strict consent procedures for whole-body specimens, he maintains that "consent is not important for body parts." Others find this view unacceptable. The Nuffield Council on Bioethics has spent years drawing up standards and ethical requirements aimed at plugging such loopholes, explains Thomas, after the revelation that in the 1990s some British hospitals had taken body parts from dead infants without consent (*Science*, 6 December 2002, p. 1867). "Von Hagens's posturing indicates that he takes the view that he is exempt from observing these requirements or standards."

Von Hagens will also have to overcome legal hurdles if he is to exhibit in the United States. The city of Munich asked him to show signed donor contracts for his plastinated cadavers, but he refused on grounds of privacy and the request was eventually dropped. But in the United States, says Wade, the Uniform Anatomical Gift Act can be used to force him to do so. And even if he does show that he has obtained informed consent, states' anatomy boards will have to give him the go-ahead based on their judgement of his intentions, says Lynn Romrell, chair of the anatomy board in Florida that blocked Von Hagens in 1998. "We decided that his intentions were not educational," says Romrell, and it will be up to Von Hagens to convince the anatomy boards in other states.

In spite of these barriers, Von Hagens says that his plans to conquer the United States in 2004 are "definite," although he is keeping his intended dates and venues under wraps. An American tour is bound to be controversial, says Wade, because "this country doesn't believe that anyone's death should be used for someone else's profit." But then again, Von Hagens is no stranger to controversy. He thrives on it. **–JOHN BOHANNON**

John Bohannon is a writer based in Paris. With reporting by Ding Yimin and Xiong Lei of *China Features* in Beijing.

Solar Physics

# A Space Weather Aerie in the Caucasus?

**The enterprising director of a cosmic ray observatory in Armenia is hoping to launch a global network of ground stations that would complement space-based forecasting**

If you're in Armenia and want to catch some solar rays, try scaling the southern peak of Mount Aragats. There, 3200 meters up, an observatory run by the Cosmic Ray Division (CRD) of the Yerevan Physics Institute casts an unblinking eye on our star. Now the Soviet-era holdover is spearheading a bold new venture: a worldwide alert service that would warn of devastating solar storms approximately half an hour before their radiation blasts strike Earth's atmosphere.

During crests in its 11-year activity cycle, the sun occasionally unleashes a violent flare often accompanied by a billion-ton burst of plasma known as a coronal mass ejection. Such solar storms have knocked out several satellites in the past 2 decades and brought down Quebec's power grid in March 1989, and they could threaten astronauts by disrupting onboard instruments or walloping them with radiation.

To forecast space weather, scientists monitor the stream of ionized particles from the sun using Earth-orbiting satellites and two spacecraft—NASA's Advanced Composition Explorer (ACE) and the Solar and Heliospheric Observatory (SOHO), a joint NASA–European Space Agency mission—that pirouette in a part of our solar system where the gravitational fields of Earth and the sun roughly cancel each other out. ACE and SOHO pick up the deluge of particles that can wreak havoc on satellites and power grids.

But many experts argue that it is risky to rely solely on satellites to flag oncoming solar storms. For one, congressional appropriators are threatening the U.S.'s premier space weather forecasting service—the National Oceanic and Atmospheric Administration's Space Environment Center (SEC), a satellite-based alert and research unit—with a 40% cut to its proposed $8.3 million budget in 2004. And the space-based sensors themselves are not fail-safe, as the recent drama surrounding SOHO demonstrated (*Science*, 4 July, p. 31).

An alert system on terra firma could provide a safety net in case spaceborne sensors were to falter. "That's a valid paradigm," says Joseph Kunches, chief of SEC's space weather operations division. In a proposal to the International Science and Technology Center (ISTC), a Moscow-based outfit that funds nonproliferation activities across the former Soviet Union, CRD director Ashot Chilingarian has outlined a novel ground-based network that would rely on the detection of high-energy particles that pelt Earth roughly 30 minutes before the brunt of a solar storm arrives. "It's a fascinating project that promises to have critical applications," says physicist Alex Chao of the Stanford Linear Accelerator Center in Menlo Park, California.

With a unique combination of detectors and homespun analytical software, Chilingarian's team thinks it can spot the high-energy vanguard of an oncoming solar storm reliably enough to allow operators to take precautions such as flicking electronic switches to safe mode. In its ISTC proposal, now being vetted by the U.S. Department of State, CRD aims to construct a pair of prototypes of detectors that could be deployed at stations around the world. Chilingarian has launched negotiations with space weather centers in Greece, Israel, Russia, the United States, and elsewhere

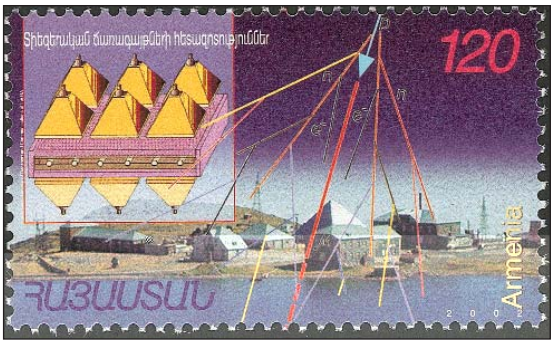
**Solar flair.** Ashot Chilingarian hopes to secure his center's future by launching a space weather alert service.

**Where the sun doesn't shine.** In winter, underground tunnels are often the only way for technician Tigran Yepiscoposian and others to move between buildings.

