Introduction

There is something about the subject of technology that turns people's minds toward the future rather than the past: the *history* of technology, as they say, does not compute. Yet this is both wrong and wrong-headed. Wrong, because technology, like every other aspect of our lives, has come from somewhere – that is, has a history. Wrong-headed, because the future is being shaped right now out of what we have to work with and think about – that is, what we have inherited from the past. Our history does not determine our future, but it provides us with both the material and the understanding with which we built that future.

All too often we fall into the easy understanding called ''technological determinism'' – that is, the assumption that technology determines what happens in society.[1] This assumption is cunningly used by advertisers to convince us that the new technology they want us to buy – the car, say, or that new dishwasher – will change our lives. If we buy the car we get the partner of our dreams, but if we don't we don't. Sometimes of course it's true – get a gun *and use it*, and we are likely to be in deep trouble. And if we get it, we are probably more likely to use it.

But it's also true that society determines technology. We have a nuclear technology because the United States wanted an atomic bomb. Research on computer technology was pushed by the Pentagon because it decided that it needed the power to crunch big numbers. The result, for many years, was that computers were huge, expensive mainframes, suitable for calculating missile trajectories but not designed to provide personal word processing for students.

Finally, to complicate matters even more, new technologies do not always have the effects they were designed to produce. The historian Joseph Corn has pointed out that when predicting the future of new technologies (that is, the futures which the technologies will determine), we usually make three key mistakes.[2] First, we assume that the new technology will completely replace the technology we used to use for that purpose (the fallacy of total revolution). Second, we assume that this replacement of one technology with a newer and better one is the only change that will take place (the fallacy of social continuity). And, third, we assume that the new technology will only solve problems (the fallacy of the technological fix). In fact, all three of these assumptions are false. Most commonly new technologies are used for some purposes, but join rather than replace the older ones. We now have jet airplanes but we also still use railroads. When we get our music from a CD rather than a piano, more than just the technology changes. And new technologies not only solve problems, they create them as well.

And often both at the same time! "Smart" cars that never crash into each other would solve a huge problem for drivers, but create an equally large problem for that army of auto repair shops, insurance companies, and others who now make a livelihood out of collisions. Results are not simply good or bad, but can often be *both* good and bad depending on where one stands in the situation.

Understanding the role of technology in our lives, in the past as in the present and future, it is important to remember that, like other aspects of our humanity, technology is the result of both choices and accidents. It does not grow out of its own logic nor is it always and inevitably progressive. It is, in fact, largely what we choose to make of it.

There are many questions that the historian of technology can ask of the technology of the past:

- Where did it come from (that is, who designed, invented, engineered it)?
- How did it work?
- Who owned it and who used it (and for what purposes)?
- What effects did it have?
- What did it mean?

When the field of the history of technology first professionalized – that is, when the Society for the History of Technology was organized (1958) and its scholarly journal *Technology and Culture* began publication – some of these questions about the past were more often asked than others. In part because the Cold War had spawned both a Nuclear Age and a Space Age as well as an Arms Race, the origins of technological innovation

seemed to have political urgency as well as intellectual appeal. In part because many of those who studied the history of technology at that time had been trained as engineers, the subject of design held an importance and a fascination that cast other questions into the shadow.

The great changes that have taken place in the past generation in the field of history as a whole, however, have left their mark also in the history of technology. For one thing, this sub-field is not alone. During these years other fields, like environmental history and most notably women's history, have also developed into flourishing enterprises with large and sophisticated literatures of their own. Women's history, especially, has been the origin of a host of new and important theories and methodologies that have excited and reshaped the entire historical profession.

More generally, the rise of social history over these same years has led many, perhaps a majority of, historians of technology to switch their focus from questions of where technologies come from to who owns and uses them, and for what purposes. The social context of technologies, as it is phrased, is particularly prone to illusions of determinism, as we see workers thrown off the job, the economy soaring, families weakened (or strengthened), the countryside denuded, and Native Americans driven off the land. At the same time we know that sometimes these are not unforeseen consequences, but the very purposes for which the technology was adopted. It is a thin line, for example, between a "labor-saving" machine, and one that throws people out of work. The anonymously but brilliantly designed American axe of pioneer days devastated the nation's forests, but that is what it was designed to do. Deforestation is a critical part of the social history of the axe, but that implement is only a part of the explanation of why this all took place.

