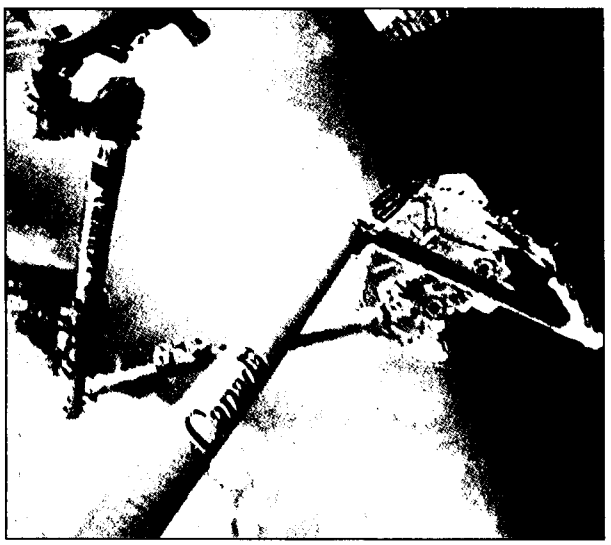
2007 or 2009 that draw on Canadian technological and scientific expertise, complement existing international efforts, and appeal to the public's sense of adventure. This summer the space agency will prime the pump by funding a series of separate space science projects at Canadian universities focusing on planetary geology, atmospheres, terrestrial analogs, and astrobiology.



Reaching out. Canada's space program hopes to move beyond robotics to support for planetary missions.

Canada already has one instrument headed to Mars. It's a thermal plasma analyzer from the University of Calgary, designed to gather data on the origin and composition of the martian atmosphere, that is due to arrive in late 2003 on board the Japanese Nozomi spacecraft. Other technologies now in use around Earth, such as Canada's highly successful synthetic aperture radar, could provide detailed maps of Mars from a high-flying orbiter. And the nation's experience with robotics could be used on a sophisticated rover on the martian surface. The space agency and Canadian industry already are working on a prototype small arm for a lander. In addition, researchers from the Arctic research station on Axel Heiberg Island hope to apply to Mars their expertise in searching for life in extreme environments.

One promising technology is a special drill, adapted to the planet's dry conditions, that could penetrate as deep as 10 meters. Hojatollah Vali, a biomineralogist at McGill University in Montreal who helped organize the May workshop, says that a group of geologists and astrobiologists at the meeting suggested putting such a drill on a martian lander. Another workshop group has proposed an orbiter with instruments to study the martian atmosphere, and a third team recommended a sample return from Phobos or Deimos. Neither moon has been explored, notes Alan Hildebrand, a geologist at the University of Calgary who participated in the workshop.

Canadian officials hope to integrate their plans with efforts already under way by NASA, the European Space Agency, and the Japanese National Space Development Agency. "We want to fill a void and not duplicate," says Alain Berinstain, chief scientist for the Canadian Space Agency's space exploration program. "We'd be delighted and overjoyed to have major Canadian participation," says James Garvin, chief scientist for NASA's Mars planning. He says the U.S. agency already is planning its own 2007 lander but might welcome a subsurface drill or robotic arm for that mission or a synthetic aperture radar on a 2009 martian orbiter.

Time is short and funding uncertain. But Canadian space and planetary scientists are hoping that their blue-sky thinking won't be too late to secure a visit to the Red Planet.

–ANDREW LAWLER

GENETICS

Faster Maps Mean Fewer Mice

A computer may be worth 1000 mice if a new genetic mapping technique pays off. The approach could markedly speed the first step in identifying genes associated with diseases, making the process cheaper and more efficient.

Although some human diseases are triggered by a genetic change in a single gene, most involve multiple genes that confer susceptibility to the disease. Because the genetic diversity of human populations makes finding these genes difficult, scientists have turned to the laboratory mouse. One way to home in on these disease-related genes is to look for naturally occurring genetic variation among inbred strains of mice that have different traits—for instance, body weight or cholesterol level. By looking for genetic markers that are associated with particular values of the trait (for instance, high body weight or high cholesterol levels), researchers can identify regions on the chromosomes, called quantitative trait loci (QTL), that likely contain genes that contribute to the trait.

