

Academician Oleg G. Gazenko:

Tribute to a Legendary Scientist and Wonderful Man

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Academician Oleg G. Gazenko was a titan in the field of space biology and the physiology and adaptation of humans to extreme environments. A legendary scientist, manager and leader, his career spans the earliest breaths of Earth organisms in space to the record-setting times of Russian cosmonauts in space stations.

A student of Vernadsky who understood the importance of living in space, Dr. Gazenko supported the development of closed ecological systems and bioregenerative space life support research in Russia. He also facilitated the cooperation of Russian space scientists with the Biosphere 2 project and served during the first two year closure experiment as a member of its Scientific Advisory Committee.

Oleg was also a man of philosophical depth and great humor. I recall sitting on a panel in Moscow with him in 1987 on the 30th anniversary of Sputnik, the first satellite to orbit the Earth, when he observed that humans had no difficulty in adapting to microgravity, their only difficulty was in dealing with the stress of returning to Earth's gravity. There is the story of a Russian cosmonaut who had just returned to Earth after setting the then record, six months, for living in space. Lying on his back, an admirer placed a bouquet of flowers on his chest. Un-readapted to Earth's gravity after his months in near zero gravity, he reported the flowers felt like a crushing weight (!). Oleg also noted that the human form changed in space – people elongate, gaining 2-3 inches (5-7.5 cm), the fluids rise in their body, changing their facial features. Oleg compared cosmonauts to figures from Modigliani paintings, and mused that our sense of beauty will alter as we adapt to living in space. When a Russian member of the audience rose to indignantly ask if we didn't owe a debt to our species, Homo sapiens, who after all were paying the costs of space exploration – Oleg simply smiled and replied, perhaps we will evolve into new species as we explore space.

Like countless others whom he touched in his long and illustrious life, I grew to love him as a friend, as well as to admire him as an implacable scientific investigator and visionary and as the gold standard of a truly cultured person and real human being, [a true “*mensch*”].

I first met Oleg in 1985 in the restaurant of the Metropol restaurant in Moscow in the early days of glasnost. John Allen, the inventor of Biosphere 2, had suggested I stop in Moscow enroute to my ecological work in Australia to make contact with the Russians in the fields of biospherics and space life support. Armed with a few names and precious phone numbers (the Moscow phone directory seemed to be a state secret). The list included Academician Gazenko's name. He came with a colleague, Acad. Anatoly Grigoriev, Gazenko's chosen successor, who led the famed State Research Center, the Institute of Biomedical Problems after Oleg's retirement, and his long-time translator, Dr. Leonid Zhurnya, who also was to become a close friend over the following decades. It was typically astute management of a difficult situation by Oleg – rather than inform me that without a month's notice and the signatures of a dozen “specialists in international relations” it would be impossible for me, an unchecked out Westerner to gain access to his Institute. So Oleg suggested a more casual and friendly meeting over caviar and vodka at the hotel where I was staying.

I told Oleg about our plans for Biosphere 2, the first English translation of selections from Vernadsky's Biosphere, and our ecotechnic demonstration projects, while he checked me out. He took my hand as we sat down – and held it for the next couple of hours until our meeting was over. Was this a traditional Russian custom of which I was unaware? Was it to check if I really drove tractors and did farm work at our ecotechnic project in outback Australia – yes, he could feel the calluses and toughness of my hand. Was it a subtle psychological test to see how I reacted? Perhaps. Or because he is a warm and empathetic human being, to whom I formed an immediate liking and kinship. Definitely. All of the above. I later learned that Oleg was for decades the unofficial confidant, psychologist and father-confessor to many teams of Salyut and Mir Space Station crews – a tribute to his psychological acumen, insight and compassion.

In due course, the “esteemed professor” whom Oleg had mysteriously said would write the foreword to the Vernadsky publication by Synergetic Press, turned out to be Dr. Yevgeny Shepelev, the first man to live in a closed ecological system. This 24 hour landmark experiment with Yevgeny living with a tank of green chlorella algae that purified and recycled his water and air, was conducted at IBMP in 1961. An astute bazaar trader, Oleg asked me, in exchange for the Vernadsky introduction, to bring a bottle of good Scotch whiskey for his international collection in his modest apartment. I was glad to oblige and to return to Moscow the following November with six of my Biosphere 2 and Institute of Ecotechnics' colleagues, including John Allen, Marie Harding, Deborah Snyder, Kathelin Gray and Robert Hahn, for a two week visit to discuss collaboration with the Russian institutes who were acknowledged leaders in the field.

