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George Dyson: Information Is Cheap, Meaning Is Expensive

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George Dyson grew up around the Institute for Advanced Study in Princeton, built kayaks in Canada and began to think about the internet before personal computers were a household staple. He talked with *The European's* Martin Eiermann about the definition of life, human progress and the importance of cognitive autarchy.

The European: A computer "is a simple mind having a will but capable of only two ideas", you have said.Does it make sense to think of a technical apparatus in biological terms?
Dyson: The quote comes from an illustration of a circuit diagram that Lewis Fry Richardson produced in 1930. It was a very prophetic idea, like most of the stuff that Richardson did. He had drawn this diagram of an indeterminate circuit, so it was impossible to predict which state the circuit would be in. Maybe those are the origins of mind: A simple and indeterminate circuit. The significance of Richardson's idea was that he broke with the assumption that computation had to be deterministic, because so few others things in the universe are deterministic. Alan Turing was very explicit that computers will never be intelligent unless they are allowed to make mistakes. The human mind is not deterministic, it is not flawless. So why would we want computers to be flawless?

The European: The ultimate indeterminate process on Earth is evolution. Yet evolution doesn't really require input and commands, it sustains and develops itself. That seems fundamentally different from the way we think about technological evolution…
Dyson: Biological evolution is a bottom-up process. There are differences between the two realms, but there are also similarities: In both biology and technology, things develop into structures of increasing complexity. That's what Nils AallBarricelli saw right away. He tried to understand the origins of the genetic code and apply that to the development of computers. The question was whether you could run computer experiments that allowed increases in systemic complexity to happen. And very quickly that stopped being an experiment and codes began evolving in the wild—not by random mutation, but by crossing and symbiosis, exactly as Barricelli prescribed.

The European: Computer code still strikes me as something where essence really precedes existence. The things a computer can do are largely constrained by the original assumptions that were built into the code. Nature is much more adaptable: If carbon-based life cannot survive, maybe something based on sulfuric acids can. Chemical and biological processes lead from completely inanimate objects to RNA, and then DNA. The plan itself is changing.
Dyson: I think the differences are much smaller than that. In biology, we got stuck with a particular

coding system that precluded anything else from moving in. It's the same in the world of code: It is constrained by the original protocols but beyond that it is very open. And the evolution of computer code is now moving much faster than the evolution of biological code.

The European: Which brings us to the question of what it means to be alive. Biology, philosophy or religion might answer that question in very different ways.
Dyson: That is a huge and unanswered question that we are unlikely to agree on. Life is whatever you define it to be. There are some clear examples of intelligent life: A kitten is clearly alive, and a human being is clearly an intelligent living being. But very quickly you get into murky areas where the answers are much less clear.

The European: Do we have to embrace the uncertainty?
Dyson: It becomes a question of judgment. Barricelli pushed for a very broad definition of life. In the 1950s, we were just beginning to travel out into space and perhaps discover an answer to whether there might be life and intelligence outside of our planet. Barricelli was concerned that we might not recognize life or intelligence when we saw it, because our definitions of what it takes to be alive or intelligent were so narrow.

The European: The answer to that question has very direct consequences for our assessment of pressing ethical questions: About PGD, about abortion, about genetic enhancements. So despite the difficulty of defining "life", it seems to me that we at least have to try to come to an agreement about the ethical standards that govern our politics and our science.
Dyson: Today's ethical standards apply to human life and increasingly to animal life as well. They don't exist for other forms of life. We don't know how we would deal with extraterrestrial forms of life if we encountered them. Like the law, ethics has to be developed one case at a time. You cannot just make a grand law that covers everything, just like you cannot make a grand ethical statement that would remain true across space and time.

The European: Is technological innovation changing the ethical landscape?
Dyson: We are pushing the boundaries of ethics, not just through computing but also through technological innovations in biology.
Does your genetic code really belong to you? What happens if someone de-codes it? Can they use and sell that information? Those are very deep ethical questions. We are all part of the living universe. So if we come across other forms of life, do we have a sense of kinship with that as well? We have seen where the lack of empathy with other living things can lead, and I hope that we will not repeat the mistakes of the past.

The European: What answers can science provide to these very ontological questions?
Dyson: I am the child of a physicist, so you cannot trust me with this answer. I grew up with the idea that physicists were ahead of the philosophers. The people I was around at the Institute for Advanced Study were thinking far ahead of their time in a very intelligent way. They saw what was going to happen before it actually did. They thought about modern computing in the 1950s, they imagined a lot of the technological progress that we would see only decades later in the real world. They were asking very theoretical questions because these ideas were still so far removed from practice. And they asked very moral questions as well, because the things they conceptualized could be used for great good or for great evil. It could go either way, so moral judgments had to be made.

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