4.

The Rise of the Coventry Bicycle Industry

And the Geographical Construction of Technology

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As a geographer, I am struck by the concentration of the early bicycle industry in a few favoured locations. In England we find that Coventry, Wolverhampton, Birmingham, and London all became established in the 1870s as centres of bicycle manufacturing.[1] In France, Paris and St. Etienne were pioneering centres[2]; in Germany, Bielefeld, while in the United States, the industry was initially concentrated in New England in towns such as Hartford in Connecticut, and Chicopee and Springfield in Massachusetts.

There is a large literature discussing the tendency of industries to cluster, going back to Alfred Marshall's classic treatise of 1919 on the Economics of Industry. In recent years the rise of industrial districts has become a particular interest of economic geographers, this interest being spurred by the emergence of numerous technopoles, and most notably of the archetype, California's Silicon Valley.[3] It is possible to account for the rise of these clusters of industry in local terms by stressing the role of brilliant inventors and entrepreneurs, of local incentives and subsidies, or of skilled labour living in the locality. Most observers recognize, however, that there are usually larger forces at work that help to explain the general tendency for many industries to cluster.

In this paper I want to examine the rise of the bicycle industry in Coventry between the years 1869 and 1880, a period when Coventry grew in a small way like Silicon Valley did a century later.

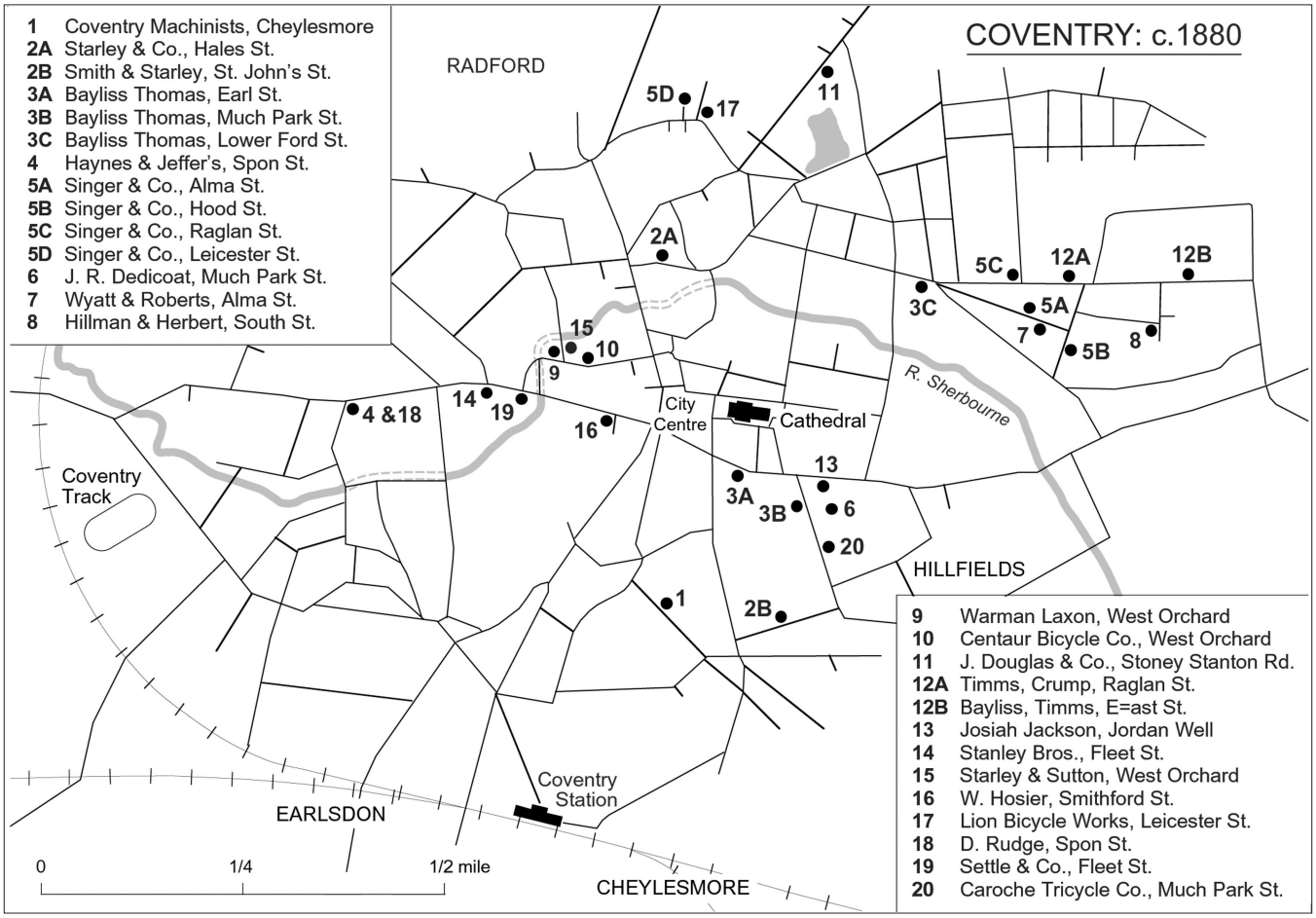
Quite a lot has been written on this subject, with many of these contributions providing valuable insights. My reasons for wanting to add to this substantial literature are twofold. First, I want to connect the case of Coventry with the ideas about the Social Construction of Technology (SCOT) proposed by Trevor Pinch, Nellie Oudshoorn , Wiebe Bijker and others as a means of expressing my reservations with some aspects of the SCOT model, and its lack of geographical specificity.[4] I offer, in its place, a modified alternative which I dub G-COT—the Geographical Construction of Technology. And second, I wish to connect the Coventry story with some of the new ideas that have been receiving a lot of attention recently in the social sciences, and particularly ideas about actors and networks, and social capital.

The Rise of the Early Bicycle Industry in Coventry, 1869–1880

The choice of 1869 as a starting date is self-evident as it was in that year the first boneshakers were manufactured in Coventry by the Coventry Machinists Company (CMC). The choice of 1880 is less obvious, but was governed by the following considerations:

1. By this year, Coventry was the largest centre for bicycle manufacture in the world. Even by 1878, Sturmey was writing: "Coventry: Eleven makers. Forty Bicycles. Machines good, for the most part of the strong or heavy class, suitable for rough and hilly roads. More bicycles are made in Coventry than in any other town, and few bad machines are ever sent out."[5] Two years later D. Rudge & Co, one the largest bicycle makers at that date, was relocated from Wolverhampton to

Fig. 4.1. Map of Coventry, circa 1880, showing major bicycle manufacturers.



