known informally as the Morella Commission after Representative Constance Morella (R–MD), its chief legislative sponsor. Last July, the commission recommended that an ongoing public-private body be established to help clear away barriers to underrepresented groups in science and engineering (www.nsf.gov/od/cawmset).

BEST man. John Yochelson's Council on Competitiveness has a new grant to boost the number of women and minority scientists.

Although the Morella panel made recommendations similar to those in a 1989 report by another congressionally mandated panel, this time there will be a visible follow-up. NSF director Rita Colwell, whose agency staffed both panels, spent the next few months cajoling the other federal agencies that had worked with the commission to chip in money for the proposed organization—an entity that didn't exist, not even on paper. And Morella urged her on. "It is extremely important," Morella wrote in a 30 November 2000 letter to Colwell, "that each agency steps forward and provides contributions to seed this collaborative entity."

In the end, eight of the nine agencies agreed. "NSF was pushing us hard," recalls Jane Coulter, deputy administrator for the Cooperative State Research, Education, and Extension Service within the Agriculture Department, one of two agencies to scrape together $50,000. NSF and five others each put up $367,000. The only agency to opt out was the Department of Education.

With the groundwork laid, the council jumped at a suggestion by NSF officials to submit a proposal. "We've been doing benchmarking for quite some time, especially in terms of regional development," says Yochelson about an organization formed in 1986 to combat the perception of Japanese technological dominance. "And the idea of looking at what works, and how communities have put together partnerships to increase diversity, seemed to resonate well with everybody we talked to."

There was no formal competition, and no other proposals were submitted. Representatives from the sponsoring agencies were asked to review the proposal, and NSF made the award official on 21 February.

A senior NSF official, Wanda Ward, will work with the council to help put BEST together. The council has already lined up a $1 million corporate donation, and it hopes to have a small staff assembled by summer. BEST will also draw advice from a public-private National Leadership Council, cochaired by Morella and Representative Eddie Bernice Johnson (R–TX). –JEFFREY MERVIS

BEHAVIORAL ECOLOGY

Elephant Matriarchs Tell Friend From Foe

Elephants have good reason to love their mothers. New research reported on page 491 shows that the lifetime experience of a matriarch helps her group discriminate friend from foe and contributes in many other important ways to the well-being of her companions.

Not only is the work "a neat demonstration," but "it probably applies to a wide range of animals," says Timothy Clutton-Brock, a behavioral ecologist at Cambridge University in the United Kingdom. Furthermore, according to animal behaviorist Richard Connor of the University of Massachusetts, Dartmouth, "the conservation implications are really profound: If that older individual is killed, it could have a very negative impact on the group."

For this work, Karen McComb of the University of Sussex in Brighton, U.K., and Sarah Durant of the Institute of Zoology in London teamed up with Cynthia Moss and her colleagues, who have tracked some 1700 elephants for the past 28 years as part of the Amboseli Elephant Research Project in Kenya. The elephants McComb studied live in about 20 small family groups, typically containing several females and their calves. Each group moves independently, sometimes encountering other groups or individuals as it forages for food.

McComb and her colleagues played back recordings of elephant calls and watched the elephants' responses. Calls from complete strangers prompted the mothers to cluster around their young, whereas familiar calls were ignored. But the groups "differed in how good they were" at discriminating friend from foe, says McComb: Some groups bunched up even at the sound of familiar calls, while others were better at picking out the strangers.

A group's ability to tell acquaintances from strangers correlated strongly with the age of the oldest female. Other factors, such as the number of calves, number of females, or even the mean age of the females, were not important. "You have this older individual who has this great storehouse of knowledge," Connor notes.

That storehouse of knowledge also contributes to the group's reproductive success. When McComb combined her 7 years of audio playback data with Moss's 3 decades of observations, she found that groups with older matriarchs at the helm produced more young per female once factors such as age were taken into account. "In evolutionary terms, you can see why intelligence was selected for," McComb notes. The matriarch's ability to spot the riskiest encounters makes life easier for her companions.

