Up the Vélorution: Appropriating the Bicycle and the Politics of Technology
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Up the Vélorution:[(1)]
Appropriating the Bicycle and the Politics of Technology[(2)]

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Introduction - Technological and Cultural Change in the World of the Bicycle

In the sociology and history of technology it has become common to talk about the 'seamless web' (Hughes 1986) of technology, economics, politics, culture and so on. These different elements are not fixed and discrete, but instead develop together in the construction and transformation of 'sociotechnical ensembles' (Bijker & Law 1992). Examples of sociotechnical change often highlight the fluctuating relationships among these elements, as their particular configuration within a sociotechnical ensemble changes over time and varies also between different social groups. A particular technological path might at one point be seen as highly desirable for a country or for a particular group, only to be understood later on or in other circumstances as something dangerous and unwise. Similarly, technological choices that were in one context regarded as foolhardy or disadvantageous might under different conditions come to be seen as the best way forward.

Such variability has always been a feature of transport, where successive innovations have been reviled and then embraced, only to be overtaken finally by the next innovation - something which has certainly been the case with bicycles, in both Britain and the USA.[(3)] In their earliest days, bicycles drew condemnation from religious leaders, moralists, physicians and members of the public frightened by such an unusual machine (McGurn 1987), only to become within a few decades the major means of transport for working people. The arrival of the motor car, however, led to the decline of cycling as a means of transport, especially once increased prosperity and cheaper cars had brought driving within the grasp of the middle and working classes.

Over just two or three decades, landscapes were transformed to support this change, embedding 'the love of the automobile' (Sachs 1992) and the 'car culture' within urban - and increasingly also rural - infrastructures (Relph 1987). At the same time, bicycles were increasingly marginalised - both materially as these infrastructures made cycling more hazardous and less widely used as a means of transport, and culturally as the purpose of a bicycle became redefined not as a mode of transport but as a piece of leisure or sporting apparatus, or at worst a child's toy. By the 1970s, then, a century after the first appearance

of the original boneshakers and high-wheelers, the bicycle had turned full circle from its initial position as a plaything of the aristocracy.

The story of the bicycle is far more complicated than this, however. Firstly, it does not end in the 1970s. Just as the intertwined embedding of cars and exclusion of bikes had begun to appear irreversible, changes in technology, culture and policy have been leading since the 1980s, and especially during the 1990s, to a revival of the bicycle at several mutually reinforcing levels: for leisure and health reasons; as a solution to the perceived environmental crisis; and also as a means of transport that is seen to solve problems of traffic congestion. These changes have been underpinned by a variety of policy changes attesting to the benefits that cycling offers in health (BMA 1992), economic (CTC 1993) and planning (DOT 1996, DETR 1998) terms. The overall result has been a growth in the purchase of bikes, especially for leisure use, though also for utility trips. A third of adults in the UK owns a bicycle compared to 15% in 1976, accounting for 2.3% of journeys - although there are percentages of up to 28% in some cities (statistics from the trade paper *Cycle Industry*). This increase, and the new meanings that are attached to bicycles, have been helped to a strong degree by changes in bicycle technology - mountain bikes especially are perceived as safer and more enjoyable to ride because of their sturdy design and upright riding position - and because of the improved braking and gearing technologies that have accompanied their growth in popularity. Bicycles have thus begun to be reappropriated as a valid form of transport, although much work still needs to be done to secure lasting change here (the National Cycling Strategy - DOT 1996 - is a crucial starting point in this respect).

Secondly, alongside the public face of bicycling that I have outlined, there has been since its earliest days another story to be told which at numerous points crosses over with - but is not wholly accounted for by - the progression of this technological artefact through different uses and meanings. This other story concerns the mavericks on the sidelines of mainstream cycling culture who challenge the conventional designs, assumptions and uses of bicycles, and quite often then influence that mainstream. These mavericks include cyclists, cycling writers, cycle designers and engineers who have appropriated the technology of the bicycle in ways that go beyond just its utilitarian role in relation to transport, sport or leisure, forming a culture - or counterculture - of cycling. In some cases, such people simply take pleasure in tinkering with technology, seeing what one can do which has not been done before - whether in terms of materials or engineering principles. For others, the objective is to test limits - to break speed records or to take a bicycle where no one else has taken one. Often these things go hand in hand, and they are frequently linked with an explicit intention of challenging the cycling establishment. Increasingly, there is an objective of challenging not only the cycling establishment but also the wider car culture, by demonstrating the green credentials and congestion-busting capabilities of cycling - highlighting, for example, the problems of car commuting by holding 'critical mass' bicycle rides through congested city centres (see McGurn 1987; or http://www.critmass.org.uk/). A further dimension of such appropriations of the bicycle is the development of new designs which address the needs of marginalised groups or communities - bikes for the disabled, for women, for conveying children, shopping or other loads, and bikes which are appropriate technologically and socially in the developing world (Lowe 1989).

What many of these cycling counterculture examples tend to share is an assumption that there is something inherent in the bicycle that makes it amenable, or even predisposed, towards appropriation by small-scale, autonomous groups with objectives which aren't part of the dominant transport or leisure cultures. Bicycles are portrayed, for example, as 'vehicles for a small planet' (ibid.), for reasons which include their low ecological impact in both production and use, their technological simplicity, their minimal infrastructure and maintenance requirements, and hence their position as an 'appropriate technology' in poor regions of the developing world. In the developed world, too, bicycles are regarded as an essential component of sustainable development, especially in the role they can play in improving the quality of urban life through sustainable urban planning (Elkin & McLaren 1991). This contrasts with a perception among cycling advocates and other environmental,

urban and transport activists of the car and related industries as promoting the degradation of communities and the destruction of the environment (ibid; Worpole 1992). The freedom promised by the car turns out in many ways to have curtailed many other freedoms - both for those without access to cars and to those who simply happened to choose the wrong place to live (ibid.; Ward 1991).

The activities of cycling counterculture participants, and their relationships with the bicycle establishment, raise some interesting questions about the possibilities for appropriating technologies, and about what makes a particular technology appropriable. Bicycles are technologically simple, yet encounters between independent innovators and the cycle industry and cycle sport regulators show that a complex sociotechnical ensemble can nevertheless build up around a simple artefact. If this ensemble is dominated by large organisations, how easy will it be for marginal actors to appropriate the technology for alternative purposes? Might such objectives be overshadowed anyway by larger players involved with struggles and appropriations of their own? And how can the appropriations of marginal groups be sustained and broadened in such a way that they transform the sociotechnical ensemble of bicycles or indeed of transport more widely?