Coventry, thereby consolidating the latter's status. By 1880 Sturmey simply announces: "Coventry, the home of the Bicycle Manufacture."[6] The population of Coventry in 1880 was close to 50,000. It is difficult to determine the number employed in the bicycle industry in the same year, but a number between 2,400 and 4,000 seems likely, with additional workers employed in the trades that supplied the bicycle industry.[7]

2. The major firms had moved beyond the early phases of artisanal production, and were engaging in fairly large scale factory production. Curtis & Beamish's Directory of 1881 states that Singer & Co.'s three manufactories on Alma St, Raglan St and Hood St. covered 6,000 square yards. It continues:

> At these works the manufacture is carried on by the extensive use of machinery and special appliances, and by division of labour, upon a very complete scale. We can only mention some of the departments, such as—forging, stamping, turning, milling, drilling, wheel-making, tool-making, fitting, examining, brazing, nickel-plating, polishing, painting, packing &c, &c. (The fitting shop should be specially mentioned—its area being 1,500 square yards, and nearly 2 hundred hands are employed in it). These departments give constant employment to hundreds of hands throughout the year, the winter months being occupied by making stock, the demand being, in the months from April to July, very great—during these months over 2,500 machines (from all manufacturers) leave Coventry every month.[8]

Thus, by the end of the 1870s, the leading makers were engaged in quite large scale production, year round, practising an elaborate division of labour. Consolidation was also beginning: in 1879 George Woodcock purchased the premises of the defunct Smith, Starley & Co., he purchased the business of Haynes, Jefferis & Co. (which he renamed The Tangent and Coventry Tricycle Co., with H.J. Lawson as manager), and in 1880 he added D. Rudge & Co. (which he purchased from Rudge's widow and moved from Wolverhampton to the Ariel Works in Coventry).

3. As the quoted report on Singer's works indicates, capital deepening was well developed, the leading firms having installed extensive dedicated capital equipment.

4. By 1880, there were at least the beginnings of sophisticated supply chains and marketing arrangements.

5. Coventry had also gained a technological lead in tricycle manufacture—indeed it became the main centre for tricycle manufacture just as the tricycle boom of the early 1880s was taking off.

The Beginnings

In 1860 James Starley was hired as an employee of Newton, Wilson & Co, of London, makers of sewing machines. During 1860 Starley had developed an improved sewing machine which went into production in early 1861.[9] He also developed a refinement, a treadle which drove the sewing machine, which was a significant improvement since it left both of the operator's hands free to manipulate the cloth. With the help of Josiah Turner, a manager with Newton Wilson & Co., these improvements to the sewing machine were patented in Starley's name in 1860.

Turner and Starley then decided to leave Newton, Wilson & Co. and establish their own firm—the European Sewing Machine Company—to manufacture this improved machine. They teamed up with Salisbury, an American, as a partner (presumably he put up some money) and on 14 May 1861 rented part of the premises of a Coventry gunsmith named John Newark that had been made available to them by local promoters.[10] Perhaps because Starley had patented a promising improvement to the sewing machine the previous year, Coventry's promoters had offered, in addition to suitable premises, £2,000 start-up capital.[11] Coventry's civic leaders had engaged in civic boosterism because the City was a rather depressed centre with high unemployment rates and many factory vacancies due to a decline in the local watch-making industry and restructuring in the ribbon trade.

The European Sewing Machine Company Limited was incorporated in 1863, and placed in trusteeship in January 1867 as a result of liabilities stemming from a patent dispute with the predatory William Thomas.[12] It was then restarted under a new name—The Coventry Sewing Machine Company—which was changed again to the Coventry Machinists Company when they began to manufacture velocipedes in 1869, this last name change being required accurately to reflect the new product range.

The arrival of Turner and Starley in Coventry was undoubtedly pivotal to the subsequent development of the bicycle industry, although I don't think the citizens of Coventry appreciated this until the mid 1870s. Coventry's watch industry was artisanal and dying in the face of competition from mass manufactured watches; the low technology silk and ribbon industries were restructuring by replacing hand looms with mechanical looms, which resulted in considerable loss of jobs.[13] The sewing machine industry introduced Coventry to new technologies, although in the 1869–1873 period Coventry's local papers had higher expectations for the new art metal work industry—especially Richardson, Ellison & Co. (which opened in October 1868)—than for the sewing machine industry. Up to 1874, there was only occasional comment in the newspapers about bicycles, but several comments in the *Coventry Herald and Free Press* about brisk business in the new sewing machine industry. Moreover in 1874, Smith and Starley licenced Haynes and Jefferis, two former employees, to make their bicycles while they concentrated on sewing machines: this action suggests that even this late, Smith and Starley saw a brighter future in sewing machines than in bicycles.

Why Did Coventry Gain This Early Toehold in the Bicycle Industry?

A number of explanations have been offered to account for the choice of Coventry by Turner and Starley. These need to be briefly listed—not because they are wrong, but because I see them as part of a larger explanation.

1. Williamson states that Coventry was "a centre (…) which badly needed new engineering enterprises."[14] Its ribbon and watch making trades had run into a series of troubles, and competition from French ribbon makers, and Swiss and American mass produced watches had made Coventry very depressed. While this is largely true, there were a number of other depressed British cities in the 1860s, all of which had vacant premises available and low rents that might have attracted Turner and Starley, so this is only partial answer.

2. Andrew Millward and William Starley note that cheap labour could be obtained in the Coventry.[15] Labour costs in Coventry were undoubtedly lower than in London, so this was a factor, but there were, in the 1860s, several British cities suffering from industrial decline and restructuring, and they, too, could offer competitive cheap labour. So low labour costs are by themselves not a sufficient explanation.

3. The incentives offered by Coventry's benefactors to attract Turner and Starley were evidently a key factor differentiating Coventry from other depressed towns.

4. Serendipity and chance were also factors. According to Williamson (whose account is suspect in many places), Starley had shown an interest in cycles in 1865 when he made a prototype lever driven four wheel velocipede with suspension wheels.[16] If this is true, then the technical knowledge then gained would have helped Starley to respond positively to an opportunity that arose three years later: "The sewing machine company has just received a novel order for a number of velocipedes from Paris, where these locomotives have lately been all the rage, and which it is expected will soon be in general use in London."[17] Josiah Turner's nephew, Rowley Turner, brought this order from Paris, bringing with him to Coventry a French-made velocipede. Soon thereafter the company (renamed CMC) began to make velocipedes. Thus it was largely by chance that CMC became familiar with the design and manufacture of velocipedes and, after 1870, along with Starley & Co., of steel bicycles. But from this point on, these

two firms began to build technical knowledge and a workforce skilled in various aspects of the bicycle trade. This laid the foundation for the geographical construction of technology, which will be discussed later.

The 1870s: The Emergence of Key Firms

Chance and luck may account for the birth of the Coventry bicycle industry, but its growth in the 1870s would seem to be a more rational process. A brief outline of the key firms will set the scene. Table 4.1 sets out in tabular form the growth of the industry.

THE COVENTRY MACHINIST COMPANY was the first company in Coventry to make bicycles—the boneshaker velocipede. It is possible that its founder, Josiah Turner, has a claim equal to James Starley to be the father of the British Cycle Trade[18]. By 1881 CMC was "among the largest manufacturers of bicycles and tricycles in the world" capable of turning out 250 bicycles and tricycles a week.[19]

SMITH & STARLEY were minor in terms of manufacturing, and after 1874 dropped out of bicycle manufacture to concentrate on making sewing machines. James Starley continued, however, to experiment with bicycle technology hence I consider his firm to remain part of the industry. The firm went into receivership in January 1877, and in 1879 George Woodcock bought its premises.

HAYNES & JEFFERIS operated from 1874 to 1879, making James Starley's machines under licence, until being purchased by George Woodcock and renamed the TANGENT & COVENTRY TRICYCLE COMPANY.

BAYLISS THOMAS was founded in 1874, making it one of the earliest makers. It became one of the largest employers making high quality machines sold throughout the world. Also established in 1874 was WYATT & ROBERTS, maker of the Paragon bicycle.

