycles to carry out certain tasks in the National Capital Region. As well, many university campuses now supply some of their officers with bicycles.[295] As for doctors and ministers, while there were undoubtedly individuals across the country who owned and used cycles to get around — Humber mentions a B.C. minister who adapted his bicycle so he could get to circuit services in and around Salmon Arm using the CPR's rails[296] — this does not seem to have been a common practice in Canada, even in the boom years of the 1890s. The weather, the distances between towns and the state of the roads probably made it more trouble than it was worth in most regions, and then the automobile came along to provide a more convenient, reliable, all-season conveyance.

For the last 100 years, Canadians have also used the bicycle for commuting. Since the safety was first introduced, proponents in the trade and outside of it have stressed this application, arguing that it was cheaper than owning a horse or an automobile and more convenient than public transport.[297] In the

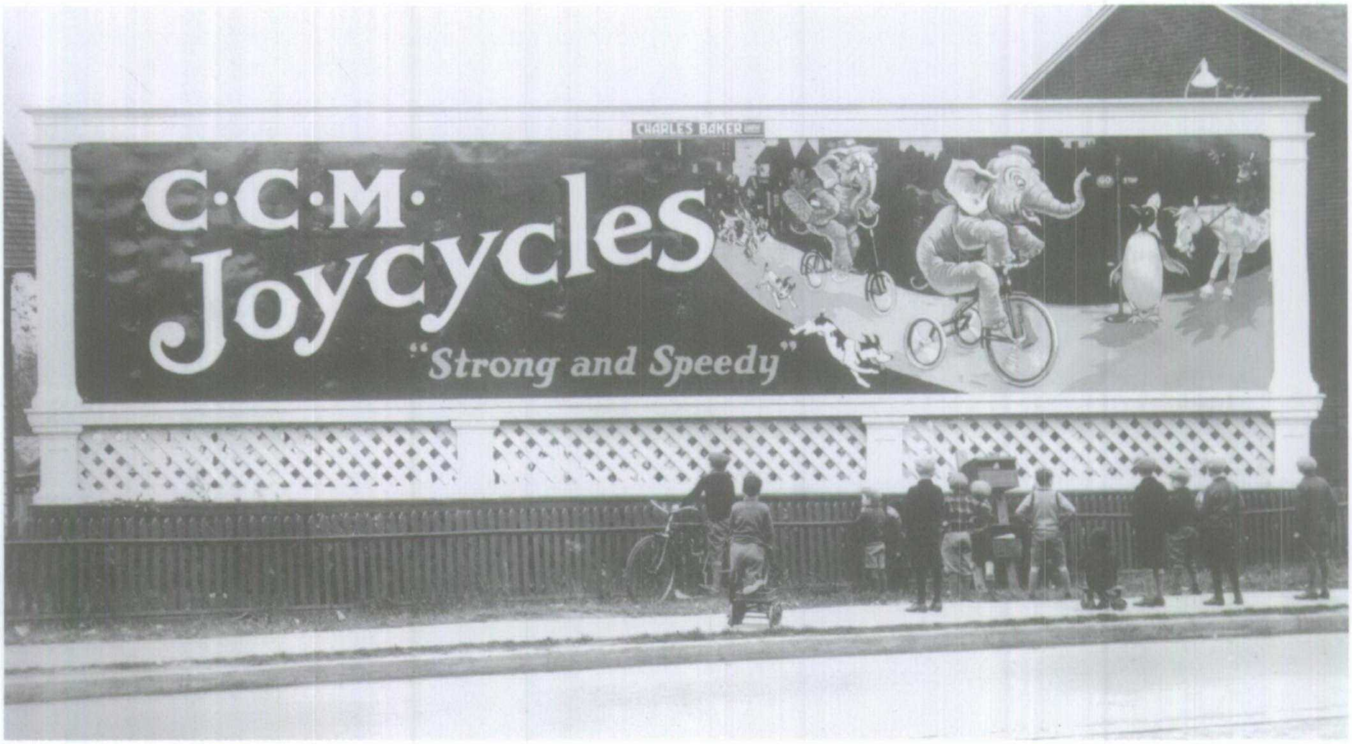
Canadian National Railways messengers with their CCM Flyte *bicycles, ca late 1930s. These young men delivered telegrams for CN and the company thought their work important enough to equip them with the latest version of the safety bicycle. (Source: Canadian National Railways, CN 38859-3)* days before the automobile and the more extensive streetcar and bus systems, these arguments probably carried some weight with those who could afford to buy a bike. The question arises, though, how many middle-class men and women would be prepared to ride bicycles to their offices and shops given all the hazards and obstacles that this entailed in most Canadian cities and towns? The truth is we do not know, but it seems likely that few well-dressed white collar workers would have been inclined to travel any distance in the city, except over the cleanest and best kept roads — horse manure was a major problem in most cities — and in the best weather. Once wealthier Canadians began buying and using automobiles, chances are that even fewer rode their bikes to work, despite the fact that the road network was steadily expanded and upgraded to accommodate the growing number of autos.

Commuting probably enjoyed minor revivals during the Depression and World War II, when cars became an unaffordable or impractical luxury for many Canadians. In the 30s, those who owned bicycles and still had jobs could ride to work. A used bicycle could also provide a cheap, reliable method of transportation for those who were looking for jobs. Moreover, bicycles were easy enough to build out of scrapped and scavenged parts if you had a few tools and a little mechanical skill.[298] Once the war began, Canadians turned to bicycle commuting because automobiles were hard to keep running with gas and repair parts in very short supply. Indeed, according to Denison, the government ruled that bicycles were "items of essential transportation" during the war. Thus while almost all production of "pleasure products" was drastically reduced or stopped altogether, "two simplified [bicycle] models for men and women were kept in production and distributed through normal domestic trade outlets on a voluntary rationing system." This "ensured fair distribution of the limited supply of wartime bicycles."[299]

Although there are no statistics to prove it, there seems to have been another marked increase in the commuter use of bicycles beginning in the 1970s. The popularity and versatility of the ten-speed road bike combined with concerns about the environment and physical fitness inspired many Canadians to look more seriously at this clean and efficient method of transportation. This trend has continued to the present and has been fuelled by the introduction of the mountain or all-terrain bike and by a growing awareness among some urban planners that bicycle use should be accommodated on city streets. The numbers, however, are still very small. In 1994, Statistics Canada surveyed a total of 6 618 000 households and 7 899 000 respondents regarding their principal method of travel to work. They found that only 154 000 people (1.95%) claimed to cycle to work, compared with 5 918 000 (75%) who drove or rode in automobiles and 907 000 (11.5%) who walked. The percentage of cycle commuters was highest, around 1.95%, in urban areas with more than 100 000 residents and fell to less that 0.5% in rural areas. Broken down by province, the statistics are perhaps a little more encouraging. Though Newfoundland and the Maritime provinces reported no cycle commuters, the western provinces were all above the national average, with Manitoba at 4.24%, Saskatchewan at 3.49%, B.C. at 3.08% and Alberta at 2.02%. Quebec registered 1.67% and Ontario reported the fewest commuters at only 1.63%. Ontario and Quebec, however, had the highest level of public transit use at 12.7% and 14%, whereas Alberta and Saskatchewan had the highest rates of automobile use at 77.5% and 76.7% respectively. Manitoba's public transit use was 8% and its automobile use was 74%.[300]

Perhaps the most common and definitely the least documented cycle commuters are children and teenagers. From the 1920s on, CCM carried a selection of cycles for young riders. These were much less numerous than the adult models but nevertheless remained a constant feature of the yearly catalogues. Throughout the 50s and 60s, the youth market became increasingly important as thousands of baby boom children across Canada rode bikes to get around the expansive new suburbs, urban neighbourhoods or small towns where they lived.[301] Cycle manufacturers even began to produce models specifically to appeal to children — the chopper is one example — rather than just making smaller versions of adult bikes as they had in the past. Every spring the streets of Canadian towns and cities filled up with newly licenced (and many unlicenced) bikes as children rode everywhere they could — to school, to sporting events, to the park, to the corner store or new mall or just over to a friend's place. No school was without a bicycle rack, few homes lacked a tire repair kit and almost every local summer fair featured a bicycle show, rodeo or parade. Though most young people now have to lock their bicycles at school and anywhere else they go, this does not seem to have discouraged them at all from cycle commuting.[302]

Apart from these fairly familiar uses of the bicycle, Canadians have also attempted to employ this technology for specialized military purposes. Because the safety bicycle was a faster and more efficient method of transportation than walking and was relatively light and portable, armies around the world began exploring its potential as a tool of war almost as soon as it was introduced. In World War I, the Canadian Corps had a cyclists' battalion, the members of which carried out a variety of duties including delivering despatches, carrying ammunition,