This chapter will address these questions by looking at three different bicycle appropriations. Firstly, within the cycle industry there has been an appropriation of control among manufacturers and retailers (and also consumers) by the globally dominant component manufacturer Shimano, set against the backdrop of changing organisational and industrial practices. Such changes form part of the context also of the other two appropriations to be discussed. Innovations in the design of bicycles often fall foul of sporting regulations which uphold established designs associated with manufacturing interests. This forms the basis of my second case study, which examines some of these conflicts and the ways in which innovators seek to bypass the cycle sport establishment. As well as consciously promoting the interests of manufacturers, bicycle design can also constrain design and poorly serve the needs of users through simple inattentiveness. The third case study examines how female designers solve the problem of bicycle designs which are implicitly gendered in ways that ignore women's requirements.

The chapter ends by examining the parallels and connections between these different aspects of cycling counterculture and the emergence of a broader 'DIY culture' in the 1990s focused around a range of issues including transport. This is where cycling and the environment come together most visibly. A key issue which arises in relation to this DIY culture is participation in decision-making about technology - about policies, plans and specific artifacts: '[u]nless individuals are able to share both in decision-making and in the actual process of development, it is bound to fail' (Elkin & McLaren 1991: 3). Before discussing my case studies, therefore, I will first examine some questions around the politics of technology.

Underlying my discussions is a position that stresses the need to take into account simultaneously the *technology*, *culture* and *organisation* of the bicycle, three dimensions which are crucial to understanding both its industry and culture. The interweaving of these dimensions makes it more appropriate to regard the bicycle (or any technology) less as a discrete artifact than as part of a wider *socio*technology (Bijker & Law 1992). Understanding the appropriation of technology must take account of this sociotechnical character. The successful appropriation of technology by marginal actors is dependent on a simultaneous transformation of its technical, cultural and organisational components.

Participation and Community in the Politics of Technology

Critical analyses of technology often reflect the approaches to transport discussed above. Some regard specific technologies or technology in general as a threat to democracy or to social and environmental sustainability, for example among certain parts of the green movement (see, for example, some of the papers in Zerzan & Carnes (eds) 1991; also Ellul 1964). Others attempt to ascertain which kinds of technology might be more or less compatible with their political and social beliefs, in order to then promote those technologies in preference over others[(4)]. A key turning point in this respect has been Lewis Mumford's influential distinction in the 1960s between what he calls 'authoritarian and democractic technics' (1964), presenting a concern with how to 'democratise' technology that has been expanded and developed by writers such as Bookchin (1974), Winner (1977, 1986) and Sclove (1995). Bookchin is the most optimistic of these, seeing great potential for democracy in the development of new machinery to replace human labour, on the grounds that it can free people from toil and allow them to pursue their own creativity, whilst providing small-scale communities with the means to provide for their own needs (1974). Bookchin appears to lack Mumford's understanding of how the implementation of such technologies interacts with and often reinforces existing relations of inequality, something which comes across as naïve in light of debates on what has since come to be termed post-Fordism or flexible specialisation (Harvey 1989; Piore & Sabel 1984; Garrahan & Stewart 1993; Hobson 1992). Bookchin nevertheless provides a valuable starting point in considering the question of 'liberatory technology', by framing this notion around three central questions:

> What is the liberatory potential of modern technology, both materially and spiritually? What tendencies, if any, are reshaping the machine for use in an organic, human-oriented society? And finally, how can the new technology and resources be used in an ecological manner - that is, to promote the balance of nature, the full development of natural regions, and the creation of organic, humanistic communities?

(1974: 86).

This set of questions has been echoed more recently by writers concerned with the design and management of technologies, primarily in a policy context and usually in relation to large scale projects (for example, Street 1992; Sclove 1995; Hajer 1996, 1995-6). An important question concerns who decides on the design of an artifact and how this then informs the relationship of policymakers, innovators and 'the public'. Tatum (1996) notably challenges the distinction between 'experts' and 'users', or between 'experts' and 'the public' that is often made in science and technology policy. He argues that such distinctions are reinforced - to the detriment of 'public' interests - even in such progressive developments as the European 'science shops' which offer academic research to community organisations and 'consensus conferences' or 'citizens' juries' which present expert evidence to panels of the lay public (see Stewart *et al* 1994; Joss 1998; Fixdal 1997).[(5)] Tatum presents as a contrast to this situation what he sees as 'a genuine "alternative politics" of participation' (1996: 25), the home power movement that has developed since the 1970s in the USA. He shows how, in their approach to technology and democracy, those involved in this movement maintain 'industry' at a small scale, keep the technology within certain limits of complexity, and ensure that consumers take an active part in designing, installing and maintaining their energy systems.

What happens, though, in most cases of technological innovation, where the goal is usually large-scale production for profit rather than small-scale production aimed to enhance self- and community development? Building on Mumford's analysis, Winner is concerned with how to break the considerable hold of such 'authoritarian technics', a hold which he regards as deriving from the embedding of particular technological choices - or imperatives - within

social structures. The choices which usually serve to develop technology in non-democratic directions 'tend to become strongly fixed in material equipment, economic investment, and social habit', leading to 'a framework . . . that will endure over many generations' (Winner 1986: 29). Winner does not regard technologies - as Bookchin appears to do - as so flexible, prior to this embedding, that they can be seen as neutral, possible to direct towards *either* democratic *or* authoritarian ends.[(6)] He considers it crucial, then, that societies subject their technological choices to careful scrutiny, and in many cases attempt to reverse authoritarian trajectories. This is not an easy path. He argues that the increasing division and subdivision of labour and of responsibility that comes with modernity means that it has become beyond the capacity of any individual to resist 'the technological imperative' or even to foresee the indirect consequences of any particular innovation. Our lack of understanding of what has gone into the production of particular artifacts constitutes, for Winner, 'technological somnambulism', which he explains as:

> an inherent tendency toward forgetfulness. . . . Technology . . . allows us to ignore our own works. It is *license to forget*. In its sphere the truths of all important processes are encased, shut away and removed from our concern . . .

(1977: 315, original emphasis).

It is through this process that technology 'enters into and becomes part of the fabric of human life and activity' (ibid.: 320), allowing its subsequent reconstruction as 'neutral and tool-like . . . without the slightest public awareness or opportunity to dispute the character of the changes underway' (ibid.: 324). The growing pervasiveness of the car, with its accompanying infrastructures, associated industries and unintended consequences such as severe congestion and pollution (Hajer 1995-6), is a prime example.

Winner's answer to this situation is something he calls 'epistemological Luddism', a dismantling of technological systems that have been identified as problematic, so as to study 'their interconnections and their relationships to human need'. The knowledge thus obtained might then be employed 'in the invention of radically different configurations of technics, better suited to nonmanipulated, consciously, and prudently articulated ends' (Winner 1977: 330). A similar call to challenge established technological assumptions can be seen in the work of Bijker, who argues that academic studies of technological change need to become transformed into 'control and intervention studies' (1993: 130). He suggests that research might show how values in industry are 'not pregiven as universal ethical laws but socially constructed together with the technology', and that '[i]nvestments, costs, and profits are not considered as unambiguously available, objective facts' but, rather, 'socially constructed in the process of managing a firm and shaping a technology'. Constructivist sociology of technology has an important capacity, for Bijker, 'to suggest alternative technological choices, to debunk the sociotechnical ensembles constructed by the powerful' (ibid.).