CREDITS: (TOP TO BOTTOM) MKHITAR KHACHATRIAN/COURTESY OF THE SUPPORT COMMITTEE FOR ARMENIA'S COSMIC RAY DIVISION; CRD

to form a network for global coverage. "He's young, aggressive, and energetic. I think he can succeed," says Yasushi Muraki of the Solar-Terrestrial Environment Laboratory at Nagoya University in Japan.

A child of the Soviet atom bomb program, CRD was founded in 1943 by two Armenian brothers, physicists Abraham and Artem Alikhanian. There were higher mountains in the Soviet Union, but Aragats was near a major city, Yerevan, and far from the war's frontlines. Before the advent of massive particle accelerators, cosmic rays were the best source of high-energy particles, and the Alikhanian brothers were "clever enough to see a connection between cosmic ray research and the theoretical research of the atomic bomb project," says Chilingarian. Although data gathered at Aragats don't appear to have helped in the development of the Soviet atom bomb, he says, the nuclear connection allowed Artem to build an impressive cosmic ray observatory. When it came to money, the sky was the limit.




**National pride.** Armenia marked CRD's 60th anniversary this year with a postage stamp.

By 1993, when Chilingarian was handed CRD's reins, state funding had all but evaporated. It's hard enough doing science at the summit: In winter, average snow depth tops 1.5 meters, and scientists are forced to scuttle from building to building through tunnels without going outdoors for days on end. Compounding their woes, their instruments were rapidly becoming antiquated. Chilingarian began a campaign to link up with other cosmic ray facilities. Drawing on his talents as a software engineer, he authored a neural network program that several multicenter collaborations use for data analysis.

Chilingarian's latest innovation is a system linking more sensitive solar monitors with fast electronics and Global Positioning System receivers to forecast potential hazards of violent solar storms. The idea for meshing data from ground-based detectors to sound an alarm came in the 1990s from someone Chilingarian calls "a giant in the field": Lev Dorman, head of Israel's Cosmic Ray Center in Tel Aviv and a senior figure at the Institute of Terrestrial Magnetism, Ionosphere, and Radiowave Propagation in Troitsk, Russia.

Chilingarian's epiphany—that Dorman's concept was feasible—came on the heels of a nasty solar storm on 14 July 2000. The Aragats detectors, near the summit and at Nor Amberd station 1200 meters down the mountain, tracked fluxes in all three classes of secondary particles produced when protons and ions from the sun impinge on the atmosphere: charged particles (electrons, protons, pions, and low-energy muons), neutrons, and high-energy muons. After the data suggested that high-energy particles could serve as a harbinger of an ill solar wind, Chilingarian says, "we decided to build our monitoring system." Although "there are several unknowns" in the relation between high- and low-energy particles, notes astronomer Vahe Petrosian of Stanford University, "none appear to be insurmountable." Such an alert service, adds Hartmut Gemmeke, head of electronics and data processing at the Forschungszentrum Karlsruhe in Germany, would "provide a necessary source for reliable and easily accessible data." He predicts that it will take 3 to 5 years to gather enough data to see if the system will pan out.

"If successful," says Chao, "this method could save satellites, power grids, and other items of interest." Charged particles overload electrical systems with extra current, initiating fake commands, altering memory files, and burning silicon chips. Turning off electronics means that the particles "pass through silicon without any consequences," Chilingarian explains. And most important to CRD, success as a space weather sentinel would make its services indispensable. That could prove to be the center's salvation as it struggles, in the economic wilderness of the Caucasus, to keep its finger on the solar pulse.

–RICHARD STONE

Genomics

# Sequencers Examine Priorities

**Now that genomes can be decoded quickly, researchers are debating how to choose which organisms to sequence next**

The most conspicuous feature of a recent gene-sequencing meeting in Virginia might have been what was absent: There was no verbal venom between once-cutthroat competitors. Instead, the Whitehead Institute's Eric Lander and former Celera president J. Craig Venter, their race to sequence the human genome behind them, calmly chatted away. Walking by the pair, Edward Rubin, director of the Department of Energy's (DOE's) Joint Genome Institute in Walnut Creek, California, did a double take. "Instead of shooting at each other, they're pointing their cannons in the same direction," says Rubin.

The invitation-only, closed-door gathering on 21 and 22 July marked a turning point in the world of gene sequencing. There, officials from the National Human Genome Research Institute (NHGRI) in Bethesda, Maryland, estimated that in the best-case scenario, over the next 4 years U.S. sequencing centers would generate a staggering 460 billion bases, the equivalent of 22 mammalian genomes. But with all the "obvious" organisms—including the human, the mouse, and the rat—now sequenced, or nearly so, the genetics community and NHGRI, its principal funder, are weighing how to proceed. The country's three massive sequencing centers, fearful of becoming mere factories churning out base after base, are lobbying to preserve influence in choosing which organisms to sequence and analyzing the genetic data they produce. Scientists who mobilized around beloved animals, from the honeybee to the chicken, and won them a spot in the sequencing queue are now wondering what they will target next.

The 30 to 40 prominent researchers who attended the meeting, many of whom commented with surprise on its collegiality, agreed that sequencing should now be driven by biological unknowns rather than popularity contests. "We should turn to using sequencing capacity to answer scientific questions that are of seminal importance," wrote Princeton University President Shirley Tilghman in an e-mail message. And if that means sequencing an organism "that by biologists' standard is obscure," she added, "so be it."

Many participants believe that today's system for prioritizing organisms doesn't capture the most pressing scientific questions. They suggested adding a new layer of four committees to the review process to divvy up sequencing proposals according to scientific goals, such as clarifying evolution or helping shed light on the human genome. Each committee, in turn, would make funding recommendations to an existing NHGRI grant review panel.

CREDIT: ARMENIAN POSTAL SERVICE