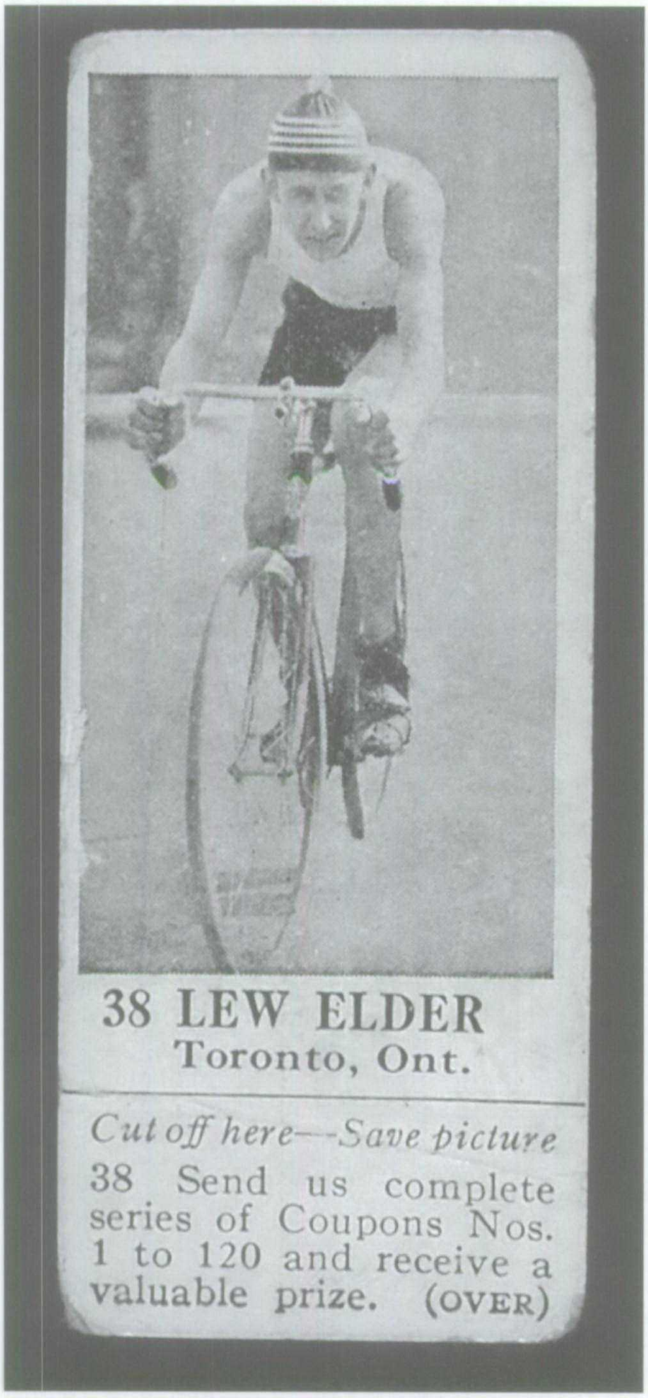


Young consumers admiring an eye-catching CCM billboard, ca 1923. CCM introduced the Joycycle *line of children's cycles in 1922. (Source: City of Toronto Archives, SC488-1476)*

helping to build trenches and lay telephone cables and retrieving the dead. Although experienced at riding in unbelievably bad conditions, members of the battalion could still only get to within a few kilometres of the front before the mud and debris forced them to continue on foot. There is no doubt that these cyclist-soldiers provided support at the front and elsewhere, but it is not at all clear that their bicycles were critical to most of the work they did.[303]

The same can probably be said of the cycle in World War II. During early amphibious landings in Italy, the Allies had been unable to move quickly into the open, unoccupied ground beyond the beaches because all their soldiers were on foot. This allowed the Germans to regain the area after the initial assault. When planning for D-Day, commanders decided to use cycle-borne infantry to follow the first assault troops and move rapidly to occupy any ground opened up by the massive attack. The Canadian army supplied certain units, notably the Stormont, Dundas and Glengarry Highlanders, with folding or collapsible bicycles that they carried with them on the landing craft and onto the beaches. But the gaps never appeared as the Germans gave no ground and counter-attacked immediately. In this context, the cycles were worse than useless; they became an unnecessary and dangerous encumbrance. Most soldiers abandoned them within a few kilometres of the beach.[304]

Another less utilitarian but equally enduring application of the bicycle in Canada is sport. Canadians have a long tradition of cycle racing, which began with the first bicycles brought or made here — boneshakers or velocipedes.[305] Like cycling generally, though, the sport did not become established until the late 1880s when the ordinary was at the height of its popularity and the safety was just beginning to emerge as an alternative. Races were set up in towns and cities across the country on indoor and outdoor tracks and on roads. At first there were no purpose-built facilities, but by the 1890s, when it was clear that the cycle was here to stay, more and more specially designed cycle tracks were being built. Road races, on the other hand, used stretches of existing roadway to test riders' endurance over distances, sometimes 100 miles (160 km) or more. In the early years, these racers had to struggle with bad roads and other vehicles as well as the other competitors. Six-day races are said to have originated in New York in 1891 and involved men riding ordinaries around an indoor track "as fast and as far" as they could go over the course of six full days. By the late 1890s when safeties had become the standard vehicle, top racers covered over 2000 miles (3218 km). When the one-man race gave way to the two-man team, the record distances grew to nearer 3000 miles (4828 km). After 1896, North American women joined this peculiarly gruelling form of cycle racing.[306]



Cut-and-collect image of cycle racer Lew Elder, ca 1920s. Elder began racing in 1923 and won numerous races and championships at the provincial, national and international level. (Source: NMST, Shields Collection)

Like the 1890s bicycle craze itself, all of these sports were international, with races all over North America and Europe. Many Canadian men and women had successful careers and some won worldwide recognition for their talent and skill in these various events. Their examples helped to keep cycle racing alive when the public fascination with cycling waned after 1900. While team sports like hockey, football, basketball and baseball steadily attracted more participants and ever-larger audiences in Canada, cycling faded into the background. Even though six-day racing declined and disappeared by the 1950s, track and road racing did not. With the strong support of cycle makers like CCM and the inspiration of countries like France and Italy where cycle racing was immensely popular, a small but dedicated group of Canadian athletes continued to race at the local, provincial, national and international levels. Their dedication finally began to pay off in the late 1960s and early 1970s when the fascination with European-style racing bikes inspired renewed interest in the sport. According to Humber, membership in cycling organizations that licenced racers, once very stable and small, began to grow. By 1986 there were some 2800 licenced racers in Canada. Interest in competitive cycling was heightened by the introduction of new forms of racing such as randonneur, cycle-cross, BMX, cross-country/ all-terrain and triathlon[307] and by the emergence of some new Canadian cycle racing stars. By the 1990s, Canada had more levels and types of competition than ever before — from local fund-raising road tours or BMX stunt trials to national time trials — and in 1996 claimed Olympic medals in both men's and women's events on the track, on the road and on the cross-country (ATB) course.[308]

Cycling for Recreation

Despite its recent growth, racing, like commuting, is only of secondary importance in the world of Canadian cycling. As in many western nations, most cyclists in Canada use their vehicles for recreational purposes. In this role, the bicycle has been consistently popular for over 100 years. Given the number of recreational fads that have come and gone and the number of leisure activities that now compete for our attention, this is quite a remarkable achievement. The reasons for its popularity can be traced back as far as the 1890s when the bicycle first made its mark on Canadian society.

Many factors made the bicycle appealing to Canadians in the 1890s. To begin with, it was a novelty. Some Canadians were familiar with earlier forms of the bicycle, especially the ordinary, which had been introduced here in the late 1870s and had quite a cult following among athletic young men in the 1880s. But, when it was introduced in this country, the safety bicycle was not only new to most people, it also looked new and distinctive to those already familiar with the high-wheeler. For certain social groups in this and other countries, newness by itself was reason enough to be interested in the safety bicycle. Victorian Canadians, like their counterparts in Britain, Europe and America, were fascinated with material things in general and new objects held a special attraction as symbols of progress. Despite deep and recurring depression, this period witnessed the production of an unparalleled number and variety of consumer goods to feed the growing desire of many middle- and upper-class citizens to display their wealth and success.[309]

In addition to being new to most Canadians, the bicycle had the added advantage of being a machine, another attribute that appealed to late 19th century Canadians. For all but the most conservative or spiritually minded citizens, technology, like newness, was good. Though the negative effects of industrialization and urbanization were, by the 1890s, conspicuously visible in cities like Toronto and Montreal, they did not lead to widespread questioning of the role of technology in society. For the majority of educated, middle- and upper-class citizens, the equation was a simple one: machines allow us to do things more quickly and efficiently than we otherwise could and this makes our domestic and work lives easier, more enjoyable and more profitable. Depending on how you used it, the bicycle could do all three.[310]

The bicycle, moreover, was not just a machine. It was a means of transportation and this added to its popularity for various and, at times, contradictory reasons. The bicycle allowed people everywhere to achieve the much-sought-after goal of overcoming the barriers of time and space. The quest for greater speed entered into almost every aspect of Victorian society from factory production to communications and transportation — time was money, so faster was definitely better. Canadians were far from immune to these forces. During the long process of building the transcontinental railway and the accompanying telegraph system, they had been told over and over by the government that modern, rapid transportation and communication systems were not merely progressive but essential to the development of a prosperous and strong Canada. Though a much less awe-inspiring technology than railways, bicycles were nonetheless seen as yet another component of the transportation revolution. According to one enthusiastic observer, these vehicles "added new and altogether unequalled powers of locomotion to those already possessed by man...and...enabled him to travel farther and faster than he has ever been able to progress by...muscles alone.[311]

As with many things Victorian, though, the bicycle also symbolized the profound contradictions of the era. For all their idealization of machines, the prosperity they created and progress they represented, middle-class Victorians did not like the industrial and urban blight that was their by-product. It was both ugly and unhealthy.[312] Observers also worried that too many of the growing number of white collar workers in the cities were leading sedentary, stressful lives, putting their health at even greater risk.[313] In this context, the bicycle, despite being a machine, came to be seen as means by which to escape a world dominated by machines and to return to a more natural, beautiful and healthful environment. In the process of escaping, the cyclist, whether stroller or scorcher, also got some welcome exercise.[314] This was more than most recreational activities or equipment could promise.