For these writers, if marginalised groups are to appropriate technology, this needs to take place within a broader context of questioning and challenging the politics of technology - and politics *per se* - with the expectation that, once appropriated, any particular artifact would become embedded within more democratic social structures. In the case of bicycles and cycling, appropriations take place within the context of a variety of cultures and sub-cultures. Whilst in some areas these cultures are explicitly aiming for a transformation of society, in others the appropriation of the bicycle has less ambitious goals. I want to explore this variety in relation to a key issue I have been setting out here - the embedding within bicycle production of certain kinds of values associated with particular manufacturing methods and organisational practices. Whilst these values have been transformed over recent decades, it has been a persistent feature of the cycling world that the culture of cycle production has

considerable knock-on effects - for example on the regulations that affect cycle sport, and on the kinds of bicycle available to the public.

An important aspect of Tatum's (1995, 1996) account of the home power movement is its position in relation to the wider energy industry. Home power activists set themselves apart from this mainstream, both in the kinds of products they deal with and in their outlook on how society should be organised and powered. A similar argument can be made regarding many of the activists I want to discuss within the world of the bicycle, who contrast themselves with the mainstream of cycling culture and the cycle industry. However, any discussion of cycling quickly slips into the wider questions around transport that I have already touched on. Although not all appropriations of the bicycle are linked to this extra-cycling dimension, an important feature of the politics of the bicycle is that for the most part it is really just a small sub-section of a wider politics of transport. The biggest players within the cycle industry are small beer compared to even the more moderate car manufacturers. Bearing this in mind, whilst I will be presenting in the next section an analysis of the ways in which assumptions about bicycles and their users have hindered innovation and participation within the cycle industry, it is important to bear in mind that to truly 'debunk' the sociotechnology of the powerful, it is necessary to look beyond this specific industry. To question the technology of the bicycle, the activities of the cycle industry or cycling as an activity only makes sense as part of a wider questioning of the trajectories of a car-based transport culture. I will consequently move on to this wider perspective in later sections.

Appropriation and Production in the Bicycle Industry

Organisations regularly change how they organise themselves, in terms of production methods, products and marketing, organisational strategies, power and authority structures, and so on (Clark 1995). In the British cycle industry there have been a number of key periods of change, founded on assumptions that there were 'better' ways of organising the industry - by making production more 'efficient', more profitable, more responsive to consumer demands, and so on. What have these changes meant for control and participation in the design, production and use of bicycles? How have these changes affected the capacity of different groups to appropriate bicycle technology?

The British bicycle industry was established in the 1870s by light engineering firms that had diversified into bicycle production from products such as sewing machines and small arms. The new industry followed the craft traditions of these firms in terms of product design, production processes and relations of production (see Harrison 1977; Rosen forthcoming). Over the following decades, these traditions evolved into a particular 'sociotechnical frame' of mass cycle production particular to British manufacturers (Rosen forthcoming; see also Bijker 1995). This frame borrowed many ideas from the American and continental European cycle industries, which were more overtly concerned with product standardisation and automated production. However, in many respects it remained distinct from them: manufacturers retained a willingness until as late as the 1930s to provide customised products; the relations of production continued until the 1960s to follow the craft workshop model of shopfloor control by the workforce, in contrast to the management control of American industry; and despite adopting a good deal of equipment for automation and flow production, this was used more to increase output than to transform the organisation of production (Rosen forthcoming; see also Hounshell 1984; Lewchuk 1987).

An important consequence of this sociotechnical frame of cycle production becoming dominant was that only a narrowly prescribed range of bicycle models came to be available to

consumers - notably four basic frame models[7] which were adapted into different kinds of products by means of a variety of styling options for components and accessories (Hudson 1960). Behind this narrowed underpinning to product ranges lay a substantial investment in plant and materials, land, factories and retail and marketing networks by what had become by the 1920s and 1930s the three key players in the industry - the manufacturers Raleigh, BSA and Hercules. This is not to say that there were no other cycle manufacturers at this time, although this became increasingly close to the truth with a growing agglomeration of companies between the early twentieth century and the post-war years[8]. Rather, there was a mutually beneficial differentiation within the industry between these large-scale manufacturers and smaller-scale producers catering for a more specialised customer base (ibid.; also Rosen forthcoming)[9]. By the mid-1930s, Raleigh, BSA and Hercules were responsible for 55% of complete bicycles produced in Britain, and employed 70% of the industry's workforce (Hudson 1960: 130). Consequently, the interest of these larger companies in retaining the value of their investment is seen by many to have constrained bicycle design and affected bicycling more generally beyond the confines of production - both of these acting against the interests of the wider bicycle community. Winner's perspective certainly assumes that this is a likely outcome, since it can be expected that the mass production trajectory of the industry until the 1960s will have had a constraining effect on alternative possibilities.

Interestingly, a sceptical outlook among commentators on the motivations of the industry has persisted well beyond the lifespan of mass production, into a period of global transformation in cycle production and (perhaps less globally) in bicycle use. From the 1970s onwards, sales in Britain (as in America) have become increasingly dominated by both bicycle and component manufacturers from the Far East. Whilst domestic production has decreased, imports have grown dramatically, with overall sales boosted by the mountain bike boom of the late 1980s and early 1990s. Most interestingly, new cycle companies have sprung up based on finished products whose components are sourced globally and built in the Far East by contract trading companies. This emergence of 'global commodity chains' (Gereffi 1994) in cycle manufacture has marked a shift away from a mass production sociotechnical frame to one of global flexibilisation (Rosen forthcoming). Crucial to this shift have been the rise of the mountain bike and the changing production methods and cycling and transport cultures that have accompanied that rise. As with production changes elsewhere (see Piore & Sabel 1984; Harvey 1989), more flexible methods for cutting and joining bicycle frame tubes that have appeared since the 1970s have enabled the same machine tools to produce a greater variety of bicycle designs, eliminating the earlier effect of sunk investment in manufacturing equipment that restricted the range of possible products. At the same time, diversifying cycling cultures - focused around health, sport, leisure, the environment, traffic congestion and sustainable transport - have produced a demand for the diversity of products which are now possible because of the new equipment.

Evaluating the shift towards a global flexibilisation of production is complicated. The contradictions of mass production make its demise by no means wholly undesirable. Whilst production workers saw their wages rise with greater industry prosperity, at the same time they suffered conditions which in some parts of the process were described as 'the nearest to the black hole of Calcutta I've ever imagined'.[10] Consumers, too, experienced both benefits - in the availability of much cheaper bicycles - and downsides - the narrow range of design choices - as the industry shifted towards mass production. A further troubling aspect of mass production was its reliance on exports and the resulting colonial relationship with overseas markets. The simultaneous collapse of the three biggest overseas bicycle markets - in the USA, Nigeria and Iran - was a key aspect of the crisis that hit the industry in the late 1970s, because Raleigh (by then the main British manufacturer) was so dependent on those markets.