SINGER & Co, was established in 1875, and became one of the largest British makers by 1880. Also founded in 1875 were the smaller maker J.R. DEDICOAT (previously machinists).

In 1876, three new makers were established:
HILLMAN & HERBERT opened the Premier Cycle Works, and soon became a major player renowned for their Kangaroo safety bicycle;
WARMAN LAXON (who probably began as wheel makers before diversifying into bicycles in 1877); and
THOMAS TOWNSEND which later became the CENTAUR BICYCLE COMPANY.

1877 saw the smaller firms of JOSIAH JACKSON and J. DOUGLAS opened.

1878 two major players, TIMMS & CRUMP (renamed Bayliss Timms in 1879), and the tricycle maker STARLEY BROS were established.

In 1879 STARLEY & SUTTON, a firm that would play a key role in Coventry's development in the 1880s, was launched, along with three other smaller firms.

1880 saw D. RUDGE & CO. relocated to Coventry, plus two smaller start-ups.

The result is that Coventry in 1880 could boast 14 cycle makers, several of them among the best known makers in the world, including CMC, Singer, Bayliss Thomas, Hillman, Herbert & Cooper, Rudge, and Starley & Sutton. The proprietors of these firms, who counted among the key actors in the bicycle industry at that time, were inter-connected by quite extensive personal and commercial production networks. In the previous 11 years these makers had:

- lodged a string of key bicycle and tricycle patents (see Table 4.3);
- advanced bicycle technology in numerous other respects;

- ❒ elevated bicycle manufacturing from artisanal production to either batch production, or a form of mass-production; and
- ❒ developed sophisticated marketing and sales organizations connecting producers with users.

Table 4.1 Coventry cycle makers, 1869–1880

COVENTRY MAKERS 1869-1880 E = established / C=closed / " = continues	1869	1870	1871	1872	1873	1874	1875	1876	1877	1878	1879	1880
TOTAL NUMBER OF MAKERS	1	2	2	2	2	4	7	10	10	13*f20*	13	13
Coventry Machinsts' Co Ltd, Cheylesmore	E	"	"	"	"	"	"	"	"	"	"	"
Starley & Co., St Agnes Wks, Hales St		E	"	*f11*	"	*f15*	"	"	*f1*	"	C*f13*	
Bayliss Thomas, St. Mary's Wks Earl St						E	*f2*	"	*f3*	"	"	"
Haynes & Jefferis, Ariel Works, Spon St						E	"	"	"	*f9*	*f12*	"
Singer & Co, Challenge Wks, Alma St							E	*f8*	"	"	"	"
J R Dedicoat, 134 Much Park St							E	"	"	"	C	*f16*
Wyatt & Roberts, Alma St							E	*f7*	C			
Hillman & Herbert, Premier Wks, South St								E	"	"	"	*f6*
Warman Laxon & Co, West Orchard								E	"	"	"	"
Thos Townsend & Sons, West Orchard (Centaur)								E*f10*	*f4*	"	"	"
J Douglas & Co, Stoney Stanton Rd									E	*f18*	C*f21*	
Timms & Crump, Raglan St (Bayliss Timms)										E	*f5*	"
Josiah Jackson, Britannia Works, Jordan Well										E*f17*	C*f19*	
Starley Bros, St. John's Wks, Fleet St.										E	"	"
Starley & Sutton, Meteor Works, West Orchard											E	"
Hobson & Winstanley, Albert Wks											E	C
W. Hosier, 31 Smithford St											E	C
Lion Bicycle Wks, Leicester St											E	C
D. Rudge & Co., Ariel Wks, Trafalgar St												E*f14*
Settle & Co, 5 Fleet St.												E
Caroche Tricycle Co, Much Park St & Jordan Well.												E

(1) becomes Smith Starley & Co
(2) moves to St.Mary's Wks, 78 Much Park St
(3) moves to Excelsior Wks, 80 Lower Ford St
(4) becomes Centaur Bicycle Co., West Orchard
(5) becomes Bayliss, Timms & Co, Raglan St and East St. In 1879 they advertised as makers of bicycles and tricycles and "sewing machines repaired".
(6) becomes Hillman, Herbert & Cooper, Premier Wks
(7) listed as Charles Digby Roberts, Alma St. in Kelly's 1876 Directory; not listed in Sturmey 1878.
(8) listed at 48 Leicester St in 1876 Directory
(9) becomes Haynes & Jefferis & Co. Ltd.
(10) listed as cotton spinners in Kelly's 1876 Directory
(11) becomes Smith & Starley, St John's St.
(12) Haynes & Jefferis & Co. is purchased by George Woodcock in Nov 1878, and is renamed the Tangent & Coventry Tricycle Co. in 1879.
(13) George Woodcock purchases Smith Starley & Co. premises.
(14) D. Rudge & Co is bought by George Woodcock from Rudge's widow and moved to Ariel Works, Coventry.
(15) Smith Starley transfer bicycle manufacture to Haynes & Jefferis, but continue developmental work.
(16) J. R. Dedicoat is listed as a machinist in Kelly's 1880 Directory
(17) Kelly's 1876 Directory lists Josiah Jackson as a machinist, Jordan Well; Sturmey 1878 lists Josiah Jackson, Jordan Well, inventor of "the coned socket and extractor nut";
(18) Listed in Sturmey 1878 as Edgwick Works, Stoney Stanton Rd
(19) listed as Jackson & Douglas (the Express) in *Bicycling News* 28 Nov. 1879 p.705. Reported in Sturmey 1879 to have "abandoned manufacture" sinc
(20) Sturmey 1878 lists 11 makers in Coventry in 1878 (Starley Bros are put separately under tricycles, and he does not include Smith, Starley & Co)
(21) Reported in Sturmey 1879 to have "abandoned manufacture" since 1878.

Sources: Stockdale and Clayton (1984): Curtis & Beamish 1874 and 1881; Kelly 1876 and 1880; White's Gazetteer 1874; Sturmey's Indispensable 1878, 1879, and 1880; Stevens, 1879; Bicycling News 28/11/1879, p.705.
Note: Dates are approximate - some are dates of incorporation, some of first production, some of first reporting in the Press.

The question to be raised is whether it was producers or users who played a more important role in Coventry's success?

Whig Histories

Until the 1970s, it was normal to attribute the development of technology to great inventors. Americans were told of Eli Whitney, Thomas Edison and the Wright Brothers, the French of Barthélemy Thimonnier, Marie Curie and Pierre Michaux, and the Scots—who claim to have invented everything—have an inordinately long list of Scottish inventors. According to this lore, most great inventors were men.

