

Bush's article created quite a stir, which is perhaps not surprising given that he was one of the most influential men in the United States. The Editor of the *Atlantic Monthly* penned a respectful preface to the article, likening it to Emerson's famous 1837 address on "The American Scholar". The Associated Press news agency put out an 800-word story about the piece on the day of publication. There was also a news story in *Time* magazine and a request from the Editors of *Life* to reprint a condensed version of the essay. In the eyes of his contemporaries, Bush was clearly no crackpot.

The *Life* edition of the piece appeared early in September 1945 with a sub-title: "A Top U.S. Scientist Forsees a Possible Future World In Which Man-Made Machines Will Start To Think". They also replaced the *Atlantic's* numbered sections with headings and added specially-commissioned illustrations.

By consenting to republication in *Life*, Bush was not only reaching the movers and shakers whose attention he craved, but a lot of other people besides.

One of them was a young radar technician named Douglas C. Engelbart, who was stationed on a Godforsaken island in the Philippines, awaiting a ship to take him home. "I was a little navy boy", Engelbart recalled many years later,

an electronics technician in World War II out in the Philippines, and getting moved from one place to another. They stuck you on an island to wait to get you assigned to somebody else. Somebody said there was a library there. It was a Red Cross library, up on stilts in a native hut, really neat, nobody there. I was poking around and found this article in *Life* magazine about his memex, and it just thrilled the hell out of me that people were thinking about something like that.ⁱ

Bush's ideas stuck in Engelbart's mind and remained there for five years, during which time he did research on wind tunnels for the agency which eventually became NASA. It was a job with great prospects at the time, but after five years he decided to give it up to pursue the dream which was to dominate the rest of his professional life - and which was to inspire successive generations of computer scientists. He decided, that instead of solving a particular problem, he would influence the very act of solving problems. - that he would devote his life to a *crusade* (a word he often used later) to use computer power to augment human capabilities.

In pursuit of this astonishing dream, Engelbart quit his job, moved to the University of California at Berkeley and did a Ph.D. in the new field of computer science. In 1957 he was hired by a think-tank called the Stanford Research Institute (SRI). Two years later he got a small grant from the Air Force Office of Scientific Research, created a lab called "the Augmentation Research Center" and set out to change the world.

The part of Bush's vision which most grabbed Engelbart's attention was his fear that the accumulated knowledge of humanity would overwhelm our ability to handle it - that we would all be swept away by the 'information explosion'. Bush saw the threat clearly; but he could only fantasise about the technology that would be necessary to meet it. Engelbart, brooding on the same problem, had one advantage over his mentor: he realized that the development of the digital computer meant that the tools for 'augmenting' the human intellect were finally to hand.

Well, almost. This was in 1963, when computers cost hundreds of thousands of dollars and were programmed via stacks of punched cards by a white-coated priesthood. The remarkable thing about Engelbart was that he and his team not only envisioned but created the future that we now take for granted - bit-mapped screens, graphics-based interfaces, multiple windowsⁱⁱ, software for creating documents structured as outlines, the 'groupware' needed for computer-mediated co-operative working, chorded keyboards and a host of other things. Oh - and he also invented the mouse, the ubiquitous pointing device which now roams a million desktops.

From our point of view, one of the most interesting features of the Augmentation system was the way it handled documents. As part of the Project Engelbart and his colleagues developed a system called NLS (for "oN Line System") which enabled intricate linking from one document in an archive to others. This system was used to store all research papers, memos, and reports in a shared workspace where they could be cross-referenced with each other.

Engelbart was that most elusive of creatures - a dreamer who got things done. He didn't just fantasise about his 'augmentation' technologies - in five years he constructed working systems which actually embodied them. There is a famous filmⁱⁱⁱ, for example, of him addressing a large audience at a Fall Joint Computer Conference in San Francisco in which he showed how a mouse and a special keypad could be used to manipulated structured documents and how people in different physical locations could work collaboratively on shared documents, on-line. It was, wrote one of those present, "the mother of all demonstrations".

As windows open and shut, and their contents reshuffled, the audience stared into the maw of cyberspace. Engelbart, with a no-hands mike, talked them through, a calming voice from Mission Control as the truly final frontier whizzed before their eyes.^{iv}

The *coup de grace* came when

control of the system was passed, like some digital football, to the Augmentation team at SRI, forty miles down the peninsula. Amazingly, nothing went wrong. Not only was the future explained, it was *there*, as Engelbart piloted through cyberspace at hyperspeed.^v

And the date of this demonstration? Why, 1968.^{vi} Bill Gates was twelve at the time; Steve Jobs was thirteen.

There are good grounds for saying that Engelbart is the father of personal computing, and yet there is an inescapable poignancy about his career. Unlike many of the other pioneering hackers and engineers who created the computer industry he did not become rich (despite the 20-odd patents he holds) and his fame extended only to those who understood the significance of what he had achieved. Most people today would recognise his name - if they recognised it at all - only in connection with his invention of the mouse.^{vii}

When Steven Levy was researching his book on the history of the Apple Macintosh, he went in search of Engelbart, and found him in a relatively obscure part of the Tymshare corporation (later purchased by McDonnell Douglas). Levy noted that the great man's office was a cubicle in one corner of a large room filled with file cabinets and similar warrens. "The Moses of computers", he recalled, "did not even rate an enclosed office".

Engelbart is now the prime mover in an outfit called the Bootstrap Institute, housed at Stanford University. In recent years, he has been showered with distinctions by the industry he helped to create. He is no longer a prophet without honour in his own land, but there is nevertheless a disappointed edge to much of his contemporary musings.

Given what he set out to do, though, could it be otherwise? Engelbart's problem was that he wanted too much: he dreamed - as Wiener and Licklider dreamed - of making computer technology as powerful and as natural an extension of human capabilities as writing or talking. He asked the really hard question - *what* is it that we really want from this technology - when most people are obsessed only with *how* to provide a particular kind of limited functionality.

The most difficult thing in life, said the great English management thinker, Geoffrey Vickers, is *knowing what to want*. Engelbart, almost alone at the time, knew what he wanted from the technology. But to have achieved his goal would have required the kind of resourcing and multi-national drive which has pushed particle physics research to the frontiers it occupies today. Even ARPA - which funded and supported Engelbart for many years - did not possess that kind of clout. It is no doubt better to have dreamed and lost than never to have dreamed at all, but it must leave a bitter taste sometimes. "I confess that I am a dreamer", he wrote in 1995. "Someone once called me 'just a dreamer'. That offended me, the 'just' part; being a real dreamer is hard work. It really gets hard when you start believing in your dreams".^{viii}

ⁱ "The Augmented Knowledge Workshop: Participants Discussion" in Adele Goldberg (Ed), *A History of Personal Workstations*, ACM Press, 1988, p.235.

ⁱⁱ His way of implementing Bush's vision of racks of cathode-ray tubes each giving a different view of a single file, or views of different but related files.

ⁱⁱⁱ The videotape is now on display at the Smithsonian Museum Exhibit on 'The Information Age'.

^{iv} *ibid.*, p.42.

^v *ibid.*, p.42.

^{vi} Sueann Ambron and Kristina Hooper (Eds), *Interactive Multimedia*, Microsoft Press, 1988, p23. The demonstration was promoted and funded by ARPA, at Bob Taylor's instigation.

^{vii} In 1997 he was awarded the annual \$500,000 Lemelson-MIT prize for the invention of the mouse.

^{viii} Douglas C. Engelbart, "Dreaming of the Future", *Byte*, September 1995.