amniotic cavity of early chick embryos, she and her colleagues found progeny of the mouse cells in the liver, spinal cord, stomach, and kidneys of about one-quarter of the surviving embryos.

Both sets of experiments produced a puzzling result, however: Neural-derived cells did not appear in the blood systems of either the mouse or chick embryos. In light of last year's results, that is a "glaring, interesting conundrum," says neuroscientist Fred Gage of the Salk Institute for Biological Studies in La Jolla, California. The cells' absence in the bloodstream "doesn't mean they can't" become blood, he says, "but it leaves open the possibility that they don't."

Even more important, several researchers say, is the question of exactly what type of cell formed the various other tissues. Frisén and his team cannot tell whether the cells that contributed to the various embryonic tissues are some sort of rare, undifferentiated cell or whether something in the embryonic environment actually reprograms a cell that had already begun to differentiate. Scientists would dearly love to know the answer to that question, as it would help them understand what molecular factors allow stem cells to change their fates.

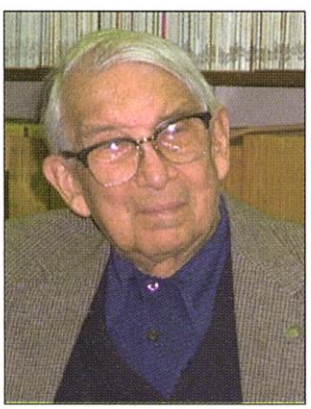
Rossant notes that it would also be nice to know whether the neural-cell chimeras would continue to develop into normal adults as ES-cell chimeras can, and especially whether the neural cells could become mature sperm and eggs. Nevertheless, she says, the work "is another demonstration that adult stem cells have more potential than we thought. Now we have to figure out how to harness that potential."

–GRETCHEN VOGEL

MATHEMATICS

## Statistical Physicists Phase Out a Dream

For decades, the Holy Grail of statistical mechanics has been a mathematical problem known as the Ising model. Introduced in the 1920s by German physicist Ernst Ising, the Ising model is a powerful tool for studying phase transitions: the abrupt changes of state that occur, for instance, when ice melts or cooling iron becomes magnetic. Although they've learned much from approximate solutions and computer simulations, physicists have long sought an exact mathematical solution to the Ising model, which would provide much more information about such still-mysterious transitions.



**Ernst Ising.** His phase-change model is doomed to be inexact.

CREDITS (LEFT TO RIGHT): S. KOBE; C. THOMAS/NASA

Unfortunately, it looks as if that's not in the cards. Sorin Istrail, a theoretical computer scientist at Celera Genomics in Rockville, Maryland, has proved that the Ising model —at least in its most general, three-dimensional (3D) form—belongs to a class of problems that theorists believe will remain unsolved forever. "People have always thought the 3D solution was just around the corner," says Alan Ferrenberg, a computational physicist at the University of Georgia, Athens. "It really means now that numerical analysis is the only way we've got to approach [the Ising model]."

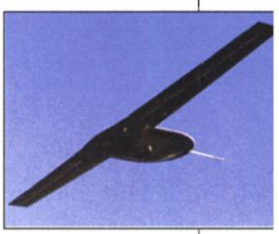
The Ising model deals with objects—say, atoms—laid out in a regular array, such as a rectangular grid or a honeycomb arrangement. The array can be 1D (think of beads on a string), a 2D grid, or a 3D lattice. What makes the model so useful is that it helps physicists understand how a large system of objects, each interacting only with its nearest neighbors, can combine to create a large-scale order. In a ferromagnet, for example, each atom has a magnetic moment that points either up or down. Pairs of neighbors with opposing moments raise the total energy of the system, while those with parallel moments lower it.

Solving the model means counting the number of arrangements that add up to each given energy level. Some versions of the Ising model can be solved exactly. Ising himself solved the 1D ferromagnetic model—and found it had no phase transition. In 1944, the Norwegian chemist Lars Onsager discovered an exact formula for the 2D model, which does possess a phase transition. But scientists have never been able to extend Ising's and Onsager's solutions to the physically realistic realm of three dimensions. "We now know why," says Istrail. "What these brilliant mathematicians and physicists failed to do, indeed cannot be done."

