HARDLY THE END OF SCIENCE

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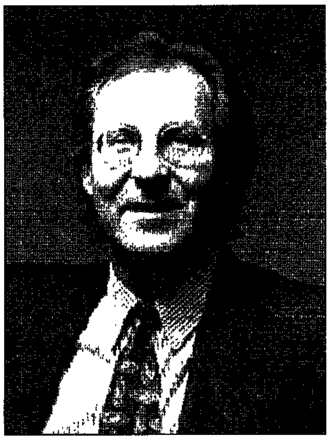
I recently heard a popular lecture by John Horgan, senior editor of *Scientific American* and author of the book *The End of Science* (Addison-Wesley, 1996). Horgan's thesis is that we should expect a major slowdown in the rate of major scientific discovery. Part of the problem is the enormous difficulty and expense of probing the natural world at both the subatomic and astronomical scales. This limits our ability to collect new data to test hypotheses. Moreover, Horgan argues that the major conceptual breakthroughs such as relativity, quantum mechanics, and DNA do a superb job of describing the world so most of modern science is devoted to derivative, almost janitorial work that merely plays out the consequences.



Before saying any more, I have to confess that I didn't read Horgan's book, only heard him lecture. That's like seeing the movie instead of reading the novel, I know, but the points I want to make are somewhat tangential to Horgan's thesis anyway.

Hearing Horgan lecture and then talking with him afterwards, it was clear that he and I have two different notions of what constitutes "science." Horgan's concept of science is centered around the physical world—the study of atoms, leptons, DNA, galaxies, nuclear fusion, field theory. Science thus defined is the product of remarkable geniuses such as Newton, Maxwell, Einstein, Bohr, Schrödinger, Crick, Watson, and their peers and successors. This is the science that largely rules academia because of tradition and postwar research funding.

But science is much broader than the physical, natural world. As Herbert Simon has so eloquently argued, there is a "science of the artificial" that includes new concepts not found in nature yet enormously useful and profoundly complex. Coding theory, cryptoanalysis, computation theory, network and switching theory are but a few subjects that are part of science but not physical in the traditional sense. Whether these are science, mathematics, or engineering is splitting hairs. These are subjects with objective realities, testable hypotheses, and reproducible results.

Viewed in this larger sense, science is extremely healthy and is contributing to society economically, culturally, and intellectually. However, many people still don't see this bigger picture of science. It's like thinking that the only productive part of an economy is the manufacture of physical objects, a belief that the software and service industries have disproved rather soundly.

Just like the debate about the viability of a service economy was decided in the marketplace, the debate over how society will support science will be decided by results—not rhetoric. This is the current American spirit towards welfare, health care, and other entitlements. It is spreading to science as well.

Computational science and engineering will figure prominently in the health of future science. Computation can go where microscopes, telescopes, spacecraft, and accelerators cannot, both in space and time. Furthermore, CSE bridges the gap between the conceptualization of novel ideas and their realization in complex systems. More and more, basic scientific research, be it in physics, biochemistry, or neurology, must be leveraged through computation to become practically useful to society at large. This is in addition to the large corpus of "artificial science" in finance, engineering, entertainment. and communications that CSE already supports.

In summary, perhaps John Horgan is right, that science narrowly defined is about to go through hard times. But when more broadly defined to include the artificial, science is an unstoppable engine increasingly fueled by computational science and engineering. ♦