Furthermore, the safety bicycle was a relatively simple machine. Though its continuous chain drive, pneumatic tires and complex frame design made it a more sophisticated piece of technology than the ordinary, it was not difficult to understand the way it worked. Better still, it was much easier and more comfortable to ride. With its low, long frame, the safety was simple to mount, had a low centre of gravity and could be adapted to suit many different-sized riders and to accommodate women's skirts. This meant that women, children, the elderly and the non-athletic could learn to ride without much difficulty. The gearing system was so efficient that even the unfit had little trouble propelling their cycles on level ground and over gentle hills. At the same time, more athletic riders soon discovered that they could go faster on the safety than on their old high-wheelers.

Another source of the bicycle's popularity in Canada and elsewhere was the fact that it lent itself to both solitary and social forms of recreation. For those individuals who wanted to escape not only the city but also the constraints and demands of middle-class society, the bicycle was the ideal tool. You could travel at your own pace without reference to schedules or timetables and, within limits, you could follow whatever route you chose. Karl Creelman of Truro, Nova Scotia, did just that when he left home in May of 1899 to see the world. Claiming that he "had a feeling of unrest" and had grown "dissatisfied" with his immediate surroundings, he spent the next two years wandering the globe, exposing himself to exhaustion, danger and disease before returning to Canada. He rode over some very demanding terrain and in unimaginably harsh climatic conditions and, later, was proud to sign himself "tramp cyclist." This was not a title likely to command respect in polite early 20th century Canadian society and thus could hardly have mitigated the embarrassment his family allegedly felt as a result of his unusual exploits.[315]

Creelman and the other trekkers who followed him, though, were the exception in early Canadian cycling. Most people who rode in the 1890s preferred more sociable forms of the pastime. Canadian men

Halifax Ramblers bicycle club, ca 1890s. This photograph probably dates from the early part of the decade since half the riders were still riding ordinaries and the others had what appear to be early safeties that pre-date the full development of the diamond frame. Also all the vehicles seem to have solid rubber tires. (Source: Nova Scotia Museum N-13.045)

had been forming and joining cycling clubs since the late 1870s and the days of the ordinary. The first such organization was the Montreal Bicycle Club, established in 1878. Two years later, US cyclists founded the League of American Wheelmen, which, by 1881, claimed 27 Canadian members, many of whom were probably based in the Maritime provinces where the American cycling influence was strong. Not to be outdone, Canadian cyclists, mainly from Ontario and Quebec, got together in 1881 and created the Canadian Wheelman's Association. Soon cyclists across the country — Victoria, Calgary, Regina, Winnipeg, Hamilton, Halifax and Truro among other places — had their own local clubs as well as national organizations to coordinate their activities. Those activities included race meets, tours, social gatherings and more serious work such as developing and disseminating road maps and signs to assist cyclists, producing publications like *The Canadian Wheelman* and lobbying governments for better roads and more recognition of the rights of cyclists.[316]

Because of the equipment they used — the ordinary — cycle club members were a small, exclusive group. For the many others who had the urge to join clubs, there were plenty more accessible ones to choose from including skating, curling, snowshoeing and tennis. With the advent of the safety, though, cycling became a much more accessible, not to mention very trendy, pastime. As a result, throughout the 1890s, the number and size of clubs expanded rapidly. In Nova Scotia, for example, enthusiastic cyclists founded clubs in Kentville, Yarmouth, Guysborough, Bridgewater, Lunenburg and New Glasgow; the last named club announced that for religious reasons it would organize no Sunday rides. *The Canadian Wheelman* and *Cycling* devoted a substantial proportion of space in every issue to club news from across the country and the correspondence columns provided further evidence of activity from coast to coast.[317]

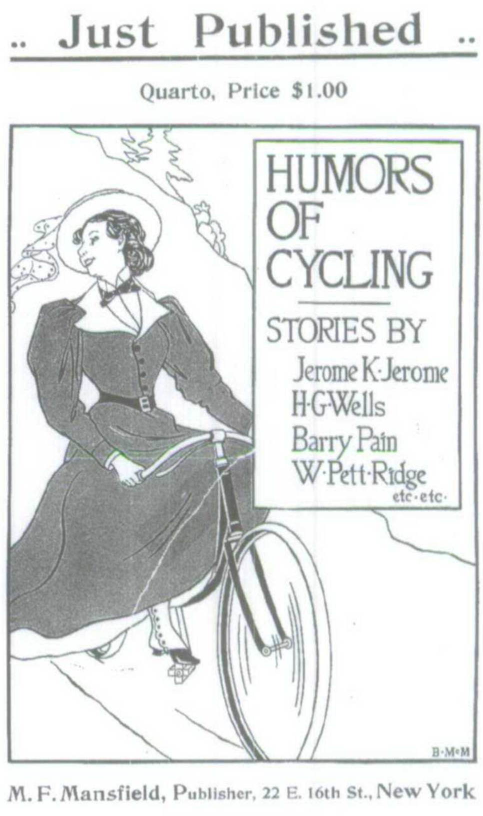
This kind of organized activity, though, was not for everyone. To begin with, many clubs were fussy about who they admitted as members. The Calgary Bicycle Club, for example, had low enough membership fees after 1896 to allow "low-paid clerks, mechanics and cash boys to join," but it continued to be dominated by the businessmen and professionals who filled its executive. Moreover, women were not permitted to join except as honorary members enjoying "very few benefits" for their money.[318] This ban on female membership was common across the country, though at least one west-coast club encouraged female participation in its tours and the Avonian Cycle Club of Windsor, Nova Scotia, voted to admit women in 1892.[319]

Many people were no doubt attracted to cycling because of the spontaneity it offered. You did not have to reserve or rent a court or rink or follow a prescribed route and schedule. You simply picked a time, a place and a companion or companions and set out to see what adventures awaited you. Thus women and casual cyclists, of whom there seem to have been a significant number, likely arranged many of their own rides and tours.[320]

The bicycle's popularity was also, in part, the product of promotion. Canadian cycle makers followed the lead of their British and American counterparts in supporting and publicizing cycling activities. They worked to enhance both the image and the reality of cycling by funding racing teams and/or events, helping to pay for cycling periodicals through their extensive advertising and no doubt lending their voices to calls for greater recognition by governments of the importance of cyclists, cycling and the cycle trade in Canada. Needless to say, it was in their interests to do all this, since greater popularity could be directly translated into greater profitability for their companies and the industry in general.

Once Canadians were firmly on the bicycle bandwagon, the media also began to focus on this, the latest society craze. Whether they supported it, hated it or merely reported on it, they could not seem to avoid talking about it. In Ontario, where the lion's share of the burgeoning cycle-manufacturing industry was located and the greatest number of cyclists concentrated, anything relating to the use of cycles and their impact on the economy and business concerned papers like the *Monetary Times*. In November of 1895, for example, it carried a brief article entitled "The Bicycle Hazard," in which it discussed how the "prevalent use of bicycles" in the last year and the resulting increase in casualty claims had "affected the coffers" of accident insurance companies. Until this "especially hard" year, these firms had not considered the "extra hazard" resulting from cycle use in its existing accident policies. The implication was that they had to pay out more money than normal to cycle-riding claimants.[321] A year later, in the same paper, a writer worried that, because of their great numbers, Toronto cyclists might hold "the deciding vote" on whether or not to allow streetcars to run on Sundays. Given their antagonism to the streetcar company whose practises often made cycling in the city hazardous, it would have made sense for them to oppose the extension of service and keep the streets all to themselves on Sundays. On May 15, 1897, Torontonians decided by a narrow margin to allow Sunday streetcars but only, according to one source, because supporters of the move went out of their way to court cyclists' votes.[322]

The media's interest in cycling went far beyond simple commercial considerations. Cycling also clearly warranted comment as social phenomenon. Much of what was written was greatly exaggerated, a common characteristic of journalistic coverage of any new technology or fad. In 1897, the *World* proclaimed that the bicycle was "king in Toronto.... Enthusiasm for the wheel pervades all classes of the community." Meanwhile, the *Calgary Herald* felt compelled to defend it against charges that it had caused, or at the very least made worse, the economic hardships of the mid-1890s by encouraging consumers to spend their money on cycles rather than groceries, dry goods and meat. Although only 120 of Calgary's 4000 inhabitants owned bicycles, the social presence of this new machine must have been such that this absurd argument was seen as plausible enough to demand a public response.[323]



During the cycling craze of the 1890s, publishers around the world produced hundreds, perhaps thousands, of books and pamphlets dealing with the technical, social and other aspects of the pastime. This particular publication contained humorous stories by various authors including H.G. Wells. (Source: NMST, Shields Collection)

Many newspapers across the country sent their reporters to cover cycle-related events. The *Truro Daily News*, for example, reported on the return of Karl Creelman and gave the story a banner headline. Similar treks in other parts of the country, no doubt, attracted equally favourable coverage. But the media also paid attention to the negative impact of the bicycle. Rush cites several issues of the *Ottawa Citizen* in the 1890s that carried reports of accidents involving cyclists, while Armstrong and Nelles quote a *Mail and Empire* article that dealt with the issue of safe cycling and the calls for regulation to reduce accidents.[324] Reporting on this subject was probably a common feature of most town and city newspapers in the 1890s, even when, as in Calgary, there were really only a handful of active cyclists.

One result of all the publicity surrounding the fad was the creation and nurturing of several enduring myths about the bicycle in turn-of-the-century Canada. Like a lot of new or newly popularized technologies, much of the information relating to cycles and cycling came from makers, clubs and other enthusiasts. These people had a natural tendency to exaggerate the extent of the bicycle's use and importance and they were joined by various other supporters and critics who lent credence to all kinds of assertions about the seemingly limitless influence of the bicycle.

