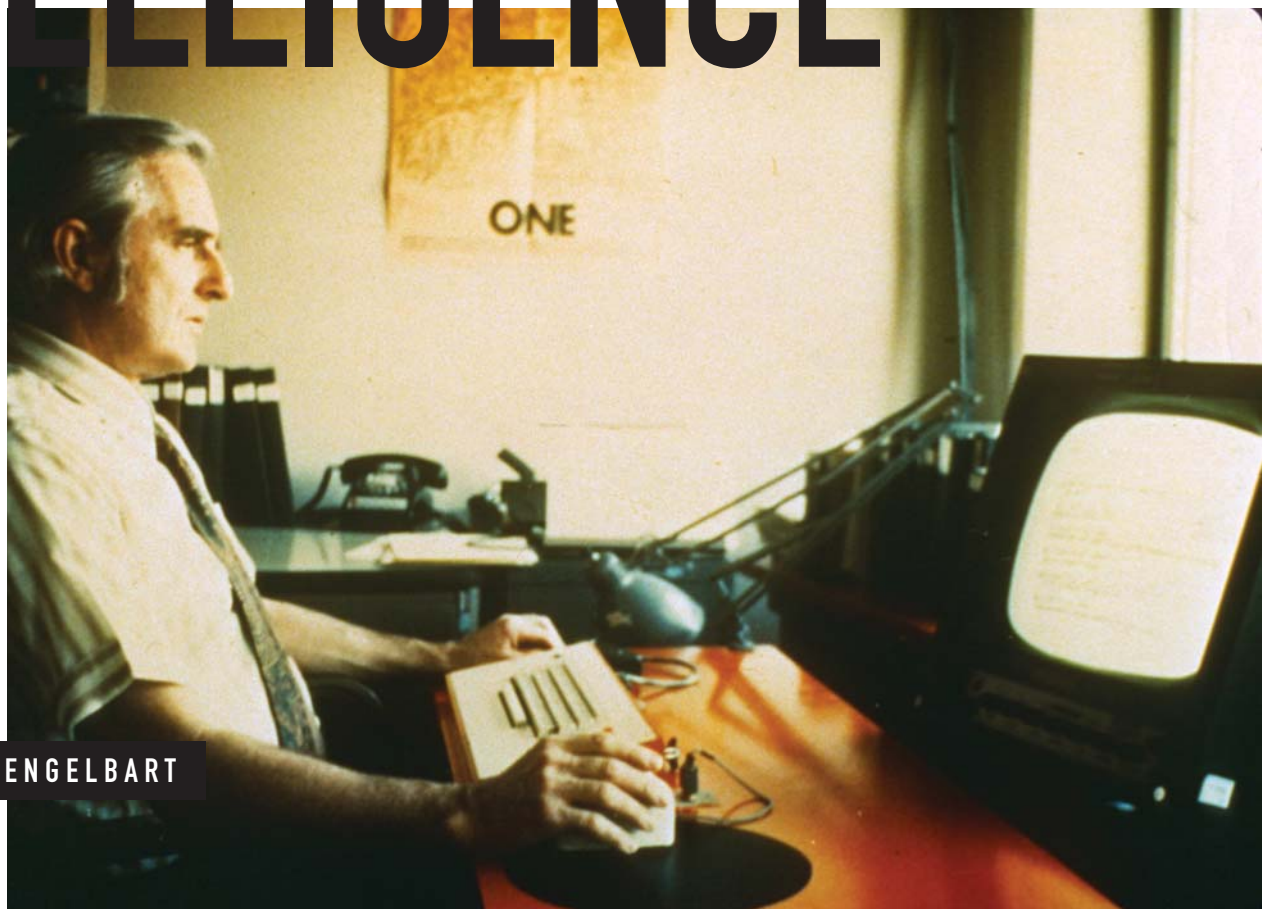
AUGMENTING INTELLIGENCE

REMARKABLE PEOPLE



DOUGLAS ENGELBART

Douglas Engelbart at an NLS (oNLine System) workstation, 1960s. NLS pioneered many aspects of modern computing including hyperlinks, browsing, online collaboration, word processing, the mouse, videoconferencing, and much more.

