tion rates, except for higher rates of miscarriage, but the risk for the cloned fetus is another matter. In cattle cloning, approximately one out of seven newborns has potentially fatal complications, such as metabolic disorders and abnormal lung development. What's more, cautions Bishop, the long-term consequences of cloning are still not well understood. Safety aside, Anne McLaren, a developmental biologist at the Wellcome/CRC Institute in Cambridge, U.K., doesn't think human reproductive cloning is ready for prime time. Such techniques are "a step too far in assisted reproduction," she says.

One practical barrier might be obtaining enough human oocytes for the transfer procedure, in which an adult cell nucleus is either injected into or fused with an oocyte from which the nucleus has been removed. Even in the most efficient animal cloning labs, fewer than 5% of nuclear transfer attempts result in live births.

Stay tuned, says Zavos, who intends to announce more details on the project at a meeting in March in Rome. **–GRETCHEN VOGEL**

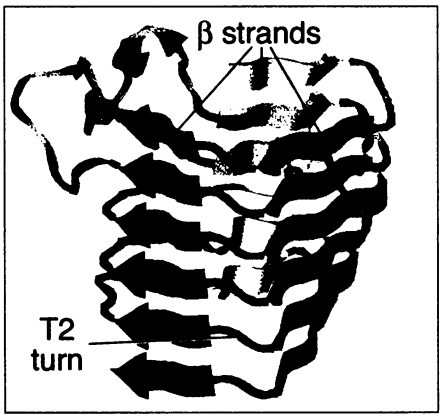
PROTEIN FOLDING

Virtual Molecules Nail Bacteria's Weapon

To understand how proteins work, biologists need to know what shapes they naturally fold into. The straightforward ways of finding out, x-ray crystallography and nuclear magnetic resonance, take as long as a year to reveal a protein's three-dimensional structure. Increasingly reliable mathematical models, however, can now predict parts of the structure much faster. In the latest computer-assisted coup, mathematicians and biologists at the Massachusetts Institute of Technology (MIT) have developed a program that predicts in milliseconds whether a protein folds into a structure called a β helix. To their surprise, they found that a protein with a β helix is like a child with a can of spray paint: It's almost surely up to no good.

"This program found a very interesting subset of proteins—whooping cough virulence factors, *Helicobacter pylori* toxins, ragweed pollen allergens, and so on," says Jonathan King, a biologist on the team who specializes in protein folding. King speculates that the β helix, a long spike, is used for attaching to or penetrating cell membranes. The work is "a tremendous accomplishment," says Peter Kim, a protein biologist who recently moved from MIT to direct Merck Research Laboratories in Rahway, New Jersey. "The bottom line is that a computer scientist has drawn attention to a class of proteins involved in human disease, which are potentially of medical significance."

The first known β helix was reported in 1993 by Frances Jurnak, an x-ray crystallographer who now works at the University of California, Irvine. It turned up in a bacterial protein called pectate lyase, which breaks down the pectin in plants' cell walls. Since then, a handful of other proteins with β helices have been found. One of them is pertactin, made by *Bordetella pertussis*, the bacterium that causes whooping cough. Because it elicits a strong immune response, pertactin has been incorporated into a new vaccine against that disease. But with only 12 known examples out of 12,000 solved proteins in the Protein Data Bank, β helices remained "low on the totem pole for structural biologists," King says.



Do the twist. Parallel β strands wrap up into a β helix.

The MIT group saw things differently. To them, the orderly structure of β helices made them ideal candidates for computational prediction. A β helix is made up of "rungs," consisting of three β strands (flat, uncoiled pieces of protein that stack into sheets with a water-loving side and a water-repelling side). A typical helix contains from 7 to 16 triangular rungs, which twist around gradually to the right. β sheets in general are hard to predict from an amino acid sequence, because residues that are widely separated in the protein's sequence may lie in adjacent rungs. Residues that lie in adjacent β strands usually match, but the residues on the "turns" between strands need not match at all. Because the turns have unpredictable lengths, it is hard for biologists to know where to look for the matching pairs. Fortunately, in the β helix each rung contains an easily recognized landmark: a very short turn, usually only two amino acid residues long, called the T2 turn.