Doctors and other medical professionals were among the first to line up for and against the bicycle. Those in favour made great claims about the positive physical and mental effects of cycling. Dyspepsia, anemia, obesity, curvature of the spine, asthma, varicose veins, heart disease and diabetes were only a few of the "ailments pronounced curable by the wheel." Neurasthenia, a nervous disorder caused by the trials of modern urban life, was a particular target of proponents of the cycling cure. The bicycle could take sufferers away from the stress and pressures of their work and other responsibilities. Many observers also claimed that cycling exercise was particularly good for women because it increased their endurance and enhanced their ability to produce healthy offspring. On the negative side were those physicians who were convinced that serious cyclists and scorchers were prone to a variety of heretofore unknown chronic injuries and ailments such as "bicycle face," a "peculiar strained, set look" produced by constant tension. According to various other medical observers, female riders risked deforming or otherwise injuring their pelvic bones, not to mention ruining their reputations as delicate and modest ladies.[325]

Social critics added their voices to the debate by suggesting that the bicycle would break down not only the barriers of time and space, but also those of class and gender. Proponents argued that, since anyone could own and learn to ride a bicycle, the roads and parks would be filled with all kinds of citizens, from workers to company presidents to fine, genteel ladies. Moreover, the bicycle would instil a camaraderie and sense of equality that other more exclusive pursuits could not. United by a sense of adventure and exhilaration, cyclists were also more inclined and better able to visit new places and learn more about how other people lived and worked. An offshoot of this argument was that cycling provided a unique opportunity for women to escape the confines of their often very circumscribed domestic lives. Whether cycling unchaperoned, with male companions or with other women, these outings gave them a new sense of independence and freedom. The bicycle, so the argument went, even encouraged them to adopt more relaxed attire including, in the most radical instances, bloomers.[326] Most liberal-minded observers probably applauded these alleged changes while the more traditional no doubt bemoaned them as yet another sign that the fabric of society was gradually being destroyed by democracy and technology.

Proponents and observers of the bicycle craze also implied that cyclists were numerous and influential, so influential, in fact, that they were a force to be reckoned with in local politics. Their vocal agitation for good roads, decent signs and more effective traffic control was taken as evidence of their strength. Thus the Sunday streetcar debate and vote in Toronto only proved what many already suspected: that cyclists were not only numerous but were also a politicized and well-organized interest group.[327]

As Rush has demonstrated, there is very little evidence to support these claims. Though cycling was certainly beneficial to the physical and mental health of riders, its curative capacities were not nearly as specific or extensive as its proponents suggested. Nor, of course, did the ailments attributed to the bicycle turn out to be as numerous or serious as its often-alarmist critics claimed. Similarly, cycling's democratic influence was greatly exaggerated. In general only middle- and upper-class Canadians had the time and money to spend on this pastime, and no one can say with any authority that cycling broadened the horizons of these groups. It is just as plausible to argue that their contact with other classes and other places reinforced their existing prejudices. In the case of women, it is true that cycling allowed them some freedom of movement they might not have otherwise had and probably encouraged some of them to consider buying and wearing more sensible clothing. It did not, however, cause or lead the movement for women's rights or even for more rational dress.

It was, at most, a contributing factor to these social forces and may only have been a symptom or effect of them.[328]

Though we do not know exactly how many Canadians owned and used cycles during this period, it seems clear that their political influence was limited. They were not particularly well-organized or active on a national scale — the Canadian Wheelman's Association never had the resources to produce maps or set up tours — and even their local efforts were seldom decisive in effecting change. For example, cyclists only added their voices to an already existing movement for better roads and traffic control in and around cities — in short, for a more sophisticated and up-to-date transportation system. Even the more specific and well-organized campaign to stop railway companies from charging extra for handling cycles was not solely dependent on the support of Canadian cyclists. Many in the tourist trade saw the policy as an obstacle to promoting travel by American cycling tourists, a lucrative market in the 1890s. Although observers believed that the votes of Toronto cyclists were the deciding factor in the Sunday streetcar vote, there is no proof that their assessment of the situation was an accurate one.[329]

When the bicycle craze suddenly ended in 1900, it became clear that, despite what its proponents had said about its pervasive presence and great importance, the bicycle was merely the latest in a long line of recreational fads. Significantly, though, while cycling was no longer *the* thing to do, Canadians did not abandon it. Once all the boosterism and hype had died down, the basic reasons for the bicycle's popularity remained intact. It was still an easy and relatively inexpensive way for Canadians to escape their immediate surroundings. While it was not the cure for everything that ailed you, it continued to be a form of healthy exercise and a recreational activity well suited to both social and solitary people. The cycle was simple enough that almost anyone could learn to maintain it and make simple repairs to it. At the same time, it often incorporated interesting technological advances that appealed to the more sophisticated rider.

For these reasons, the bicycle retained its place as an important leisure tool over the decades. CCM did a good and growing business in men's, women's and children's vehicles after 1910 and also sold thousands, perhaps millions, of replacement parts for older machines. Canadian cyclists did many of the same

Bicycle outing at Clear Lake, Manitoba, 1955. These young Canadians seem to have discovered that the bicycle is an ideal way to enjoy the company of friends, mild summer weather and beautiful natural surroundings. (Source: Provincial Archives of Manitoba — Clear Lake 30 Bicycle Outing, 1955) things they had during the boom, from local rides through city parks or the countryside to long distance tours that lasted months or even years. There were organized activities, though these seem to have become much less common as club memberships dwindled. Essentially, the bicycle assumed the persistent yet low-profile presence in our lives that was to become its hallmark.

Recreational cycling in Canada has experienced several significant revivals during which its popularity probably surpassed that of the 1890s, if production statistics are any indication. In the late 1940s and 1950s, many Canadian workers won contracts that gave them higher wages, shorter work weeks and paid holidays. With more money and more leisure time, they discovered the pleasures of recreation including, no doubt, cycling. Along with prosperity came children and as the baby boom kids grew up they too wanted bicycles. By the mid-1960s, CCM was claiming that the cycle market was worth $25 900 000. Thus, though most of their working lives were dominated by motorized transport — this era was also noted for increased consumption of automobiles — Canadians bought an unprecedented number of bicycles.[330]

The revival of the 1970s in some ways was more like the first great bicycle craze of the 1890s. During this period, Canadians came face to face with the consequences of the unparalleled affluence of the previous two decades. The environment was a mess and the average Canadian was overfed, under-active and leading an increasingly stressful life. In addition, the Middle East oil embargo caused rationing, high prices and long line-ups at gas stations, making operating a motor vehicle very inconvenient. This inspired even more Canadians to experiment with cycling, which was much kinder to the environment than the automobile. Cycles used much less steel and other materials, burned no fossil fuel, produced no emissions and made very little noise. With government telling Canadians that they were embarrassingly out of shape and encouraging them to get more exercise, the bicycle seemed an obvious way to deal with two problems at once. It also did not hurt that sleek, fast, European-style ten-speeds were becoming readily available in North America. Canadians could get fit, do their bit for the environment and look good while they were doing it — an appealing scenario if ever there was one.

In some ways, Canadians have yet to get over the 1970s. Though still among the biggest consumers of cars and the gasoline that fuels them, as a nation we are probably more environmentally aware of the impact of our habits on the world than ever before. That concern has contributed to the continued popularity of the bicycle, as has our persistent pre-occupation with physical fitness. The introduction of new high-tech forms of the bicycle — ATB and BMX — has also had a predictably positive impact. According to the Canadian Cycling Association, there has been a significant increase in the number of Canadians who cycle for recreation. In 1981, surveyors determined that 9 456 000 Canadians, or 41.9% of the population, cycled at least once a year. By 1988, the figure had increased to 10 553 000 (or 44.9%) and in 1992, estimates placed it at 11 220 000 (44.2%) Canadians. Among those who were counted as cycling at least once a year were a great many people who cycled more frequently, from one to ten times per year to twice or more each week. In each of four categories (boys age 5–9 [est.], girls age 5–9 [est.], males ten and over and females ten and over), the numbers grew substantially between 1981 and 1992. It is thus not surprising that, in recent years, Canadians have consistently ranked cycling as the third most popular form of recreation in their lives, after walking and swimming.[331]

Selling the Bicycle

Virtually every author who has written about the bicycle boom of the 1890s or about the rise of the consumer culture around that time has commented on the importance of cycle advertising. One analyst commenting in 1929 went as far as to give advertising "almost complete credit for creating demand for bicycles."[332] Since then, other writers have pointed out that this argument fails to explain why the market crashed despite general prosperity and continued expenditures on advertising. In this context, they suggest that while advertising certainly enhanced demand, there were other important and often intangible factors (like fashion) that persuaded people to buy bicycles. Still, they concede that those in the trade during the 1890s obviously believed in the enormous power of advertising and invested a great deal of time, effort and money in it.[333]

What did all this advertising achieve? According to American sources, the bicycle helped to forge the link between advertising and the mass consumption of luxury goods. It was the first expensive, non-essential product to be sold in such numbers — over 1.2 million bicycles per year were produced in the US in the mid-1890s. Also, the bicycle industry was among the first to introduce annual model changes as a way of selling more products. Even a company like Sears Roebuck, which prided itself on offering a low-cost alternative to the big name makers, began to produce new models each year and used advertising to persuade buyers that they really ought to have latest and most sophisticated technology.[334] It probably seemed unbelievable to many people at the time that consumers would spend $100 on a bike one season and then replace it the very next year. Yet this approach to marketing was so successful that it was eventually adopted by the automobile industry.