Many of the accounts of the rise of the Coventry cycle industry conform to this Whig tradition. In particular, one of the leading inventors based in Coventry, James Starley, has on several occasions been canonised by writers of Whig histories. Thus Sammy Bartleet wrote in 1931:

> It has often been said that mechanical genius is hereditary, and this was so in the case of James Starley, who inherited habits of industry, as well as a good name, from his grandfather, John Starley.[20]

In a similar vein, Viscount Bury and Lacy Hillier attributed the rise of Coventry's bicycle industry largely to local creative talents: they note that in the 1860s the city's ribbon trade had declined, so that:

> The city was therefore eager to welcome a new enterprise, and, the bicycle having attracted a good deal of attention, it was taken up by the late James Starley and other ingenious inventors, and Coventry soon became noted for the excellent machines that were despatched from its workshops, as they were a great improvement upon the imported specimens… [Coventry] thus became the metropolis of the cycling trade, and the centre from which thousands of the best machines are distributed annually throughout the civilised world.[21]

They continue:

> Many ingenious mechanicians laboured at this time in the field of cycling invention, prominent amongst them being Mr James Starley. Keen of apprehension, fertile in expedients, Mr Starley had been for a long time mixed up with business in Coventry, principally directing his attention to the development of sewing machines, in which he had introduced considerable improvements. He had, in addition, invented a host of useful and ingenious appliances for one purpose or another… Starley's inventive faculties were soon at work on the new vehicle [the bicycle] and he rapidly introduced many improvements…

These Whig histories, which stress the production side, have been criticised by sociologists such as Bijker on three main grounds. First, they often attribute breakthroughs to the heroic proprietors of the workshops in which the new technologies were developed, or to the leaders of research groups, when in reality teams of employees worked on a project, bouncing around ideas and experimenting with different prototypes; in such settings, technological development is a social process. This is not to deny that there are "eureka moments," when great minds have a flash of insight, but even then, teams have often played an important contributory role by sharing ideas and developing models.

Second, these stories are constructed according to the notion of instrumental rationality; we are told that the inventors had a clear vision of what they were doing, ignoring the role of serendipity in many discoveries.

And third, as the SCOT school stresses, the productionist approach ignores the role of consumers (many of whom are women), and the social settings within which new technologies are consumed. Inventions have not always been used by consumers the way they were supposed to be, and sometimes unanticipated uses have been found for them. Most inventions are ignored, and exist today only in patent books, while others have been modified beyond recognition. Consumers have adapted innovations to their culture and environment in different ways. These sorts of outcomes have led to the emergence of a radically different interpretation of how technology is developed, one which contends that "ingenuity and creativity are always

linked to wider social interactions and cultural processes."[22]

The Social Construction of Technology

Bijker's approach to technological development is summarised only briefly as it has been debated elsewhere.[23] He uses local stories about innovations to build up theoretical constructs that account for the technical narratives. He links artefacts with society via relevant social groups, which is to say a group of persons (actors) who view an artefact in a similar way and come to develop a common understanding of what the artefact in question stands for.[24] For his case study of the highwheel bicycle, Bijker focuses on two relevant social groups, on the one hand the athletic young men who valued the machine as a macho bicycle,[25] and a second group composed mainly of older riders and women who understood the high bicycle as an unsafe bicycle. This ability to deconstruct an object and arrive at two or more discourses about it illustrates the approach's interpretative flexibility.[26]

The final elements of Bijker's constructivist model are the connected concepts of closure and stabilisation. Closure occurs when the various discourses surrounding an artefact are resolved, interpretative flexibility disappears, and one agreed upon interpretation becomes generally accepted. Such a consensus may be achieved in various ways, some fast, some slow and negotiated, but the net effect is that an artefact no longer has diverse meanings. Part of the process of closure, says Bijker, is the way a dominant discourse about an artefact becomes stabilised within a social group.[27]

The argument that technology is socially constructed, and that the voices of users need to be heard are not here in question. But from a geographical perspective, I have some reservations with Bijker's formulation of the SCOT model which I attempt to resolve in the next section.

1. The key concepts in the SCOT model have a high level of generality, which is both a strength and a weakness. They leave considerable latitude for application across a wide range of fields, as Bijker demonstrates, and they can be interpreted in a range of different contexts. On the other hand questionable applications are hard to refute precisely because of this generality.

2. Bijker's argument stresses the importance of contingency and context. But in his case studies he argues that closure leads to generally accepted (read universal) interpretations of particular objects when these objects (e.g., the bicycle) clearly have different meanings in different places, and (I would argue as a geographer) are capable of having those different meanings in perpetuity. In fact I would argue that substantial differences in meanings should be the norm, given the cultural diversity that characterises the human appraisal of artefacts. So the approach appears to be poststructural/postmodern in allowing difference and fragmented understandings, but (inconsistently) his interpretations tend to arrive at universal (modern) understandings of artefacts. This is a serious contradiction.

3. As a result of No. 2, closure and stabilization may never happen: e.g., the bicycle in the U.S. and China have totally different meanings to this day. In fact, this may be the typical case.

4. They do admit that inventors have a role, but inventors are put in the background—especially in the new book on users. Specifically, there is a need to recognise that in favourable settings users and inventors interact, often intensively. Moreover, inventors are normally more important in the early developmental stage of an industry, consumers in the mature stage when little product development is occurring.

5. Interactions between makers and users are prompted by social economies such as are found in "new" industrial spaces—like Coventry in the 1870s, Detroit in the 1920s, and Silicon Valley in the 1980s.

6. The SCOT approach assumes that inventors are heavily dependent on feedback from users. Some are, but some inventors have a good feel for what society wants—and most inventors are users too.

The Geographical Construction of Technology: Re-Visioning the SCOT Model

The SCOT model evidently moves the emphasis in interpreting technological development from production to consumption, indeed a contribution published by Nellie Oudshoorn and Trevor Pinch in 2003 is appropriately entitled *Users Matter*. But as a geographer (with all the prejudices that go with years of immersion in a discipline), I find certain aspects of the SCOT model noted above troublesome.

The simple step of inserting a geographical dimension into the descriptive model has two effects. First, it allows society to construct different meanings around innovations in different places, with meanings that do not necessarily stabilize. Thus in Canada the ice bicycle appeared soon after the velocipede was introduced from abroad, becoming the precursor to the snowmobile with a technological lineage that is distinctly Canadian.[28] In America, the bicycle was sidelined by the automobile early in the twentieth century and thereafter became largely a child's plaything—the sidewalk bicycle—until American youth discovered the BMX, and Californians the MTB. The Italians and French, in contrast, took to racing bicycles with tremendous enthusiasm with their technological developments focused on racing performance, the Dutch took to cycling as part of their everyday life, while the British became ardent cycle tourers, rain or shine, developing excellent touring bicycles.

Second, it allows the possibility that producers and consumers in specific geographical settings interact to construct new technologies. For more than a decade, geographers and historians have sought to qualify the image of modernity as a monolithic project with almost universal dimensions.[29] The main thrust of geographical commentaries on modernity is to stress the way it manifested itself in different ways in different settings. For example, David Harvey's brilliant study of modernity in Paris reveals a society that was actively seeking to create a modern city like no other.[30]

Few centres of technical modernity have attracted more attention in recent years than Silicon Valley. I distill from the extensive literature on Silicon Valley, and particularly the work of AnnaLee Saxenian, four main points about the construction of technology.[31] First, lots of very talented inventors were based in Silicon Valley: Castells and Hall tell us that by the end of the 1980s Silicon Valley was the workplace for 330,000 high-tech workers, including 6,000 PhDs in engineering and science.[32] Most of these scientists were recruited and migrated from elsewhere to create this concentration of talent. Second, these researchers interacted scientifically and intellectually with each other, often quite intensively. There was a constant fusion and fission of small firms as researchers set up their own start-up firms, then merged with others or were taken over. Scientists moved from employer to employer, sometimes with remarkable rapidity, each time bringing knowledge with them, sharing it, and also acquiring new knowledge in their new work setting.

