MONGOLIA

Science Hopes to Rebound In Post–Cold War Era

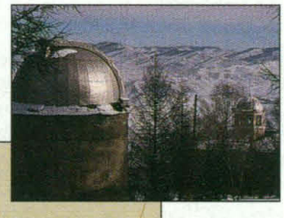
Newly democratic, Mongolia hopes Western links will help it to overcome its isolation and regain its scientific prowess

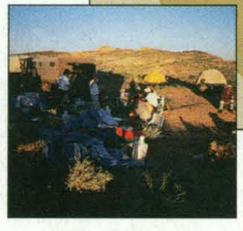
ULAAN BAATAR, MONGOLIA—A decade ago, this vast, isolated, and rugged country boasted a surprisingly strong research enterprise with 100 research institutes, 3000 researchers, and an annual influx of scientists from other parts of the East Bloc. "Our expertise and capacity was very high," says B. Chadraa, president of the Mongolian Academy of Sciences and a Moscow-trained physicist. "We worked closely with Russia and [East] Germany." Mongolia's geography helped: The Soviets built a series of seismological stations to monitor nuclear tests across the border in China, and they funded operations at a hilltop of telescopes to observe U.S. spy satellites through Mongolia's clear skies. In addition, the dinosaur graveyards of the Gobi desert were a big draw for paleontologists.

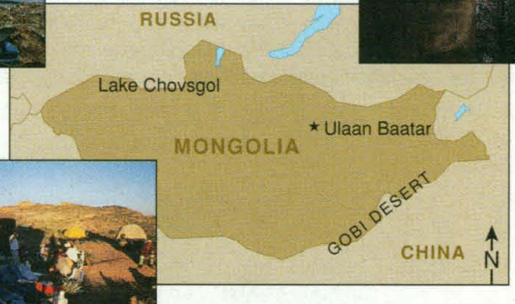
But in 1991 Russia withdrew hundreds of thousands of its troops, and the generous subsidies for outside university education and research work disappeared. Today, the telescopes are shuttered by a lack of money for photographic plates, and the seismic stations are silent. So officials in this new democracy are looking West for help in building on modest initiatives in seismology and higher education and leveraging Mongolia's natural assets. Those efforts, the country's researchers note proudly, reach back 700 years, when Mongol emperor Kublai Khan organized the first international academy of sciences in Beijing.

But creating those links won't be easy for a country that largely banned Westerners for half a century. "The situation was very difficult," says Bazaryn Bekhtur, director of the Institute of Astronomy and Geophysics, sitting in the traditional round nomadic tent called a ger still favored by Mongolians. Bekhtur was visiting a group of Canadian astronomers camped out on a vast plain 50 miles south of the capital to monitor last fall's Leonid meteor shower. "We tried to set up some cooperation with Western countries," he says, "but they had no good information on Mongolian science and technology. And we had no good information on them." Communications were limited because the second language for most Mongolian researchers is Russian or German, not English.

The government reacted to the crisis caused by the abrupt loss of Soviet support by reducing the number of scientific institutes to 20, with 11 devoted to basic research in the physical, biological, and social sciences. And while government spending on science and technology has held fairly steady at almost $3 million since 1991, the end of Soviet subsidies for oil and other essentials has triggered an inflationary spiral that has eaten heavily into purchasing power. "There is enough money to keep current programs going, but not for anything new," says Chadraa. At least one-third of Mongolian researchers have abandoned science since the end of the Soviet era, he estimates. "The good people are leaving to go into business and politics," says Bekhtur mournfully.







Natural advantages. Mongolia hopes a bank of telescopes outside the capital, the fossil-rich Gobi desert, and a pristine Lake Chovsgol will lure more Western scientists.

Bekhtur's mountaintop institute, on the outskirts of the capital, once was a beehive of activity. Soviet intelligence services came for a firsthand look at U.S. spy satellites and clues to their intended targets, while scientists conducted regular astronomical research. Today, Bekhtur's annual budget of about $75,000 has been only partially appropriated, and its bank of 10 telescopes, along with a large building for classrooms and offices, is largely empty. Astronomer Bayaraa Togookhuu waits in vain for Western scientists to show interest in a finely crafted 20-inch Schmidt telescope once used for variable star research. "A few thousand dollars is all that is needed to upgrade it," says Martin Connors, an astronomer at Athabasca University in northern Alberta, Canada, who recently inspected the Schmidt telescope. The site's clear and dry air, its altitude and location on the opposite side of the globe from North America, and its political stability make it "potentially a good place for astronomy," adds Bill Chang, who handles Mongolian-related research at the U.S. National Science Foundation (NSF).