Cycle manufacturers were certainly not the first entrepreneurs to discover the value of advertising. American mail order and sewing machine companies had been using this form of marketing since the 1860s and 1870s. Nor did cycle companies invent the basic forms — advertisements in trade journals and mass-circulation magazines and newspapers, retail catalogues and posters. As well, the content of bicycle advertisements, in general, followed well-established patterns. Most manufacturers favoured "reason-why" copy in both their ads and their catalogues, stressing the rational benefits of their particular product or range of products. Their posters and the covers of their catalogues, on the other hand, often reflected a more emotional approach, for example, images showing people enjoying the product or attractive artwork that caught and kept the audience's eye.[335]

Yet, while the ideas may not have been new, what bicycle companies did with them was. First of all, the sheer volume of their advertising was overwhelming. By one estimate, 10% of all advertising in the US in 1898 featured bicycles. Monarch Bicycles spent $105 000 on newspaper and magazine advertisements in 1896 alone. Major makers like Pope and Western Wheel Works probably spent as much if not more, and the results that seemed to come from these investments encouraged many companies outside the cycle trade to consider increasing their spending on advertising.[336]

Besides the dollars spent, bicycle companies also influenced the content and format of promotional copy, especially catalogues. At first glance, the catalogues produced by many cycle companies seem like incongruous mixtures of art and technology. The covers were often colourful images of fanciful, glamorous or inspiring scenes, executed in the latest artistic styles. Inside, the reader found a variety of fairly consistent elements including introductory copy outlining the latest improvements to the products, graphic images of each model along with specifications and special features, and detailed information on critical components and how they were made. Many makers also included images of their plant and larger makers like Pope, Western Wheel Works and Lozier sometimes provided extensive descriptions of their plants and the specialized machinery they used. One advertising analyst criticized what he saw as an overly technical format, but, at the time, modern machinery and technical processes were very appealing to customers who often prided themselves on being in the vanguard of material progress.[337]

The Canadian situation during this period was similar. The safety craze took a little longer to reach Canada and so cycle companies were slower to adopt advertising as a marketing technique. The popular press first began to carry ads for imported safeties in 1892. It was not until the following year that ads for Canadian-based companies — Comet, Wanderer, Gendron and Goold — began to appear, despite the fact that Canada's two cycling magazines, *The Canadian Wheelman* and *Cycling* had been set up in 1890.[338] Within five years, though, Canadian manufacturers, encouraged by increased tariffs on imported vehicles, had begun to set up their own factories and distribution networks. They also began to advertise.

Not surprisingly, the promotional tactics adopted by Canadian manufacturers followed the successful formula established by American companies, reflecting the strong links between the two industries. Like the American advertisements upon which they were based, Canadian cycle ads almost exclusively followed the "reason-why" or rationalist model. Within this general framework they took a variety of forms. Massey-Harris copy followed the example set by Pope's Columbia ads and offered simple appeals based on their well-known and respected brand name.[339] The Goold Company favoured testimonials from a wide range of cyclists: the Earl and Countess of Aberdeen; a 250-lb (113-kg) police chief who claimed that his Red Bird had stood up well to "a thorough test" over "the roughest roads;" and a famous trick cyclist who used the company's Whaleback rims for all his dangerous feats. Goold also used more indirect testimonials such as the names of champion riders and their accomplishments or cycle industry honours won by the Red Bird.[340] In its early material, Gendron also used the records of winning racers who used their product.[341] Both Welland Vale and Lozier focussed on the technical merits of their machines. The former company advertised its use of the latest, patented technology — the Fauber one-piece crank mechanism — using a detailed drawing and an infringement notice to emphasize the superiority of the device.[342]

Two types of information were conspicuously absent from these and the vast majority of the other cycle advertisements in the trade magazines. There were no outright appeals to status, style or fashion. Even the testimonials stressed the quality and durability of the vehicles much more than the fact that important or discerning people had chosen to ride them. There was also little attempt to promote domestically made brands over imports simply because they were Canadian. The Gendron

Manufacturing Company placed the most prominent ad in *The Canadian Wheelman* to mention national issues. After having established the superiority of their product by listing various racing accomplishments, the ad went on (in very small print) to note that "Canada is a great deal more in need of capital than imported bikes."[343]

After 1899, with the end of the boom and the formation of CCM, nationalist content became a feature of Canadian cycle industry advertising. CCM's foreign ads were the most obvious example of this type of approach. In a series of ads placed in British periodicals in 1901, CCM used slogans like "Good Things from the Colonies," "Made under the Flag," "Support Colonial Enterprise" and "Foster Intercolonial Trade." In details of the printed copy, the company claimed that "Australia alone" purchased 8000 per year and that the Fifth Contingent Queensland Imperial Bushmen had equipped their cycle corps with Canadian machines in preparation for the South African War.[344]

CCM also made nationalism a feature of its domestic promotion. In its 1920 catalogue, the company boasted that "90% of the Parts of Every C.C.M. Bicycle are 'Made in Canada'." It went on to list many of the domestically made parts and also reminded its customers and dealers that this policy represented "work for our returned men, busy factories and good times for all." Though the presentation of this information changed over the years and the appeals to Canadian patriotism generally became less strident, references to "made in Canada" products remained a constant feature of CCM's catalogue copy until at least the 1960s.[345]

In recent times, cycle makers have carried on some of the traditions established in the 1890s. Most advertising is found in specialist magazines like *Bicycle Guide* and *Pedal*. These magazines are aimed almost exclusively at "serious" cyclists who spend thousands of dollars on their machines and accessories. Needless to say the content and format of the ads reflect this fact. Like the cycle makers of the 1890s, modern advertisers use a combination of technology, testimonials and appeals to established brand name reputations to promote their products. A September 1996 Trek advertisement in *Bicycle Guide* uses all three. It explains how OCLV carbon is lighter, stronger and stiffer than other frame materials and uses a photograph of the 1995 US pro champion astride one of its cycles to prove it. The Trek name, though not very prominent in the ad, still supports the overall message that this is a superior cycle. There are numerous other advertisements in cycling magazines that follow this same basic pattern, though they generally use only one or two of these elements.

Modern cycle advertisers have also departed from the formula established by their predecessors. Perhaps the most obvious departure is in the use of ads that appeal to the desire for status. These take many different forms, but among the most blatant are those for Specialized products. They have eye-catching photographs — some action shots, some stills of people or bicycles — and generally contain a smattering of technical information about the special characteristics of the product. The overwhelming message, though, is that these products are for hard-riding, macho cyclists only. In a cycling shoe ad, the reader discovers that these shoes will equip them "for hours of leg-burning, lung-busting fun." A mountain bike advertised in the same magazine is said to make nausea, poison oak and burning lungs enjoyable. An earlier and even more unabashedly macho piece warned readers and potential buyers, "Don't bring a knife to a gunfight, cowboy."[346]

This appeal to the special status of serious cyclists is not at all uncommon in the world of advertising. To people from the audiophile and the computer whiz to the devoted runner and cyclist, the idea of being different from and better than the ordinary citizen is extremely appealing. Advertisers have learned how to cater to this class of consumer not just by focussing on very specific aspects of the technology they use, but also by reinforcing the view that the technology is just a means to a higher end. That end could be the most accurate sound reproduction, solving an incredibly complex problem or having the run or ride of your life, but your superior knowledge, skill and dedication deserve to be enhanced by only the best equipment.[347]

These advertisements, which appear almost exclusively in bicycle magazines, have little direct impact on most cycle buyers. They do, however, effectively enlist conspicuous "high-performance" cyclists to establish new standards of prestige and technological sophistication. These, in turn, influence popular demand. In this sense, advertising clearly encourages and shapes demand by promoting constant technological change. Yet, if the long history of the bicycle tells us anything, what really sells this machine is its simplicity, efficiency and versatility.

