A Culture of Improvement: Technology and the Western Millennium by Robert Friedel

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Robert Friedel's *A Culture of Improvement* is a notable achievement, an engaging, well written, well-grounded distillation and synthesis of academic research in the history of Western technology. Informatively illustrated with new drawings, paintings, and photographs, it should replace widely used earlier texts on the history of technology, such as those by George Basalla, D. S. L. Cardwell, James McClellan, Lewis Mumford, and Arnold Pacey.

His narrative relies on a commitment to the social construction of technology, perhaps most saliently expressed in his chapter 'Networks', where he notes that

> the particular ways in which these new capabilities [media technologies] were developed and exploited were not determined by science at all, but by the complex combination of personal ambitions, social currents, markets, and politics that lay at the foundation of all important technological change. [516]

Friedel's book has two major theses. The first is that over the past 1000 years, the West has developed a 'culture of improvement', which places great value on technological improvement and its sustainability. The second, perhaps more debatable in terms of quantitative measures, is that the rate of technological change has accelerated in the past 500 years because of new, more effective means of making improvement part of a sustained series of changes.

If there is one sure bet that one could make about the American character, it is belief in Progress. My students almost universally use the word in talking about the role of science and technology in society.

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Their view of the recent past is one of an accelerating technological bounty, an explosion unparalleled, transformative of material and social life for the better. We live in the best of all possible worlds, and it's only getting better! Woe betide those who would reign in unfettered creativity and invention.

The principal value of Friedel's account is that he avoids the problematic and debatable idea of 'Progress', and the determination of what desirable goal or goals humanity is progressing toward. Instead he prefers 'improvement', which includes both the gradual evolution of a technology and the unexpected revolutionary transformation of a technology. Improvement tends thus to be localized and particular, although attitudes towards improvement may be diffuse and general. Indeed, Friedel takes care to set technological change in social, economic, and technical context, and seems taken with what he calls 'attitude(s)' toward technical change and innovation.

The focus on improvement has another virtue: it can help explain the contingent and contextual character of technological change, as well as how and why some technological changes catch on while others do not. The 'Culture of Improvement' means simply that 'things could be done better', and what constitutes improvement depends on differing individual and group perspectives. Hence, improvement is both contingent and specific in terms of goals and the times. Not all societies exhibit a belief in or commitment to the value of improvement; and, where such beliefs or commitments exist, they may be limited to particular technologies, not a general feature either of practitioners or society in general.

Such a focus helps make sense of the long periods in which little change in technology seems to have been characteristic. For example, the invention of the water wheel sometime in the first century BC led to its use for grinding grain. Except for a few isolated and temporary cases of other applications, for the next 1000 years or so the water wheel's potential as a general power source for a variety of applications remained unappreciated and unexploited. Not until almost the turn of the first millennium AD was the water wheel applied to a variety of other tasks, such powering bellows and trip hammers in iron forging, felting cloth, sawing wood, crushing olives, tanning bark, powering borers, rolling metals flat, stamping coins, cutting stone, operating pumps, and so forth.

A similar example is illustrated by astronomical instruments, which from their description by Claudius Ptolemy in his *Almagest* (*ca* AD 150) remained essentially unchanged until the Middle Ages, despite shortcomings and opportunities for improvement obvious to the modern eye (and temperament). About 35 years ago, I needed to have models of Ptolemy's instruments made for a lecture; and for several weeks, every day or two, the person in charge of making them, an experimental physicist, would come to suggest modifications to make them 'better'. His attitude toward improvement was irrepressible and totally incongruent with that of those past astronomers who were satisfied with their instruments for more than a 1000 years.

Friedel undertakes to explain how improvement gradually came, from scattered appearances in the European High Middle Ages (1000–1300), sometimes called the 'First Industrial Revolution', to be widely acknowledged, expected, and of great social value in the 18th and early 19th century West. After the middle of the 19th century, widespread technological change became part of Western social expectations, and contributed to the rise of a belief in unending Progress.

