Press Releases

Meet the People Shaping the Future of Science
On a Cosmic Shoestring

By Fred Pearce, New Scientist magazine, January 19, 2002

Prof. Chilingaryan, Head of Armenia's Cosmic Ray Division
Photo by Joerg Heimann

What's it like to be a top scientist in a country without a science policy? Ashot Chilingarian should know. He runs a cosmic ray observatory at the top of Mount Aragats in Armenia, a leftover from the cold war. It is the leading laboratory of its kind in the world, and our best chance of getting reliable early warnings of severe solar radiation storms that can cause billions of dollars' worth of damage to satellites, telecoms and power systems. At this time of year it takes him a 10-hour ride through the snow in an old Soviet bulldozer to get there, and each time he prays the storms haven't blown the roof off. He could work in the West for many times his Armenian salary. Fred Pearce asks him why he stays

What are the big differences between working under the Soviet system and today?

In Soviet times, much of our work was secret. I couldn't send papers to Western journals, or participate in international conferences. International collaboration only occurred under the strict supervision of bureaucrats from Moscow. So we were ignored. But I did have as much money as I wanted to do my work. Our institute's budget was many times what it is today. We did well because we used to be part of a big Soviet ministry where military science was concentrated. Fifty years ago, when the observatory was set up, cosmic ray research was seen as part of the theoretical basis for the Soviet atomic bomb project. Particle physics was then mostly done with cosmic rays. Later, we investigated the hazards from cosmic rays to the electronics on military missiles. Today, Armenia is independent and that is all gone. There is not even a science policy in Armenia. Basically, I have nobody to report to. I can collaborate with whomever I choose, send PhD students to international conferences and start whatever projects I like. I have total freedom--if I can find the money.

How have you kept going? Where does your funding come from?

Our overall budget for this observatory is only $200 000 a year--that's for a

total staff of 100, including 40 scientists. In the West it would cost a hundred times more to do what we do, because of higher salaries and so on. About a sixth of our budget is supposed to come from the Armenian government. But for the past two years it has not been meeting its obligations. It doesn't even pay the electricity bill. We scientists haven't been paid a salary by them since last April. So our strategy is to build an international reputation, through collaborations and scientific networks, to attract international funds. Two-thirds of our money now comes from scientific institutions abroad, half of that in grants from the International Science and Technology Centre in Moscow, set up to provide peaceful employment for ex-Soviet weapons and radiation scientists. We got money from NATO to establish Internet links. The rest comes from the Armenian diaspora. We have some good friends among Armenians in the US, who help us.

Armenia was seen as the science centre of the Soviet Union, for physics especially. Has that all gone?

Yes, and you can understand why. The average government salary for scientists is only $30 a month, though here we pay an extra $100 a month from our international funds. Because of this many scientists and students are leaving Armenia. They can earn a hundred times their state salary by going abroad. In any case, many of Armenia's best facilities have been shut down. The Yerevan particle accelerator, in its day one of the biggest in the world, has been in operation for only a month out of the past nine years because there is no money to run it. In the 1980s, we had plans to install gamma-ray telescopes here on Mount Aragats. But after the collapse of the Soviet Union, the two scientists involved moved the project to the Canary Islands, where they have got German and Spanish funding.

Has your standard of living deteriorated?

Not much today. I have what I need. But things were very bad between 1991 and 1993, after independence, when almost everything stopped in Armenia. We had no electricity or heating most of the time, and there was no water in my family's apartment on the 15th floor. I had to go and fetch water from the street several times a day. There was no lift and no light in the corridors and it was terribly difficult to climb the icy steps.

Do you come from a scientific family?

My father, Agassi, was director of Armenia's Institute of Zoology. I have worked as a physicist in Armenia for 30 years, with short periods at CERN, and in Moscow, Dublin and Karlsruhe. I became head of the cosmic ray observatory in 1993. My son graduates in mathematics from Moscow State University this summer. He is only interested in computers and helps maintain our server here. I hope I can persuade him to work in Armenia.

Does the observatory have a future?