Third, the work style was built around open spaces and laboratories where teams were constantly interacting. And this exchange of ideas and knowledge continued outside the workplace while jogging, drinking coffee, and in many other social settings. The distinction between workplace and social/family spaces became fuzzy—to a degree they were merged into a continuum. And fourthly, Harrison notes the importance of political factors: government expenditures, especially defense contracts and work for the U.S. space programme, infused substantial amounts of money into the Californian system.[33]

A whole new vocabulary was developed in industrial geography during the 1990s that reflected growing interest in the innovative industrial spaces occupied by the new economy. This vocabulary defined an interconnected set of concepts, which include: transactional economies; reflexivity; territorial development; relational assets; economic conventions; flexible specialisation; path dependency; learning economies; untraded interdependencies; new industrial spaces; technopoles; knowledge-intensive industries—all of which have relevance to the present discussion.[34] They are facets of a new model of territorial industrial development stressing the importance of regional clusters of knowledge and skills where

new economy products and services are developed. These goods and services—microelectronics, software and biotechnology being three obvious examples—have high value-added, research and innovation are corporate priorities, the results lead to frequent changes to product design, their production involves specialist firms that group together in different ways for different projects, and they employ skilled workers who are expected to browse information sources widely as part of their work. Social networks are crucial as knowledge and ideas are exchanged continually both in face-to-face contacts and in electronic exchanges. Richard Florida has dubbed these workers the creative class.[35]

A social economy is marked by numerous transactions involving trade, technology and knowledge, occurring between firms and individuals. These transactions require that the actors in a network trust each other, practice mutuality to support each other, and are willing to share knowledge; they may compete in some respects, but in other respects they collaborate. Good social networks greatly facilitate such transactions and they create social capital. I believe that these ideas about a social economy are applicable to the development of Coventry in the 1870s.

Coventry as a Social Economy

By 1880 Coventry had become the largest centre of bicycle production in the world through a process that was social in many respects. The leading entrepreneurs were often former employees of other firms in the cycle industry, while a few began to manufacture in closely related activities such as machining, as wheelwrights, or manufacturing sewing machines. They were busy creating new knowledge about bicycles and tricycles, and although some of these discoveries were protected by patents, or simply kept under wraps, a fair degree of knowledge was shared through franchises, sub-contracting, licencing, joint patents, gossip, and skilled workers with technical knowledge being hired from firm to firm.

There were elaborate social networks connecting the makers—they had worked together, shared premises, raced against each other on the road and the track, joined the same bicycle clubs, and some had family connections. There had to be trust for these firms to cooperate the way they did, although there were also undoubtedly disagreements as well. The actors in the Coventry bicycle trade were connected by these networks, and by the shared experiences, trust, and shared value systems that made the networks work; they represent social capital which was invaluable in the development of Coventry's bicycle manufacturing complex.[36] Equally important, these networks also connected the producers with users—indeed the makers were themselves often serious users of the technology. These points will be illustrated by some specific examples drawn from Coventry.

Key aspects of the start-up of the bicycle industry were social. Local development initiatives taken by entrepreneurs and philanthropists (especially the Rev. Sidney H. Widdrington) in the 1860s were apparently crucial in attracting Turner and Starley to Coventry, as well as other entrepreneurs in a number of unrelated industries. In making this move in 1861, Turner and Starley brought with them a group of bright young workers to make their new sewing machines—some of whom subsequently went on to establish their own bicycle firms. And it was a family member—Josiah Turner's nephew, Rowley Turner—who first introduced the velocipede to the Coventry Sewing Machine Company in late 1868.[37]

The growth of the industry from these small beginnings was profoundly social. The movement of employees and ownership among the manufacturing firms was sufficiently common that it is simplest to summarize the most important moves in Table 4.2. It is evident that most of the major makers had previously worked for another firm and had gained familiarity with many aspects of the industry before setting up their own enterprise.

There are a number of instances where Coventry bicycle makers shared intellectual property, as is shown by the list (Table 4.3) of the major cycle-related patents attributable to Coventry makers. For instance, in 1870 William Hillman and James Starley were the joint patentees of the "speed gear" and the "tension hub" used on the Ariel highwheel bicycle. Inventions were shared, and their manufacture franchised: thus in 1877 it was announced that

Warman Laxon & Co would manufacture a safety brake on the rear wheel that James Starley had invented and jointly patented with his nephew, John Kemp Starley in 1876 as No. 4478.[38] In 1878 William Hillman patented the double hollow forks (DHF), but Sturmey (1879) shows that within a year other makers were advertising variations on DHF bicycles including Singer's DHF Challenge, and Bayliss Thomas's Double Hollow Fork. In 1879, Hillman & Herbert announced that they had licenced Singer to use their patented "DHF" (i.e shared knowledge) and nobody else could use "DHF."[39] Bayliss Thomas were evidently one of the targets, and by September 1879 they had changed the name of their product to "DEHF," while the Centaur Bicycle Company had a "double-fluted hollow fork" (DFHF), Keen a "fluted hollow fork Norwood," and Gribbin of Manchester a "Hanover DTF."

Another interesting example of shared intellectual property is found in patent No. 1272 of 1880 (improved crank key etc.), where the joint patentees are William Hillman, John Kemp Starley, and George Singer (representing three different companies). There are many other examples of Coventry cycle makers sharing knowledge by formal and informal means, giving the impression of an entrepreneurial culture very different from the monopolist behaviour of Colonel Pope described by Bruce Epperson (this volume).

Whereas integrated firms tend to manufacture most of their own components, in a social economy the subcontracting and purchasing of goods and services from suppliers is the norm. Again, there is ample evidence of this occurring in Coventry. As already noted, in 1874 Smith and Starley licensed Haynes and Jefferis to make their bicycles, so that they could concentrate on sewing machine production. But Curtis and Beamish's Coventry Directory of 1874 also lists Smith and Starley as wheel manufacturers supplying the perambulator and bath chair industries so they, too, were suppliers to other industries. The same 1874 Directory also lists on page 110 thirteen engineering and machining firms, among which at least three—J R Dedicoat, George Townsend, and Wyatt & Roberts later in the 1870s became bicycle manufacturers having first presumably done work for the cycle industry. When, in 1881, Nahum Salamon left his position as managing director of CMC and set up the Bicycle and Tricycle Supply Company he subcontracted the manufacture of his machines to Singer & Co.

Similarly, an advertisement in the 1881 edition of Curtis and Beamish's Directory states that at William Simmons' Britannia Works, and at Warman Laxon & Co.'s works, wheels were supplied to other manufacturers, while in 1877 it was reported that J. Johnson's Bicyclist's Patent Mile Indicator was being made under licence by Dedicoat.[40] Dedicoat were also manufactured stop bells.[41] Clearly there were a range of firms in Coventry which supported the cycle industry. Andrew Millward says of the British cycle industry's early growth: "This [existing industrial] infrastructure contributed to the comparative ease of entry into cycle manufacture since cycles were suited to existing industries in terms of the materials they used and their processes of manufacture."[42] The evidence for Coventry certainly bears out this statement.

