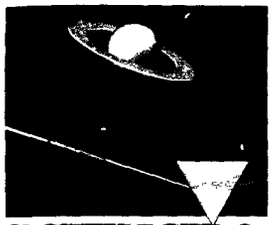


SCIENCE & TECHNOLOGY

Virtual 'Life' Evolves in the Lab

By Simson L. Garfinkel

■ *Thomas Ray built an artificial ecology inside his computer's memory bank. ... The environment evolved different programs, predators on those programs, and an assortment of other digital flora and fauna.*

CAN life exist inside a computer?

Before dismissing the question as idle speculation, it is necessary to come up with a definition of "life." As journalist Steven Levy shows in his newest book, "Artificial Life," it's a process scientists can now simulate with such fidelity that drawing distinctions between simulation and reality may no longer be a fruitful pursuit.

Life, argues Levy, has the ability to create something out of nothing. With enough energy and raw materials, organic life reproduces itself, as anybody who has grown a potted English ivy knows firsthand. The second quality of organic life is its ability to change – to custom-tailor itself to its environment through trial and error and survival of the fittest.

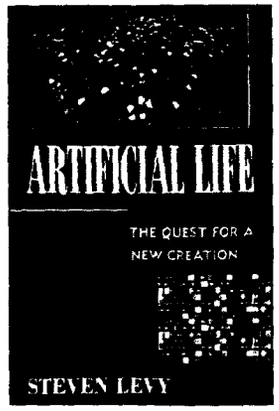
These days, the existence of self-replicating computer programs should come as no surprise to most computer users. Many have heard of computer "viruses." These programs, written by a few antisocial programmers, have hopped from floppy disk to hard-drive and back to floppy disk, and literally encircled the world. Levy argues that viruses like "Brain" and "Friday the 13th" are quasi-life forms, occupying a murky existence on the cusp between the living and the inanimate, just as biological viruses do. The difference between a biological virus and a computer virus is that one is based on molecules made of carbon, hydrogen, and nitrogen, and the other is based on information – a particular alignment of ones and zeros.

The real action in artificial life today isn't in the wild, but in laboratories at places like the Massachusetts Institute of Technology, the University of California/Los Angeles, and the University of Delaware. And the most exciting advances are not discovering new ways of propagating these artificial vermin, but developing new ones through a radical new computer-science technique: evolution.

The idea is simple: Build a world inside a computer that is populated by organisms that are, themselves, computer programs. Give the programs tasks to complete. At the end of each generation, pair up the most successful computer programs and have them "mate."

How do computer programs mate? They create progeny programs that contain instructions randomly derived from each "parent." In practice, 99 percent of the programs created this way fail to work. But some survive. And after thousands of generations have passed with millions of individual programs created, some of them work better than those devised by humans.

One exciting development Levy describes is at the University of Delaware, where an evolutionary biologist named Thomas Ray built an artificial ecology inside his computer's memory bank. Within hours after inoculating the system with a program named "Ancestor," the environment had evolved different programs, predators on those programs, and an assortment of other digital flora and fauna.



ARTIFICIAL LIFE: THE QUEST FOR A NEW CREATION
By Steven Levy
Pantheon Books, 390 pp., $24

Like his previous bestseller, "Hackers: Heroes of the Computer Revolution," Levy's new book is at its best when he is looking into the professional lives of computer scientists and engineers. He has a flair for bringing these stories to life, describing, for example, how Dr. Ray inoculated the soup of his computer simulation late one night, working on a table in the bedroom of his apartment while his wife slept.

Sadly, as with "Hackers," in his quest to make the book approachable to those without degrees in computer science or higher math, Levy eliminates many details that would make the book more enjoyable to those expert audiences. That's a shame, because the technically inclined are the main readership for this volume.

Obsessed with the fate of the space program and the superconducting supercollider, the nation's popular-science press has largely ignored the amazing creation happening inside the laboratories that are researching artificial life. Artificial life often arises inside a computer without the experimenter explicitly coding in the rules for its existence. These artificial organisms learn to exploit the nooks and crannies of their universe in ways never dreamed of by their human programmers.

"The conclusion I draw from it," Levy quotes Ray as saying, "is that virtual life is out there, waiting for us to create environments for it to evolve into."

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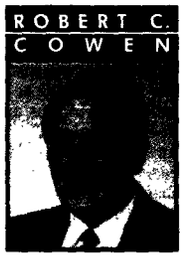
Spinning Straw Into Gold Happens Only in Fairy Tales

SCIENTISTS competing for government research funds should take a hint from an old folk story. It tells of a peasant who persuaded a king to marry his daughter by claiming she could spin straw into gold. Once married, the king locked her in a room with a pile of straw and told her to get on with it.

Boosters who make exaggerated claims for payoffs from scientific research may find themselves in a comparable predicament. A dwarf performed the required magic for the hapless queen. But scientists and administrators caught overpromising the economic benefits of basic research will have no Rumpelstiltskin to help them out.

Princeton University president Harold Shapiro apparently had this in mind when he told the President's Council of Advisors on Science and Technology that "some universities [have] oversold the benefits to local constituencies." He added that such hucksterism may "turn on us."

Public disappointment when expected commercial payoffs don't materialize could weaken support for science generally. Moreover, Robert Rosenzweig, president of the Association of American Universities, warns that the mere expectation of such payoffs can compromise scientific quality.



Dr. Rosenzweig, who represents 58 United States and Canadian research universities, told the council that the belief "that science and technology are the keys to local and regional economic development" inspires the US Congress to earmark research money for projects in members' home regions without review of the projects' scientific merit. "The political forces for wider [geographical] distribution [of funding] are so strong that program resources will be spread ever thinner, making concentration of quality harder to sustain" he said.

The scientific community may also injure itself as scientists in one field use the economic hype coming from competing fields to undermine the credibility of their rivals. Such infighting has become the hallmark of debates over funding the particle physicists' Superconducting Supercollider (SSC) accelerator and the National Aeronautics and Space Administration's (NASA) space station. Boosters portray the projects as critical sources of unrealistic practical benefits. Opponents see them as money hogs that will starve other areas of science.

NASA administrator Daniel Goldin recently claimed that "space-based research in the life sciences and biotechnology will revolutionize our way of life in the 21st century."

Claims like that prompted National Institutes of Health (NIH) director Bernadine Healy to tell Mr. Goldin that "the implication that NIH views future space experiments as critical to the overall success of biomedical research" are "particularly disturbing." She said such claims do "a serious disservice ... by the creation of unrealistic expectations and overpromise."

Meanwhile, physicists supporting the SSC are tarred with the hype of some fellow boosters. The latter claim vast economic benefits in fields such as medicine, water resources, or biology that have nothing to do with particle physics. James Krumhanal, former president of the American Physical Society, which supports the project, says such "extravagant representations to the public of potential fruits from the SSC are fictitious and ethically irresponsible."

In short, trying to justify specific research projects by claiming specific economic benefits is dangerous. It distorts research funding, splits the scientific community, and misleads the public. Instead, scientists should fight for sustained support for basic research across the board as an investment in knowledge. History shows this does produce enormous – but generally unpredictable – practical payoffs in the long run. And that's no fairy tale.