While working at Sandia National Laboratories, Istrail proved that computing the energy states for the general 3D Ising model is what computer scientists call an NP-complete problem—one of a class of recalcitrant calculations that theorists believe can be solved only by arduous brute-force computations. In effect, an exact solution to the Ising model would provide the key to efficient algorithms for solving thousands of other computational problems, ranging from factoring large numbers to the notorious traveling salesman problem, in which the salesman must find the most efficient route through a given number of cities. Al-

## ScienceScope

**Defenses Raised** In February, President Clinton alarmed academic researchers in math, engineering, and computing—fields that get major military funding—by proposing to slash the Department of Defense's (DOD's) applied research spending by 8%, while boosting basic funding by 4% (*Science*, 11 February, p. 952). But leaders of the House and Senate panels that oversee DOD's budget promised to do more to keep innovative ideas flowing (such as drone aircraft, right)—and last week they followed through.



On 25 May, the House Appropriations Committee approved a bill providing $3.4 billion to applied studies, about 2% below this year's level, while giving basic research a 12% increase to $1.3 billion. Earlier, a Senate panel approved even rosier numbers, giving applied and basic science increases of 5% and 10%, respectively.

"We are pleased that Congress has recognized the importance of basic research, but we will continue to push for overall increases," says Caroline Trupp Gil of the American Chemical Society and the Coalition for National Security Research, a lobbying alliance. Computer researchers, for instance, will be pushing to raise some program budgets to requested levels when the full House and Senate vote on the bills later this month.

**Hair of the Bear** DNA samples taken from grizzly bear hair may help resolve a bitter dispute over the size of the bear population in and around Wyoming's Yellowstone National Park. Last month, federal scientists released a preliminary count of bears in Yellowstone's Lake area based on hairs found on barbed wire fur catchers. The figure—84 individuals, compared to 44 estimated in the 1980s from bear tracks—benefits from "a much more sophisticated technology" for tracking bear numbers, says Chuck Schwartz, head of the Interagency Grizzly Bear Study Team.

Schwartz now wants to do a Yellowstone-wide hair study to help pin down grizzly population trends—information that could prove pivotal in the debate over whether the animals should be removed from the U.S. endangered species list (*Science*, 23 April 1999, p. 568). A similar new study in Montana's Glacier National Park proved useful, but it's "not an inexpensive proposition," Schwartz says. A baseline bear count could cost $1 million, with more surveys needed to establish trends.

der analysis, which may have been as brief as a statement that there were no significant sex differences. That share remained constant over the period, Vidaver adds.

NIH's Pinn says that the analysis is premature, because the studies would have been funded before the 1993 law was implemented. But Greenberger counters that the NIH began urging the inclusion of women starting in 1986, adding that "we thought at least we'd see a trend" toward more gender analyses.

The society isn't waiting for NIH to make things happen. On 25 May, it wrote to the editors of 32 leading journals, calling on them to revise publication guidelines to require a sex analysis. **–LAURA HELMUTH**

VACCINE DEVELOPMENT

## Radical Steps Urged to Help Underserved

**BETHESDA, MARYLAND**—These are miraculous times for researchers working on vaccines for the world's major scourges. For years, their plea for more funding, political attention, and greater involvement from the pharmaceutical industry fell on deaf ears. But recently, their cause has been embraced by politicians around the world—indeed, President Clinton seems determined to make it part of his legacy—and industry leaders have promised to do what they can. Suddenly, anything seems possible.

So when a broad group of researchers, big-pharma CEOs, and public health experts met last week at Clinton's request to discuss the main obstacles on the road to new vaccines for AIDS, malaria, and tuberculosis,* meeting organizers urged them to think big. "Now is your chance, folks!" beamed Anthony Fauci, director of the National Institute of Allergy and Infectious Diseases (NIAID), who said the ideas would help shape the Administration's future policy. The participants were happy to comply, with proposals that range from a 10- or 20-fold budget increase to a new, more flexible funding agency to circumvent the National Institutes of Health's (NIH's) bureaucracy. A few even proposed a crash effort akin to the Apollo program that put a man on the moon within a decade.