Some links between firms require formal trade contacts whereas other interdependencies involve trust, mutuality and shared knowledge which are not physically traded even though they are important indicators of social capital. Bicycle races, as Andrew Ritchie stresses, were especially important

Fig. 4.2. James Starley, as portrayed on the Starley Monument in Coventry. Presumably his nose was intact originally.

in producing knowledge about what technologies worked best, and providing rapid feedback from users to makers.[43] A few examples will illustrate some cases relating to Coventry's makers:

At the velocipede races held at Leamington on 19th June 1869, the competitors included Hillman, Turner, Cooper, Starley, Palmer, and Spicer (in other words, a mix of producers and users competed).[44]

An 1870 bicycle match held in Coventry between Bayliss (on a 40-inch wheel) and Johnson (on 36-inch wheel): here Bayliss, a maker, is also a user.[45]

- On 27 September 1872, Mr. Potts rode an Ariel made by Smith & Starley from London to Sunderland in 3.5 days as the makers sponsored a user for promotional purposes.

- On 4 October 1872, George Singer rode a 48 inch CMC ordinary from Coventry to London in 11 hours 45 minutes, including 2.5 hours stoppage. Here the rider was an employee of CMC, a future independent bicycle maker, and a long-suffering user.

- Henry Sturmey becomes publisher of the annual *Sturmey's Indispensable Handbook* from 1878 onwards. Sturmey lived in Coventry, was well known to the Coventry makers, and invariably gave Coventry makers good coverage in his annual publications.

- On 26 February 1875, at the Annual Dinner of the Coventry Bicycle Club, Mr. J. Warman, a rival bicycle maker but also clearly a friend, proposed a toast to the health of Mr. Starley who "has done more for the benefit of bicycle riders and of the success of the bicycle than any other gentleman in the trade."[46] A toast was then proposed to the bicycle manufacturers of Coventry. In this convivial setting, makers and users were demonstrating the mutual interest expected of a social economy.

- Iliffe & Sons were a local Coventry publishing house who went on to publish major journals and books on cycling including Sturmey's annual reports, *The Cyclist,* and *Bicycling News*. Coventry's makers got good press and coverage from local publishers. Iliffe advertised in *The Bicycling Times* that their printing services were available to bicycle manufacturers, agencies and clubs.[47]

- Thomas Steven's Stevengraphs were made in Coventry. His silkscreen, "The Last Lap" (of the finish of a race on ordinaries), was a well known image, implicitly promoting the home town. His firm also made silk badges for many bicycle clubs.

- James Starley's (1830–1881) funeral was attended by, among others, Marriott, G. Singer, W. Hillman, W.H. Herbert, J. Bayliss, J. Thomas, W. Iliffe, G. Woodcock, Ald. Gulson, G.H. Hayward, E.R. Settle and several other important figures in the early Coventry bicycle industry.

- The early phase of the bicycle industry's development in Coventry was demonstrably accompanied by the development of a social economy. Many of the key workers had gained their earliest experience of bicycle manufacture in the CMC stable, or with Smith and Starley, and several others had worked for other firms before setting up their own firm, taking technological know-how and ideas with them. They had raced against one another in promotional races, with the makers getting first-hand opinions about their machines from the professionals participating.[48] They experimented together, shared ideas and patents, rode on club rides together, and met socially from time to time. Some entrepreneurs in linked industries moved from supplying the bicycle industry to becoming bicycle makers themselves. And users and makers were frequently side by side, no doubt bantering and gossiping about bicycle technology.

Table 4.2: The movement of employees and family connections among firms: some examples

1861: Turner and Starley leave Newton Wilson & Co of London to set up the European Sewing Machine Co in Coventry.

1870: Starley and Hillman leave CMC to set up Starley & Co.

1870: John Thomas, employee of CMC, and later partner of Bayliss Thomas helps found the Coventry Bicycle Association (reconstituted as CBC in 1875)

1874: Haynes and Jefferis, employees of Starley & Co are licensed to make Starley's bicycles.

1874: Bayliss, former CMC employee 1868-1874, sets up Bayliss Thomas.

1875: George Gilbert, first apprenticed at Skidmore's art metal company and then employee at CMC joins Thomas Townsend and Edmund Mushing in establishing the Centaur Bicycle Co.

1875: Singer, a former employee of CMC, creates Singer & Co at the Challenge Works.

1876: Hillman (former CMC and Starley employee) and Herbert (former CMC employee), create their own firm at the Premier works.

1876: Warman, a former employee of CMC and Smith & Starley, establishes Warman, Laxon.

1876: Timms, having worked for Haynes and Jefferis, establishes Timms and Crump in 1878.

1878: Starley Bros is set up by sons of James Starley.

1878: Charles W Iliffe M.D. of Coventry (a member of the publishing family) is a Director of Haynes and Jefferis.

1879: John Kemp Starley, nephew of James and former employee of Starley & Co, sets up Starley and Sutton.

1879: lawyer George Woodcock purchases Haynes and Jefferis plus the defunct firm of Smith & Starley, and (in 1880) purchases the firm of the late Daniel Rudge from his widow and moves it to Coventry.

Table 4.3: Major Bicycle Patents Originating in Coventry (based on list of Patents for Velocipedes (Class 136) and Wheels for Vehicles (Class 144), 1870–1880

1870

No. 2236: Hillman, William and Starley, James (The speed gear, and tension spokes)

No. 3207: Turner, Josiah (adjustable cranks)

1874

No. 3959: Starley, James (two-track bicycle for women riders; tangent spokes)

1875

No. 1339: Turner, Josiah (adjustable handle bars)

1876

No. 60: Jackson, Josiah (brake, footrest, pedal, handlebar improvements)

No. 3197: Hillman, William (various improvements in front-driving bicycles; conical ends to axles)

No. 3983: Singer, George (removable handlebars)

No. 4255: Turner, Josiah (forks, footrests and brakes)

No. 4478: Starley, James and Starley, John Kemp (lever-driven rotary tricycle + hubs and spokes and several other improvements)

No. 4672: Hillman, William (hand driving mechanism)

No. 5018: Turner, Josiah (improved axles)

1877

No. 38: Dedicoat, John Richard (improvements to springing, brake pedals and stop bell)

No. 972: Lawson, Henry John (improvements to the safety bicycle)

No. 1956: Starley, James and Starley, John Marshall (the Coventry Convertible Sociable Tricycle, and several other improvements)

No. 2365: Townsend, Isaac Thomas (threaded cranks)

No. 2861: Turner, Josiah (training wheels for an ordinary bicycle)

No. 3065: Douglas, James (agate surface for bearings)

No. 3388: Starley, James (balance gear or differential)

No. 3602: Jackson, Josiah (driving action using clutch etc.)

No. 3689: Salamon, Nahum (hollow section felloes)

No. 3792: Singer, George (tricycle with 2 front steering wheels and one rear driving wheel)

No. 4818: Elliott, James (rocking saddle)

No. 4849: Turner, Josiah (hollow triangular backbone and forks; etc.)