Notes

280. These statistics come from a compilation produced by the Canadian Cycling Association. They have used a variety of source surveys including Decima Research's, "Decima Sport and Entertainment Survey," 1992; the Canada Fitness and Lifestyle Research Institute's "Campbell's Survey on Well-Being," 1988 and "Canada Fitness Survey," 1981 and Statistics Canada's "Households and the Environment," 11-526, 1991. Humber, p. 25, described the bicycle-riding population of Canada as "a significant minority."
281. One exception to this rule is Calgary where licence statistics from 1917 to 1944 were preserved. Collected on a monthly basis, they reveal that in 1917, a total of 2386 cycles were registered. By 1929, that total had risen to 3734 and by 1944, to 9927. All the figures for these years can be found in David Glass, "A History of the Development of the Bicycle including the Canadian Industry and Alberta Usage" (Edmonton: Reynolds-Alberta Museum, 1985) pp. 118–121.
282. For examples of some other attempts at the history of the bicycle in Canada see William Henderson, "Pedal Power," *The Ontario Technologist*, vol. 18, no. 3 (May/June 1976) pp. 3–8 and Leonard L. Knott, "Bicycles: a two-wheel revolution," *Canadian Business*, vol. 25 (June 1952) pp. 32–33, 116–119. Neither of these pieces are trustworthy. David Glass' background paper written for the Reynolds-Alberta Museum is more reliable and thorough but still lacks useful references for much of the text.
283. Harrison, pp. 288, 291, 298. Harrison used a ratio of £1=$5 in his article on the British cycle industry. Denison, p. 23 and Humber, p. 55. Neither of these authors provides sources for their statistical information.
284. Though I have yet to see a well-documented explanation of the reasons the cycle craze ended so abruptly, research and common sense seems to point to several contributing factors. First among these is economic. During the boom, makers kept increasing productive capacity which, when the market was saturated, led to an over-supply, intense competition and finally collapse. The collapse was made worse by the fact that cycling, like many fashionable pastimes before and after it, gradually lost its appeal to the trendy set as it became familiar and more accessible to ever larger numbers of people. These conspicuous consumers were not only the most likely to buy expensive models and to replace them regularly with newer ones but they also drew attention to the pastime in a way that humbler riders seldom could. Also, after riding for a while many cyclists probably began to see through the hype to some of the bicycle's limitations, especially in Canada where roads were far from well-developed and the summers were short.
285. See Rush's summary of Dominion Bureau of Statistics data, pp. 162–175.
286. Rush, p. 175. I have added and rounded off the unit figures provided on this page.
287. Rush, pp. 162–175; Robert Nykor, "Our cycling oldsters help a boom," *Financial Post*, 57: 10, 3 August 1963 and David Thompson, "Market grows young saves bike industry," *Financial Post*, 56: 21, 3 March 1962.
288. Douglas Cunningham, "This year, we're buying more bicycles than cars," *Financial Post*, 66: 13, 26 August, 1972; French, n.p., and Canada, Department of Industry, Trade and Commerce, pp. 5, 6, 8.
289. These statistics come from the Canadian Cycling Association's compilation of data on cycling demographics. They used a combination of survey sources including Statistics Canada and Decima. Their sheets also include numbers from the 1980s comparing ownership figures on a per-person basis with those of other countries and outlining characteristics of owners in Canada including level of education, age of family head, area of residence and household type.
290. These statistics come from the Canadian Cycling Association's compilation of data on cycle consumption and use held in my research files.
291. With the exception of some show and stunt riding, the bicycle is always a means of transportation. In this particular context, I use transportation to mean working, utilitarian applications of the machine as opposed to cycling as exercise or as a leisure-time activity.
292. All of this information is anecdotal, based on my observations and those of friends and colleagues who cycle to work on a regular basis. Many cities have begun to make at least a token effort to accommodate cycling commuters when building or rebuilding roads and other public spaces. But bicycle lanes are still few and far between in most urban areas and not many employers have facilities to store bicycles securely. Fewer still provide showers and changerooms for their cycling employees.
293. CCM catalogues from 1918 until the late 1950s contain descriptions and images of their Delivery models. The market for these vehicles must have been fairly steady since the company constantly upgraded the vehicle, including building the 1937 model of light alloy tubing. See Chapter 5 for more information. Information on modern bicycle couriers is, again, anecdotal, based on my observations over several years.
294. A photograph ca 1909 shows the Winnipeg Police Force posing with several cycles.
295. Humber, p. 53; Rush, "The Bicycle Boom...," p. 6 and anecdotal evidence based on personal observation in Ottawa and elsewhere. Also, see "News Briefs," *Pedal* vol. 10, no. 7 (September 1996) p. 5, for a photo and a few sentences about the cycle-equipped security staff at the White House in Washington, D.C.
296. Humber, p. 10.
297. See for example, a Massey-Harris advertisement from 1896 showing a lawyer, a clergyman, a doctor, a policeman, a postman, a soldier, a mechanic and a farmer all using bicycles either in their work or to get to it. *Massey's* Magazine (April 1896) n.p. See also Canada Cycle and Motor Company Limited, *CCM*, 1920, p. 2. The company copy explains why "most people really need a bicycle," and goes on to describe various useful and cost saving applications.
298. Bryan Dewalt told me that his father built himself a bicycle largely out of parts found at the local dump.
299. Denison, p. 57.
300. Statistics Canada, *Households and the Environment 1994*, Catalogue 11-526 Occasional, Table 13 (by province) p. 42 and Table 19 (by size of area of residence) p. 46. The Canadian Cycling Association also reported that in 1986, a Toronto survey found that 3% of daily passenger trips in the city took place on bicycles. Five years later, the Regional Municipality of Ottawa-Carleton determined that 10% of such trips were by bicycle.
301. By looking at CCM catalogues for the 20 years between 1940 and 1960, it is easy to see a substantial increase in the number and variety of juvenile and children's bicycles after 1950.
302. Most of this information comes from my own experiences and observations growing up in the 1960s. Humber

also mentions the bicycle as a fixture of childhood in the 1950s along with the hoola-hoop, bubble gum cards, and Davy Crockett. Humber, p. 11.

303. Humber, pp. 65–74. In the last 100 days of the war, when the front began to move, the cyclists were apparently called up to act as "advance patrols and troubleshooters," and thus had more need of their mounts.

304. Humber p. 77. Humber says little about what the purpose of cycle-mounted infantrymen was and why the element of surprise mentioned by his source was so important.

305. Humber recounts the colourful history of cycle racing in Canada from the 1880s.

306. For the stories from the early days of racing in Canada, see Humber, pp. 97–121 and Heather Watts, *Silent Steeds. Cycling in Nova Scotia to 1900* (Halifax: Nova Scotia Museum, 1985) pp. 34–38. For Humber's discussion of six-day racing in Canada see pp. 123–137. General information on this type of racing can be found in Arthur J. Palmer, *Riding High. The Story of the Bicycle* (New York: E.P. Dutton & Company, Inc., 1956) pp. 181–183.

307. Randonneur racers must cover a long distance in a specified period of time. Cycle-cross is a cross-country form of racing over widely varied terrain in which racers are expected to dismount and carry their bikes, which must be very light and very strong, over any impassable stretches. ATB riders also compete over rough cross-country and mountain courses but stay on their bikes at all times. There are also obstacle/stunt courses for ATB riders. Similarly, BMXers compete on dirt tracks and cross-country, on obstacle courses and also do free-style stunts using ramps. In the triathlon, contestants run, swim and cycle over a pre-set route. Humber, pp. 10–11.

308. See Humber, pp. 139–159 for the stories of Canada's cycling heroes and heroines to 1986. For details of our athletes' most recent achievements see Ron Hayman and Laura Robinson, "Centennial Olympic Games, 5 Cycling Medals for Canada," *Pedal*, vol. 10, no. 7 (September 1996) pp. 6–16.

309. Anita Rush, "The Bicycle Boom...," p. 8 and Simon J. Bronner, "Reading Consumer Culture," in Simon J. Bronner, (ed.), *Consuming Visions Accumulation and Display of Goods in America, 1880–1920* (New York: W.W. Norton & Company, 1989) pp. 40–50. Not surprisingly, the department store was also a product of this era, set up by ambitious merchants determined to exploit the growing demand among the middle and prosperous working classes for all kinds of new and newly affordable consumer goods. Bronner, pp. 40–50 and Bliss, pp. 288–290. See also James D. Norris, *Advertising and the Transformation of American Society, 1865–1920* (New York: Greenwood Press, 1990).

310. Bumsted, pp. 90–101.

311. Luther H. Porter, *How to Tour by Wheel: An Indispensable Guide to the Successful Use of the Wheel* (New York: Dodd, Mead & Co., 1896) p. 7, quoted in Rush, "The Bicycle Boom...," p. 8.

312. There are any number of Canadian social histories that deal with the impact of industrialization on our cities. I used Bumsted's chapter on "Urban Canada, 1885–1919," pp. 69–100.

313. Rush, "The Bicycle Boom...," pp. 9–10. American historians have produced a significant body of work on the health and fitness movement at the turn of the century. Motivated in part by concerns about the physical and moral degeneration of the white "race" and its inability to withstand the pressures of immigration, it actively promoted a variety of recreational sports including cycling. See Harvey Green, *Fit for America* (Baltimore: Johns Hopkins University Press, 1986) pp. 228–233; James C. Whorton, *Crusaders for Fitness* (Princeton: Princeton University Press, 1982) pp. 304–330 and Donald J. Mrozek, *Sport and the American Mentality, 1880–1910* (Knoxville, Tennessee: University of Tennessee Press, 1983) pp. 108–109. Canadian historians have yet to explore the impact of this movement here, though the same concerns about the decline of the white, Anglo-Saxon population were voiced by various Canadian social critics and observers. See Bumsted, pp. 157–162.

314. Rush, "The Bicycle Boom...," p. 8. Rush provides a succinct overview of the escapist attraction of cycling during the 1890s, including some of the more radical incarnations of this urge, such as 100-mile or century runs and across-the-country and around-the-world tours. The Shields collection contains many sources — guides, manuals, promotional literature and memoirs — that stress the benefits of getting out into the countryside despite the often bad roads and sometimes less than friendly locals.

315. Watts, pp. 27–28 and Humber, pp. 17–18.

316. Humber, pp. 33–35; Watts, p. 23; Rush, "The Bicycle Boom...," p. 9 and NMST Collection Profile, *Bicycles* (Ottawa: National Museum of Science and Technology, 1990) n.p. Rush argues that the "good roads" component of club activity in Canada was "poorly coordinated and sporadic," and had little discernable impact on Canadian legislators. Rush, "The Bicycle Boom...," pp. 3–5. For a brief discussion of the influence of the League of American Wheelmen in the Maritimes see Watts, p. 26 and Humber, p. 38.

317. Humber, pp. 33–35; Rush, "The Bicycle Boom...," p. 9; NMST Collection Profile, n.p. and Watts, pp. 23–26. For more detailed information on the varied and interesting activities of some of these clubs see Humber, pp. 37–47.

