Daniel Hillis on Artificial Intelligence

INSIGHTS

Interview by Randall Rothenberg

IN A CONVERTED FACTORY OVERLOOKING THE CHARLES RIVER IN CAMBRIDGE, MASSACHUSETTS, DANIEL HILLIS, TWENTY-NINE, IS ENGAGED WITH SOME SIXTY COLLEAGUES IN BUILDING A THINKING MACHINE FOR A COMPANY STRAIGHTFORWARDLY called Thinking Machines Corporation. Several firms are dedicated to expanding the frontiers of artificial intelligence (AI), but Thinking Machines is further ahead than most; it expects to have its first commercially viable prototype model, called the Connection Machine, available within the year.

That the two-year-old company, which boasts among its associates Nobel laureate Richard Feynman and former Massachusetts Institute of Technology president Jerome Wiesner, is as close as it is to replicating human thought in a machine is due in no small part to Danny Hillis. As an undergraduate and graduate student at MIT, Hillis fell under the spell of Marvin Minsky, the former director of the school's pioneering Artificial Intelligence Laboratory. He devoted himself to breaking what computer scientists refer to as the Von Neumann bottleneck—the separation inside the computer of the processor and the memory, which allows the computer to process only one element at a time and slows the computing process. Hillis's innovation is conceptual and architectural: he has systemically combined the processing and memory functions in a structure known as parallel processing. What should emerge from his work are
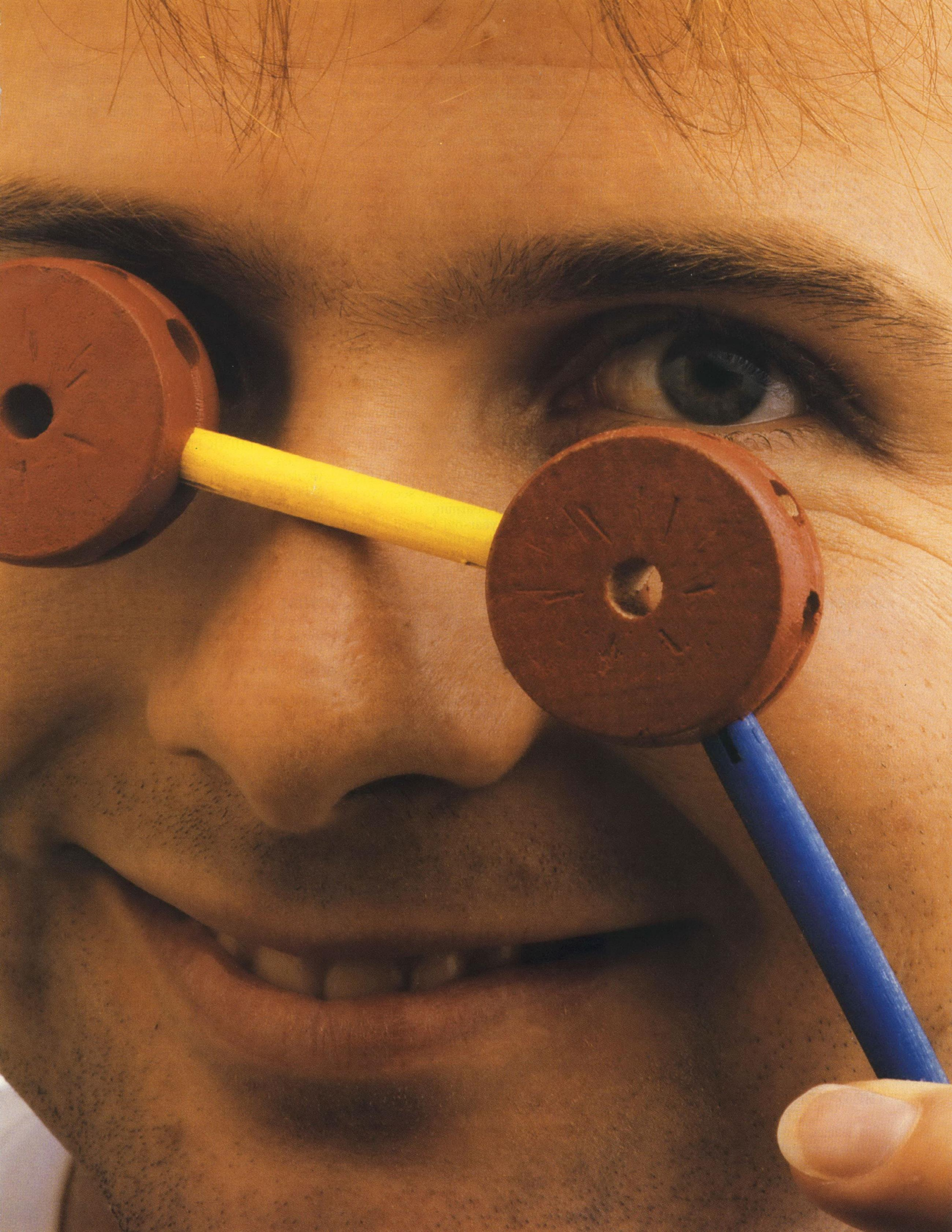
RANDALL ROTHENBERG's *profile of Robert A. Swanson appeared in the December 1984 Register.*

