ECS 188 Clint Stevenson and Stephanie Liu

Lewis Mumford's *Technics and Civilization* is both a chronicle and a critique of the development of technology alongside society. Mumford sees the development of modern technology as having occurred in three distinct phases—greatly oversimplifying, one could say that the phases represent the shift from "wood and water" to "coal and iron" and finally to "alloy and electricity". The work is also intensely concerned with the relationship between war and technology. Though the book was written in 1934, its insights transcend the decades and are surprisingly applicable today.

An issue concerning us right now, Mumford talks at length about the influences of war on technological advancement, in fact, "at every stage in its modern development it was war rather than industry and trade that showed in complete outline the main features that characterize the machine." [1] We may be inclined to say that warfare, rather than necessity, is the mother of invention. The large majority of new discoveries and inventions aren't discovered by quirky inventors in their basement labs. Instead, we have research and development teams working in large corporations with grants from the US Military. It is somewhat unsettling to think that many of our brightest minds are hired to further their fields under the watchful direction of our military.

Of course, many inventions developed by the military make their way into civilian life arguably completely separated from its intended martial use. The most obvious example comes from ARPA (Advanced Research Projects Agency); the Internet. The Department of Defense was very interested in developing a way for computers to communicate with each other so that they could have command and control over information during wartime. [2] The wide and varying effects of the Internet on our society are still to be seen, and history will probably tell us that it is a great boon to us; bringing many people together, making the world smaller. However, it should give us pause, especially since half of us, as computer scientists, will be working for the military in some shape or form. We live in a country where much the creative forces are driven, ultimately, by violent goals. How would things be different if projects were funded with world peace as the end objective?

After giving broad insights about how technology has affected society in general, the author begins tracing its roots by cataloguing them into approximate phases.

Mumford calls the first stage in the development of modern technics the “eotechnic phase”. This phase refers to the state of technology generally between 1000-1750 AD, although this first phase peaked in the United States around 1850. The eotechnic was the “water and wood” phase—water as its source of power, and wood the materials it was built on.

Mumford begins with this phase because several inventions created during the period laid the foundations for the state of technology in his day. His so-called “primary inventions” are mechanical clocks, the telescope, cheap paper, print, the printing-press, the magnetic compass, and the scientific method, chosen because they made a rapid expansion of scientific and technical knowledge possible. The mechanical clock was important for another reason, however—it made the actions of men coordinated and regular, preparing mankind to be compatible with the machines of the future. Machines need constant attention from engineers, maintenance personnel, and operators. They must be serviced regularly, and (in the case of assembly lines) must be scheduled to run in chronographic synchronization with other machines. The universal synchronization made possible by the clock allowed people to interact with machines regularly and at the appropriate intervals.

The eotechnic phase also saw important developments in glass: the convex lens gave us reading spectacles, adding years to the length of time a human being can read in his life. It enhanced our ability to study the stars and allowed us to see bacteria for the first time. Glass also improved chemistry—it's light, malleable, transparent, and does not easily react with most substances. It even changed the self; it was in this period that windows and mirrors became a reality. The pronounced existences of self-consciousness, introspection, and mirror conversation are due largely to the mirror.

Industrial processes involving machines started to take root in the eotechnic phase. The most important advancement was the shift in sources of power—from human and animal power to water and wind power. This change saved a great deal of labor, and led to the obsession with efficiency and cost-saving that characterized the period that followed the eotechnic phase, the paleotechnic phase.

By the end of the eotechnic phase, "our mode of thinking, our means of production, our manner of living…" [6] had changed into something which had assimilated the presence of the machine. We had begun to harness the forces of nature in the mills and textile factories, and there was a need to "consolidate and systematize the great advances that had been made."[6]

The paleotechnic phase responded to this need. A seemingly inexplicable burst of invention started around 1750, yielding machines such as the steam engine and the blast furnace which made mass-production and industrialization possible.

The capitalists of the era sought only to maximize production and profit regardless of the cost. Forests were destroyed to make way for railroads and provide materials to support mines, poisonous industrial and biological wastes were carelessly dumped into rivers, and the air was so polluted that children were born feeble and deformed, and the sun could scarcely penetrate the smog. Energy was severely wasted; the steam engine was only 10% efficient, and much of the fuel went up the flue.

Worse than these offenses, however, is the mechanization of their workers. Workers were indeed paid slave wages, forced to work long hours, and suffered miserable conditions, but they were also made a mechanical part of the factory. They rose at the same time every day, they labored for up to 14 hours in a day, they even wore the colors of iron and machinery; black, grey, and brown were common. People lived their lives outside of work only to keep from going insane. Any part of life which could not be sold or rented to a factory owner became useless. Even in schools, the curriculum was reduced to the bare essentials of the factory worker. Children in factory towns were taught “silence, absence of motion, complete passivity, response only upon the application of an outer stimulus, rote learning, verbal parroting,” and “piece-work acquisition of knowledge.” [7] Workers also faced the very real threat of being replaced by machines when they considered whether to strike against unfair labor conditions. The life of a worker in the paleotechnic phase was mechanical, desolate, and hopeless.

The paleotechnic period tended to overproduce. Because the system impoverished the workers of a nation, no one was able to buy the goods it produced. Even if it paid the workers decently, the rate of consumption of natural resources was not sustainable. A new phase of technology needed to arise.

Emerging from the coal mines of the paleotechnic phase, the neotechnic phase brought about many changes in how industry utilized the environment, "it was the vineyard and the farm and then physiological laboratory that directed many of the most fruitful investigations and contributed to some of the most radical inventions and discoveries of the neotechnic phase." [3] The big shift from the coal mines was due to the harnessing of electricity in this era, a great new source of energy that could be produced just about anywhere. This brought with it an increased use of copper and aluminum because of the high degree of conductivity.

The beginnings of the neotechnic phase can be approximately fixed at the perfection of the water-turbine in 1832. By 1850, many discoveries set the stage for the rest of the era; the electric cell, the storage cell, the motor, the electric lamp, the spectroscope, and the doctrine of the conservation of energy. Using these fundamental inventions, the electric power station and the radio telegraph were invented.

In this phase we also see an emphasis on the establishment of general laws rather than specific inventions; the invention is but a derivative product, "it was Hertz who invented the radio telegraph, not Marconi and De Forest." [4] This started a more deliberate and systematic invention. Serendipity and isolated inspiration came to count less and less. The neotechnic phase demanded scientific exactness from every field, from architecture to education, as we strived to be more mechanical, more precise, "paleotechnics regarded only the figures to the left of the decimal, whereas neotechnics is preoccupied with those to the right." [5]

The neotechnic phase also diminished the limitations of distance and time. Instant communication in the form of radio and telephone, and widespread use of the motor car started changing the world to what it is today.

We thought this book did an outstanding job of chronicling the development of technology after 1000 AD. Nearly all of Mumford’s claims are backed up with specific examples, and we often found ourselves in awe of his ability to collect, analyze, and interpret so many obscure moments in history. It’s an excellent collection of insights into the intimate relationship between man and machine.

Works Cited

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2. Ruthfield, Scott, “The Internet’s History and Development: From Wartime Tool to the Fish-Cam,” http://www.acm.org/crossroads/xrds2-1/inet-history.html
3. Mumford, Lewis, *Technics and Civilization*, Harbinger, 1934, pg. 216
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6. Mumford, Lewis, *Technics and Civilization*, Harbinger, 1934, pg. 151
7. Mumford, Lewis, *Technics and Civilization*, Harbinger, 1934, pg. 176