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Staff-written highlights of developments in technology and the microcomputer industry, compiled from Microbytes Daily and BYTEWEEK reports

Computer Scientists Warn of Physical Limits

Conquering the future frontiers of computing won't be easy, especially with something as big as physics getting in the way. That's the message four researchers delivered to fellow computer scientists at the eleventh World Computer Congress held in San Francisco recently.

Tommaso Toffoli of MIT said that in about 10 years, ICs simply won't be able to get any smaller. Toffoli and Teuvo Kohonen, of the Helsinki University of Technology, both pointed out that the density of microprocessors has been increasing by a factor of 10 every five years. That means that in 10 years, each transistor in a CPU will be one one-hundredth of its current size. But as those transistors get smaller, designers will face the problem of "tunneling"—electrons that won't behave in the expected ways—which means that physical CPU errors would become much more common.

To make computers work accurately beyond that level, Toffoli said, they'll have to depend on the microscopic physics of two electrons rather than the statistical mechanics of millions of electrons. "Maybe in 20 or 40 years we'll have computers where each bit is a quark, and then they will be reliable again," he said.

Kohonen proposed leaving conventional deterministic computers behind in favor of neural networks, using analog systems and a statistical description of data. But, Kohonen admitted, "You wouldn't want to use a neural net to keep your bank account; they're not accurate enough for that."

Gen Matsumoto, of Japan's

Electrotechnical Laboratory, offered another alternative: "biocomputing." While neural networks mimic brain activity in computers, biocomputing attempts to electronically duplicate the actual structure of the brain. Matsumoto said that biocomputing work has been going on for five years as part of Japan's "fifth-generation computer project," but at \$2 million it's only about 1 percent of the ambitious endeavor's budget.

In an informal poll, Toffoli asked the audience of researchers if they thought that within 10 years it would be possible to hold an extended intelligent conversation with a computer. Almost no one in the audience said yes.

Although digital computers have changed greatly in form over the centuries, said Vladimir Cerny of Comenius University in Czechoslovakia, they haven't changed in function. "We've called it accounting, then calculating, then computing, and now data processing—but the way we do it hasn't changed that much," he said. "Perhaps there is a bigger variety of dynamical systems that can be used for computing." The question isn't whether a machine can compute numbers, Cerny said, but whether it processes information; that's what makes them interesting, he added.

And what happens when machines get much, much better at processing information of all kinds? As Toffoli put it, "Eventually some computers may be interesting enough that they will be able to say, 'Look, leave me alone and let me think about what I want to think about.'"