But finding these QTLs is costly. Geneticists must cross two mouse strains that differ in the trait, produce hundreds or thousands of offspring, and determine the phenotype and genetic signature of each mouse. It takes months just to produce the mice and often years to analyze the animals. And that's just the starting point, as finding a QTL provides only a rough idea of where the gene resides. Further work is needed to pinpoint the gene and the mutations within that gene that lead to increased susceptibility to a disease.

Now, a team of scientists has come up with a way to accelerate that process. As they report on page 1915, they have compiled a database of common genetic markers called single nucleotide polymorphisms (SNPs) and developed a computer algorithm to sift through these "alternative spellings" among mouse strains. This enables them to identify QTLs "in silico" in a fraction of the time it currently takes researchers in the lab.

"Identifying a QTL isn't going to take years anymore; it's going to take weeks at greatly reduced cost," says Robert Karp, director of the genetics program at the National Institute on Alcohol Abuse and Alcoholism, who was not involved in the work. The technique "makes the first part of [gene identification] easier, which means you're not exhausted for the rest of the search."

To pull this off, Gary Peltz of Roche Bioscience in Palo Alto, California, along with colleagues at Roche, Stanford University, and Oregon Health Sciences University in Portland, pooled SNP data on 15 commonly used strains of inbred mice. The Roche team identified more than 500 of the SNPs; the remaining 2848 were identified by other researchers.

Then Peltz and his co-workers created an algorithm that would let them query the SNP database to identify QTLs almost instantly. A user inputs phenotype data on a particular trait, say, body weight, that varies among multiple strains of mice. The algorithm looks for SNP patterns that are similar among strains with similar phenotypes, but different among strains with different phenotypes. Those SNP patterns indicate QTLs that could contain genes contributing to that trait.

To test the algorithm, the researchers fed published phenotypic data for 10 different traits (including tendency to consume alcohol, bone mineral density, and an allergen-induced asthmalike response) into the computer and checked the computer-predicted loci against published QTLs mapped through the conventional process of mouse breeding. They matched 75% of the time.

Although the method still leaves large chunks of DNA to search for the culprit gene, Peltz anticipates that as the database grows, the algorithm will pinpoint smaller candidate regions with higher accuracy. He hopes to have 5000 SNPs by the end of the year and to eventually add several additional

CREDIT: AP PHOTO/NASA TV

strains, which will provide more genetic and behavioral diversity to compare. The team, funded by the National Institutes of Health, has made its SNP database and gene-hunting algorithm freely available on the Web (mouseSNP.roche.com). "It's a great resource," says geneticist Carollee Barlow of the Salk Institute for Biological Studies in La Jolla, California.

The traits used in the trial run haven't been mapped down to the gene level by any method, so no "gold standards" exist to test the method, cautions Dean Shepherd of the University of California, San Francisco: "To prove what the method is really worth, we'll have to actually find some specific mutations that explain the differences in phenotype." As other researchers search for their own favorite genes, the effectiveness of this new method for mapping QTLs should quickly become apparent. Shepherd, for one, is optimistic, saying "It's extremely likely that in the near future this will really have a significant payoff."

Unemployed? If a new mapping technique pans out, thousands of lab mice may be out of work.

–R. JOHN DAVENPORT

PCR

Roche Dealt a Setback On European Taq Patent

A key biotechnology patent belonging to Swiss pharmaceutical giant Hoffmann-La Roche ran aground on the legal shoals of a third continent last week. On 30 May the European Patent Office (EPO) revoked Roche's patent on native Taq polymerase, a crucial element of the polymerase chain reaction (PCR), the ubiquitous technique used to amplify snippets of DNA. Roche officials say they will appeal the ruling. But this is a costly setback, because the company is already fighting to overturn related decisions in both the United States and Australia.