Over the course of the 1980s, the process-based production epitomised by repetitive tasks and long conveyors was replaced with a product-based approach, involving shorter tracks, robotics and laser equipment and worker cells. Parallel initiatives such as 'Success Through

Quality' (STQ) are commonly portrayed as providing a more co-operative workplace that is less alienating for workers than the earlier production lines (Piore & Sabel 1984; Hall & Jacques (eds) 1989). However, it is important to note that severe industrial action in the 1970s was, alongside lost markets, a major catalyst of the recent changes in the industry. Consequently, Raleigh can be seen in part to have used technological and organisational innovation to make its operations less vulnerable to industrial action - robots do not strike![(11)] Whilst there were, then, visible benefits to the abandonment of mass production and adoption of more flexible approaches in the cycle industry (alongside the considerable pain caused by the 'downsizing' of a decaying industry - see Mort & Michael 1998), from a perspective concerned with widening participation in technology there is serious cause for discomfort.

This is highlighted by the ways that relations within the industry have changed since the 1970s, notably in the case of the Japanese component manufacturer Shimano, perceived by many to have aims of dominating the entire industry. Shimano's reputation for high quality, cutting edge components has given the company, especially among mountain bikers, a market recognition that has translated almost into a widespread 'compulsion' to use Shimano products. Retailers and hence also manufacturers are obliged to meet that demand: to not specify Shimano components is to risk being left with unsold goods at the end of the season. The downside of this is that Shimano's products are designed around built-in obsolescence - intended to maximise either quality or sales, depending on how sympathetic you are towards Shimano - and this is exacerbated by their being inaccessible for DIY repairs: if a Shimano component goes wrong it must usually be either repaired by an 'expert' or discarded and replaced.

In addition to Shimano's market dominance, its business practices are widely scorned among other manufacturers and retailers. The company's radical annual product changes and innovations can leave its industry customers in trouble if they still hold old stock at the end of the season. It has also been criticised for penalising bicycle manufacturers that want to buy only a partial selection of components. Such experiences have led to a general cynicism about Shimano's motivations, and a fear that it is out to control and transform the industry, with rumours, for example, that it aims to 'shake out the dead wood . . . and get rid of overcapacity'.[(12)] Given such worries, it is no surprise that my interviews with cycle industry actors in the mid-1990s bore out the commonly-voiced desire among retailers quoted in the cycling press to break this stranglehold.

A different dimension to the Shimano story is that their rapid innovations have helped make the functions of braking and gear changing more straightforward and unproblematic for inexperienced cyclists, and were thus a major factor in the growth of cycling during the 1980s and 1990s. The widespread loyalty to Shimano among cyclists is based on the fact that their innovations (with a few exceptions) generally work very well and quickly filter down the price range. The company's commitment to improving cycle technology, exemplified in its early product development for mountain bike components, means that even those who are cynical about Shimano tend to recognise its contribution to the development of cycling and cycle technology.

Shimano has, then, appropriated for itself a central role within the cycling world, making itself an ***obligatory passage point*** for other manufacturers, retailers and consumers (Callon 1986). Paradoxically, Shimano's success has been achieved through supporting the reappropriation of cycling by various groups whose needs were often poorly catered for previously - those concerned with health and fitness, leisure and the environment. The nature of Shimano's appropriation has, though, set certain limitations on the kinds of involvement possible for others: rapid innovation and market dominance effectively tie the majority of other actors into Shimano's corporate strategy, whilst built-in obsolescence and opaque product design make users dependent on the expertise of professionals, and at the same time distant from those professionals. The cycling world being constructed by Shimano is antithetical, then, to the kinds of technogical decision processes advocated by writers such as

Mumford, Winner and Sclove and exemplified in the home power movement described by Tatum. Consumers of Shinano products are constructed precisely ***as*** consumers, not as active participants. In contrast, grassroots appropriations of the bicycle bear close resemblances to Tatum's home power activists. I will discuss some of these in the next two sections.

Before moving on to such groups, it is worth noting a few small examples in the cycle industry where different kinds of appropriations to that of Shimano have appeared, outside the general hope that Shimano's hold on the industry will be broken. Most notably there are five co-operatively run cycle shops in Britain, which as well as displaying the more usual traits of workers' co-ops - shared responsibility, a lack of hierarchy among the members, a levelling of pay, and so on - operate an informal network by meeting occasionally to discuss trade, helping each other out over stock, and in some cases producing their own range of bikes. These retailers stand out among cycle shops in making themselves accessible to inexperienced riders put off by jargon and complicated equipment, and ensuring that a customer buys the right bike for their needs rather than simply the most fashionable option. They also play an active role in their local communities, for example supporting local racing teams.

A second example of a workers' co-op, this time in cycle manufacturing, is Nigel Dean Cycles, a small producer of high quality 'off-the-peg' racing and touring bikes that was established as a co-operative by the staff when its founder retired. Whilst Nigel Dean appears to have opted for a more formal allocation of responsibilities than the cycle shops (for example, in having a Managing Director), the company has attempted also to set an example regarding broader relations in the industry. When I spoke to them in 1994, for example, they were attempting to equip their bicycles with components made by the European firm Sachs rather than those of Shimano. Orbit, another small manufacturer of high quality off-the-shelf bikes, whilst not a co-operative, also endeavours to take a socially-responsible position, responding to customers' needs, promoting wider environmental and transport-related issues and contributing a share of profits to cycling and related charities.

Such examples of companies trying to improve relations among manufacturers, retailers and users, to make production more sustainable, and to promote cycling as a form of transport are encouraging. However, their relatively low key and small scale nature shows that much more would need to be done in order to focus the cycle industry around a more liberatory, ecological and equitable conception of technology. Such a shift would require, for example, a reconfiguring of the global relations of production that have emerged over the last two decades - global commodity chains, especially, would need to develop more equitable structures, as Gereffi suggests (1994). A globally equitable bicycle industry would need to be centred around small companies using local resources to supply local needs. This is perhaps where the innovators in the cycling countercultural might have a role, as I will discuss in the following sections.