"People who've studied elephants for a long time have always felt there are strong cultural attachments [within groups], but they're really hard to quantify," notes Andrew Dobson, an ecologist at Princeton University. McComb's approach provides "a way of actually showing how behavior and experience accrued over a long lifetime translates into benefits for the whole group," he says.

For that reason, the work sends a strong message to conservationists. "When you poach an animal, you are not just taking one life away; you're taking away the influence of that animal on other animals," says Hal Whitehead, a marine biologist at Dalhousie University in Halifax, Canada. That loss could be particularly great if the individual is an elder statesman of the group.

Grandma knows best. By having a keen nose for strangers, the matriarchs in elephant clans help their families prosper.

Sperm whales could be a case in point, notes Whitehead. They have a social structure similar to that of elephants, with small groups of females that communally look after and defend their young, wander many kilometers in search of food, and have chance encounters with other sperm whales. Given McComb's new data, Whitehead wonders whether the low birthrates recorded in sperm whales off the coasts of Peru, Chile, Japan, and even northwestern Europe—compared to whales in the Caribbean—are a vestige of

CREDITS: (TOP TO BOTTOM) COUNCIL ON COMPETITIVENESS; KAREN MCCOMB whaling practiced until some 18 years ago. If whalers consistently took the larger, older individuals, he suggests, the groups may have "lost their social knowledge and may be less successful." –ELIZABETH PENNISI

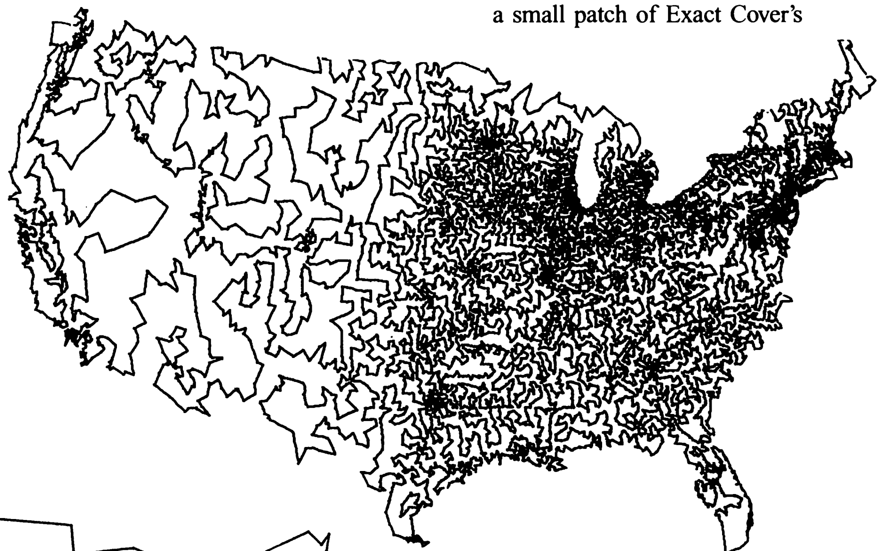
QUANTUM COMPUTING

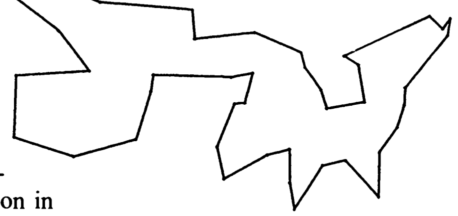
Souped-Up Software Gets a Virtual Test

Amazing things, quantum computers. On paper, they can outpace conventional computers a billionfold, bringing new worlds of computation within human reach. The only hitch is that no one has built one that does that yet. That raises a practical problem for designers of quantum software: How do you test a potential "killer app" for a machine that doesn't exist?

If you have time, you can run it on machines that do exist. That's how researchers led by Edward Farhi and Jeffrey Goldstone of the Massachusetts Institute of Technology in Cambridge and Sam Gutmann of Northeastern University in Boston pitted a quantum algorithm against one of the toughest problems in computer science. In preliminary tests, described on page 472 of this issue, the algorithm racked up an encouraging virtual track record that left some scientists hankering for more.

