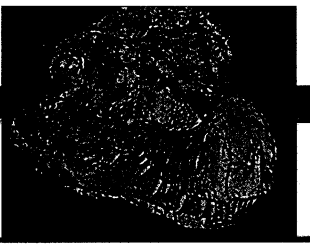
The trials of the clone rangers

Digital dinosaur dissection



Stress and Eastern Europe's coronary crisis

ton, members of the Lunar Soil Characterization Consortium reported that micrometeorite impacts and the solar wind cause reddening, at least for the only rock exposed to space weathering that they could get their hands on—lunar "soils" returned by Apollo astronauts. Microscopist Lindsay Keller of MVA Inc. in Norcross, Georgia, and consortium colleagues showed how specks of iron less than 10 nanometers in size revealed by transmission electron spectroscopy account for most of the mysterious lunar reddening. "We've identified the culprit behind the space-weathering effect," said Keller.

On the moon, according to the picture developed by the members of the consortium, micrometeorites and the charged particles of the solar wind release the iron of rock particles. It is reduced to the metallic state and deposited as "nanophase iron" on soil particle surfaces. Planetary scientist Bruce Hapke of the University of Pittsburgh told the LPSC that, according to his calculations, the solar wind alone can create enough nanophase iron to redden asteroids. "His model and the lunar soil results fit together perfectly," says planetary scientist Carlé Pieters of Brown University and the consortium. "S asteroids fit with what you'd expect for a space-weathered ordinary chondrite." Meteoriticist Harry McSween of the University of Tennessee, Knoxville, agrees. "I thought space weathering was a rather bizarre idea when I first heard it," he says, "but I can't see any way around it now. It's exciting that NEAR Shoemaker is orbiting a body that is like the most common type of meteorite that falls to Earth."

–RICHARD A. KERR

PLANT GENETICS

From Genome to Functional Genomics

Plant scientists are an impatient lot. They are about to complete the first genetic sequence of a flowering plant, a wild mustard called *Arabidopsis thaliana*. But even before the last A's, C's, G's, and T's are deposited in GenBank, a group of plant scientists has hatched an ambitious plan for the next phase: figuring out the function of all 25,000 genes. Announced last week, the plan, which has the blessing of the National Science Foundation (NSF), came with another bit of good news for the *Arabidopsis* community: the unexpected release of a set of molecular markers for finding those genes.

The 130-million-base-pair *Arabidopsis* genome is expected to be fully sequenced in July and published by year's end, 3 years ahead of schedule. Already, information gleaned from decoding this simple plant—the equivalent of the lab mouse—has made "a quantitative change" in research, says Carnegie Institution plant scientist Chris Somerville, whittling the time for isolating genes from years to weeks and thus speeding genetic discoveries ranging from more healthful soybean oil to a protein that may lead to faster growing crops.

All in one. Biologists want to probe the functions of all 25,000 *Arabidopsis* genes.

Not content to rest on their laurels, *Arabidopsis* experts now want to determine what proteins are expressed by every single gene, each protein's job within the cell, and their biochemistry—a task that could take 10 years and cost $500 million. The 2010 Project, as it's called, was fleshed out at a January workshop at the Salk Institute for Biological Studies in La Jolla, California; it was recently released on the Web (www.arabidopsis.org/workshop1.html) and is also summarized in this month's issue of *Plant Physiology*. Proponents say the multinational project will shed light on a host of questions—from how gene expression in any species is influenced by environment to the minimum number of genes needed to make a plant.

The group's ultimate goal is to create a "virtual plant" on the Internet, where scientists can click on an *Arabidopsis* cell at any stage of development, from seed to seed-dropping adult, and see every protein being expressed and the connections among them. However, plan co-author Joe Ecker of the University of Pennsylvania in Philadelphia cautions that the 2010 Project will take them only partway there; for now, they will settle for knowing what all the individual proteins do.