When we filed into the conference room at IBMP, Oleg opened the meeting by displaying a virtual United Nations of small flags on the side cabinet and asked which he should place next to the Soviet flag. I replied that Institute of Ecotechnics was a U.K. registered institute, Biosphere 2 was a U.S. joint venture, and our members came from all-around the world, but that we were not a government institution. Oleg thought for a moment, said with a laugh that he had no pirate flag available, but would use both the U.S. and British flags. He added that he had always admired the freedom and bravery of pirates, but wondered, if we began working together, how long we would last. [In retrospect, who could have guessed that the Soviet Union itself would be history in less than five years, although IBMP continues its exemplary work as a Russian Academy of Sciences research institute?]



At the IBMP meeting in 1986, Acad. Oleg Gazenko and Mark Nelson in foreground, in the rear of the photo, John Allen (left), inventor Biosphere 2, and Yevgeny Shepelev, first man to live in a closed ecological system (right).

We had heard of a very advanced Soviet project in closed ecological systems and life support, “Bios-3”, conducted at the Institute of Biophysics in the forbidden city of Krasnoyarsk, Siberia and headed by Josef Gitelson. NASA colleagues tried to discourage me: Either: the project was fictitious, a smokescreen to make the rest of the world think the Russians were ahead, or was so top-secret that we would never gain permission to meet the scientists or see the facility.

Sure enough, a day after we enquired about Bios-3, with a theatrical flourish, Oleg summoned Josef Gitelson into the conference room where we were meeting at IBMP. He existed! And under his arm was a 30-minute Moscow TV documentary on Bios-3. Less than 3 years later, we would organize along with Oleg and Josef's Institutes the 2nd International Workshop on Biospherics and Closed Ecological Systems at Krasnoyarsk, becoming the first Western scientists to enter the city since 1919. Perestroika and glasnost was moving more rapidly than anyone could have predicted.

Another telling moment of that meeting occurred after we had enthusiastically continued our discussions after normal working hours. Oleg diplomatically pointed out that he and his colleagues were most happy to continue our conversation, but the problem was the driver of the Institute's car. The Soviet Union was a dictatorship of the proletariat, Oleg explained with a straight face (there were the usual "international relations" observer on hand in the shadows to make sure no anti-Soviet, revisionist or heretical comments were made), so the choice was either to take the chauffeured car ride back to our hotel right then, or use the Metro. We scarcely hesitated, choosing to continue the stimulating discussions and to later navigate the splendid Moscow Metro. I know we gained a few points in Oleg's estimation of how real we were by that decision.

How real and courageous our new Russian friends were, we learned as we exchanged stories. As a physiologist, pilot and a mountaineer, Dr. Gzenko knew from personal experience and experiment the problems pilots faced performing in extreme conditions. A pioneer in high-altitude medicine, he was the responsible medical doctor and expert in body fluid regulation during the flights of Yuri Gagarin and his successors. Oleg also went on four expeditions to the North Pole, the islands of the Arctic Ocean and the Karakorum desert. His institute did experiments in all sorts of extreme conditions. A typical one was placing people on floating pieces of iceberg in the Arctic and monitoring how they fared over the new few weeks. Yevgeny Shepelev pulled me out of a meeting once to have a smoke outside and share an educational experience. With a mischievous smile, he recounted how he left his pioneering 24-hour experiment to the cheers of his fellow workers at IBMP. On an impulse, a few minutes later, he quietly went back to the chamber and re-entered, almost gagging at the smells of the internal atmosphere. The green algae had regenerated the carbon dioxide he exhaled, turning it into oxygen. But it was less successful in cleaning up the myriad of trace gases that accumulate in a closed system – and which gave it a foul odor. But like the lobster in the slowly warming pot, he had habituated to it during his stay and could no longer smell it. It was an excellent warning as we prepared for the challenges we'd face in Biosphere 2. Another story which others at