Yes. One of our main future commercial activities is going to be forecasting solar radiation storms, when unpredictable fluxes of protons and electrons cross the Solar System and reach the Earth. They can cripple satellites and endanger astronauts. The world is depending more and more on satellites for telecommunications, GPS navigation, weather forecasts and so on. If these

were knocked out it would be a global disaster. It could black out the cellphone networks, for instance. Solar storms also set off geomagnetic storms in the Earth's atmosphere that can bring down power grids. Remember the famous disaster in Quebec in 1989, when a solar storm knocked out electrical transformers? The province had no electricity for 10 hours in freezing temperatures. We are at a time of historically low activity from this space weather. We know from examining 500 years of ice cores drilled from the Antarctic that the 19th century saw much more intense solar activity. And the signs are that activity is now rising again in the 21st century. Satellites are not equipped to cope with this, so there is real danger.

But surely NASA satellites already do forecasts? What can you offer?

NASA can announce when the storms arrive, but it cannot give accurate early warnings or predict how severe they will be. We think we can do that. NASA uses detectors aboard a satellite in space. They can directly measure the low-energy solar particles that do the damage. But on the ground we can use a much larger array of detectors, covering hundreds of square metres, to measure the much smaller fluxes of high-energy particles that come ahead of them. These high-energy particles reach the Earth from the Sun in as little as 10 minutes. That can provide between 30 and 60 minutes' warning of the most dangerous radiation from solar storms--enough time for astronauts to abandon their space walks and for satellites to shut down sensitive equipment. We believe that by correlating the space and ground-based observations in real time, we can provide the first reliable instant forecasts via the Internet.

What equipment do you use for this?

We use neutron monitors that we have had since Soviet times, plus a muon telescope and a solar scintillation telescope. If we detect abrupt increases, our software will start to analyse the data and if necessary issue a formal alert via the Internet. We have been running a test service since earlier this year, but we are planning additional detectors and improved data handling and software. We just reached a period of maximum solar activity and over the next three to four years there is a high risk of severe storms. Of course we cannot watch solar activity 24 hours a day from here. But we hope to set up an alert system with other cosmic ray centres in Switzerland, Bolivia, Tibet and Japan to do that. It will be the best in the world.

This could be a lucrative business . . .

We think the forecast and alert system could become a major commercial activity for us. We want commercial contracts to provide a service to telecommunications companies and others. I can say that our service, when it is fully functioning, will be the only accurate service that can forecast the hazard of--in particular--very severe radiation storms. Such storms are expected to be very rare--there have been three in the past 50 years, in 1956, 1972 and 1989. But the consequences can be very serious. We think we can help save billions of dollars by issuing warnings, allowing satellites to switch off their electronics before a severe storm.

What other research do you do?

With German collaborators, we are trying to discover the origins of cosmic

rays. We are analysing the energy spectra of different nuclei in cosmic rays to see whether they come from supernova explosions--the most powerful known explosions in the Universe. We are also looking at the physical mechanisms behind solar flares, which could help improve our forecasts. And we are working with the Huntsman Cancer Institute at the University of Utah to see whether statistical software developed for cosmic ray physics can be used to isolate how gene clusters are expressed in cancerous tissue.

You are on top of the highest mountain in Armenia. The height must make it good for capturing cosmic rays, but it must make life rather inconvenient . . .

Yes. It is lovely in summer, but the winters are long. Even though we are at the same latitude as Naples, we are at 3200 metres and it gets very cold up here, averaging -15 °C in winter and going down to -40 °C at night. The roads are not cleared of snow as they were in Soviet times. We can only reach the station once every three weeks, using very old Soviet bulldozers. We have tunnels between the buildings so we don't have to go outside. But it is the winds that are most dangerous. I am afraid the roof on our main laboratory may blow off this winter. It has not been repaired for a long time. Over New Year the electricity line blew down and we had no power to operate the equipment.

What will you do if it does blow off?

Oh, that's easy. We'll go and get it back again. We don't have another. The physical structure of our buildings is actually our biggest problem. We get money from abroad for equipment and scientific personnel, but nobody wants to pay for basic infrastructure. The government should do that, but I'm sure we will not get money from them in the future. We are trying to raise money from the Armenian diaspora in the US to repair our buildings. We would like to make money from tourists using rooms here in summer. It is a lovely spot, 3200 metres up on the shore of Lake Kari with the summit of Mount Aragats behind. There is good walking. But first we have to repair the rooms.

It sounds daunting. Why do you stay?

I like the mountains. But also, whatever the problems, I can do my science here. And I don't want to stop cosmic ray research in Armenia. We have done really good work here, and we will do so again.