"If it is truly powerful, then it is very broadly applicable," says John Preskill, a theorist at the California Institute of Technology in Pasadena. Although the algorithm's prospects remain "highly speculative," Preskill says, "the incentive to press forward with the daunting task of building large-scale quantum computers will be greatly strengthened if quantum computers are really as powerful as the work of Farhi *et al.* suggests."





Where next? Problems such as finding the best route through many cities can stump ordinary computers but may yield to quantum ones.

SOURCES: (TOP TO BOTTOM) APPLEGATE, BIXBY, CHVATAL, AND COOK (1998); GEORGE DANTZIG, RAY FULKERSON, AND SELMER JOHNSON (1954)

The dream machines get their potential power from storing information in objects that obey quantum laws, such as electrons, atomic nuclei, or molecules. Whereas each bit stored in a classical computer can take on only one of two values—0 or 1—the "qubits" in a quantum computer can also exist in a strange state called superposition, in which, in a sense, they possess every possible value at once. That gives quantum computers an amazing knack for parallel processing, raising hopes that they might conquer problems that ordinary classical computers can't handle.

The Mount Everest of computer science is a class of problems known as NP-complete. Algorithms designed to solve NP-complete problems mushroom exponentially into impossibly long calculations as the size of the input increases. One famous example is to find the most efficient route for a traveling salesman who must visit every city on his map once and only once. As the number of cities increases, the problem quickly becomes so complex that, in general, conventional computer algorithms can't solve it for more than a few thousand cities. (The current world record is 3038.)

To tame that exponential monster, computer scientists are hunting for a problem-solving algorithm whose run-time grows more slowly, with some power of the size of the input. One such "polynomial time" algorithm is all they need, because mathematicians have proved that any algorithm that solves one NP-complete problem in polynomial time will crack every other NP-complete problem, too. Last year the Clay Mathematics Institute in Cambridge, Massachusetts, offered a $1 million bounty to anyone who either writes such an algorithm or proves that it can't be done (*Science*, 26 May 2000, p. 1328).

An NP-complete problem, Farhi and his colleagues decided, was just the thing for road-testing a virtual quantum computer. A year earlier, they had devised a way to program a quantum computer to solve an NP-complete problem called Exact Cover. Exact Cover is like Twenty Questions played with bits: Given a series of rules describing a string of ones and zeroes, the player must decide whether the string exists. The quantum algorithm "isn't clever," Farhi says, but it always gets a solution sooner or later. "The question is how long is long enough."

To find out, the scientists programmed a cluster of workstations to simulate a quantum computer running the algorithm, by running in sequence the operations that a quantum machine would perform simultaneously. Then they fed it various combinations of rules and waited for it to crank out the answers. Although the problems weren't difficult (a nonquantum desktop PC could have solved each one in a fraction of a second, Farhi says), the simulation took days to find each solution. The quantum run-time, it turned out, grew in proportion to the length of the bit string, squared. That put the algorithm solidly within polynomial time—the realm of practical solvability.

Time to alert the Clay Institute? Unfortunately not, Farhi says. Even if quantum algorithms qualify for the prize, a few promising results are a far cry from a mathematical proof, he points out. Besides, the simple problems in the simulation represented only a small patch of Exact Cover's infinite terrain. Harder ones might have made the algorithm stumble.

Some computer scientists think that's exactly what is in the cards. "I don't expect any quantum approach to give a speedup of NP-complete problems in polynomial time," says Charles Bennett, a quantum-computing researcher at IBM's Thomas J. Watson Research Center in Yorktown Heights, New York. To do that, he thinks, an algorithm would have to target some still-unknown Achilles' heel in the problems themselves—a feat he considers unlikely.

Preskill, however, is guardedly optimistic about the algorithm. Although the evidence is still "far from conclusive," he says, "I think it is a promising idea that ought to be pursued aggressively." Farhi says that's just what he has in mind. –MARK K. ANDERSON

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