Interview: Academician Erik Galimov

Vernadsky Institute Probes Earth, Oceans, and Space

In his final book, left unedited before his death in 1945, The Chemical Structure of the Earth's Biosphere and Its Surroundings, *Russian/Ukrainian scientist Vladimir Vernadsky examined the cosmic dimensions of the formation of the Earth's biosphere. Before there was the technology available for the* in situ *study of the Earth's neighborhood, Vernadsky proposed that only by situating the development of the Earth and its biosphere in the context of the development of the cosmos, could we understand our home planet.*

Academician Erik Galimov is the director of the Vernadsky Institute of Geochemistry and Analytical Chemistry in Moscow, which was created by Vernadsky and named for him after his death. Academician Galimov sits on the Presidium of the Russian Academy of Sciences, and has directed the Institute since 1992. He is also the vice president of the International Association of Geochemistry and Cosmochemistry, and Chairman of the Committee on Meteorites. He is a member of the Advisory Commission of the Academy of Sciences on the Cosmos, and editor of the journal Geokhimia.

Academician Galimov was interviewed by EIR*'s Technology Editor, Marsha Freeman, in Beijing, China, on July 26, during the 8th conference of the International Lunar Exploration Working Group. At that conference, Galimov presented the Institute's controversial theory of the origin and creation of the Moon. Further coverage of that conference will appear in* EIR.

EIR: Can you describe the history of the Vernadsky Institute, and some of the areas of research that its scientists have been involved in?

Galimov: The Institute was founded as a chemical laboratory, and was first located in Petersburg. Then, during the Second World War, it was shifted to Moscow. In the beginning of 1945, Vernadsky died, and he was succeeded, in his leadership of the laboratory, by his student, A.P. Vinogradov.

After the war, you remember the situation—there was an atomic project, and for this project, the plutonium for weapons had to be very pure. It was important to do very accurate and sensitive analytical work with plutonium to make sure it would be good enough to be used. When people involved with the atomic program looked around to see who could do this work, they discovered that the best ones were in the biogeochemical laboratory, which had nothing to do before with such things as weapons. The laboratory had made very good measurements on the composition of marine entities.

In fact, the United States had published the thick volume of work by Vinogradov, entitled, *The Chemical Composition of Marine Organisms.* It is probably the best volume of data, with very high precision; that was why the biogeochemical lab was invited to do this work. It was successful work, and the lab provided what was needed, with good accuracy and reliable results. After that, it was transformed into the Institute for Geochemistry and Analytical Chemistry. It was under the Academy of Sciences from the beginning. Work on the atomic project was done between 1945-1949. In 1949, the Russian atomic bomb was successfully tested. It was not the end of this work, but was the end of this phase in which the laboratory was involved.

EIR: What work followed that, for the atomic bomb project?

Galimov: The next phase was related to space research. That is why I am here at this conference!

Academician Vinogradov, who was director of the Institute, thought about global geochemistry, and if you are thinking about planetary geochemistry, you unavoidably come to the conclusion that you should compare this planet with other planets, and with the Moon. When rocket facilities were being developed, Vinogradov was one of the leading scientists in Russia who suggested that missiles, which were designed for military purposes, should be used for launching [the first Earth satellite] Sputnik, and then for research of the Moon. Vinogradov was the first to propose this.

The first launch of a Soviet lunar mission was in 1959. It was not quite successful because it flew by the Moon, but the next one delivered some man-made equipment to the Moon's surface. Then, we flew a spacecraft, for the first time, to the far side of the Moon, which mankind had never seen before. Our Institute was involved in this work.

The first lunar samples were delivered by our automatic spacecraft. (These were unmanned; Apollo was a manned mission.) We had robotic missions—Luna 16, Luna 20, Luna 24—and those missions collected samples from the Moon's surface and delivered them to Earth. In fact, to the present time, these samples are deposited and preserved in a special laboratory in our Institute.

We were involved in almost all of the planetary missions. The next was to Venus, where data were collected by the spacecraft Venera 1-16; the same for Mars. We have many institutions related to space research.

EIR: What is the Vernadsky Institue's relationship to IKI, the well-known Institute for Space Research?

Galimov: We have one institute that designs and produces spacecraft frames, and that is Lavochkin. Another produces rockets, which is Khrunichev. And the Institute for Space Research—IKI—mainly deals with the engineering systems for spacecraft, such as its orientation to the stars, and service systems. They do the communications and control systems, and develop some of the scientific instruments, but not that many.

We design the instruments and do the analysis and data interpretation. IKI has no interpretation system. This is completely our part.

EIR: What other areas of research is the Institute involved in?

Galimov: Of course, our Institute does analytical chemistry. From the beginning, we were involved in the analysis of the chemistry of radioactive elements. This goes back to the atomic project.

EIR: Actually, I believe it goes back further, to the beginnings of the study of radioactivity that Vernadsky himself was involved in.

Galimov: Of course, but we have a big laboratory with remote manipulators, to deal with very high levels of radioactivity, with transuranic elements [those having an atomic number greater than 92 (uranium)], and it is much more serious work.

More recently, we applied this work for ecological control, to study radiation after Chernobyl [the 1986 nuclear accident in Ukraine]. We have teams that collect samples and measure the radioactivity, to predict safety, and recovery work.

Moreover, we have an oceanographic ship, which is also part of our Institute. One of our recent projects was a study of the radiological situation in the Arctic Sea, measuring the levels of cesium, strontium, and plutonium. Why?

The Kara Sea is part of the Arctic Ocean, along the coast of northern Russia, where many of the atomic, thermonuclear tests took place, in Novaya Zemlya. It is not a secret that our North Fleet contained many atomic submarines. You had to do something with the radioactive waste, and when the time came, the atomic reactors were buried there. We had a big icebreaker with several nuclear reactors in it, which was also buried in this area.