Racing and Regulations

The next case I want to discuss, the regulation of cycle racing, exemplifies Winner's argument in providing an example of how the embedding of certain production methods within an industry has been perceived to shape trajectories in the world of cycling beyond simply the products themselves. Racing, and specifically the regulations which govern it, are felt to have been strongly influenced by the embedding of large-scale production within the cycle industry, despite its shift towards greater flexibility . Racing has been central to the story of the bicycle since the days of the 'running machine', invented in 1817, from which the

objects we now recognise as bicycles were later adapted. In the establishment of bicycle industries first in France in the 1860s and then in Britain in the 1870s, racing acted both as a commercial and a technological testing ground for new machines and equipment, and also as a major focus of cycling culture. Aside from the large crowds which were drawn to cycle races, making this a highly propserous business in itself, racing was used strategically by the early manufacturers to establish the quality and speed of their machines, and also as a means of bringing 'rhetorical closure' (Pinch & Bijker 1984) to debates between advocates of the high-wheelers that had first appeared in the 1870s and the new, lower, safety bicycles which first emerged in the mid-1880s (McGurn 1987 provides a good account of early cycle racing).

Regulations for cycle sport were first introduced at an international level with the founding in 1900 of the Union Cycliste Internationale (UCI), whose objectives included ensuring that 'the form of racing cycles should be similar to those prevailing at the time. Only minor variations would be allowed' (Sanders 1991: 49). The stated rationale for this was to prevent the cost of new innovations from excluding anybody from competition. However, many commentators and designers regard the rules as excluding not competitors but *innovators*, since they have an essentially conservative effect on bicycle design. There have been several cases over the years of innovators coming into conflict with the UCI for breaching its rules. I will outline some examples where the UCI has banned innovative designs.

Several early challenges to the UCI rules about bicycle design came from designer-riders of recumbent bicycles, bicycles that are ridden lying or sitting back rather than sitting upright or forward (see Figure 1). These machines first made an impact on cycle racing in the 1930s, the culmination of experiments with recumbents and fairings (streamlined covers to make a bicycle more aerodynamic) dating at least as far back as 1913. In 1933 Marcel Berthet set a new Hour record (the distance record for one hours' track racing) on his faired Velodyne recumbent and repeated this for a second time in the same year (Ballantine 1991: 140). His long-time racing rival, Oscar Egg, responded with his own recumbent design, and the two between them pushed the Hour distance up on faired and unfaired recumbents, substantially exceeding the speeds which could be achieved on a conventional bicycle (for key speed milestones see *Cycling Weekly* 5291, 24/7/93).

The response of the UCI to recumbents was to redefine the specifications of qualifying bicycles so as to exclude recumbents, since their speed effectively meant that no conventional bicycle could again win a record. According to Ballantine, from 1938 onwards the regulations required that 'a bicycle had to have a diamond frame, be built from tubes with specific diameters, and have wheels of a certain size that were a certain distance apart' (Ballantine 1991: 17). In other words, 'the Velocar wasn't actually a bicycle' at all (Ballantine & Grant 1992: 127).

Recumbents seem to have become almost invisible over the following few decades, not remerging until the growth of interest in 'alternative technology' (Boyle & Harper (eds) 1976) from the late 1960s and especially the 1970s. One strand that emerged out of this movement was a concern with human powered vehicles (HPVs), a term which includes all bicycles and tricycles but refers especially to recumbent and other unusual designs. Organisations such as the International Human-Powered Vehicle Association (IHPVA) and the British Human-Power Club (BHPC) sprang up to champion this cause, putting into place an alternative set of institutions to organise and regulate competitions which have spurred a new set of speed records that far exceed those overseen by the UCI (Ballantine & Grant 1992). Alongside such organisations there has developed a wider context of the cycling counterculture discussed above, centred especially around certain cycling magazines, social and competitive events.

The influence of this counterculture on the cycling mainstream is evident from its high profile in relation to innovations. Two key players, Richard Ballantine and Richard Grant, for example, were the people who first introduced mountain bikes into the UK, by importing some from the first producers in California. Similarly, Mike Burrows, a key innovator within

the cycling counterculture, has also been at the heart of several controversies in the world of mainstream cycle racing, as well as working as a design consultant to the massive Taiwanese manufacturer Giant. To return to the issue of racing, Burrows also came into conflict with UCI regulations with his Windcheetah bicycle, which featured a monocoque (ie. single-piece) frame moulded from carbon-fibre. Burrows' first prototype of this bicycle was taken by the British Cycling Federation to the World Championships in Italy in 1985, where it was deemed illegal by the UCI for not meeting the required specifications. In 1990 these requirements were relaxed to take account of the new materials being used in cycle design, allowing its development into the Lotus Sport 'Superbike' on which Chris Boardman won the 4000m pursuit event at the Barcelona Olympics in 1992 (see Figure 2) (Ballantine & Grant 1992: 62-3; QED 1993).

Regulations are not, then, completely fixed, and can at times respond to new developments. Rather than specifying the materials used, the UCI's revised regulations stated instead that 'machines must be viable, marketable and able to be used by all types of sporting cyclist' - this constitutes the organisation's Rule 49 (British Cycling Federation 1994: 229-30). Nevertheless, whilst these revised regulations no longer prevent bicycles built from newer materials from entering races, they were accompanied by specifications for frame dimensions which have continued to exclude machines which don't at least resemble the conventional diamond frame (see Figure 3). This rule is justified on the grounds of a need 'to limit the design of bikes on the road to more or less what exists at the moment', as a means of keeping the cost of cycling within 'the range of the man in the street' (UCI President Hein Verbruggen, quoted in *Cycling Weekly* 5318, 5/2/94: 5).

Many cycling commentators have seen the UCI regulations not as a means of protecting the interests of 'the man [or woman] in the street', but rather as a means of protecting industrial investments which required a focus on a narrow range of products which is felt to have stifled innovation. Cycle design is commonly felt to have more-or-less stagnated from the turn of the century until the invention of the Moulton small-wheeled suspension bicycle in the late 1950s. Whilst seeing this stagnation as 'suicidal' for the industry in the face of competition from motorcycles and motorcars in the early twentieth century, for Alderson it was a direct consequence of the cost of laying down 'vast machinery' for mass production of standardised products (ibid.; Caunter 1955: 51). From this perspective, it was in the interests of the industry for racing regulations to restrict technological developments that might stimulate a demand for alternatives that could not be produced in the same factories - a view put across with conviction by Richard Ballantine regarding the Burrows/Lotus Sport Superbike (1992: 39). The eventual acceptance by the UCI of the innovative materials and design used for that bicycle indicates that racing regulations are perhaps gradually recognising the shift from a mass to a more flexible frame of cycle production, leaving aside the on-going ban on recuments[(13)].

The emergence of a new outlook - reflecting changes in the production capabilities - among regulators of road racing suggests that the relationship between innovation and regulation is fluid rather than fixed. This is supported by a comparison with mountain biking, which specifies only the wheel and tyre sizes of competing bicycles. Mountain bike racing also features a 'no outside assistance' rule that - in contrast to road racing - requires riders to start and finish on the same machine and to carry out their own repairs using only spares carried with them on the race (tools may be borrowed from other riders). This has been presented as a crucial *stimulus* to innovation by riders and commentators. Deb Murrell, a top British mountain bike racer since the late-1980s, argues in an article in *Mountain Biker* magazine that technological innovations such as suspension, and componentry developments that have made mountain bikes faster, stronger and safer, can be attributed to the need of racers to be self-sufficient on the course. She suggests that 'if outside assistance was introduced, bike design would stagnate. Designers would no longer be forced into finding technological advances to better their rivals' (1992: 39).