1878

No. 316: Townsend, Isaac Thomas (Centaur sliding saddle)

No. 716: Bayliss, Thomas/ Thomas, John/ Slaughter John/ and Elliott, James (various improvements to the bicycle)

No. 2249: Hillman, William (The Double Hollow Fork, and steering for tricycles)

No. 2492: Lawson, Henry John (various improvements to the velocipede)

No. 3131: Turner Josiah, et al. (Rubber mounted spring of the Club Special

No. 3310: Warman, John Icely (Improved drive for tricycle)

No. 4265: Singer, George (the Xtraordinary, + tricycle improvement)

No. 4657: Starley, John Marshall and Starley, John Kemp (folding tricycle—the Compressus)

1879

No. 395: Salamon, Nahum (improved bearings)

No. 417: Townsend, Isaac Thomas (improvements to bicycle and tricycle)

No. 2920: Turner, Josiah and Dewey, Alfred (crank and fork improvements)

No. 3027: Hillman, William (double ball bearing race etc.)

No. 3156: Singer, George (improvements to roller bearings)

No. 4000: Turner, Josiah (improved driving gear)

No. 4542: Townsend, Isaac Thomas (telescopic arms on backbone)

No. 4842: Bayliss, Thomas, Thomas, John, and Slaughter, John (gear wheel drive used on Excelsior tricycles

No. 5244: Singer, George and Granger, William (improved bearing)

1880

No. 165: Bonner, John (improved pedal)

No. 817: Hillman, William (new tricycle)

No. 1272: Hillman, William, Starley, John Kemp, and Singer, George (improved keyed crank, etc.)

No. 2786: Turner, Josiah (Coned axle with keyway)

No. 3105: Bonner, John (improved pedal)

No. 3843: White, Joseph (improved bell)

No. 3913: Lawson, Henry John (gas engine applied to a velocipede)

No. 4037: Aviss, Llewellyn (spur wheel gear)

No. 4432: Hillman, William (improved spring, step, bearing, ball pedals, and seat applied to Premier machines)

No. 5046: Starley, John Kemp (clutch driving gear, brake and roller bearings)

No. 5410: Hillman, William (improved balance gear etc.)

No. 5448: Townsend, Isaac Thomas (improved steering and spring)

No. 5511: Starley, James (folding frame)

Source: Robert Edward Phillips, Abridgements of the Specifications Relating to Velocipedes (London: Iliffe and Son, 1886).

Conclusion

Like the microprocessor industry in San Jose, the bicycle industry in Coventry formed an interconnected network of "actors" and innovative firms, it created a pool of skilled entrepreneurs and workers, ideas were shared, and the actors, although competitive, were also to a degree cooperative. Their technology was largely constructed locally; they copied, they stimulated each other, they shared ideas, they listened to users, they watched which bicycles won at races, they were often their own users, and they received lots of feedback from customers, witness the testimonial letters included in most catalogues (and the complaints that did not make it into print, but were certainly read). They built up social capital including personal connections that worked, kept going over time, spreading ideas and knowledge about bicycles. These were people that share common interests, values and long-term goals, and became a rich resource in Coventry.

There were obvious trade connections amongst the Coventry makers and suppliers, with various smaller firms supplying specialist services and parts to the larger makers. In addition, there were untraded interdependencies: I suspect the publishing connections were particularly advantageous. In sum, both producers *and* users mattered in Coventry because this was a place where they interacted in many ways, especially in the early developmental years of the industry. Such was the setting of Coventry in the 1870s.

Acknowledgements:

I wish to thanks Nick Clayton for his extensive help on numerous occasions in tracking down information on Coventry in this early period. Carolyn King's skills in drawing the map of Coventry is also much appreciated.

Endnotes

1 Nick Clayton "A missed opportunity? Bicycle manufacturing in Manchester 1880–1900" (Unpublished ms, 2004) explains how Manchester took an early lead as a pioneering centre of British velocipede manufacturing in 1869–70 but, for reasons that so far remain unclear, did not sustain this head-start in the years that followed.

2 André Vant, *L'Industrie du Cycle dans la Région Stéphanoise* (Lyon: Éditions Lyonnaises d'Art et d'Histoire, 1993.)

3 A good overview is presented in Ash Amin, "Industrial districts," in *A Companion to Economic Geography* edited by Eric Sheppard and Trevor Barnes (Oxford: Blackwell, 2000), pp. 149–168.

4 Wiebe Bijker, *Of Bicycles, Bakelites and Bulbs: Toward a Theory of Sociotechnical Change* (Cambridge, Mass.: MIT Press, 1995); Trevor Pinch and Wiebe Bijker "The social construction of facts and artefacts: or how the sociology of science and the sociology of technology might benefit each other," *Social Studies of Science*, 14 (1984), pp. 399–441.

5 Henry Sturmey, *The "Indispensable" Bicyclist's Handbook and Guide to Bicycling* (Weymouth: H. A. Judd) 1878, p. 103.

6 Henry Sturmey, *The "Indispensable" Bicyclist's Handbook and Guide to Bicycling* (Weymouth: H. A. Judd) 1878, p. 135.

7 I arrived at this crude estimate as follows: Curtis and Beamish's Directory of Coventry for 1881 states that Singer & Co's three factories covered 6,000 square yards. Since the fitting shop employed nearly 200 hands and covered 1,500 square yards, Singer's total employment was likely in the 600–800 range. Singer at this time appears to have accounted for 20-25% of the total of 2500 machines shipped from Coventry during the summer months. This suggests that the Coventry cycle makers as a whole employed between 600 / 0.25 = 2,400 and 800 / 0.2 = 4,000 employees.

8 Curtis & Beamish, *Directory of Coventry1881* (Coventry: Curtis and Beamish, 1881) p.xxxix.

9 William Starley, *The Life and Inventions of James Starley* (unpublished: lodged in Coventry City Library, 1902), p. 14.

10 A.E. Harrison, *Growth, Entrepreneurship and Capital Formation in the United Kingdom's Cycle and Related Industries* (Unpublished PhD thesis, University of York, 1977, p. 50.)

11 When the European Sewing Machine Company Limited was incorporated in 1863, neither Turner, Starley nor Salisbury were listed as subscribers of capital to this company. A wealthy local philanthropist—the Rev. Sidney H. Widdrington—and other local entrepreneurs had promoted a number of new industries in Coventry in the early 1860s in an imaginative local development initiative (Harrison, 1977, loc. cit.). Curtis and Beamish's Directory of Coventry 1874–75) p. xxxiii-xxxiv list a number of these initiatives including an elastic web maker, a maker of "Bradford stuff," and a cotton spinning and weaving firm started in 1860 "for the purpose of affording employment to the poor and then starving of the city."

12 Starley, op. cit., p.16 attributed this failure to lack of capital.

13 Founded by French Huguenots after the Revocation of the Edict of Nantes by Louis XIV in 1685, trade in this luxury good had always depended upon the rise and fall of economies, which made it quite cyclical. There had been industrial unrest between workers and masters, with a major strike in 1860 (Geoffrey Williamson, *Wheels Within Wheels: The Story of the Starleys of Coventry* (London: Geoffrey Bles, 1966) p. 39, after which Coventry's "lost markets could not be recaptured" (p.40) and the industry ran "into a series of troubles" (p.38). Yet Curtis and Beamish's Directory of 1874 reports that there were 1,500 silk looms in Coventry in 1862, versus 3,000 in 1873, which hardly suggests a trade in extremis. This was, however, a very considerable decline from the peak of 17,000 or 18,000 looms reported by Viscount Bury and G. Lacy Hillier *Cycling* (London: Longmans, Green & Co., 1887) p. 61 as the peak at some unspecified earlier date. Moreover the frequent trade reports on the ribbon industry in the *Coventry Herald and Free Press* during the 1870s indicate periods of low demand, but also times when the manufacturers were quite busy: e.g. in March 5 1869: "Extreme depression prevails in the ribbon trade," but in early 1871 the trade is better, and by July of that year "very good." In short, suggestions by Williamson, and Starley that the ribbon trade was severely depressed need revising. The small old hand looms were being replaced by larger mechanical looms and jobs were being lost as a smaller number of mechanised firms began to emerge.