Another former "secret" is that there are two big rivers, the Ob and the Yenesei in Siberia, that flow into the Kara Sea. Both rivers, on their banks, have factories that deal with plutonium. If something happened, an accident, radioactive pollution would go through the rivers, to the Kara Sea, and then to the Arctic Ocean.

G. Makarov

The Vernadsky Institute monitored radiological levels in the Arctic Sea, measuring levels of cesium, strontium, and plutonium, because spent reactors of nuclear submarines and an icebreaker were buried there, said Galimov. Here, an atomic icebreaker.

The public and the whole world were interested in the radioactive situation there, because if we pollute the Kara Sea, the circulation of water would quickly spread the radioactivity to other places—to Canada, the U.S.A., Alaska, etc. We were the first to very carefully measure the radioactive situation in this region. We asked the authorities to invite our foreign colleagues to participate in our expeditions, and we gave them the opportunity to collect samples and make measurements themselves.

EIR: What did you find?

Galimov: We found that there is nothing special, from the standpoint of radioactive safety. The radioactivity in this area is no higher than some other places. There is some difference in very specific places, but the [integrity of the buried reactors] is still preserved, and there is no leakage. Now, the area is open for testing for everybody.

Our ship is mostly used for geochemical and geological study. You probably know the *Glomar Challenger?* It is a deep-sea drilling project [operating from 1968 to 1983]. I participated in an expedition on it in 1976. There is now a new American ship, which I've also sailed on, called *JOIDES Resolution* [Joint Oceanographic Institutions for Deep Earth Sampling].

EIR: It seems that the Institute has successfully extended Vernadsky's work on the biogeochemistry of the Earth, to the oceans and to space.

Galimov: Vernadsky was the first to propose the necessity, that if you want to know the Earth, you should go to space, because you cannot come to any conclusions if you cannot compare. With only one investigation, it is difficult to make conclusive arguments. This is "comparative planetology." That is the term he coined.

EIR: As the world is developing economically, it will become important to look to the world's oceans for new sources of minerals and raw materials. Does your ocean research include the mapping of such resources?

Galimov: Of course, planetary geochemistry also involves investigations of oil and gas and other materials. But our Institute is for fundamental research, so we don't deal directly with any applications. Of course, we are also interested in the resources aspect, for manganese, for iron concretions. We study hydrothermal activity in the ocean, not with an accent to explore for possible resources, but more to make a model of those resources which are fossilized, to understand the geochemical situation in which these ores can be formed.

The same for oil and gas. We try to understand how petroleum originated. Which environment is most favorable for this? What organic matter is involved? We study organic sediments as a starting point for these processes, which eventually led to the formation of petroleum.

For exmple, our relationship to the petroleum industry is in organic geochemistry. We are not an applied institution, which is bad, because we have no money! We completely depend upon the government. If there is a difficult situation, it is difficult for us.

EIR: At this lunar conference, you presented a paper challenging the currently held theory that the Moon originated from a large impact hitting the Earth, which spewed material into orbit, condensing at some point to form the Moon. It is not often that scientists have the courage to challenge theories that have become "popular."

Galimov: You understand very well what happens in science. I think that this model that now exists as a paradigm—the giant impact model—suffers from many, many shortcomings, and I tried to show some. But what about our model? Our suggestion is that there was a cloud of particles at the beginning of the Solar System. At first, when the Sun formed, there were a lot of particles surrounding it. A gravitational instability formed the particles into small clouds, and the clouds connected together, and grew. Finally, there was an appreciable amount of particles which collapsed.

At first, the collapse into bodies was not efficient, as the solar wind was blowing gas from the interior part of the Solar System. Why is Jupiter so big? Because hydrogen and volatiles were blown out to the periphery. The gas never collapsed, forming the outer planets, but the inner part of the forming Solar System was mostly particles, not gas, and the particles did collapse.

As the particles collapsed, energy was released, and the particles become heated, and evaporated. The evaporation is a very important part of our model. The material that became the Earth and Moon separated into two fragments.

EIR: So you are proposing that they both formed at the same time?

Galimov: Yes, from the same material. Because when something becomes smaller, but with a rotation, the rate of rotation increases, and pieces can separate. Previous scientists had calculated that that is impossible, so this possibility for formation was forgotten. One of our ideas that is really new, is that—I repeat—when the moment of inertia is preserved, and the rate of rotation becomes faster, there can be a separation, due to centrifugal force.

Scientists had calculated that this rotation moment is not enough to separate the Moon and the Earth. There had earlier been an hypothesis of separation, but it had been shown to be mathematically impossible. But we came back to this hypothesis, because we undestand that these particles evaporate, and when the particles evaporate, they produce an additional force that works against gravitation, and this made possible the separation. We calculated our results, and I have a simulation, and you can see how the two fragments form.

We try to also see what the chemical composition of the Moon and Earth would be, and found a very satisfactory coincidence. We looked at what happened to the siderphile elements, which are like iron. In the giant impact model, these data are completely discordant. In our model, it is OK.

Isotope analysis is very important, and it indicates that the Moon and Earth come from the exactly the same, common source. In the giant impact theory, most of the material that makes up the Moon would have to come from some unknown impactor, which would not have come from our zone of the Solar System, but somehwere else, because it would have to hit at an angle. So it's very strange that the composition of the impact would be the same as the Earth.

Many aspects become completely understandable this way.

EIR: How many scientists are working at the Institute, on this broad array of scientific investigations?

Galimov: We have more than 600 scientists today. It was even bigger—we had 1,200, but there was a very hard period, when we lost some people. It is still a very robust Institute.