BY MARC WEBER

In 1945, a young naval radar operator was waiting to be shipped home in the slack days after victory in WWII. He read a magazine article in his Philippine jungle base that proposed a new kind of information system based on a fabulous desk called a Memex. Its two side-by-side microfilm readers and a host of hidden machinery would let you browse and create links between spools on any subject. The idea was to use the power of machines to make the whole of human knowledge accessible to all, and to let people add to and refine that knowledge in a virtuous circle.

Some years later that sailor, Douglas Engelbart, now a thoughtful and restless engineer at the NASA (then NACA) Ames research center in Mountain View, California, had an epiphany. Perhaps the new digital computer—not microfilm—could form the heart of a system like the one he'd read about. He imagined moving through information space the way a radar screen let you navigate through physical space.

The article he'd read was "As We May Think," by leading US scientist Vannevar Bush, a polymath who had built analog computers as well as played a major role in the development of the atomic bomb. Bush's article mirrored some of the ideas of early twentieth century pioneers including Paul Otlet and writer H.G. Wells about using the power of machines to assemble all knowledge in a kind of "world brain." To Engelbart, the flexibility of the computer opened up a whole new set of possibilities. He decided that building such a system would be his life's work.

Navigating Knowledge

But as I wrote in my blog piece on 2013 Museum Fellow Bob Taylor, the man who funded Douglas Engelbart through many of his most productive years, the idea of using digital computers to share information wasn't exactly an easy sell in the 1950s and early '60s. Why would you waste these fabulously expensive data crunchers on something as quotidian as communication, in a world that already had telephones, printing, telegraphs, photography, TV, and radio? Just as wild was Engelbart's idea that each person would sit in front of their own keyboard and fabulously expensive radar-style video screen, interacting in real time with the computer and through it, with each other.

Engelbart was not completely alone; a few others had begun to see the computer as the ultimate information machine. A brilliantly precocious college student named Ted Nelson came up with an independent concept of using associative links to navigate and organize all the world's knowledge into a new kind of multimedia literature, and he coined the term *hypertext*.

Two other fellow travelers were in a position to offer Engelbart extraordinarily concrete help. At the military's Advanced Research Projects Administration (ARPA), J.C.R. Licklider and his protégé Bob Taylor would later co-author a paper called "The Computer as a Communications Device." With funding from Taylor, first at NASA and then at ARPA, as well as from several others, Engelbart began to turn his vision into reality.

His goal was nothing less than to augment human intellect—to harness people's ability to collaboratively solve the world's important problems. He believed that properly trained and with the right computer tools, we could raise our "collective IQ." By putting knowledge at the fingertips of those who needed it, and letting them share their refinements and insights with others, he hoped to start a feed-forward process he called "bootstrapping." Each improvement would help accelerate further advances in method, and so on. The concept of bootstrapping also went far beyond computers. Much of his work, and that of his group, was aimed at improving the organizational processes that can help lead to innovation.

This vision was in stark contrast to his artificial intelligence contemporaries, who wanted to create an alternate intelligence on computers rather than help turbo-charge human intelligence. This early fork in the road still leaves its mark on computing today.

Engelbart started a laboratory at SRI (International Stanford Research Institute at the time). He grandly named it the Augmented Human Intellect Research Center (AHIRC), later shortened to Augmentation Research Center (ARC). At the peak he would have 50 people working for him.

Doug Engelbart had a thoughtful, gentle manner, and a wonderfully open smile. When he met people he was charming and often funny. At the same time he gave the sense that he was considering things

Replica of first mouse invented by Doug Engelbart and Bill English in 1964, the first mouse was carved from a block of California redwood.

The better we get at getting better, the faster we will get better.

DOUGLAS ENGELBART

really, really deeply; that there was some serious purpose to everything he did. With prematurely gray hair and deep-set eyes framed by his large nose and prominent brows, he had the perfect presence for a visionary, or a guru.

As a manager he was often hands-off when it came to operational details, but concerned with communicating his vision so that others could help build it. He wasn't terribly interested in technical details either. But he was brilliant at inspiring some of the best programmers and engineers of the time to come and work with him.

In a sense, Engelbart and his teams only built one big thing in his long career, the oNLine System (NLS), later repurposed as Augment. The mouse was merely Engelbart's idea for a convenient input device, which hardware wizard Bill English developed as one of several ergonomic accessories to that system; the chord keyset was another.