The outlook appears slightly brighter for Mongolian geologists and geophysicists. The Comprehensive Test Ban Treaty Organization in Vienna wants to place five seismic stations across Mongolia to keep a watch out for rogue nuclear tests. Chadraa says the $1.6 million contract, still under negotiation, would provide the ability to detect any atmospheric explosions and to measure for airborne radioactivity. Although the stations are designed for minimal maintenance, meaning few jobs for Mongolian scientists, Chadraa hopes they will lead to increased contacts between Mongolian and Western researchers.

Another possibility for greater contact is further exploration of the country's recent seismic history. "There have been several earthquakes in the last 50 years near magnitude 8," says Jack Medlin, head of the Asian and Pacific geology section for the U.S. Geological Survey (USGS), which has sponsored four expeditions. The pattern of inner-continental quakes resembles activity in the U.S. midsection, and Mongolian fault lines are often exposed rather than buried under layers of rock.

USGS also is working with Mongolia and several other Asian nations to analyze the continent's mineral deposits. The next step, says Medlin, would be for Mongolia to conduct its own mineral assessment and environmental survey, at a cost of several million dollars. A USGS team will return to Ulaan Baatar in late spring to discuss the plan, which would require outside funding. In the meantime, a number of U.S. scientists have received NSF money to work with their Mongolian counterparts on everything from dinosaur fossils and grassland ecology to the pristine depths of Lake Chovsgol. A proposal from the Mongolian government to set aside vast tracts of land for conservation purposes could provide additional research opportunities.

Such cooperative efforts can only do so

CREDITS: (CLOCKWISE FROM LEFT) R. M. PECK/VIREO; M. CONNORS/ATHABASCA UNIVERSITY; AMERICAN MUSEUM OF NATURAL HISTORY

much to improve the country's science, however. In the long term, Mongolian administrators acknowledge that a better educated population will be essential. And that means supplementing the country's only major university. So in 1997 Chadraa converted a former Russian high-rise building into a campus, called the Ulaan Baatar University, that is run by the University of Colorado, Denver (UCD). The unusual arrangement, which UCD pioneered in Moscow and Beijing, gives the 60 Mongolian students now enrolled a chance to learn English, earn a U.S. degree, and apply for study in Denver or other U.S. universities. The academy and its U.S. partner share the cost of the $4000 annual tuition. In addition, the Mongolian government subsidizes 30 graduate students at Denver and at other U.S. universities.

Chadraa, who also holds the position of university rector, acknowledges that the UCD relationship is a gamble. "It's hard for us—the textbooks, the tuition are very expensive, and we have spent a lot of money developing this." But such a connection is a vital step toward raising a new generation of English-speaking researchers. For their part, UCD officials see the arrangement, which they hope will at least break even, as an opportunity to expand their presence in Asia.

Mongolia's efforts to build a peaceful democratic society and create a market economy win praise from foreigners, who contrast it with the chaos enveloping other parts of the former Soviet Bloc. Nevertheless, day-to-day life remains bleak. "Mongolia is a small country, and there is little support for science," says one Mongolian researcher, noting that "science is at the bottom of the list" of programs funded by the country's Ministry of Enlightenment, which supports education, culture, and science. That is the harsh reality in a nation of few roads, schools, and exports, and whose airline is hard pressed to pay for maintenance on its single Airbus jet. But Mongolian researchers are betting they can extend the country's history of international contacts to bolster its scientific prowess.