14 Williamson, op. cit., 1966, p. 36 (see note 16).

15 Andrew Millward, "The genesis of the British cycle industry," *Proceedings of the First International Conference of Cycling History*, (Glasgow: Scotland Museum of Transport, 1993) , pp. 59–78. Starley, 1902, op. cit.

16 Derek Roberts' "Comment sheet on *Wheels Within Wheels* by Geoffrey Williamson" (reproduced by the author, 2002) is extremely important. He reveals that Williamson had used as a major source an unpublished historical novel about James Starley that contained many statements not based in fact—but Williamson proceeded to treat them as fact. In turn, many of the

fictitious statements in Williamson's book have been repeated by other authors.

17 *The Coventry Herald and Free Press*, 27 November 1868.

18 Despite many inquiries, I have failed to unearth any details of Josiah Turner's life, or death. My search of archives in Coventry, Warwick and London have not succeeded locating a picture of him. Even Google came up empty. I find this absence of information on a major figure in the bicycle trade quite curious.

19 *Curtis & Beamish's Directory*, 1881, p. xxxviii.

20 Horace W. Bartleet, *Bartleet's Bicycle Book* (London: Burrow, 1931) (reprinted with corrections 1983) p. 12.

21 Viscount Bury and G. Lacy Hillier, *Cycling* (London: Longmans, Green & Co, 1887), p. 61.

22 Bijker, 1995, op. cit., p. 2.

23 Nick Clayton "SCOT: Does it answer?"Technology and Culture, 43 (2002), 351–360; Wiebe Bijker and Trevor Pinch, "SCOT answers: other questions," *Technology and Culture*, 43 (2002), pp. 361–369; Bruce Epperson, "Does SCOT answer? A comment," *Technology and Culture*, 43 (2002), pp. 371–3.

24 Pinch and Bijker, 1984, op. cit. f4.

25 "*Macho*" is a relatively new term in the English language, used to reflect an aggressive sub-culture in the late twentieth century. The 2002 edition of the *Oxford Dictionary of Word History* states that the word "macho" entered English from Mexican-Spanish in the 1940s, but did not achieve widespread use until about 1980. Macho is also an individual quality. Within a group one person may be recognized as "macho," another as "laid back." My reading of the minute books and the press clippings of the Montreal Bicycle Club between its founding in 1878 and 1890 (i.e. the highwheel phase) lead me to a slightly different deconstruction of this "macho" category. I interpret club membership in North America as being built around a form of citizenship that valued the high bicycle as a sporting activity which perpetuated the etiquette of the cavalry evident in the American civil war. Gallantry, discipline, and gentlemanly conduct were expected of club members, collectively, along lines proposed by Charles E. Pratt, *The American Bicycler: A Manual for the Observer, the Learner, and the Expert* (Boston: Rockwell and Churchill, 1879). Pratt's programme for bicycle clubs included bugle calls, cavalry riding formations, standard bearers, a hierarchy of officers and troops, and cavalry dress, hence I believe that the terms *cavalier* or *gallant* come closer than *macho* to the attitude of this relevant social group. These terms also anticipate that all club members will comport themselves in a gentlemanly way, with nobody standing out as a macho individual (Glen Norcliffe, "Associations, modernity and the insider-citizens of a Victorian highwheel bicycle club," *Citizenship Studies*, forthcoming).

26 Bijker, 1995, op. cit. f.4, pp. 73–77.

27 Bijker, 1995, op. cit. f.4, pp. 84–88.

28 Glen Norcliffe, *The Ride to Modernity: The Bicycle in Canada, 1869–1900* (Toronto: University of Toronto Press, 2001).

29 Miles Ogborn, *Spaces of Modernity: London's Geographies 1680–1780* (London: Guildford, 1998); Keith Walden, *Becoming Modern in Toronto* (Toronto: University of Toronto Press, 1997).

30 David Harvey, *Paris, Capital of Modernity* (London: Routledge, 2003).

31 AnnaLee Saxenian, *Regional Advantage: Culture and Competition in Silicon Valley and Route 128*. (Cambridge, Mass: Harvard University Press, 1996).

32 Manual Castells and Peter Hall, *Technopoles of the World: the Making of Twenty-First-Century Industrial Complexes* (London: Routledge, 1994).

33 Benjamin Harrison, *Lean and Mean: the Changing Landscape of Corporate Power in the Age of Flexibility* (New York: Basic Books, 1994).

34 These terms are defined in the *Dictionary of Geography*. For further elaboration of the key concepts, see Storper, Sayer and Walker.

35 Richard Florida, *The Rise of the Creative Class: And How It's Transforming Work, Leisure, Community and Everyday Life*. New York: Basic Books 2002.

36 For a discussion of social capital see: John Harriss and Paolo De Renzio "Missing link" or analytically missing?: the concept of social capital," *Journal of International Development*, 9 (1997), pp. 919–937.

37 This date is confirmed by a report in *The Coventry Herald and Free Press* 27 November 1868 stating: "The sewing machine company… have just received a novel order for a number of velocipedes from Paris, where these locomotives have lately been all the rage, and which it is expected will soon be in general use in London." A report in *The Coventry Times* 10 March 1869 (p. 5) stating that :"The new two-wheeled velocipede is being manufactured at the works of the Coventry Sewing Machine Company" indicates that it took about 12–14 weeks to gear up for actual production.

38 For a discussion of social capital see: John Harriss and Paolo De Renzio "'Missing Link' or Analytically Missing?: The Concept of Social Capital," *Journal of International Development*, 9 (1997), pp. 919–937.

39 *Bicycling News*, 4 Feb. 1879.

40 *Bicycling Times*, Vol. 1 (2) 31 May 1877, p. 21.

41 *Bicycle Journal*, No. 87, 10 April 1878.

42 Andrew Millward, *Factors Contributing to the Sustained Success of the UK Cycle Industry 1870–1939*. Unpublished doctoral thesis, Faculty of Commerce and Social Sciences, University of Birmingham (1999), p. 433.

43 Andrew Ritchie, "The origins of bicycle racing in England, 1868–1870," *Cycle History: Proceedings of the 7th International Cycle History Conference* (San Francisco: Van der Plas Publications, 1997) 43–56.

44 *Coventry Herald and Free Press,* 25 June 1869.

45 *Coventry Herald and Free Press,* 11 March 1870.

46 *Coventry Herald and Free Press*, 26 February 1875.

47 *Bicycling Times*, 4 April 1878, p. 243.

48 At late as 2 August 1875, J.K. Starley participated in a race (admittedly a slow race) as part of the Coventry Philanthropic Institution's annual fête at Allersley Park—Bayliss also raced *(Coventry Herald and Free Press* 6 August 1875). A year later Starley was racing again, in his 46th year, with J.I. Warman and F.J. Thomas *(Coventry Herald and Free Press,* 15 September 1876).