what proportion of the captive panda population will be used for IVF tests, but his assistant, He Guangxin, director of the Chengdu Zoo, states that the team won't begin working with live pandas "until after we have perfected our skills on some less precious animals."

The IVF project has already been endorsed by a scientific review panel reporting to planning officials in Chengdu, and it is being reviewed by the State Planning Commission, which oversees all large science and technology projects. Although municipal governments provide much of the support for captive pandas—the Beijing Zoo, for example, spends $75,000 a year caring for its 15 pandas—the Ministry of Construction is responsible for captive breeding programs on a national level. Zhao Qingguo, a ministry official, says zoos remind visitors of the importance of protecting pandas and other precious animals in addition to offering a refuge for species nearing extinction and an opportunity for reseachers. "The natural reserves, which are usually inaccessible to ordinary visitors, won't produce such a striking and appealing effect," he says.

At the same time, the government plans to spend $7.2 million over 10 years to improve 13 existing panda reserves, create 14 more—mostly in Sichuan—and build 17 corridors of bamboo groves between reserves. It is part of an effort, begun in 1992, that is seeking $30 million in foreign contributions. "We hold that pandas should live in the wild rather than captivity," says Zhou Zhihua, a staff member of the Protect Giant Panda Office of the Department of Wildlife and Forest Plant Protection within the Ministry of Forestry. "Zoos should only serve as a supplement."

But Zhou admits that the international community has been less generous than Chinese officials had hoped. "Our biggest problem is funding," she says. To date, China has received a total of $2.3 million from South Korea and Japan for a 10-year loan of giant pandas to those countries. Reflecting the delicate balance between captive breeding and conservation efforts, each ministry was allotted $1.03 million, with the remainder going to the pandas' home zoos.

Given the symbolic importance of the panda, the debate in China is being followed closely by scientists and conservationists throughout the world. "Whatever they do, the whole world will be watching," says virologist Stephen O'Brien of the U.S. National Cancer Institute, who has worked with Pan and Lu and been closely involved in international conservation efforts. "That's just the way it is with pandas."

–Zhou Meiyue

Zhou Meiyue is a reporter for China Features *in Beijing.*

AFTER THE BREAKUP

Civil War Leaves Once-Proud Georgian Science in Tatters

TBILISI—The problems confronting the scientific communities of the 15 new nations created by the breakup of the Soviet Union are depressingly familiar: an all-powerful academy, reluctant to give up control over funding; overstaffed institutes full of aging equipment; and shattered economies that can no longer afford a bloated scientific enterprise. But in the southern republic of Georgia, it is hard to imagine how any science survives at all. Shortly after declaring independence in 1991, Georgia was plunged into almost 2 years of civil war. Although the conflict is now restricted to the breakaway republic of Abkhazia in northwestern Georgia, this country of 5 million people is exhausted—its gross national product is $350 per person, on a par with Mozambique. And not surprisingly, Georgian science, which once boasted a strong math community and a productive suite of optical telescopes (see box), is in crisis.

Once nourished by bountiful Soviet coffers, many of Georgia's scientific institutes are now as lifeless as the dark traffic lights in electricity-starved Tbilisi. Yet the Georgian Academy of Sciences has resisted cutting the 10,000-person staff in its 50 institutes, despite receiving a budget last year of just $2.5 million—$250 per person to pay for everything from salary to electricity bills.

R. STONE

Glorious past. Once-thriving academy has 10,000 staff members in 50 institutes.

"There are too many scientists in Georgia," says physicist Tamar Khulordova, director of the International Science Foundation's (ISF's) Georgia office. "They are all poor, hungry, and cold." With the economic situation showing no signs of improving, the academy may have to act soon. "The time for reform has arrived," says Peter Mamradze, first deputy to Georgia's State Minister.

At stake are the few healthy research teams that have sustained themselves on Western grants, such as those from the ISF, the fund set up by U.S. financier George Soros, and the European Union's INTAS program. But many of these grants are expiring this year, leaving top scientists high and dry.

Physicist Tamaz Butkhuzi argues that without fundamental reform, science in Georgia cannot survive. Butkhuzi spent 15 years at Moscow's Lebedev Institute of Physics before coming to Tbilisi State University (TSU) in 1992 to launch a research program on semiconductors. He returned because Georgia lacked this field and because, he says, "I love my native land." Butkhuzi, however, returned in the middle of the civil war. The streets were dangerous, and workers plundered their own labs. For instance, says Butkhuzi, in 1992 a TSU employee destroyed a $20,000 transformer to pilfer $100 worth of copper wire.

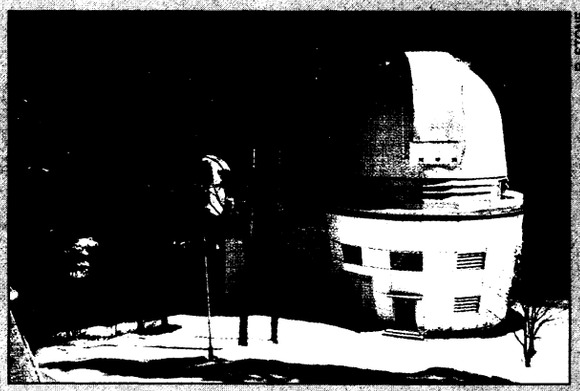
Intercity travel was not only dangerous but prohibitively expensive. "We could not get gasoline to go on collecting trips," says Gia Nakhutsrishvili, director of the Institute of Botany. Tamaz Agladze, head of the Georgian Technical University's electrochemical engineering department, pressed ahead with a planned international electrochemistry conference in Tbilisi in 1991, but only 30 people came, including a few scientists from Germany and Hungary. Those who turned up experienced real wartime science. "We had discussions even as machine guns fired in the streets," says Agladze.

