THE LAST WORD

THE FUTURE OF COMPUTATIONAL SCIENCE—in 1977

By Charles Day


That same spring, Philip Abelson, the last physicist to serve as Science’s editor in chief, devoted an entire issue of the magazine to what he called the electronics revolution. The issue’s timing was apt. Three of the earliest and most successful personal computers—the Apple II, Commodore International’s Personal Electronic Transactor (PET), and Tandy’s TRS-80—made their debuts in 1977. As Abelson recognized, advances in the design and manufacture of integrated circuits were propelling a revolution in the availability and capability of computers.

If you scan the table of contents of that issue (www.sciencemag.org/content/195/4283.toc), you’ll find a total of 27 articles. They covered such diverse topics as electronic mail, satellite communications, computing in banking and marketing, the future of integrated circuits, and software engineering. One article presciently addressed the use of electronic media in education.

Computational science was included, too. Seven members of the technical staff at Bell Labs wrote an article entitled “Computers and Research.” When I read the article for the first time this week, I was struck by how much William Baker and his coauthors got right. Not knowing how computational power would evolve, they took a broad, imaginative view of how computers would benefit research—and not just in crunching numbers.

The Bell Labs group predicted the positive impact of computers on scientific publishing. They also recognized the importance of computer science in its theoretical aspect (to elucidate the scope of what problems can be solved computationally) and in its practical aspect (to develop new computer languages).

But what most impressed me about the article was the observation that computers would change the ideas that scientists would come up with:

Broadly, these are now more complex ideas about more complex matters. But a complicated idea is worthless unless something can be done about it. What has changed is the usable level of idea complexity. Computers have significantly expanded the domain of tractable complexity.

By tractable complexity, Baker and his coauthors didn’t simply mean a bigger calculation with more mathematical terms. Rather, they anticipated the use of computers in such messily intricate fields as ecology, psychology, and economics. Now, the frontiers of tractable complexity include topics such as climate change, strongly correlated electron systems, and cell metabolism.

Besides bringing evermore complex problems into the realm of the tractable, where does the future of computers and research lie? Given the increasing sophistication of 3D printing, I foresee that computers will be used not only to design and analyze experiments, as they are today, but also to direct experiments’ assembly and performance.

To see what I mean, imagine a spacecraft touching down on the surface of an icy extrasolar planet that lies far beyond the range of practical back-and-forth telecommunications. Once the spacecraft’s drill has broken through the ice, sensor-equipped tentacles unfurl in the water below to evaluate the conditions. Based on the sensor data, the onboard computer equips its fleet of robot submarines with the appropriate mix of sensors designed to maximize the success of its mission: finding life.

Reference


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