That alone is an enormous job. The 2010 Project will first support "genome technology centers" that will supply the necessary tools, such as DNA chips for studying gene expression, libraries of cloned genes, and knockout strains. The project is likely to draw on the talents of labs already gearing up to do high-throughput functional genomics of the nematode *C. elegans*, fruit fly, and human. Firmly behind the proposal, NSF has asked for $25 million for the 2010 Project for fiscal year 2001, an amount that Ecker hopes will grow or be supplemented by other agencies.

Also last week Cereon Genomics LLC, a subsidiary of Pharmacia Corp., released a set of more than 39,000 SNPs, or single-nucleotide polymorphisms, gene hunters' new favorite tool (www.arabidopsis.org/cereon/index.html). Until now, only about 400 SNPs have been publicly available for *Arabidopsis*. "It's a huge number if you consider the genome size," says David Meinke, an *Arabidopsis* researcher at Oklahoma State University in Stillwater—enough to isolate nearly all the genes. What's more, says Somerville, Cereon is releasing the SNPs with virtually "no strings," as academic and nonprofit users are free to patent discoveries made with these SNPs. With that and a major functional genomics project in the works, *Arabidopsis* researchers are clearly on a roll.

–JOCELYN KAISER

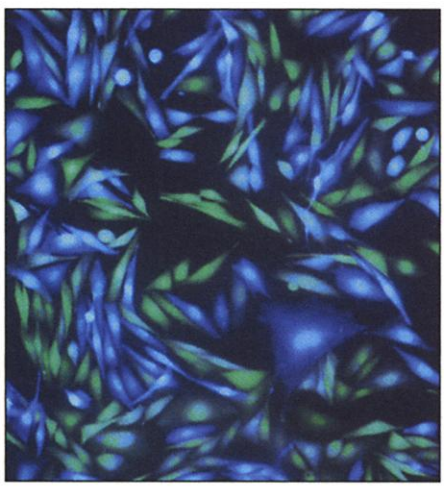
BIOTECHNOLOGY

Disease Group Invests In Do-It-Yourself Drugs

Chafing at the slow pace of commercial drug development, a disease advocacy group set out last week to finance new medicines for its constituency. On 31 May, the Cystic Fibrosis (CF) Foundation of Bethesda, Maryland, announced that it will invest at least $30 million in a small biotech firm, Aurora Biosciences of San Diego, to identify compounds that might prove useful in treating CF. This project, fueled initially by a donation of $20 million from the Bill and Melinda Gates Foundation, marks a new departure in the growing trend of patient groups taking charge of biomedical research.

CREDIT: DEVERE PATTON

The plan calls for Aurora to screen several hundred thousand molecules in its library over the next 5 years and identify two or three that might be candidate drugs for CF. If this approach yields some promising "hits," the CF Foundation plans to pay Aurora an additional $16.9 million to prepare the candidates for clinical trials. Carrying the drugs through to final approval, however, would require coinvestment by a major pharmaceutical company. Profits would be shared among the CF Foundation and its business partners, but the foundation would immediately plow all of its own royalties directly back into research on new therapies.



Quest. Aurora will use its blue-green fluorescent technology to screen for candidate CF drugs.

CF Foundation president Robert Beall thinks this new "virtual drug company," a hybrid profit-nonprofit venture, is unique in the pharmaceutical industry. His group decided to take the plunge into drug R&D because it didn't want to wait for manufacturers of small-molecule drugs to take an interest in CF. A decade ago when the CF gene was discovered, researchers hoped new drugs would follow close behind. The discovery yielded a wealth of information about what goes amiss in the disease, but translating those insights into therapies has been slow. The CF Foundation is involved in at least 20 collaborative projects and is now supporting clinical trials of gene therapies, using three different types of gene transfer vectors. But this is the first time it has tried to lead the discovery process itself.