The regulations governing mountain bikes thus work in the opposite way to those governing road and track bikes. For mountain bikers, the 'no outside assistance' rule is supported as an enabling piece of legislation harking back to the individualist but at the same time non-discriminatory spirit of the sport's early days - anybody can win a race on any bike as long as it, and they, are in good working order[(14)] (ibid.). A similar pioneering spirit motivates the proponents of unconventional road and track machines, but in those cases they find themselves in conflict with an older set of regulations associated with earlier production constraints. Consequently, the rules are seen to favour a conservative industry which regards new technology as problematic. In both cases, technology, regulations and culture are intimately tied together in the sociotechnology of the bicycle.

Looking back to the issue of technology and participation, the difference between road racing and mountain biking appears to lie largely in how legitimate those setting the regulations are perceived to be by those active in the sport - whether as innovators or competitors. As a newer sport, mountain biking regulators appear to have remained in closer touch with the sport's participants than those in the UCI, helped no doubt by the fact that it was only by the mid-1990s that mountain biking was beginning to become recognised in large-scale international contexts (for example the Olympics) where a bureaucracy such as the UCI might have cause to emerge. Moreover, the underlying commitment among mountain bikers to an equitable individualism has perhaps helped prevent a remote bureaucracy like the UCI from taking control. Similarly, those involved in developing unconventional bikes which fall outside the UCI's self-imposed remit have found it more fruitful to appropriate not just the technology of the bicycle but also the institutions associated with it, setting up their own competitive environment and hence being able to ignore the mainstream regulators.

These cases raise an interesting question regarding Sclove's 'design criteria for a democratic politics of technology', which include the need to balance small-scale communitarian and co-operative technologies against those which are more individualised (1995: 98). The worlds of cycling, cycle design and cycle production have all been characterised by a high level of individual initiative, but this has been tempered - since at least the time of the first bicycle boom in the 1890s - with a general ease of access: start-up costs within the industry have historically always been low, whilst entry into cycle sport needs initially no more than a moderately-priced bicycle (see Harrison 1977; Ritchie 1975; McGurn 1987; Harris 1976). Bicycle technology is thus individualised in one sense, but this individualism is generalised and non-exclusive. For participants in road racing, mountain biking and the cycling counterculture, this translates into a desire - which the UCI has been felt to hinder - for governing institutions which reflect this egalitarian openness.

The Gendering of Bicycle Design

Another area where the biycle industry is criticised for conservatism is in the gendering of bicycles, since designs continue in many cases to reflect Victorian morality and clothing habits rather than any contemporary rationality (Ritchie 1975; McGurn 1987). Bicycles targeted specifically at women and girls clearly 'configure' their users (Woolgar 1991) by building into the machines assumptions not just about female tastes in terms of colour and graphics, but also about the differences between male and female bodily proportions. In response, a number of (mostly) female designers and engineers have begun to question these standard assumptions and to address bicycle design from a perspective that takes women's concerns as its starting point.

Whilst many women's and girls' bicycles are clearly marked as such through the use of particular colour schemes and model names, more important from the point of view of

comfort and fit are gendered differentiations between men's and women's bikes that are less clearly visible to those without cycle engineering knowledge. Unlike machines, human beings are not produced to standard sizes and dimensions. This has begun to be addressed by the larger scale manufacturers through the use of a more refined approach to 'frame geometry' (the various angles and tube lengths that determine the size and shape of a bike). Notions such as 'proportional geometry' take account of the different sizes and dimensions of different rider's bodies, often leading to variations not just between different models but for different sized versions of the same model. For example, a shorter rider generally needs a bike which is not just less high but also less long. When it comes to the physical proportions of men and women, this is even more important, although the exact nature of the difference is disputed among cycle engineers. Some claim that a woman's legs are typically longer proportionally than her trunk. This means that a woman and a man of the *same* height would require different frame geometries (Figure 4). Others dispute this claim - according to the Cyclists' Touring Club's (CTC) Technical Officer, Chris Juden, for both men and women, whatever their size, the average person's inside leg length is 47% of their stature (1994: 19). For him, where men and women differ is in how they sit on a bicycle: he claims that women both sit further back and bend forward from a higher point on the spine than men (ibid.). Either way, both sides in the debate require physical differences to be addressed by different designs for men and women.

Nevertheless, most cycle design continues to pay little attention to such questions. When it comes to bicycles for women, this usually means simply that 'ladies'' models tend as they always have to be identical to the equivalent 'gentlemen's' models, except that they lack a crossbar - a design originally intended to make it easier to cycle in the voluminous skirts of the late nineteenth century. Even leaving frame geometry aside, from an engineering point of view this design makes for a less sturdy bike that is more vulnerable to stress. A woman wanting to race or to do any sustained riding would be best advised to use a bike with a crossbar.

It isn't just frames whose gendering can be problematic. Letters and articles in the cycling press regularly highlight problems with componentry, for example the difficulty of obtaining comfortable saddles, or brake levers for dropped handlebars which can be operated by people with small hands (see, for example, the special features on women and cycling in *Mountain Biker* {June 1993} and *New Cyclist* {August 1993}, and the regular 'Women and cycling' page in the Cyclists' Touring Club's magazine *CT&C*).

Women cyclists are, then, faced with a paradox when buying a non-customised bicycle - they can choose a 'lady's' bike, which may feel more comfortable to ride but will be a less strong machine and is likely to have lower specification components and fewer gears; or they can buy a stronger machine which is better suited for its intended use, but less well suited to their body. With most brands, where women's frames differ from men's only in the absence of a top tube, this choice is more restricted still - the 'lady's' bike may not even be more comfortable. And even customised bikes can come with built-in biases. A widely-used framebuilders' resource, Richard Talbot's *Designing and Building Your Own Frameset* (1984), assumes in its tables and figures that customers will be male in size and even appearance[15]. Similarly, a woman mountain bike racer and framebuilder, Isla Rowntree, pointed out to me a fundamental flaw in the construction of the Bioracer system used to translate a customer's measurements into a frame design: the data in Bioracer's computer was derived from the measurements of 2,000 professional male racing cyclists[16]. Whilst users of both these guides can take account of individual differences when it comes to fitting a bicycle for a particular customer, the building of such assumptions into the design specifications bears out Sclove's call for democratic input into technology not to begin only at the point of implementation.