318. Henry C. Klassen, "Bicycles and Automobiles in Early Calgary," *Alberta History* (Spring 1976) pp. 4–5. Klassen provides quite a bit of interesting but undocumented information on the bicycle trade and bicycle use in Calgary, including the club movement there.

319. Agnes Deans Cameron, "A Sad Cycling Experience," *Western Recreation* (1896) p. 128 and Watts, p. 31. Cameron's lively account of a disastrous club run to Otter Point on B.C.'s rugged coast is filled with vivid glimpses of the challenges facing any cyclists in this challenging terrain. The hills were more demanding than expected, not all the cycles were up to the task, food was hard to come by and the weather turned ugly. The tourists spent a great deal of time pushing or having their bikes carried for them and ended up wet, exhausted and dispirited. And all this took place on an organized club tour!

320. There is no statistical evidence relating to use by club or non-club members. Larger clubs tended to keep records, some of which have been preserved, so we know a little bit about club membership and activities. For casual riders, all we have to go on are photographs and personal accounts of cycling activities where they exist.

321. "The Bicycle Hazard," *Monetary Times*, November 29, 1895, p. 693.

322. *Monetary Times*, August 14, 1896 quoted in Christopher Armstrong and H.V. Nelles, *The Revenge of the Methodist Bicycle Company Sunday Streetcars and Municipal Reform in Toronto, 1888–1897* (Toronto: Peter Martin Associates Limited, 1977) pp. 170–171. Though it is not entirely clear, it seems that Armstrong and

Nelles are the ones making the assertion that the "bicycle" vote carried the day for Sunday streetcars.

323. *World*, April 3, 1897, quoted in Armstrong and Nelles, pp. 170–171 and Klassen, pp. 1, 3–4. Klassen did not provide references for his quotations so I do not know exactly when the *Calgary Herald* published its comments on the bicycle and hard economic times.
324. Watts, p. 28; Rush, "The Bicycle Boom...," p. 11, notes 33 and 34 and Armstrong and Nelles, p. 170.
325. Whorton, pp. 308–309, 312–328. Whorton mentioned the claim of one Canadian doctor opposed to women cycling that "bicycle riding produces in the female a distinct orgasm."
326. See Rush, "The Bicycle Boom...," pp. 3–4 for a discussion of this and other claims made about the bicycle.
327. See Rush, "The Bicycle Boom...," pp. 3–6 and Armstrong and Nelles, pp. 170–171. The same streetcar company that had so recently courted Toronto cyclists' support for Sunday streetcars subsequently blamed the bicycle for the lower than expected ridership that the new service attracted, adding support to claims about the pervasive influence of the bicycle. Armstrong and Nelles, p. 171.
328. Rush, "The Bicycle Boom...," pp. 2–3.
329. Rush, "The Bicycle Boom...," pp. 3–6.
330. Canada Cycle and Motor Company Limited, *CCM*, 1966, n.p.
331. See Canadian Cycling Association statistics in research files.
332. Frank Presbrey made this claim in his book, *The History and Development of Advertising* (New York: Doubleday, Doran, 1929). The quote is from Norris, p. 78.
333. Though neither of them state it outright, Norris and Bronner both imply that advertising was only one factor in creating and sustaining demand for bicycles. They also recognize that the manufacturers were firmly convinced of its importance. Norris, pp. 78–80 and Bronner, pp. 32–37.
334. Bronner, pp. 34–36.
335. Norris, pp. 21–24, 47–48, 71–73.
336. Norris, pp. 78–80 and Frank Presbrey, *The History and Development of Advertising*, pp. 363. 410–412, quoted in Bronner, pp. 33–34.
337. Geoffrey Rider, "Trade Catalogues: Perspectives on the Form and Function of a Canadian Research Resource," Research Essay presented to the Institute for Canadian Studies (Ottawa: Carleton University, 1991) pp. 77–79 and Business, Canada, "A Criticism of Bicycle Advertising," *Printers' Ink*, vol. 20, no. 6 (11 August 1897) p. 10 quoted in Rider, p. 77.
338. Rider, pp. 72–73.
339. *The Canadian Wheelman*, vol. XIII, no. 23 (19 October 1896) p. 2 and *The Canadian Wheelman*, vol. XIV, no. 2 (7 December 1896) p. 35. Compare with Columbia ad on page 27 of vol. XIII, no. 23, "Consider the Nameplates: How They Multiply!"
340. These ads all come from *The Canadian Wheelman* issues. The first is on the back cover of vol. XIV, no. 10 (5 April 1897). The second and third are on the inside back cover of vol. XV, no. 24 (3 November 1898) and inside front cover of vol. XV, no. 24 (3 November 1898). The third and fourth appear on the back covers of vol. XIII, no. 23 (19 October 1898) and vol. XIV, no. 2 (7 December 1896) respectively.
341. See miscellaneous issues of *The Canadian Wheelman* from 1896 to 1899.
342. See miscellaneous issues of *The Canadian Wheelman* from 1896 to 1899.
343. This ad appears just inside the front cover (missing on our copy) of *The Canadian Wheelman*, vol. XIV, no. 9 (15 March 1897).
344. Copies of these advertisements which seem to come from the British magazine *Cycling* (March 1901–June 1901) were supplied by the Ontario Agricultural Museum. I believe they are part of the Massey-Harris collection.
345. Canada Cycle and Motor Company Limited, *CCM*, 1920, n.p.
346. All of these advertisements can be found in two issues of *Bicycle Guide*, issue 32 (September 1996) and issue 34 (November 1996).
347. For an interesting perspective on some aspects of this mentality see Joseph O'Connel, "The Fine-Tuning of a Golden Ear: High-End Audio and the Evolutionary Model of Technology," *Technology and Culture*, vol. 33, no. 1 (January 1992) pp. 1–37.

7. Conclusion

The bicycle did not transform Canadian society in any very obvious way. From the time it was first introduced in the late 1860s until the present day, Canadians have used it primarily as a recreational vehicle. Yet the story of the bicycle is an interesting one. What began as a product of small workshops catering to a few enthusiasts eventually became so popular that it spawned new forms of leisure and sport and a whole new manufacturing industry.

From a technological point of view, the bicycle is an incredibly simple and efficient machine. It developed gradually, the product of countless inventors, mechanics and builders who wanted to find a way to make people more mobile. Though most of the earliest forms of cycles have long since been discarded, looking back we can see how these vehicles and their makers contributed to the evolution of the modern bicycle. Baron von Drais proved that a vehicle with two in-line wheels could be propelled, steered and balanced all at once and that, with practice, riders could cover more ground, more quickly than they could by walking. Dennis Johnson focussed attention on the need to reduce weight and friction as much as possible to make the machines easier to propel. Later inventors began the search for a better method of propelling the cycle. Several came up with the same answer in the 1860s — the pedal bicycle, then called the velocipede. This creation demonstrated that a rider could balance a two-wheeler with both feet off the ground.

Once builders had settled on pedals and cranks as the most effective means of propulsion, their attention turned to reducing the weight and enhancing the speed of the vehicle. They developed spoked suspension wheels, frames made of steel tubing and rubber tires — all of which were critical to later cycle advances — to make the vehicles lighter. Their answer to the demand for greater speed was to increase the size of the front wheel. The high-wheel bicycle was so commercially successful that it gave rise to cycle manufacturing industries in several countries. Its conspicuous presence also helped to fuel the public's interest in cycling. But since only athletic young men could ride the ordinary, cycle makers began to design a variety of safer cycles. Initially they mostly produced tricycles and modified ordinaries. Their work with these types of vehicles gave them critical experience with chain and sprocket drive systems. By the 1880s, several builders decided to apply this knowledge to a new, lower type of two-wheeler, which soon became known as the safety bicycle. After its introduction, the safety bicycle quickly became the standard form of cycle, eclipsing all others by the 1890s. Since that time its performance and durability have been enhanced by many technical improvements and design variations.

The bicycle also became the basis for an innovative manufacturing industry. The boom of the 1890s and its immediate aftermath brought major changes to what had been a relatively small and stable industry. The rapid increase in demand was followed by a sudden collapse and intense domestic and international competition. Both before and after the collapse, bicycle makers had to focus a great deal of attention on technological innovation in the factory in order to streamline production, increase output and reduce costs. This trend began in the US, where both demand and competition were strongest, and led to the development and application of cost saving machinery, metal-working techniques and factory organization. By the end of the boom, American makers were the most productive in the world and other countries began to adopt their mass-production techniques, including the widespread use of pressed sheet-steel for making lugs, brackets, hubs and sprockets. Though much of the overdeveloped cycle industry collapsed soon after the boom ended in the late 1890s, the companies that survived found that upgrading production technology was critical to remaining competitive in the much smaller world market. Successful makers have also taken full advantage of the many improvements in materials and processes that have been introduced since 1900 to produce lighter, faster, sturdier, safer and more comfortable cycles.

In Canada, the safety boom created an industry almost overnight. Before 1895, most of the cycles made in this country were simply assembled from parts imported from the US and Britain. The high demand for and profitability of this product in the midst of a serious depression persuaded the federal government to impose tariffs on foreign imports. All of a sudden, it made economic sense for Canadians to build the factories and buy the equipment needed to manufacture bicycles domestically. By 1898, there were probably 25 cycle makers in Canada and several claimed to be expanding their facilities almost yearly to keep up with demand. Like their American counterparts, they also adopted processes and machinery that increased output and cut costs. Meanwhile, supporting industries sprang up to supply the factories with equipment, materials and parts, while entrepreneurs set up wholesale and retail outlets across the country to distribute and sell the finished products. Hundreds, perhaps thousands, of Canadians were engaged in the cycle trade in one way or another before it all came to a crashing halt at the turn of the 20th century.