Big drug companies have not been drawn to the field, Beall notes, because the number of CF patients who might buy a drug is relatively small—only about 30,000 in the United States. And he says that "when we tried to get them involved" in searching for interesting new compounds, "they didn't return our calls." So the foundation hired a consultant to vet innovative small firms; they quickly settled on Aurora. The company maintains a library of 400,000 small molecules that can be screened at high speed for medical applications. Aurora is a particularly good fit for the CF Foundation, says Beall, because it specializes in assaying proteins that permeate the cell membrane, based on a proprietary blue versus green fluorescence test developed by Roger Tsien and colleagues of the University of California, San Diego (*Science*, 2 January 1998, p. 84). CF is a disease in which chloride flow through the cell membrane is restricted.

Aurora will use cells from CF patients to test whether compounds help restore normal ion channel function, says Paul Negulescu, vice president for discovery biology. "We provide the discovery engine," he says, "and [the CF Foundation] provides an extensive and sophisticated [drug] development network." The foundation manages a clinical trial network based at eight centers around the country, coordinated by a team at the Children's Hospital of Seattle. This approach, Negulescu says, could serve as the model for "a new type of drug-discovery process" for other orphan diseases, including those that primarily affect poor nations.

Francis Collins, director of the National Human Genome Research Institute and co-discoverer of the CF gene, says "this roll-up-your sleeves partnership" between a disease advocacy group and a drug discovery company is novel. "The CF Foundation is taking an interesting step: This obviously has a high risk, but could also have a high payoff if it works." By providing early support for the discovery of new drugs, Collins says, the foundation assures that the disease "will get more attention and more cutting-edge approaches than it would otherwise."

–ELIOT MARSHALL

BIOMECHANICS

Geckos Climb by the Hairs of Their Toes

The Tokay gecko is the envy of every serious rock climber and Spiderman wannabe. This tropical lizard defies gravity, running up walls and upside down across ceilings as readily as across floors. It can hang from one toe pad—that's akin to holding oneself in midair by one fingertip. And that pad sticks to walls even in a vacuum and underwater. *Gecko gecko*'s secret: rows of tiny hairs with multiple split ends on the bottom of each pad, says Kellar Autumn, a biomechanist at Lewis and Clark College in Portland, Oregon.

While he was a postdoctoral fellow in Robert Full's lab at the University of California, Berkeley, Autumn figured out how these tiny hairs—each no taller and much more slender than the period at the end of this sentence—can be so strong. Armed with that knowledge, Autumn, Full, and

ScienceScope

Muzzled Watchdog The Indian government has stripped its Atomic Energy Regulatory Board of its role in overseeing the safety of the nation's nuclear weapons program, a move that critics fear will aggravate problems at deteriorating weapons facilities. The action, taken in April but revealed last week, will allow the Bhabha Atomic Research Center (BARC) in Mumbai, the nation's leading weapons lab, to create its own safety panel.

The shift leaves weaponeers free to set weak safety standards, critics say. "In one stroke, the safety assurance and regulation of the mostly old and dilapidated BARC facilities have been made the responsibility of those who are managing these installations," A. Gopalakrishnan, the former head of the board, told the Indian press. But R. Chidambaram (below), chair of the Atomic Energy Commission, says that India is merely following the lead of other nuclear powers in separating regulation of civilian and military plants.

Edwin Lyman of the nonprofit Nuclear Control Institute in Washington, D.C., disputes that claim: "Actually, the trend in the U.S. is in the other direction," with weapons labs coming under increasing scrutiny. He sees the Indian decision as a misstep: "I can only expect things to deteriorate under the new system."

Biocomputing Burst A push to get the National Institutes of Health (NIH) to fund more computing research is gaining ground. The agency this week announced a $10 million initiative to develop National Programs of Excellence in Biomedical Computing that will nurture a new generation of byte-savvy biologists.

Last year, an NIH advisory panel called for creating up to 20 such centers at U.S. universities to encourage cooperation between cyberscientists and biologists and create better software and networks for manipulating the mushrooming biological data sets (*Science*, 11 June 1999, p. 1742). The new program will take a first step toward that goal by providing funds for universities to sketch out their vision of a biocomputing center and try out some pilot projects.

Contributors: Pallava Bagla and David Malakoff

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