Yet if you tried to map the features of NLS to the computing world we know today, you would have to include pretty much all the core features of the web as well as word processing, spell checkers, online collaboration in forms like wikis and Google Docs, videoconferencing tools, personal information software for things like grocery lists, a full featured email system, archiving software for saving documents with permanent identifiers, and some features of databases. Other features wouldn't map at all, since they still haven't reached wide use. These include documents that are editable by multiple applications rather than belonging to a single one, and a whole host of specialized hypertext features.

How could one system do so much? When Engelbart and his few peers imagined the future of computer communication in the early 1960s, the power of the machine was already clear to them, as was the fact that this power would get exponentially cheaper and faster (later immortalized as Moore's Law).

The rest was gloriously wide open; a blank frontier in which to build not just castles, but whole cities made of sand and imagination. There were no standards to support, no established players to consider in business strategies, no relevant conventional wisdom from advisors and investors. The result? By the mid-1960s Engelbart and his team had actually prototyped many of the core features of the computing world that would unfold over the next 40 years, plus others that may come.

Similarly, Ted Nelson independently conceived a number of these features plus his own vision of new kinds of electronic literature and multimedia, and built out some of them with help from his former schoolmate Andy van Dam. J.C.R. Licklider and Bob Taylor laid out quite different, but also sweeping visions of the future of computing.

By contrast, an example of an ambitious and lavishly funded computing project today might be launching a new social network within the ecosystem of established precedents.

Partly as a result of their lofty aspirations, Engelbart and his researchers forged close connections with many key figures of the 1960s counterculture. There was Stewart Brand of the *Whole Earth Catalog*, Ken Kesey and his Merry Pranksters, and many others. Like the ARPANET community that would follow, the ARC lab represented an uneasy intersection of two very different flavors of open-ended exploration; that of military-funded research, and the sometimes idealistic, sometimes just for kicks questing of an emerging caste of hippie hackers. This intersection is beautifully explored in John Markoff's book *What the Dormouse Said*.

In 1968, Engelbart and his staff put on the so-called "Mother of all Demos" at a major conference in San Francisco, showing off all the features they had developed over the years. For ninety minutes, the stunned audience of over 1,000 computer professionals witnessed many of the features of modern computing for the first time: live videoconferencing, document sharing, word processing, windows, and a strange pointing device jokingly referred to as "the mouse." Elements on the screen linked to other elements using associative links—or hypertext.

Only Connect

In the late 1960s, NLS was a timesharing program, meaning that it ran on a single computer shared by a community of perhaps a couple of hundred users who logged in from their own terminals. True computer-to-computer networking promised to create far larger communities, but it was still in the process of being invented. Engelbart and his lab played a significant role in that process.

Bob Taylor of ARPA had asked Engelbart to have his ARC lab host one of three centers on the experimental ARPANET; the Network Information Center, or NIC. This would act as a central library and card catalog for all of the information on the growing network, with the archives of the ARC group itself as a foundation. It would also maintain the central directory for all of the computers on the ARPANET, a function that later evolved into the familiar Domain Name System (.com, .org, etc.).

Engelbart enthusiastically agreed; he saw the chance to expand the reach of NLS from hundreds of users on timesharing systems to thousands all over the country and beyond; the start of a true online world. His team even made plans to add multimedia, foreshadowing features on the web a quarter century hence.

At the end of 1969, ARC programmer Bill Duvall became one of the first two users on the ARPANET, the world's first major general-purpose computer network. Over the next two decades the SRI NIC would play a pivotal role in the expansion of the ARPANET and later the Internet.

Fragmentation

But the fortunes of the ARC lab itself began to falter. In 1969 Bob Taylor left ARPA, and ARPA itself also changed its funding policies as part of a general government belt-tightening. Grants began to dry up, and SRI management, always wary of Engelbart's freewheeling group of renegades in colorfully patched jeans, started to make more demands. Engelbart, who was more of a visionary leader than a hands-on manager, felt things slipping away.

The NIC and the ARPANET did indeed bring NLS to a broader spectrum of users, but for those who only used it occasionally it was a lot to learn. It also required every user to login to the NIC server, which soon got overloaded and slow. So the NIC turned to simpler but faster tools for accessing its information.