One result of bringing social history into the history of technology is that it allows us to see all those many Americans who were not engineers and inventors, but who lived lives surrounded by technologies. Workers, for example, could now be seen operating machines, breaking them, and sometimes repairing them, maintaining them, and once in a while modifying them in useful ways – a kind of design not taken note of by studies concentrating on engineers. Women working in homes were revealed to be managing sometimes complicated technological systems. Cooking involved not only the design of meals, but the use of energy in specialized stoves to cook food (properly prepared) in a variety of containers, all of which had to be cleaned, repaired and replaced, sometimes with better ones, using a variety of instruments (knives, spoons, beaters, etc.) which also had to be cleaned, repaired and replaced.

Enslaved Africans were discovered to have artisanal skills, some brought over from Africa, like inoculating for smallpox, and others

learned in this country, like cooperage or shoemaking. At the turn of the last century African-Americans became electricians and steam engineers, inventors and manufacturers. All of these people had failed to make it onto the pages of histories of technology for a generation, and only now in the twenty-first century are people of color (any color other than white, that is) being recognized as technological players in American history.

Interestingly, Native Americans are still largely invisible in the study of technology in America. Just as Indians are found in *natural* history museums, and not in most history museums, so it has been more often anthropologists than historians who have interested themselves in the technologies of indigenous peoples. What little we do know, however, suggests that it made a difference whether or not Indians had muskets and revolvers, and whether they could repair them and make the ammunition necessary for their use. We also know that, as with other "races," Indians were judged to be savage or civilized in part by their technologies, so "color" was a matter not merely of skin but also of tools.

And so with other groups. Through the lens of social history we can see that children were once thought not to be technologically capable and were therefore subjected to long periods of apprenticeship before being trusted with the tools and machines of grown men and women. (To be manly meant not only to not be womanly, but not to be boyish either.) By the end of the twentieth century, interestingly enough, it was thought that only children and young adults were capable of truly mastering the electronic gadgets that increasingly filled our homes. Through all this time, however, toys scaled down from adult technologies, whether ironing boards or Erector sets, have been thought to prepare the young for the real world of grown-up technology.[3]

In recent years, social history has been joined (though certainly not replaced) by what can be called cultural history. Broadly speaking, cultural history in this field focuses on what technologies mean – or, to use the language of its practitioners, what technologies represent. As the historian Lynn Hunt has written, "the accent in cultural history is on close examination – of texts, of pictures, and of actions – and on an open-mindedness to what those examinations will reveal."[4] I take this to mean that while an internalist might want to investigate who invented the automobile and how it has been changed mechanically over the years, and a social historian might want to know how quickly African-Americans were able to purchase and use automobiles, a cultural historian would want to know what such purchase and use meant to Black Americans – what car ownership and use represented to them (and probably to others as well).

Most of the chapters in this collection could probably be categorized as examples of social history, often with a sensitivity to cultural dimensions in the stories they tell. Theodore Steinberg, for example, looks carefully at how the building of dams in New England during the early years of the Industrial Revolution affected the farmers and fishery workers who had used the waters in radically different ways. Arthur McEvoy, while tracing the way in which industrial workers were endangered in their workplaces, also deals with the meanings attributed to risk and responsibility within the law; a kind of blending of social and cultural history. Bruce Sinclair describes the ways in which the members of one local engineering society represented their professional aspirations and fears in an elaborate pageant. My own contribution acknowledges the social and economic forces which blocked the development of ''appropriate'' technologies, but insists that the gendered nature of attacks on such technologies as solar power greatly weakened the credibility of their advocates. And Rachel Maines convincingly demonstrates that sexuality can be medicalized in such a way as to socially mask the erotic. Taken together, the ten chapters in this volume, and the primary documents that support them, provide a snapshot of American technologies, and the ways in which we can think about and understand them.