Yet the Canadian cycle industry survived the collapse of the market. CCM, formed in 1899 by a merger of five of the largest Canadian makers in an attempt to control the supply of cycles, struggled to stay afloat in the early years. By 1920, though, it had established itself as the premier cycle manufacturer in the country. It maintained that position by regularly upgrading and improving its factory, staying in touch with the advances in materials and design, producing a full range of high-quality cycles and replacement parts (most of which it made in its own factory) and developing and cultivating a large and loyal network of small dealers to sell its products. This approach carried the company through the Depression and World War II, so that by the 1950s its brand names were familiar to millions of Canadians and its corporate image was one of conservative reliability.

Without access to corporate records it is hard to say what caused CCM to stumble and fall in the 1970s. It seems, though, that the trouble started in the 1960s when a series of new owners began to favour taking short-term profits over investing in long-term assets like the factory, the employees and the dealers. When low-cost foreign competition began to increase in the 1970s, these problems became even more evident. Even a massive infusion of taxpayers' money and a new series of tariffs could not save CCM and in 1982 it was declared bankrupt.

The demise of CCM brought an end to an era but not to cycle making in Canada. Though more and more of the parts used to make cycles are made by specialist manufacturers in Canada and abroad, a variety of companies still build bicycles in this country. There are numerous small, artisan-type makers who produce several hundred high-performance vehicles each year and do custom work to order. Rocky Mountain and Norco are larger firms that specialize in expensive mountain bikes. Currently, there are three big makers — Raleigh, Victoria Precision and Procycle — that offer a full line of children's, juvenile's and adult's vehicles with a wide style and price range. Like the manufacturers of the 1890s, these companies have found it necessary to upgrade their factory equipment and their products on a regular basis to remain competitive in the international cycle market.

The fact that the bicycle industry continues to exist in Canada is an indication that this technology has a role in our lives. Despite the harsh climate and difficult geography of much of this country, we embraced the bicycle in the 1890s and have never really let go of it. At first, it was fashionable and wealthy Canadians who made cycling the thing to do in one's spare time. After all, the bicycle was the very latest means of transportation, a machine that could give its owner mobility and independence. Worried about their sedentary, stressful lives and disgusted by the visible effects of industrialization and urbanization, they rode to escape the cities, to get some exercise and to enjoy the company of like-minded people in a pleasant environment. Urged on by the medical profession, the media, cycle clubs and salesmen, these early cyclists braved terrible roads, inclement weather, exhaustion and ridicule.

Though the safety fad was over by 1900, the bicycle remained a popular recreational device in Canada. Because of its simplicity and efficiency, almost anyone, from the unfit to the serious athlete, can enjoy it. Cycling gives riders a measure of independence and mobility that no other form of transportation can. It can be a solitary or a social pastime, a means of escape or an excuse for getting together. And whatever the reason for riding a bike, it will always be good exercise and a good way to enjoy the outdoors during our all-too-brief summers. For these and countless other personal reasons, Canadians continue to buy and use millions of bicycles every year. Though much has changed in this country over the decades, the bicycle and its by-products are still going strong.

Appendix A: Bicycle Statistics for Canada, 1920–1959[1]

Year	Domestic production	Imports	Exports
1920	34 958	N/A	N/A
1921	10 317	N/A	N/A
1922	19 590	N/A	N/A
1923	24 668	N/A	N/A
1924	22 158	N/A	N/A
1925	27 482	N/A	N/A
1926	26 101	2 957	168
1927	24 549	4 879	143
1928	27 999	6 281	209
1929	33 482	9 743	207
1930	26 826	7 548	81
1931	18 429	5 710	53
1932	16 627	3 141	36
1933	18 215	5 989	20
1934	32 647	7 623	59
1935	37 248	9 469	101
1936	48 571	13 572	107
1937	63 927	14 229	104
1938	58 985	6 955	83
1939	70 567	2 613	54
1940	86 500	5 965	39
1941	100 838	5 869	233
1942	72 120	1 226	60
1943	47 463	918	26
1944	66 108	120	1 267
1945	74 337	3 316	186
1946	85 804	21 629	3 058
1947	90 644	51 912	4 378
1948	124 717	51 402	2 311
1949	130 413	29 352	33
1950	122 031	29 283	266
1951	91 611	37 034	52
1952	82 375	30 315	90
1953	101 460	63 124	181
1954	71 530	91 382	32
1955	96 371	94 256	52
1956	100 884	124 167	10
1957	N/A	128 813	9
1958	109 093	131 161	10
1959	134 987	141 339	10

[1] This information pertains solely to domestic bicycle production, imports and exports and does not include items such as tricycles, bicycle parts or accessories. The information was derived from the Annual Industrial Censuses, Dominion Bureau of Statistics (DBS), which were published under the auspices of the following sections of the Bureau:

1926–45	Mining, Metallurgical & Chemical Branch
1946–48	Mining, Metallurgical & Chemical Section
1949–52	Industry & Merchandising Division, Mining, Metallurgical & Chemical Section
1954–58	Industry & Merchandising Division, Metal & Chemical Products Section
1959–60	Industry & Merchandising Division

Similar and additional statistics relating to domestic cycle production can be found in The Bicycle Manufacturing Industry *published annually by DBS from 1926 to 1959 and cited in the bibliography.*

Appendix B: Bicycles as a Method of Transportation

Principal Method of Travel to Work[1] by Province, 1994

Province	No. of households[2]	Public transit	Motor vehicle (driver)	Motor vehicle (passenger)	Bicycle	Walk only	Other	Not certain[3]
		Principle Method of Travel to Work						
Nfld.	92	—	73 D	17 E	—	11 F	—	5 G
P.E.I	28	—	24 D	5 E	—	—	—	—
N.S.	195	13 G	156 D	33 E	—	17 F	—	13 F
N.B.	150	4 G	124 D	26 E	—	10 F	—	10 F
Quebec	1 675	250 E	1 283 C	161 E	33 G	142 E	—H	104 E
Ontario	2 519	411 D	2 007 C	252 D	49 F	158 E	—H	138 E
Manitoba	247	25 F	194 C	33 E	13 F	28 F	—	13 F
Saskatchewan	219	8 F	176 C	24 E	9 F	25 E	—	16 E
Alberta	634	71 E	509 C	60 E	15 G	47 E	—	40 F
B.C.	861	124 E	670 C	92 E	32 F	75 E	—H	45 F
Canada	6 618	907 D	5 216 B	702 D	154 E	515 D	20 G	385 D

1 The principal method of travel to work for each member during the second week of May, 1994.
2 Refers to households where at least one member worked outside the home.
3 Includes cases where respondents did not provide an answer or where consistencies between the number of workers and the number of methods of travel could not be resolved.

Source: Statistics Canada - Cat. No. 11-526

Principal Method of Travel to Work[1] by Size of Area of Residence, Canada 1994

	No. of households[2]	Public transit	Motor vehicle (driver)	Motor vehicle (passenger)	Bicycle	Walk only	Other	Not certain[3]
Urban, population ≥ 100 000	4 254	865 D	3 224 C	431 D	99 E	303 E	—H	251 E
Urban, population 30 000–99 999	587	24 F	495 D	61 E	20 F	41 E	—	33 F
Urban, population < 30 000	781	11 F	626 D	103 D	25 F	100 E	—	51 E
Rural areas	996	6 G	871 C	107 E	10 F	72 E	—	49 E
Total	6 618	907 D	5 216 B	702 D	154 E	515 D	20 G	385 D

1 The principal method of travel to work for each member during the second week of May, 1994.
2 Refers to households where at least one member worked outside the home.
3 Includes cases where respondents did not provide an answer or where inconsistencies between the the number of workers and the number of methods of travel could not be resolved.

Alphabetic Designation of Percent Standard Error

Alphabetic indicator	The standard error as a percent of the estimate		
A	0.0	to	0.5
B	0.6	to	1.0
C	1.1	to	2.5
D	2.6	to	5.0
E	5.1	to	10.0
F	10.1	to	16.5
G	16.6	to	25.0
H	25.1+		

Source: Statistics Canada - Cat. No. 11-526

Appendix C: The Prevalence of Bicycles and Cycling in Canada[1]

Popularity of Sport/Recreation Activities (age ≥ 10, participation once a year or more)

Rank	Activity	Percentage of population		
		1992	1998	1981
1	Walking	72%	63%	57%
2	Swimming	70%	42%	36%
3	**Bicycling**	**66%**	**40%**	**38%**
4	Gardening	64%	52%	30%
5	Bowling	48%	17%	8%
6	Skating	45%	22%	21%

Bicycles per Person (late 1980s)

Netherlands	0.79
Germany	0.74
Sweden	0.69
Denmark	0.67
United States	0.42
Australia	0.42
Canada	**0.39**
France	0.33
China	0.27
South Korea	0.15
India	0.06
Malawi	0.01

Bicycles Sales in Canada

Year	Number of units sold (in millions)	Total sales (in millions of dollars)
1984	1.45	229
1985	1.50	278
1986	1.35	259
1987	1.30	279
1988	1.25	282
1989	1.25	288
1990	1.25	305
1991 (estimate)	1.30	312

Types of Bicycles Sold In Canada (1990-91)

All-terrain bicycles	62%
Children's bicycles	18%
Hybrid bicycles	10%
City bicycles	5%
Racing bicycles	3%
BMX bicycles	2%

[1] Statistics compiled by the Canadian Cycling Association. Reprinted with permission.

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