IBMP told us, was that Yevgeny was a volunteer in an experiment in deliberate dehydration in a hot desert region – and succeeded in being the last one remaining after days with a carefully measured but inadequate amount of drinking water.. But Yevgeny had complained when the experiment was finally terminated because the medical doctors were concerned for his long-term health. He wanted to go on, to find out how much dehydration a person could survive! Ganna Meleshka told us of a 30-day closure experiment at IBMP in the years following Yevgeny's closure, in such confined conditions that the test subjects could only stand or sit down – there wasn't room to fully stretch out. [When we asked how they had endured this, she laconically replied that it wasn't a problem; the volunteers were good Party members].

In addition to meeting the great pioneers in biospherics and life support at IBMP (e.g., Shepelev, Ganna Meleshka, Vladimir Sychev) and Bios-3, and making plans for collaborative work and welcoming Russian researchers at Biosphere 2, we laid plans for international meetings in the field. Oleg said because of the Cold War, the first meeting had to be at a neutral site and a center for world science, such as London or Vienna. Since our Institute of Ecotechnics had its registered office in London and our world cultural/artistic project, the October Gallery, was right in the Bloomsbury district, close to the British Museum, London it was. This was the agreement that led to the historic first international meeting on biospherics and closed ecological systems at the Royal Society in 1987.



Royal Society, London, 1987: first conference on Biospherics and Closed Ecological Systems: at podium left, Josef Gitelson, director of Bios-3 and the Institute of Biophysics, Krasnoyarsk; seated from left: Margaret Augustine, CEO and co-designer, Biosphere 2, Ganna Meleshka, pioneer in closed systems, IBMP; Clair Folsome, University of Hawaii, created first laboratory closed ecospheres and served on Biosphere 2 Project Review Committee, Bill Knott, head of the NASA Breadboard Project, Kennedy Space Center, Florida.

Standing on right: Mark Nelson, chairing the conference, and asking question from audience: Roy Walford, UCLA Medical School and Chief Medical Officer, Biosphere 2 closure experiment, 1991-1993.

Oleg visited Biosphere 2, along with Josef Gitelson, Yevgeny Shepelev and Leonid Zhurnya while the facility was still under construction. Josef and I had presented papers at the annual Princeton, New Jersey conference sponsored by Gerard O'Neill's Space Studies Institute. Then Josef and I took the train down to Washington D.C. and meeting Oleg, Leonid and Yevgeny there who had just finished a NASA-Soviet meeting on space cooperation, we flew out to Tucson, Arizona.

Our honored guests donned hard hats to visit Biosphere 2, then a vast construction site, with stainless steel liners going in under the facility and the first glass panes of the over 6000 with 20 kilometers (12.5 miles) of seams that had to be made virtually air-tight for Biosphere 2 to function as the world's first biospheric closed ecological system.. They visited the research greenhouses where the agricultural systems to feed the biospherians were being developed and the crew trained as "subsistence farmers", and the 3000+ species of plants from around the world were being grown for the analogue wilderness areas from rainforest to desert. The term "Noosphere" is virtually unknown in the United States, but is widely known in Russian due to the work of Vernadsky and others he worked with at the Sorbonne University in Paris in the 1920s. A sphere of intelligence in which humanity learns to harmonize its actions with the global biosphere and becomes a conscious, cooperative agent of evolution – Vernadsky saw it as the next step in the evolution of the Earth's biosphere. We were touched when Josef Gitelson in his talk said his only complaint about Biosphere 2 was that the project had the wrong name; it should have been termed "Noosphere 1". Perhaps he and our other Russian intelligentsia didn't realize that in the late 1980s for Americans, even the term "biosphere" was exotic and unusual!