It would appear that something significant, perhaps a 'turning point', with regard to establishing a 'culture of improvement' took place in the 16th and 17th centuries. It takes Friedel five chapters to deal with technological change between 1000 and 1500, with relatively little material from the 1400s. Even though they were presumably without *A Culture of Improvement* by 1500, Islam, India, and China were roughly comparable to the West in terms of the level of science and technology. Then, the West began to outstrip the rest of the world in widespread technological change, but just why it did so remains unclear. Friedel characterizes the period from 1500–1700 as one of 'enormous changes in the status and meaning of technology' [154]. On his account, it would appear that the period was a turning point in the diffusion, acceptance, and expectation of technological improvement. The consequences take up a majority of the book, nearly half of which concerns the technological changes of the Industrial Revolution (1700–1900).

The book's chapters, roughly chronologically ordered, but topical within, consist of thematically related developments in science and technology, together with supporting and interwoven social and historical context. Friedel occasionally reserves dealing with an individual or topic until a later chapter, so that what at first might

seem like an omission later turns out to be treated in a different context. For example, in dealing with the rise of civil engineering in the 17th and 18th centuries, and in comparing France with Britain, he devotes several paragraphs to prominent French engineers, but in turning to Britain, does not mention John Smeaton, sometimes termed 'the father of civil engineering'. Smeaton, however, turns up in a later chapter on steam engines. Another example of this concerns the topic of mining and miners, important and valued technology and labor in the medieval period, a topic largely absent until the 16th century publication of *De re metallica* by Agricola.

In order to cover the significant technological, socio-economic, and cultural changes of 1,000 years in 25 chapters, Friedel has by necessity to be selective. Yet his coverage is masterfully comprehensive, with but a few minor lacunae. For example, in discussing Harrison's invention of the marine chronometer, there is no mention of the parallel, less empirical and more theoretical French approach and success. Also absent is another French invention which often figures in weaving and information technology, the Jacquard loom. And there's no mention of one of the key responses to the critiques in the 1970s of technology, the Office of Technology Assessment (1972–1995), which served Congress well until the Office's demise, and served as a model for other countries to emulate.

Friedel considers the costs as well as the benefits of 'improvements', noting that there are both winners and losers as technology changes. One of the greatest costs was the gradual exclusion of women from technology, especially in the 16th and 17th centuries, from traditional crafts, food, and textiles. As the economic importance of cloth-making increased, women's dominance of the trade faded. Women were increasingly seen as outside the domain of technical improvement. If women's participation in the sciences in the late 20th century has in many fields approached parity with men, computer science and engineering still remain overwhelmingly male dominated domains.

There were other costs as well. If in 1700 'improvements were to expand the opportunities for work, not reduce overall labor', by 1800, productive employment 'no longer seemed necessary' as improvement's focus changed from moral and spiritual uplift to individual and

group self-improvement. The costs of the factory system in child labor, disease, pollution, and disemployment were immeasurable, and are still being levied.

In dealing with the military's role in technological change, Friedel notes that 'The improvement of violence became a large-scale enterprise itself', and labels World War I a 'shock to the culture of improvement and moral uplift', with its lesson that technology has no limits. The greatest shock, however, came with the development of eugenics, whose negative form led to 'moral disaster'.

Nonetheless the allure of improvement maintained such power that in the mid-20th century 'the improvement of technologies of all kinds appeared to be an imperative.' Even as the critical ferment of the 1970s over the environment, racism, the Vietnam War, women's rights, and technology left a continuing legacy, the culture of improvement continues dominant to this day, with the rise of networks of power and information, genetic engineering, globalization, and the decline of the local.

At the end of his book, Friedel deals explicitly with the problem of extrapolating from a widespread belief in improvement to its consequent creation of a common underlying culture supporting that belief (sometimes termed technological convergence):

> The culture of improvement... is now a worldwide set of beliefs and expectations. The belief in technological improvement, however, does not and cannot extend to shared beliefs about culture, values, or the best way for humans to live. The dramatic power of technology and the powerful promise of its unending improvement have led to the misperception of more widely shared values in the world. This has, in turn, led to serious errors of judgment, policy, and understanding. [540]

Debates over technological change will continue, because fundamentally they are about who we are, and how we should live. Without a sense of history to clarify and enlighten those debates, we are only too likely to succumb to Langdon Winner's 'technological somnambulism'. For the concerned college student and educated layperson, Robert Friedel's book is an unusually rich and informative historical resource.