Bonnie Berger, Lenore Cohen, and Phil Bradley in the MIT mathematics department incorporated this information into a computer program called BetaWrap. The program first identifies a likely T2 turn and assigns a score to the adjacent regions based on the probability that they will form β strands. Then it scans farther down the sequence for strands that have a high probability of stacking well onto the two already found. The program computes this probability by analyzing hundreds of known β sheets in the Protein Data Bank, but *not* the 12 known β helices. Tested to see whether it could pick the known β helix–bearing proteins out of a lineup, BetaWrap scored 12 out of 12—a feat no rival program could match.

Next, Berger turned the program loose on the larger SWISS-PROT database, consisting of proteins with unknown structure. BetaWrap found hundreds of β-helix candidates, some of which scored even higher than the known β helices. When Berger showed the list to King, he was astounded to see that the top 100 candidates were all bacterial proteins—even though Berger's team had no way of telling bacterial proteins apart from mouse or human proteins. "That's when he believed us, because we produced these things that made biological sense," Berger says. Berger announced the results at this month's meeting of the American Mathematical Society in New Orleans.

BetaWrap's predictions still must be checked by crystallography, a process that will probably take at least a year. But some researchers already plan to use the program's results as a springboard for new research. "I'm immediately going to run BetaWrap on viral genome sequences," Jurnak says, to see whether bacteria are indeed the only source of β helices. **–DANA MACKENZIE**

Dana Mackenzie is a writer in Santa Cruz, California.

PHILANTHROPY

Gates Gives Booster Shot to AIDS Vaccines

DAVOS, SWITZERLAND—In a huge boost for efforts to develop an AIDS vaccine, Bill Gates announced at the World Economic Forum here on 27 January that the foundation named after himself and his wife, Melinda, will give $100 million to the International AIDS Vaccine Initiative (IAVI). The 5-year grant—the largest single philanthropic donation ever for AIDS research—helps put the New York City–based nonprofit on track to launch clinical trials of three of its most promising AIDS vaccines by 2007.

Unsolicited grant. Gates announcing $100 million to IAVI.

With $21 billion in assets, the Bill and Melinda Gates Foundation gives away hundreds of millions

CREDITS: (TOP TO BOTTOM) BONNIE BERGER/MIT; HERBERT KNOSOWSKI/AP

of dollars a year to health and educational organizations. It has become a major funder of vaccine programs for developing countries, including a $750 million grant over 5 years to the Global Fund for Children's Vaccines to pay for childhood vaccinations in the 70 poorest countries worldwide.

Paving the way for the foundation's big-time plunge into AIDS vaccines was a dinner party at the Gates mansion in 1998 attended by IAVI chief Seth Berkley. The Microsoft chair was seeking advice on how his foundation might significantly improve public health through contributions of large sums of money. At the dinner, Gates told *Science* that he asked Berkley, "Where is money a limiting factor in stopping AIDS?"

Berkley had long argued that a vaccine is the best hope for stopping AIDS. He pitched Gates on IAVI's "social venture capital" approach, in which the nonprofit gives drug companies the rights to produce and sell vaccines that it helps develop, as long as the firms pledge to distribute vaccines widely to poor nations at a reasonable cost.

Intrigued, Gates says he started reading up on AIDS vaccines. Encouraging evidence that vaccines could be feasible included experiments demonstrating protection conferred to some primates, and the fact that some people who have been exposed to HIV multiple times have not become infected; they appear to be resistant. But the bottom line was a showstopper: "There was no market incentive to create a vaccine" against AIDS in developing countries, Gates says.

So when Gates decided to create that incentive, Berkley's connection paid off. The Gates Foundation gave $1.5 million to IAVI in 1998, and another $25 million a year later. Gates is well known for putting money only into projects that he has researched. For that reason, says Pfizer CEO Hank McKinnell, the Gates Foundation confers credibility on grant recipients: "A lot of [charitable] organizations send out a lot of little checks," McKinnell says. "Gates sends large amounts of money to a few organizations, but they're the very best."