These days, Georgian scientists don't have to worry about bullets, but they do have to worry about money. The state pays a nominal salary, roughly $15 a month, which is between 5% and 10% of salaries in Soviet days. In Nakhutsrishvili's botany institute, he says, only the five groups with ISF grants and a handful of other scientists—about 30 of the institute's 200 staff members—are "working really hard." Libraries lack the money to subscribe to most journals.

Observatory Fades Away in Splendid Isolation

ABASTUMANI, GEORGIA—In 1994, astronomers around the world prepared themselves for the grandest event in planetary science in decades—comet Shoemaker-Levy 9's fiery impact with Jupiter. But their colleagues at the Abastumani Observatory in southwestern Georgia nearly missed the show altogether. This was not because of cloudy skies or equipment failure, but because electricity is in such short supply in the region. Astronomers here did, however, manage to scrape together enough money to buy two extra hours of electricity to view the event.

Like many other scientific institutions in Georgia (see main text), Abastumani—the former Soviet Union's first mountaintop observatory—is fighting for survival. During the winter months, with just 4 hours of electricity a day, room temperatures approach freezing and Abastumani's scientists analyze old data in front of gas stoves in their apartments. Telescopes and support equipment are turned on only for maintenance. The staff members "are heroes for working under such conditions," says observatory director Jumber Lominadze, who is based in the capital, Tbilisi.



R. STONE

Out in the cold. Abastumani observatory, which did pioneering studies of the Crab Nebula, is now barely functioning.

The observatory today is a pale reminder of its post–World War II heyday, when astronomers did pioneering studies on the Crab Nebula and, with an array of telescopes that includes a 40-centimeter refractor and a 70-centimeter meniscus telescope, discovered more than a dozen supernovas. Following the breakup of the Soviet Union and the Georgian civil war, the observatory's decline was swift. Its 1995 budget of $30,000 had to cover a 180-person staff and escalating operating costs. The budget is expected to increase fourfold this year, Lominadze says, but such a jump will only pay for salaries and utilities.

Lominadze faces a formidable task in keeping the observatory going. Since becoming director in 1992, he has tried to strengthen ties with Western scientists. He held an international plasma astrophysics workshop here the same year, but for the last 2 years he has been unable to persuade Western scientists to visit Abastumani. The observatory has almost no money to upgrade its equipment. It did get a shot in the arm last May, when it received the first installment of a 2-year grant from the Russian State Committee of Science for a collaboration between Georgia, Kazakhstan, Russia, Ukraine, and Uzbekistan to study optical relativistic objects. In addition, the observatory has received grants from the International Science Foundation, the European Union's INTAS program, and the European Southern Observatory. Such grants have helped the astronomers buy computers, charge-coupled device detectors, and other equipment.

Lominadze hopes Western interest will pick up—especially in the summer and fall, when the weather is pleasant and Georgia's hydroelectric plants have sufficiently high water levels to provide constant power. He and his deputies are even considering launching a tourism business to raise money. "Astrotourism may be our only way out," says astrophysicist and deputy director George Melikidze. Nevertheless, Lominadze recognizes that, like most directors of Georgian laboratories, he will have to cut the observatory's payroll if Abastumani is to have any hope of surviving.

Few of Abastumani's aging staff—only six people are under 35 years old—are willing to leave on their own. Perched atop 1700-meter Mount Kanobili, the observatory and the surrounding resort region are a tranquil retreat from Tbilisi, and many of the scientists have lived and worked in the area for decades. "The winters may be extremely hard now," says astronomer Victor Japiashvili, a veteran of 50 years at Abastumani, "but I still prefer to stay."

–R.S.

"There is no possibility to see all the necessary literature—we are in complete isolation," says TSU mathematician Khvedri Inassaridze.

Part of the problem, according to many researchers interviewed by *Science*, is that having been suddenly cut off from Soviet science, Georgia lacks its own scientific identity. "Traditionally, the strong fundamental science has been in Moscow," says Agladze. "The academy must develop basic research," says Giorgi Kharadze, director of the Institute of Physics.

But scientists also realize that they must help rebuild the country and shore up applied research that fits Georgia's industrial strengths. The Institute of Physics is negotiating with Danish concerns to establish a wind farm in the Caucasus Mountains capable of generating several hundred megawatts of power. And Agladze's institute is trying to persuade several German firms to invest $40 million in a plant to process the country's rich deposits of manganese ore. "The only possibility to escape from our situation is to get money from industry," Agladze says. Indeed, the government has given institutes free rein to explore such ties. "They say, 'Go and do what you like, but just don't sell any government property,' " says botanist Tamaz Gamkrelidze.

Most researchers now acknowledge, however, that survival will require some bloodletting. "We have to reduce the number of scientists drastically," says Mamradze. Last year, the International Monetary Fund recommended that Georgia ax 60% of its 400,000 public-sector jobs, which include scientists. "Most applied scientists," Mamradze says, "need to find jobs in industry." The academy did order institutes to cut 25% of their staff, but many positions eliminated had already been vacated by emigrants or former scientists.

Patience with the academy is running thin, and it is looking increasingly likely that the government will have to force the issue. "Academy reform will be much discussed by all relevant government structures this year," says Mamradze. "We have to understand that the old life is finished forever." Presidium member Jumber Lominadze, director of the Abastumani observatory, says the academy has reached a crossroads and must be reorganized. However, he says, scientists must be aware of the costs: "In my opinion it would be better to cut. But we have a big problem: People have to eat. What would they do if they weren't employed?"

–Richard Stone