CREDIT: AP PHOTO/T. HADEBE

**Unmet need.** Malaria kills a million people a year, mostly in Africa, but no vaccine exists. Momentum is building to change that.

Epidemiologists say vaccines are the only practical way to cut the death toll from AIDS (currently estimated at 2.6 million annually), TB (which kills 1.5 million to 2 million), and malaria (more than a million). Doing so would also be a boon for development, economists point out: In Africa, especially, sickness and death take a huge toll on the economy.

Yet funding for most types of vaccine research has been hard to come by because the big killers overwhelmingly afflict the developing world. NIH currently spends a paltry $6.5 million a year to find a vaccine for TB and $25 million for malaria. (Vaccine studies for AIDS, which poses more of a threat to the U.S. population, will get an estimated $250 million this year.) Pharmaceutical companies have been reluctant to bet much of their R&D budgets on these vaccines, as expected returns are low, and developing countries don't always respect industry patents. For the same reasons, cash-starved small biotech companies have a hard time attracting venture capital.

To help break the pattern, Clinton proposed a Millennium Vaccine Initiative in January, which includes increased funding for NIH, a $50 million contribution to the Global Alliance for Vaccines and Immunization, and a $1 billion tax break on vaccine sales to stimulate industry investments. Several bills before Congress would do more or less the same, and some European countries are considering similar steps. The issue will also be on the agenda when leaders of the eight major industrial nations meet next month in Okinawa, Japan.

Not all of the proposals to come out of the NIH meeting, however, are likely to make it onto the table, at least in their current form. The malaria researchers, for instance, want the president to initiate an "aggressive malaria vaccine program" and raise funding to $500 million a year. The group also thinks the U.S. should agree to purchase $500 million a year worth of vaccines, if one gets developed, to guarantee that there is a market. The AIDS group pleaded for a 10-fold funding hike for vaccine studies in general, while the TB researchers suggested setting up something

* Vaccines for HIV/AIDS, Malaria and Tuberculosis: Addressing the Presidential Challenge, 22 to 23 May, at NIH.

## ScienceScope

**Vaccine Variation** The National Institutes of Health (NIH) is restructuring its HIV vaccine research in a move designed to spark flagging efforts to combat the global AIDS epidemic. The agency recently abandoned its current two-pronged approach, which used separate networks of academic and clinical centers to run early-stage domestic and late-stage international vaccine trials. In its place, NIH is forming a single HIV Vaccine Trials Network, a system of nine U.S. academic centers. Most will be paired with clinics in countries suffering the brunt of AIDS deaths.

The shift is a response to criticism that the existing networks—the U.S.-based AIDS Vaccine Evaluation Group and the international HIV Network for Prevention Trials—lacked coordination. Critics also argued that scientific priorities were being set by NIH bureaucrats, not researchers. The new approach will move much of the administrative control and priority setting to a Core Operations Center run by Lawrence Corey of the Fred Hutchinson Cancer Research Center in Seattle, Washington.

The makeover isn't a sure bet to succeed, says Mark Mulligan, who runs one of the new network's centers at the University of Alabama, Birmingham. But, he adds, "when there's not success, the structure gets changed to try to stimulate some new vitality."

**Family Quarrel** Energy Secretary Bill Richardson moved quickly last week to break up an internal fight over the future of the world's largest laser. While publicly supportive of the National Ignition Facility (NIF) being built at California's Lawrence Livermore National Laboratory, some officials at New Mexico's Sandia and Los Alamos national laboratories have long privately attacked the project as ill conceived. And recent news that NIF is $1 billion over budget (*Science*, 5 May, p. 782) has only added to fears that Livermore may eat into its sister labs' budgets.

To prevent that, Sandia vice president Tom Hunter told the *Albuquerque Tribune* on 25 May that NIF should be downsized so that it will not "disrupt the investment needed" at the other labs. But Hunter's statement was "out of line," "the type of lab divisiveness which is extremely unhelpful," and "will be totally disregarded," Richardson promised in a statement. The discord, however, may raise questions in Congress, which will vote on NIF's budget later this year.

**Contributors: David Malakoff, Jocelyn Kaiser, Robert F. Service**