The 1999 cash influx from Gates and from other organizations allowed IAVI to put one promising vaccine program on a fast track. In this effort, a team from Oxford University in the U.K. and the University of Nairobi in Kenya are developing a vaccine based on the clade A HIV-1 virus, the most common form of HIV in Kenya. They inject DNA from the strain into skin or muscle cells to produce an immune response. They follow this with a vaccinia Ankara vaccine, a cowpox virus modified to produce HIV proteins to stimulate a second immune response. Early clinical trials of this one-two punch began in Oxford last August and were scheduled to start in Nairobi earlier this week.

The new money from the Gates Foundation will come in $20 million chunks over each of the next 5 years. It's a challenge grant, meaning that the foundation expects other organizations to help IAVI raise the $550 million needed to launch the three trials; counting the Gates money, IAVI has $230 million. That puts the nonprofit in the AIDS vaccine big leagues.

It's unclear how easy it will be to raise the rest. Although Glaxo Wellcome has contributed to IAVI, other drug companies are taking a wait-and-see attitude. McKinnell says that if IAVI comes through with an effective vaccine, Pfizer—which is not now working on an AIDS vaccine—would consider producing and selling it. By "taking an almost free-market approach" to charity, says McKinnell, Gates and Berkley are giving AIDS vaccines a chance.

—RICHARD BRANDT

Richard Brandt is a science and technology writer based in San Francisco.

PALEONTOLOGY

Doubts Raised About Dinosaur Heart

The discovery quickened pulses around the globe. Last April, a team of scientists unveiled a fossilized dinosaur heart—evidence suggesting that dinosaurs were indeed warm-blooded (*Science*, 21 April 2000, p. 416). The dinosaur itself, a 4-meter-long *Thescelosaurus* found in the Hell Creek Formation of northwestern South Dakota, became the hugely popular showpiece of a new $71 million museum in Raleigh, North Carolina. But in *Science* Online this week (see Technical Comments at www.sciencemag.org/cgi/content/full/291/5505/783a), two paleontologists and a geologist argue that the grapefruit-sized structure is no heart at all but only a deceptive lump of minerals.

Funny valentine. Paleontologists disagree about whether a stony lump in the chest of *Thescelosaurus* is a fossilized heart or a common rock.

Fossilized soft tissue is extraordinarily rare, even in the best conditions, says Tim Rowe of the University of Texas, Austin. So it was "a real stretch" to suppose that a dead heart could have turned to stone in the delta rivers that coursed through South Dakota some 66 million years ago. Hungry bacteria in the flowing waters would have made short work of such tasty tissue, Rowe says.

Rowe, a noted expert in computerized tomography scanning of fossils, says CT images posted on the Web by the dino-heart enthusiasts bear out his skepticism. "If it's a heart, it ought to look like one," he says—and to him it doesn't. He notes that one of the two supposed ventricles appears almost entirely closed and thus lacks any way for substantial amounts of blood to enter or leave. Features of a normal heart, such as the atria and coronary arteries, are missing, and the aorta lacks the branching vessels found in living relatives of dinosaurs. Instead, Rowe thinks the structure is an ironstone concretion. Such concretions, precipitated by bacteria, are common in the Hell Creek Formation, he says.

But Dale Russell, a paleontologist at North Carolina State University in Raleigh, thinks the heart is getting a bad rap. The decay of heart tissue, he says, could have been delayed if the dinosaur lay in an anoxic, swamplike microhabitat—a scenario that seems plausible to Ray Rogers, a sedimentologist and taphonomist at Macalester College in St. Paul, Minnesota, who's familiar with the Hell Creek Formation. The lack of detail is easily explained, Russell says: "This heart was rotten; it wasn't the kind of heart you can lay on a dissecting table." Russell and his colleagues since have done higher resolution CT scans of the heart and are searching them for other details.

But what's the point, wonders Larry Witmer of Ohio University's College of Osteopathic Medicine in Athens. "Even if it is a heart, it's not clear that it's telling anything about the biology of the animal," he says, because key features of the organ may have rotted away. The main value of a certified heart, he says, would be as palpable proof that the Hell Creek rocks hold more than just the bones of ancient creatures. And that prospect alone may be enough to get some hearts beating again. —ERIK STOKSTAD

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