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History of Technology - Review of Waldrop's *The Dream Machine*

M. Mitchel Waldrop's *The Dream Machine: J.C.R. Licklider and the Revolution that made Computing Personal* has an entirely different flavor than previous readings this term. Written by a journalist, its classification leans more towards science writing than science studies. Waldrop discusses (in vivid detail) the evolution of computers from ENIAC to PCs and the co-evolution of networking from Arpanet to Internet. He frames his story around the people (from von Neumann to Jobs) and places (from Cambridge to Silicon Valley) that shaped the technology. In particular, he establishes J.C.R. Licklider as a catalyst, drawing together people, money, and ideas to build the infrastructure needed for the information revolution. His story is engaging and well told. What it lacks, compared to our other class readings, is how the history of science and technology connects to other dynamics of culture. Even though he does not state such connections, his material speaks to larger themes developed over the course of the semester. I will trace three thematic arcs - technology as a multidisciplinary pursuit, technology's influence on "landscape", and the social aspect of technology - to show how the texts of this semester flow into each other and create coherent histories.

One aspect of the history Waldrop depicts is the simultaneous development of the fields of computer science, artificial intelligence, and brain and cognitive science. Licklider himself is a trained mathematician and psychologist who turns his focus to computers. Figuring out how a computer should 'think' forces scientists to reinterpret how humans think. New understanding of human cognition, in turn, influences computer logic. Licklider understood this mutually beneficial relationship and brought graduate students into his early-career acoustics lab "to work on understanding behavior in terms of cybernetics-style control and communications" (110). This was not the first time scientists drew on models from other disciplines to develop thinking in their own field. In *The Soundscape of Modernity*, Thompson discusses how acoustic scientists gained momentum when they compared sound waves to electrical signals. As soon as this

analogy was conceived, acoustics had a new toolbox of models and equations to apply to sound. Computer Science and acoustics are two examples of an emerging field drawing on methodology from slightly more established (though still evolving) fields.

One might ask why emerging fields look to other disciplines. Thomas Hughes indirectly offers an answer to this phenomenon in *American Genesis*. "Independents could not depend on science and abstract theory as guides into the future, because they were exploring beyond the front edge of technology and of knowledge. They probed beyond the realm of theory" (48). When forging a new disciplinary frontier, the scientist can chose whether to proceed laboriously with trial and error experimentation or look for inspiration in other fields. Both methods can yield success, but seeing the connection between two fields can perhaps speed up the process and influence more than just the emerging field.

Another theme revisited several times during the semester was the influence of technology and machines on the "landscape". Landscape can mean both the physical and intellectual world. We discussed the influence on images at length with Rabinbach and Kern. However, we started out the semester with Chandler and Cronon who both wrote about the impact of the railroad. In *Nature's Metropolis*, Cronon describes two oft-used metaphors for the railroad.

> On the one hand, [boosters] assimilated the railroad to the doctrine of natural advantages, merging first and second nature so that the two became almost indistinguishable…Wherever the railroads went they brought sudden sweeping change to the landscapes and communities through which they passed, suggesting the second metaphor…Railroads were more than just natural; their power to transform landscapes partook of the supernatural. (72)

Metaphors aside, railroads changed the conception of time and space, standardizing time and making places feel closer. Chandler acknowledges this important effect of the railroad, however he devotes his writing to analyzing how the railroad changed the landscape of management in America. Railroads required hierarchy and labor specialization, which propagated into other industrial enterprises.

How does Waldrop's history extend this theme of technology influencing the landscape? The most apparent connection is the way in which the internet has once again changed people's perception of distance. Waldrop offers an anecdote of researchers in emerging computer science programs not knowing their colleagues on the other side of the country until they were able to message each other through Arpanet (326). Computers and the Internet also changed the way management was done. However, unlike railroads, which according to Chandler changed managerial ways out of necessity to work with the technology, the Internet changed management style as a byproduct of its invention. Waldrop describes the first infiltration of the technology into the office when in 1972, Steve Lukasik, the director of ARPA, was connected to Arpanet by an engineer and told he could use it for E-mail. "He was the first person outside of IPTO and the research centers even to be on the Arpanet, and he had fallen in love with E-mail. He loved it so much, in fact, that he quickly decided to bring ARPA itself on-line" (325).

The changed landscape of management through E-mail overlaps with the third thematic arc exemplified by *The Dream Machine*: the affect technology has on society. This affect is multifaceted, thus it is worth narrowing the scope to two interactions: technology can either minimize or glorify the user. Waldrop focuses on the positive interaction between the user and the machine. "The real significance of computing was to be found not in this gadget or that gadget, but in how the technology was woven into the fabric of human life" (342). This notion of computer-human symbiosis was the vision Licklider had for computing from the start. However, other scientists were amazed not only by the symbiosis between *a human* and *a computer*, but also by the greater community that the technology facilitated. Bob Fano refers to computing as a sociological phenomenon: one that traces back to the start of Project MAC at MIT in 1963 and continues to shape person-to-machine-to-person interaction today. " 'All sorts of human things happened, ranging from people destroying keyboards out of frustration, to friendship being born out of using somebody else's program'" (227).

Furthermore, even with the looming threat of computers replacing and/or minimizing the human user, the computer's adoption by the counterculture in the 1960s temporarily staved off this threat. A program like Spacewar symbolized the reinvention of the personality of the computer its ability to empower of the people.

> Spacewar, [Stewart] Brand contended, was not just fun; it also symbolized a profound shift in the nature of technology. Instead of continuing to be oppressed by remote, cold mainframes grinding out data for the establishment, he said, we were now moving into an era of humane computing… [the democratization of access to information would] help individuals organize for action, challenge the established order, and generally serve the People and not the System. (388)

We needn't look far to find examples of the other, minimizing type of human-machine interaction. Hounshell, during his discussion of American manufacturing, considers the transference of skill between worker and machine. As the machines became more proficient at manufacturing, the worker became increasingly deskilled. With the rise of the assembly line, the worker was no more than a cog in the process. The replacement of machine for man is seen in the books illustrations. First, there exists a single person and a single machine (63 and 66). In the next evolutionary stage the factory is introduced and there are many machines and many operators (86). The workers were still performing skillful tasks such as hand fitting and filing. Finally, Fordism places the machine as the subject of factory depictions and the human is removed from the frame (232).

While Hounshell's history deskills and removes technicians from the process, Mindell argues that the *USS Monitor* created not only a new type of technology, but also a new user. "In order to create a successful, sustaining technology, [Ericsson] had to create the users as well as the machines: he had to educate them in living, sailing, and fighting in his new mode of warfare" (121). The demand made on the human to adapt (in this case) his self to the new technology is mirrored in the computer age.

In class, I criticized Waldrop for simply reciting history without saying anything about it. In retrospect, I acknowledge that he *is* selective in the way he tells the story. His anecdotes highlight salient themes in the history of technology. He recognizes that emerging fields are

often the product of several disciplines. In addition to changing academic landscapes, computers are yet another technology that altered people's conception of distance. Finally, modern computing drastically reshaped social relationships (between people and between users and machines). Each arc is still playing out in today's society, as computers continue to shape academic, social, business, and industrial environments.