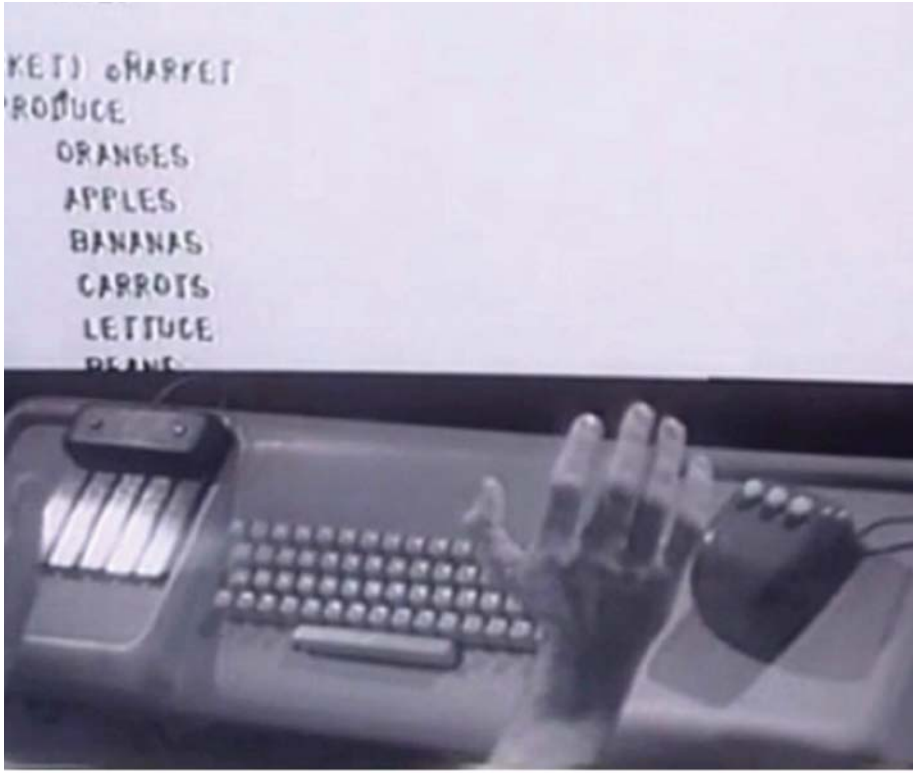
Another blow came when Bob Taylor became the leader of the Computer Systems Laboratory at Xerox's newly created and lavishly funded Palo Alto Research Center, or PARC. The ARC lab's former benefactor began to hire more and more ARC team members to build his own "Office of the Future," eventually including some of Engelbart's closest lieutenants like Bill English, Jeff Rulifson, and Bill Duvall. The bitter joke ran that ARC was a training program for PARC.

The ARC alums brought many of the baseline concepts pioneered in NLS to PARC, and thus into the stream of development that eventually led to much of modern computing. Yet after the internal failure of the PARC On-Line Office System (POLOS) project, which was meant to be a PARC version of NLS, a lot got left out as well—from hypertext links to the overall emphasis on collaboration and augmenting human intellect.

In 1977, SRI sold the ARC project to Tymshare, later a subsidiary of McDonnell-Douglas. There, Engelbart and his remaining team turned NLS into Augment, and adapted it to run under Internet protocols (TCP/IP). However, the momentum was gone, and Tymshare had little interest in pursuing Engelbart's main goals. He retired from Tymshare in 1986, and continued to pursue his vision in offices provided by a grateful mouse-maker, Logitech.

Engelbart continued to speak widely, and in 1988 he founded the Bootstrap Institute with his daughter Christina, one of four children, to perpetuate his work. He won the National Medal of Technology, the Lemelson-MIT Prize, the Turing Award, and was a Fellow of the Computer History Museum. Widowed in 1997, he and his second wife Karen attended public events into the spring of 2013.

Douglas Engelbart died on July 2, 2013 at his home in Atherton, California. He was 88. ○



oNLine System (NLS), with keyset and mouse. NLS was meant to be used for navigating knowledge of all kinds, including everyday needs like grocery lists.

Some of the main records of Engelbart's laboratory at SRI are in the Museum's collection. Contributions in his memory may be made to the Douglas Engelbart Memorial Fund, which helps support preservation for and access to these materials.