WHY CAN'T A COMPUTER BE MORE LIKE A MAN?

the fastest computers known to man. Hillis, who spoke with us in his toy-strewn office as long-haired, shoeless programmers fiddled with computers in the background, believes that life after artificial intelligence may never be the same.

HUMAN INTELLIGENCE VERSUS ARTIFICIAL INTELLIGENCE

"The way the human mind works, when you get smarter, you get faster. It seems to be able to look at large numbers of possibilities at once. For instance, it's very hard for a human to play chess; it requires a lot of conscious effort. This is trivial for a computer. On the other hand, a human can tell the difference between a dog and a cat—we can't make a computer do that. Actually we could, but the computer would probably take days."

SMARTER ISN'T NECESSARILY SMARTER

"Why did nothing come of prior AI research? I believe it was a fundamental defect in the computers they were using. It's simple engineering. They have memory in one box and processing in another box. That means that if you try to put a lot of knowledge in, then the thing is going to be very, very slow. In particular, the more it learns, the stupider it gets, because the slower it goes. There's a paradox there, that you can't make it smarter by adding more information, because it gets slower."

THE ANSWER IS PARALLEL PROCESSING

"It's an architectural approach. There are two things you call parallel processing. One is people trying to take a few ordinary computers and get them to work together and break up the problem before them. Another is doing computation in a totally different way, where you're looking at the problem from the beginning as if it were broken into millions of different pieces. In the multiprocessing approach, you literally do it all at once, every point, all million of them. It's almost like a replication of the brain's neurocircuitry, to do everything at once. That's what the machine I'm building, the Connection Machine, has done."

HOW WE SHOULD THINK ABOUT A MACHINE THAT THINKS

"The sense of being a pioneer, of doing something that really changes how people think about themselves, that's important to me. A thinking machine really does change our whole way of seeing ourselves, of what's important about us. It changes religion and philosophy. That's part of what attracts me to it."

THE DANGER OF DEMYSTIFYING THE MIND

"In Galileo's time there was a moral question in saying that the planetary bodies behave the same way as Earth, that Earth was just another rock up there. It was a big issue; the Church got involved and it was upsetting. After a while people began to realize that being at the center of the universe wasn't everything. I think the same thing happened more recently with the theory of evolution, and I think there will be another revolution like that about the mind. I think it will bother people, the idea that other things besides humans can be intelligent. But I think that when it's all over, it won't present a threat to what's good about us. It will help us to focus upon the reality of what is good about us."

WHERE THE REVOLUTION BEGINS...

