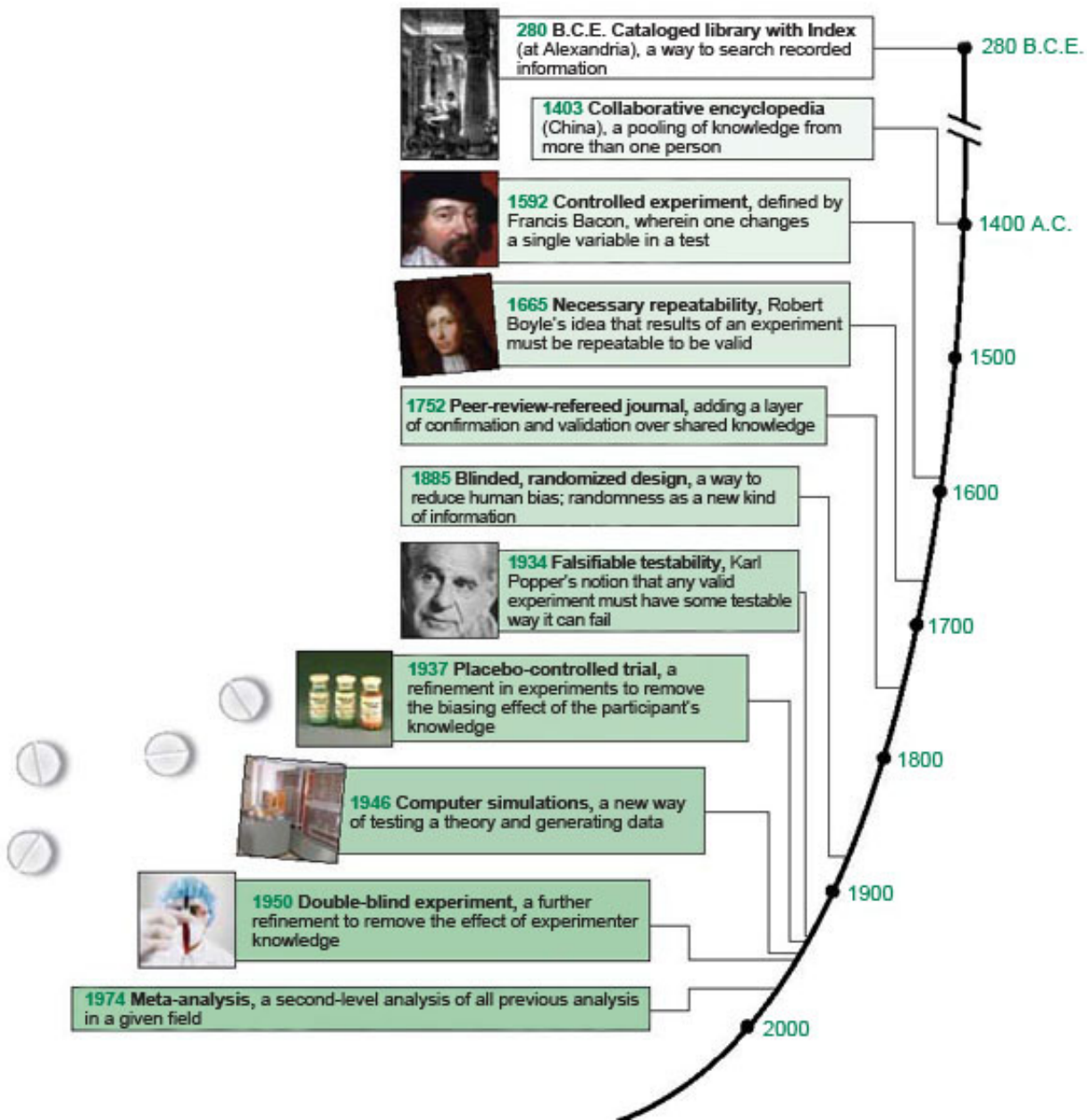


Evolving the Scientific Method

Technology is changing the way we conduct science.