Beginning in the seventeenth century, peoples from different parts of Europe brought their essentially medieval technologies to the Americas, at first blending with and eventually displacing most of the tools and techniques used by the indigenous peoples already living here. Axes and saws were used to convert vast forests into both lumber and farm lands, while water mills and windmills were erected to process the natural and agricultural bounty of the land. In a period when nearly all Americans, enslaved as well as free, worked on the land, the tools of field and farmstead were of critical importance. Neither conservative nor self-sufficient, as Judith McGaw points out in her chapter, colonial Americans applied old technologies to novel materials and situations. Wood was arguably the most important, and certainly the most ubiquitous, material with which people worked, and hand-tools were far more numerous than any machines. People learned to use those tools through experience, either structured as in an apprenticeship or haphazardly through necessity. Despite the growing importance of industries such as iron smelting and fabrication, British economic policy continued to insist that the colonies should avoid manufactures, sending raw materials to the home country to be converted into finished goods.

The year 1763 saw the end of the French and Indian Wars and marked the end also of long years of ''salutary neglect'' by the British government and the beginnings of heightened tensions between England and

America, as the former searched for ways of better integrating the colonies with imperial policy. The next year, in 1764, James Watt was given a model steam engine at Edinburgh University, and began those improvements which as much as any one cause marked the beginning of the Industrial Revolution. The next quarter century witnessed, in fact, the birth of two great revolutions: the Industrial in the old country and the American in the new.

During this period Watt's improved steam engine was set to work in a number of different industries, not only grinding grain and pumping water, but, as importantly, creating a tremendous demand for both coal and iron. Machines powered by water were invented and set to work to spin and weave cotton and wool. Canals were built to speed commerce and the profession of civil engineer was born. In other words, new industrial technologies were transforming Britain into what would come to be known as the Workshop of the World. This transformation, which ushered in the Modern world, brought with it a vast amount of suffering among what was being formed as a British industrial proletariat.

Having won their political independence from Great Britain during these same years, Americans faced both the opportunity and the necessity of shaping their own political economy. An entirely agricultural society was not possible (indeed, the colonies had never been such), but the twin necessities of importing the industrial technology of the Industrial Revolution without bringing with it the resulting degradation of labor were seen as highly problematic. The enrichment of a few at the expense of the many, as Steinberg's chapter makes clear, was not to be accomplished without resistance. Workshops in the wilderness, as they were sometimes called, were bought at a price. On the other hand, the need to create a balanced economy, with agriculture, manufactures and commerce nicely supporting each other, seemed to require the exploitation of the country's vast natural resources and this, in turn, appeared most easily done by importing the new technologies of England.

The resulting rush to build mills, dig canals, construct turnpikes and eventually railroads, open mines, and raise up great cities (with their own engineering infrastructures of waterworks, sewers, streets, and lighting) created a modern America in which the farmers and artisans of an earlier time became machine-tenders and shop clerks. Slowly, the public and private institutions changed as well, sometimes to accommodate and sometimes to encourage modernization. Corporations replaced partnerships, factories replaced mills, and chattel slavery was eventually replaced with a ''free'' market of labor, even in the South. In his chapter, Arthur McEvoy traces some of the ways in which these forces created and attempted to control new environments for work.

We easily see factory workers as ''labor,'' and we are not surprised that ''labor-saving'' machines readily found their way into industrial production during the nineteenth century in America. It is important to also realize, however, that this drive for efficiency and mechanization was broadly felt across the nation and applied to a wide variety of sites and tasks. On farms, such machines as the McCormick reaper were rapidly adopted for harvesting grain crops and by the end of the century electricity was being shown to have a large potential for stationary farm work. In the West, both lumber and mining interests adopted aids such as dynamite and crosscut saws to speed exploitation of the nation's natural resources.

As Rachel Maines shows in her chapter, even physicians eagerly sought mechanical devices which would help them in the diagnosis and treatment of human maladies, including the ''hysteria'' which many claimed to find in their female patients. In a report on the extent and effects of mechanization in a large number of industries in 1898, the US Commissioner of Labor stated flatly that ''hand methods are going out of use.''[5] For those who hired labor, increasing productivity and profits proved powerful inducements to mechanize work. For those, like doctors, who did most of their own work, the avoidance of tiring and time-consuming tasks was equally attractive.