"I worked for a while for Seymour Papert, the developer of LOGO, a programming language for children that uses movable turtles to teach the fundamentals of computer languages. When we were teaching the children on the computers, I was careful never to say I was teaching; we would just sit down and play. One day some visiting educator came by and went into the classroom and looked at this and said to one of the kids, 'Gee, this is great. You really seem to be enjoying yourself learning math here.' And this twelve-year-old turned around and said, absolutely authoritatively, 'This ain't math. This is fun.'"

...AND WHERE IT GOES

"I've lived in Africa and Calcutta. My father was studying hepatitis. Every time a hepatitis outbreak would occur, we would go and live there. So I was very aware of the Third World problem. I was very inspired by the idea that resource-poor countries, which don't have the steel or oil or minerals that we do, are not necessarily so handicapped in the information age. There is no reason why a country like India, for instance, can't have the same information industries as the U.S."

THE CONNECTION MACHINE IS LIKE A SOCIETY

"We get things done as a civilization by having lots of individual agents who are relatively incapable and dumb, compared with what the civilization as a whole is capable of. But we are able to adapt our communications patterns; if you and I need to talk to do our thing, we can pick up the phone or we can meet. That's what's going on inside the Connection Machine. Each of these individual processing units is trying to do its own little piece of the whole problem. Meanwhile, some of the processing units are trying to coordinate the pieces, in much the same way that people adapt communications patterns in a society."

A SCIENTIST IS LIKE A HUMAN BEING

"It's not that laymen think in a certain way and scientists think in equations. The truth is, if you ask Richard Feynman how he thinks about particle physics, he really has some dumb little analogy down there. True, he works out the equations to explain it to everybody. But in his head he's playing with soccer balls."

A BOY AND HIS TOYS

"One of the most fun things I did while I was at MIT was build a computer out of Tinkertoys. We put about a day's worth of thought into it and a couple of months of implementation. It's a six-foot cube, packed with Tinkertoys. It plays ticktacktoe. It never loses, but it ties. And it lets you have the first move."

THE COMPUTER IS OUR FRIEND

"It's a thinking, feeling machine. Let's say it's time to get a new model. Here's this thing that you've lived with for ten years of your life. It's become your companion. Are you going to drop it in the trash can? Turn it off? I don't have the answer."

YOU THINK I'M CRAZY, EH?

"Tears actually came to my eyes when we decommissioned the big AI machine at MIT. This was the first machine that ever exhibited any sense of intelligence. It had done the first chess-playing programs, for instance. I had come to think of it as a friend. It was a stupid friend, but it was a friend. And we turned it off!"

WHAT TO DO ABOUT BIG BROTHER

"Anything that's powerful changes the world. The idea of having a computer that's a hundred times faster, that suddenly makes it possible for the government to do a new kind of watching over everybody is a frightening concept. One approach I think people take is they deny the bad consequences. It's a very tempting approach to take, because you don't want to think emotionally that what you are going to be doing can be used for evil. That's where a lot of the 'coldness' of science comes from. Then there are people who face the issue in the other way—'I'm not going to do it! I'm going to stay away from this important, changing field because then I'd have to face the issues.' I see that as a cop-out, as much as the other. It's sort of protecting your personal integrity and letting the world go to hell. And I think there is a third approach, which in some sense is the least satisfying. You admit that there may be a problem and try to do your best to steer toward the right thing. That's dangerous territory. There's always the temptation to rationalize, to say, 'Well, gee, I really want to work on this project, and even though it's going to be used for guided cruise missiles, I really want to study three-dimensional analysis and these guys are willing to pay me for it.'"

DANNY HILLIS'S NEXT CHALLENGE

"That's the one thing I haven't quite worked out yet—how this is going to get me a ride on the space shuttle." ❻

DANIEL HILLIS ON ARTIFICIAL INTELLIGENCE

ESQUIRE | DECEMBER 1985

Reprinted from the Esquire Archive

https://classic.esquire.com/article/19851201117/print