Images: Wikipedia (from top): Library of Alexandria; Francis Bacon; Robert Boyle; Karl Popper (courtesy of LSE library); Placebo (courtesy of Elaine and Arthur Shapiro); Zuse Z3 computer (courtesy of Deutschen Museum in München)

Science is our most potent invention because it has given us a method to keep reinventing it. All our collective knowledge and expertise (that's science) began with relatively simple arrangements of information. The simplest organization was the invention of the fact. Facts became codified not by science, but by the European legal system in the 1500s. In court lawyers had to establish agreed-upon observations as evidence that could not shift later. Science adopted this useful innovation. Over time, the novel ways in which knowledge could be ordered increased. This complex apparatus for determining the factual correctness of information, and relating it to old knowledge, is what we call science.

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The scientific method is not one uniform “method.” It is a collection of scores of techniques and processes that has evolved over centuries (and continues to evolve). Each method is one small step that incrementally increases the unity of knowledge in society. A few of the seminal inventions that furthered the development of the scientific method are shown in the accompanying illustration.

Together these landmark innovations created the modern practice of science. (I am ignoring various alternative claims of priority because the exact dates don’t matter for this illustration.) A typical scientific discovery today will rely on facts (data) and a falsifiable hypothesis; be tested in repeatable, controlled experiments, perhaps with placebos and double-blind controls; and be reported in a peer-reviewed journal and indexed in a library of related reports.

The scientific method, like science itself, is accumulated structure. New scientific instruments and tools add new ways to gather and organize information. Recent methods build upon earlier techniques. Technological advances keep adding connections among facts and more complex relations among ideas. As this short timeline makes clear, many of the key innovations of what we now think of as “the” scientific method are relatively recent. The classic double-blind experiment, for instance, in which neither the subject nor the tester is aware of what treatment is being given, was not named or widely used until the 1950s. The placebo was not used until the 1930s. It is hard to imagine science today without these methods.

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This relative newness makes one wonder what “essential” method in science will be invented next. The nature of science is still in flux; the technium is rapidly discovering new ways to know.

What is the technium? As described on my Web site, TheTechnium.org, it designates the greater sphere of technology—one that goes beyond hardware to include culture, law, social institutions, and intellectual creations of all types. In short, it’s anything that springs from the human mind. It includes hard technology, but much else of human creation as well. I see this extended face of technology as a whole system with its own dynamics.

Given the acceleration of knowledge, the explosion of information, and the rate of progress, the nature of the scientific process is on a course to change more in the next 50 years than it has in the last 400 years. What might be some new processes in the future? One could imagine that the inclusion of negative results will become routine. And that computer proofs will become more reliable, common, and trusted. And that wiki journals will contain reports that are not fixed, but are continually modified and edited in real time—all could become part and parcel of the scientific method.

At the core of science’s self-modification is technology. New tools enable new ways of discovery, different ways of structuring information. We call that organization knowledge. With technological innovations the structure of our knowledge evolves. The achievement of science is to discover new things; the evolution of science is to organize the discoveries in new ways. Even the organization of our tools themselves is a type of knowledge. Right now, with the advance of communication technology and computers, we have entered a new way of knowing. The thrust of the technium’s trajectory is to further organize the avalanche of information and tools we are generating and to increase the structure of the made world.

Kevin Kelly is Senior Maverick at *Wired* magazine, which he cofounded in 1993. He is also editor and publisher of the [Cool Tools](#) website. Formerly, he was publisher and editor of the *Whole Earth Review*, a journal of unorthodox technical news; he cofounded the ongoing Hackers’ Conference; and was involved with the launch of the WELL, a pioneering online service started in 1985. He is

author of the best-selling *New Rules for the New Economy* and the classic book on decentralized emergent systems, *Out of Control*.

This essay is adapted from Kelly's latest book, *What Technology Wants (Viking/Penguin)*, published in October 2010. You may read the first chapter at <http://www.kk.org/books/what-technology-wants.php>