If we tend not to think of doctors' offices as sites of production, neither do we automatically think of homes in these terms; the home is more often thought of as a retreat from the modern world of industry and mechanization. But it is, in fact, the traditional workplace of women, where production and reproduction take place. Meals, cleanliness, comfort, and even babies are the results of specific activities and as factories, and later farms, began to adopt machinery so too did the domestic workplace. Christine Kleinegger's chapter argues that the mechanization of both sites of rural production, the farmhouse and the barn, was contentious, contingent, and heavily gendered.

The mechanization of farm and factory, home and white collar office, was accompanied by a dramatic rise in the number of engineers in the country. Beginning early in the nineteenth century, engineering grew to become, by the twentieth, the largest of the new professions spawned by the Industrial Revolution. One by one civil engineers, then mining, then mechanical, then electrical, then chemical, and finally dozens of more specialized engineers organized to meet the needs of both the economy and their own employment prospects. In his chapter, Bruce Sinclair discovers a culture among engineers in St Louis during the early years of the Great Depression which cast an honest, perhaps even a bit cynical, eye on the professional paths they followed, and the social conditions under which they labored. ''Progress,'' both technological and

professional, was not the straight, clear, inevitable, and innocent path which they might have wished, and in which many people believed.

The fact that the path of technological development had to be deliberately constructed, rather than simply followed, was obvious also to the post-Second World War generation of engineers, scientists, military leaders, and politicians who wanted very much to enjoy and celebrate a bright, new, ''Atomic Age.'' As the historian Thomas P. Hughes points out, ''the long history of projects extends back at least as far as the building of the great Egyptian pyramids and the Middle Eastern irrigation systems.'' In contrast to those builders, however, he also notes that ''those presiding over technological projects today expect the systems they build to evolve continuously and to require new projects to sustain the evolution.''[6] Michael Smith's contribution to this volume traces the efforts of nuclear enthusiasts to ''sell the atom'' to the American public. The cultural link between Hiroshima and Walt Disney's ''Our Friend the Atom'' was not obvious, nor was it easily drawn.

The fact that nuclear technology could do great harm but also, or so it was alleged, great good should not surprise us; few things are all good or all bad. Indeed, it is not uncommon for the same events to be ''good'' for some people and ''bad'' for others at the same time. One example of this is investigated by Venus Green, in her chapter on racial factors in the employment policies of the telephone system. The pursuit of mechanization, to the point, and beyond, of automation, can be undertaken for a number of reasons and often several at the same time. Just as the labor market is segmented – by sex, by race, by skill, and so forth – so can labor-*saving* devices impact different segments of that market differently.

Just as technological ''progress'' can be instigated and nurtured in different ways and for different purposes, so can it be hindered, even blocked. The so-called oil crisis of the 1970s gave immediacy to growing environmental concerns over the effects of what might be called ''over development'' in the United States. The large technological systems that appeared to dominate American life, from interstate highways to interlocking electrical grids, began to seem dangerous and undesirable to some, who proposed technologies more ''appropriate'' to a healthy and sustainable society as well as natural environment. In my own chapter in this collection I point out the ways in which the political economy of technology can work in tandem (or at odds) with cultural constructions such as gender norms.

Notes

1 Merritt Roe Smith and Leo Marx, eds, *Does Technology Drive History? The Dilemma of Technological Determinism* (Cambridge, MA: MIT Press, 1994).

2 Joseph J. Corn, ed., *Imagining Tomorrow: History, Technology, and the American Future* (Cambridge, MA: MIT Press, 1986), pp. 219–21.
3 Carroll W. Pursell, Jr, "Toys, Technology and Sex Roles in America, 1920–1940," in *Dynamos and Virgins Revisited: Women and Technological Change in History*, ed. Martha Moore Trescott (Metuchen, NJ: Scarecrow Press, 1979), pp. 252–67.
4 "Introduction," in *The New Cultural History*, ed. Lynn Hunt (Berkeley: University of California Press, 1989), p. 22.
5 *Hand and Machine Labor. Volume I, Introduction and Analysis. Thirteenth Annual Report of the Commissioner of Labor, 1898* (Washington, DC: GPO, 1899), p. 6.
6 Thomas P. Hughes, *Rescuing Prometheus* (New York: Pantheon Books, 1998), pp. 6, 7.

Further Reading

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