The ruling marked another in a string of victories for a group of small biotech companies that have challenged Roche's Taq patents in recent years. The companies, led by biological reagent supplier Promega of Madison, Wisconsin, have argued among other things that labs in the United States and Russia isolated the native Taq (n-Taq) enzyme before scientists at Cetus Corp., which transferred the patent to Roche in 1992. The Munich-based EPO agreed, ruling that the patent EP-0-258-017 B1 was invalid. "This decision reaffirms once again what Promega and many others in the research community have long believed: that the Taq patents should never have been issued," says Promega CEO William Liton.

The decision means that Promega can continue to sell n-Taq without paying royalties to Roche. Roche officials argue that this has little effect on the bottom line, because n-Taq makes up only 10% of the Taq they sell; the other 90% is recombinant forms of Taq (r-Taq), which are widely used in automated gene-sequencing machines and are covered by separate patents. But Promega's general counsel Brenda Furlow contends that the legal damage to Roche is broader, because some of the provisions of the patent struck down by the EPO applied to r-Taq, and Roche's separate r-Taq patent is currently being challenged in Europe. "We think the recombinant [Taq] claims will fall," says Furlow.

Genetics researchers are hoping that Roche's patent troubles will bring down prices. Although gene sequencers predominantly use r-Taq, n-Taq remains widely used in a host of other genetic studies, such as genotyping, a procedure used to sort out how genes are inherited in families. These studies typically require Taq or another polymerase enzyme to amplify specific DNA strands. "This is done very well with native Taq," says Maynard Olson, who heads a genome sequencing center at the University of Washington, Seattle. But cost remains a big issue.

Taq currently costs about 50 cents for the amplification step used in a single round of genotyping, says Olson: "There would be a lot more genotyping done if it only cost a penny for the Taq." Olson adds that he is hopeful that if Roche does wind up losing its hold on the Taq patents, this will encourage other companies to enter the market and bring down the cost. "That would be very welcome for us," agrees James Weber, a geneticist whose lab conducts approximately 6 million genotypes a year at the Marshfield Medical Research Foundation in Wisconsin. Weber says that about 8% of his research budget currently goes to paying for Taq. "If we could reduce the cost of Taq, we could produce more genotypes per year. No doubt."

–ROBERT F. SERVICE

ScienceScope

Cuts Coming? Japan's attempts to rein in a budget deficit could crimp spending on science. Last week an advisory council to new Prime Minister Junichiro Koizumi recommended a "large-scale reduction" in funding for public corporations, which include several major science agencies.

The main targets of the cuts are the bodies that run Japan's toll roads and airports. But the budget ax may also fall on RIKEN, the country's largest collection of research labs; the Japan Atomic Energy Research Institute, which leads the nation's efforts on the International Thermonuclear Experimental Reactor project; and the National Space Development Agency (NASDA), which leads Japan's contribution to the international space station and other space activities (such as satellite launch, above). The overall goal is a 20% cut in the $44 billion allotted to public corporations, according to media reports. A NASDA official says that the space agency will "probably be affected, but we just don't know how."

German Reforms Advance Germany's federal cabinet has approved research minister Edelgard Bulmahn's controversial plan to create "junior professorships" and pay professors based on merit rather than seniority. But more than 3700 professors are fighting the reform plan, which also faces opposition in the German parliament.

The 30 May cabinet approval paves the way for likely approval by Germany's lower house of parliament, the Bundestag, this fall. But opponents in the Bundesrat, the upper house composed of the governors of Germany's 16 states, say the plan could impose hefty costs on the states, which bear primary responsibility for universities. Although Bulmahn's plan would provide $170 million between 2002 and 2005 to subsidize new "junior professor" slots, critics contend that it will force cash-strapped states to reduce student enrollments to free up funds for salaries.

Bulmahn isn't backing down. She says the reforms—which also would phase out the nation's archaic Habilitation post-Ph.D. requirement for professorships—are an important step toward "significantly modernizing the higher education landscape."

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