Rowntree has been one of a number of designers whose solution to women's problems in finding suitable bikes is to build them herself. When I spoke to her she was producing custom-built mountain bikes for women, as well as children's 'Trailerbikes' and even a

prototype city bike. Her particular approach to bike design was flavoured noticeably by her position as a competitve mountain biker[(17)] - her solution to the question of women's riding position matched the frame geometry of 'aggressive' downhill racing. Frame geometry to her was the central component of a comfortable bike:

> You see with the saddle, people say if you're saddlesore, then . . . the saddle's wrong. . . . actually it's not necessarily the saddle that's causing the problem, it's the seat angle that's causing the problem, it means you're sitting in the wrong place, all the weight is put on the front of the woman . . . which is where it's delicate, instead of being taken a bit further back and on the arms. If they had the right seat angle, the saddle would suddenly pale into insignificance. But because that's where you're sore it's immediately where you think the problem lies . . . [a comfortable saddle is] only fine tuning, your comfort at the end of it, if you don't get the major things right first, and then your choice of saddle will be the icing on the cake. It's not the other way round, that isn't the first thing.

An alternative approach is taken by Georgena Terry, who manufactures a wide range of components - such as saddles and clothing - as well as complete bikes, specifically for women. Terry's method, echoing that of the CTC's Chris Juden (1994), is to take a more conservative approach to frame geometry whilst using alternative components - not just saddles, but also a smaller front wheel to allow the same frame angles on a small bike as on a larger one. The important point about these two women - and others such as Smart Tart mountain bikes and the retailer and custom frame-builder for women, Why? Bikes - is that they have responded to the cycle industry's reluctance to cater for women by taking things into their own hands - an appropriation of the bicycle by and for women cyclists.

The fact that they have been able to do this underlines the point made earlier about the ease of entry into the cycling world. It is notable also that the open debate within cycling circles about gendered design differences has emerged most prominently within the last decade or so, the same period that has seen both the shift towards more flexible design and production possibilities, ***and*** a greater number of women taking part in all kinds of cycling. This suggests again the close (though not pregiven) links between technological and cultural change. A convergence of new industrial capabilities with new cultural interests which exploit those capabilities and which are popular among women has enabled women cyclists to reappropriate a technology that has frequently been male-dominated, both in sport and transport.

DIY Culture and the Appropriation of the Bicycle

The cycling counterculture I have discussed in this chapter is one of the fora where this gendering of bicycle technology has been most prominently aired, and this issue among many others provides a focus also for a broader politics of technology - both narrowly in terms of bicycles themselves, but also more generally in relation to wider transport issues.

The vision of cycling promoted by cycling counterculture participants such as Ballantine, Burrows and so on takes a holistic approach that celebrates all forms of cycling and opposes narrower views (such as the hostility to mountain bikes found in more traditional cycling

circles - see the letters pages of the CTC's journal *CT&C*, for example). They are especially commited to commuter cycling as an alternative to motorised traffic, and this has resulted both in a conscious search for practical designs which can overcome the limitations of established models (see, for example, *New Cyclist* 17 {November/December 1991}: 40-1; *New Cyclist* 30 {February 1993}: 25; *New Cyclist* 26 {October 1992}: 23), and in a championing of wider transport campaigning issues (see, for example, the columns of Patrick Field and Richard Ballantine throughout the history of *New Cyclist* and *Cycling Weekly*, around 1987-1995). There is a clear desire, here, to raise the status of cycling in Britain closer to that in northern European countries such as the Netherlands, Denmark and Germany. This is accompanied by a sense of belonging to a cycling community, and a belief in the need for some degree of collective action to bring this about - something that contrasts perhaps with the individualism of some sports cycling.

As well as their wide-ranging outlook on what counts as a valid bicycle or as valid cycling activities, members of the cycling counterculture blur - as is commonly the case in the world of bicycles - the distinction between designers, manufacturers and users that is commonly made in studies of technology (see Bijker, Hughes & Pinch (eds) 1987; Bijker & Law (eds) 1992). In many bicycle firms, designers and other staff tend to be cyclists themselves. Likewise, many serious cyclists build or at least customise their own machines. At meetings of the British Human Power Club (BHPC), or the Lancaster-based CycleFest celebration of cycling, the same people can be found acting at once both as innovators and competitors, designers and consumers of the various products being promoted. Someone like Mike Burrows, especially, crosses a number of boundaries: between the mainstream and the margins; between sport and leisure; and between the worlds of professional, scientific, cycling and the amateur - he himself continues to be an amateur bicycle innovator and competitor alongside his professional role in a packaging firm.

This cycling counterculture can be understood to some degree in terms of the 'cultures of resistance' discussed by McKay (1996), especially where he is concerned with transport-focused resistance and 'DIY culture' (see also Brass & Koziell 1997). McKay traces back to the (non-cycling) counterculture of the 1960s, and especially the British free festival movement of the early 1970s, a genealogy for the variety of groups that were brought together in Britain by the 1994 Criminal Justice Act - these include New Age Travellers, punks, ravers, and direct action campaigners who in the early 1990s adapted the tactics of the peave movement to protest against the then government's road-building programme. Whilst there are a few gaps in McKay's genealogy, it is striking that of all the groups he discusses, it is the last mentioned whose outlook appears most holistic, and least based in a single issue:

> The anti-roads movement embraces issues of land ownership, environmentalism, health and pollution, technology, big business, regional and self-empowerment and self-development, the power of the law itself.

(McKay 1996: 135)

At the same time, anti-road campaigners are often the most vociferously sceptical of technological progress - 'technophobic' in McKay's words (ibid.: 156).

McKay's book in fact covers a variety of often understated but interesting examples where there is a reworking of the relations of power, access and control over technology: the rejection of motorised transport in favour of horse-drawn carts among some festival-goers; the autonomous production and distribution networks developed by the anarchist punk band Crass (see also Rosen 1997); the embracing of new music technologies by the producers of rave music; and the apparent rejection of technology by groups such as the Dongas, the 'tribe' formed to protest against the M3 motorway link at Twyford Down in Hampshire.

McKay's analysis of the role of technology within the worldview of roads protestors is not entirely fair - such groups may reject the car culture but new developments in information and communications technologies such as the internet, fax and mobile phones have been crucial to their methods of mobilisation. Their position is more accurately described, then, not as technophobic but techno-sceptic, bringing us back to writers such as Mumford and Winner, and it is interesting in both its similarities and differences from the critique of technology that was inherent in the 1960s counterculture (Roszak 1971). The latter in many ways laid the foundations for the alternative technology movement which led to both home power and human power. It would be fair to argue that more recent anti-roads and land use protests in Britain bring to the alternative politics of technology a new focus, serving as practical examples of Winner's notion of epistemological Luddism - a conscious standing back from and taking stock of the technological development that has led to the destruction of historic landscapes in order to reduce car journey times by a few minutes.