–ANDREW LAWLER

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MEETING AMERICAN ASTRONOMICAL SOCIETY

New Clues to the Habits of Heavyweights

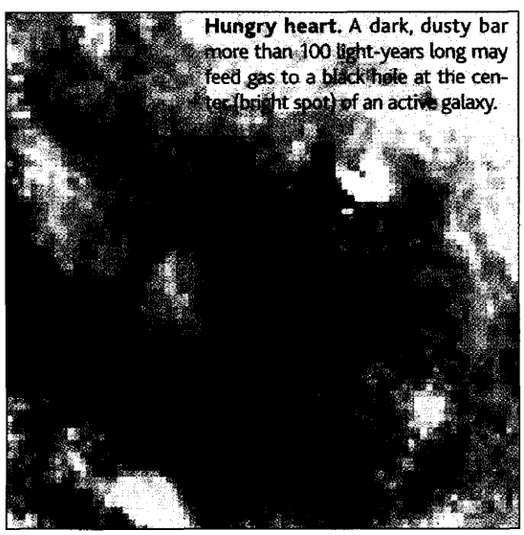
AUSTIN, TEXAS—People who go to extremes often make the news, and the same goes for outlandish celestial objects: neutron stars and black holes. At the astronomy meeting here, clues to two mysteries emerged: how black holes fuel themselves and how some newborn neutron stars hide from view.

A Black Hole's Feeding Tube

What feeds the cosmic manic-depressives called Seyfert galaxies? When these flickering galaxies are at their brightest, a tiny region at their core can outshine the entire Milky Way. Astrophysicists have theorized that a bar of gas, perhaps 100 light-years across, forms and acts as a "feeding tube" to squirt material into a central black hole, where the material gives off one last "Geronimo!" of brilliant electromagnetic radiation before vanishing into the gravitational maw. Eventually the bar disappears and gas settles more slowly to the center of the galaxy, which ceases its hyperkinetic ways and gives off a merely ordinary glow.

Until the American Astronomical Society meeting, however, no such bar had ever been reported. At the meeting, a team led by Almudena Alonso-Herrero of the University of Arizona, Tucson, and Roberto Maiolino of the Osservatorio di Arcetri in Florence, Italy, announced that they had used the Hubble Space Telescope (HST) and other instruments to pick out a small bar and trace the motion of its gas, which appears to be streaming toward the center of a Seyfert galaxy in full throat. "It could be that this is catching [a black hole] in the actual act of fueling," says Michael Regan, an astronomer at the Carnegie Institution of Washington.

If so, the implications could go beyond Seyfert galaxies, because other so-called "active" galaxies—such as the much more brilliant quasars—may work in a similar way. Astronomers doubt that the full picture of how black holes are fed has emerged just yet, but Maiolino points out that Seyferts, with properties midway between ordinary galaxies and quasars, are good places to test the physics of the feeding. And Seyferts like the one his team studied, called Circinus, are much closer than quasars, making them easier to study. At a distance of 10 million light-years, Circinus "is a next-door neighbor compared to quasars," says Maiolino.



Hungry heart. A dark, dusty bar more than 100 light-years long may feed gas to a black hole at the center (bright spot) of an active galaxy.

CREDIT: J. HESTER AND P. SCOWEN/ARIZONA STATE UNIVERSITY/NASA

Theories say that gas bars could form spontaneously, when gravity amplifies slight ripples in the disk of a galaxy. As gravity pulls in more and more gas, it would smash together in the bar, forming shock waves that could brake the spinning motion that the gas shares with the galaxy as a whole. No longer in the grip of centrifugal force, the material would quickly drain along the bar toward the black hole, like a roulette ball falling to the center of the wheel after it loses its spin. The final acceleration of the material around and into the black hole would throw off photons and produce the Seyfert galaxy's radiation, from an area the size of the solar system.

Ground-based telescopes can't resolve the fine detail needed to see such a bar at the center of another galaxy, so the team turned to the HST, working in infrared wavelengths that can penetrate dust at galactic centers. When the team took a close look at Circinus, one of the nearest Seyferts, the bar popped out of the HST images. Alonso-Herrero says that once they knew exactly where to look, they were then able to use data from the 3.9-meter Anglo-Australian Telescope in Australia to estimate the gas velocities from slight shifts in the wavelengths of the light that emerged.

"We were really amazed at how the observations resemble" the theory, says Alonso-Herrero. "It does appear to be forcing gas into the middle, in the way that models predict," says Andrew Wilson, an astrophysicist at the University of Maryland, College Park, who visited the team's poster presentation here.

But not every Seyfert may dine the same way. In a poster right next to Alonso-