Against this broad background of resistance and appropriation around transport and technology, the designers and commentators concerned specifically with bicycles and cycling - who challenge conventional assumptions about bicycle forms, about the predominant components of bicycle construction or about the gendering of bicycles - fall somewhere in between the different perspectives on technology presented by McKay. Like the anti-roads protestors (some of whom also belong to the cycling counterculture), they are not confined to a single issue in the range of their concerns. However, they neither wholeheartedly embrace technology like the ravers, nor thoroughly reject it like the Dongas might seem to. Instead, technology is an integral part of their world, perhaps even its core.

What is at stake for members of the cycling counterculture is not technology itself but who decides its characteristics, and who controls both the technology and the institutions around it - whether that is the large manufacturers and sports regulators, or the small-scale innovators and advocates and the alternative institutions they have established. As such, they are motivated by concerns closely allied to those who advocate democratic technics. Their activities meet, for example, many of the criteria of what Tatum terms a 'genuine alternative politics of participation'. Like the home power movement, cycle designers and consumers have broken down the boundaries between producer and consumer. Their focal interest is an inherently simple technology which makes it easily accessible to users, and they share information in an egalitarian and communitarian way whilst actively promoting their cause to a wider audience.

There are differences, though, between home power and human power. Tatum's account of home power indicates the ambiguous position of movement participants towards adopting goals concerned with wider political change - they are for the most part sceptical of mainstream political processes and locate their own commitments within a more grassroots and individualistic framework (1996). This is not such an easy option for members of the cycling counterculture, because of the way that stepping beyond the narrow confines of bicycle technology nearly always leads into questions of wider transport culture and transport policy. What the Dongas and others show is that making this extra step does not need to involve abandoning grassroots perspectives or a politics of the personal. I would argue, furthermore, that the lack of a clear boundary between cycling issues and wider transport issues makes this step essential if bicycle appropriations are to have any wider impact either within or beyond the cycle industry.

The examples of cooperation in the industry and within the cycling counterculture provide pause for thought here. Given the positive contribution cycling is seen to make in terms of democratising transport and mobility, is it possible also to introduce structures to facilitate greater participation in bicycle design for users and greater worker input into workplace organisation? How might the cycle industry build on the epistemological Luddism of transport demonstrated by roads protestors, in order to capitalise both on the achievements of the cycling counterculture and on the fact that its products are widely regarded as inherently beneficial to communities and to the environment? In other words, can the appropriations of

the bicycle I have been discussing become the basis of a new sociotechnical frame of cycle production, and what would this look like *after* global flexibilisation?

The task of shifting towards such a frame highlights Law & Bijker's point about the 'obduracy' of technology, by which technologies become less open to shaping by, and more shaping *of*, society (1992) - a concept reminiscent of Winner's technological somnambulism. Dismantling - or at least reconfiguring - the global networks of the cycle industry will not be an easy job. Moreover, as I have already highlighted, these networks are embedded within broader systems of transport infrastructure whose obduracy is only just beginning to be addressed at either policy or cultural levels. Motorised transport has come to dominate decisions around not just transport planning, but urban design more generally, regarding questions such as the location of shopping and leisure facilities (Worpole 1992). The obduracy of the 'great car economy' (Media Natura 1990) is thus rooted in material structures which will prove extremely difficult to break down.

More importantly, the success of any such development will require a broad-based understanding of sociotechnical change that does not focus just on particular artifacts, but brings together the organisation and distribution of production with the culture of technology. In particular, a new sociotechnical frame of cycle production will require the cycle industry to engage more with those in the cycling counterculture who have appropriated the bicycle for a variety of reasons and who have been the source of the most sustained critique of cycling institutions and conventions, and of transport issues more broadly.

Notes

1. I first came across the term 'vélorution' in the radical cycling press in the UK during the early or mid-1990s. It was used by cycle campaigners to link cycling (the original term for bicycles was vŽlocipedes) with the direct action movement which had begun to engage with transport issues such as the government road-building programme. McGurn attributes the term to the radical Montreal-based cycle campaign group *La Monde à Bicyclette* (1987: 178).

2. The empirical cases in this chapter are drawn from my PhD fieldwork carried out at Lancaster University 1991-5 and funded by the ESRC/SERC (SERC award number 91302983). The analytical issues have been further developed during research at SATSU whilst located at Anglia Polytechnic University. Thanks especially to Brian Rappert for helpful comments on the structure of this paper, and to David Skinner.

3. The situation has been remarkably different in other parts of Europe, in Asia and in Africa - some of these differences will be discussed later in this chapter, but only to the extent that they relate to the British case.

4. Such an approach can be seen, for example, in the contrasting versions of socialism presented in the nineteenth œntury by writers such as Edward Bellamy (1888) and William Morris (1890), as well of course as Marx (1970). Morris wrote his novel *News From Nowhere*, set in a deindustrialised utopian London where individual self-development and craft skills have replaced the values of industrial capitalism, in response to Bellamy's *Looking Backward*, set in a society where centrally-managed production provides for every conceivable want or need. Marx's position regarding technology cuts across these somewhat, valuing the potential benefits of individual fulfilment through work whilst being impressed by the power of industrial production (see MacKenzie 1984). Unfortunately later Marxists have often focused more on the latter than the former (see J Clark 1984 on Lenin and Trotsky; and Gramsci 1971).

5. An American example of such endeavours can be found in the work of Sclove's Loka Institute, which has recently held an experimental Citizens' Panel on 'Telecommunications and the Future of Democracy' - see http://www.loka.org/pages/results.htm.

6. He cites nuclear power, in particular, as a case where authoritarianism is almost inherent to the social structures which must be built around this technology (1986).

7. There were, in addition, specialist frame designs such as delivery bikes, tricycles, and particular 'trademark' models such as Raleigh's X-frame bicycle.

8. The culmination of this trend was that, having bought the cycle interests of BSA in 1957, Raleigh itself was absorbed three years later into what was by then Hercules' parent company, the TI Group. Following this 'merger', 80% of UK cycle production came under the control of one company.

9. Note that this mutual coexistence contrasts with the 'industrial divide' model put forward by Piore & Sabel (1984) where whole industries are seen to be forced to choose *en masse* between a mass production or flexible specialisation approach.

10. From Nottingham Local Studies Library, 1982 Oral History Project, transcript A5, p.2.

11. But see Latour 1992 for an example of one that did.

12. Quotation from a designer at the mountain bike company Muddy Fox, 1993.

13. This ban can be understood as no more than a response to the futility of racing upright bikes against recumbents, although it is interesting to speculate what might have happened to the cycle industry and to cycling in general had the speed records of recumbents led to a retooling within the industry.

14. The 'no outside assistance' rule has also also used to evoke two of the key discourses of mountain biking - the 'spirit of independence' and 'the notion of being able to ride away from civilization' (see *Mountain Biker* May 1993: 132 and Midsummer 1992: 94). For a discussion of these discourses and their role in mountain bike culture, see Rosen 1993.

15. One of the drawings in this book features a man with a neat side parting.

16. Interviewed May 1993.

17. She has since stopped building bicycles in favour of a racing career with Team Raleigh.

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