The Russian pioneers in the field visiting Biosphere 2. Pictured above in the research greenhouses of the Biospheric Research and Development Center at the project site in Oracle, Arizona: from left: Josef Gitelson, Oleg Gazenko, Yevgeny Shepelev and Leonid Zhurnya.:

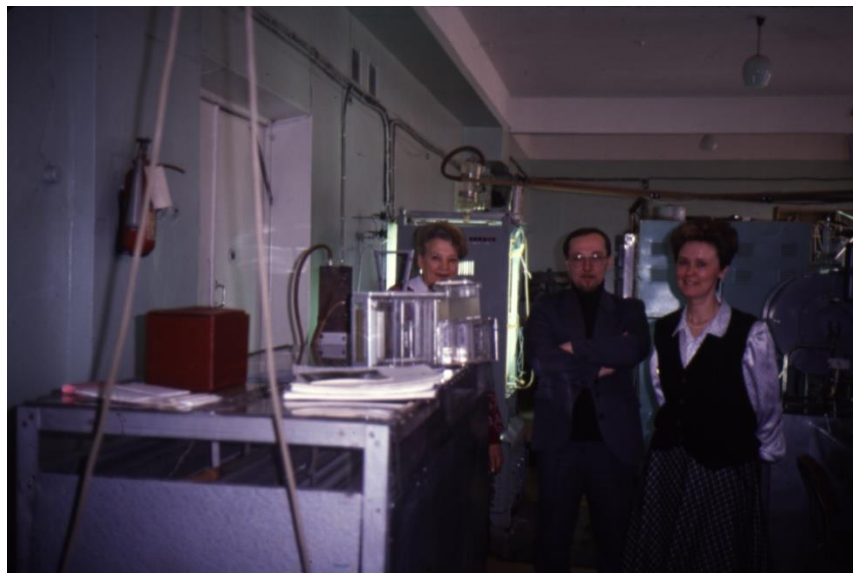


Oleg Gazenko and John Allen outside Biosphere 2 during construction, 1988.

John Allen and I were invited again to Russia in 1988 for the commemoration of the 125th anniversary of Vladimir Vernadsky's birth. It was mid-way through perestroika, and the event held successively in Leningrad, Kiev and Moscow offered mind-boggling montages of old and new Soviet realities. In Kiev for example, the program called for an event at the V.I. Lenin State Library, which by the day of the event had been renamed the V.I. Vernadsky State Library (he had been born in the Ukraine). No one mentioned the somewhat significant name change. When I asked one of the Russian scientists in attendance, he replied "there are plenty enough things named after Lenin in this country. He won't miss one library." There was also a screening of a new Russian TV documentary on Vernadsky's life. The film emphasized the independence from

ideological agendas and devotion to scientific truth that Vernadsky always showed, despite a number of students of his being purged and sent to the Siberian gulag during the Stalin years. By the time we reached Moscow for the final events at the Academy of Sciences, there was no display of typical Soviet symbols – and the celebration of Vernadsky's legacy, which included founding over a dozen Russian research institutes, become the occasion for championing the independence of science from political control.

But some things hadn't yet changed. When one of the European scientists was asked to write out his talk so the translator could see it and prepare better for the translation, the old and distinguished professor was obliged to write it out a 2nd time, because it was impossible to get permission to use a photocopier. These devices were considered a potential printing press, and like all information-disseminating devices, were kept under strict control.. Similarly, when we arrived in Moscow and contacted Oleg to see if we could come to IBMP for meetings, there was a long silence on the phone. Clearly, he didn't have the time to get all the required permission signatures to come to the Institute. This was a problem since we were in the midst of designing a collaborative small closed system experiment to fly on an upcoming Russian Bio-satellite (Bio-sputnik) space flight. After a pause, Oleg told us to be in our rooms at the Rossiya Hotel near Red Square at a specific time the next day.



Ganna Meleshka, Vladimir Sychev and Margarita Levinskih in the Laboratory of Closed Ecological Systems, IBMP. In the foreground on the table is an aquarium similar to that used in

the Biosatellite experiment collaboratively done by Biosphere 2, the University of Arizona Veterinary School and IBMP in 1989.

The next day Vladimir Sychev and Leonid Zhurnya arrived at the Rossiya with unusually bulky winter coats on, and looking a little furtive and secretive. Sure enough, as they took off their coats, underneath they had concealed the prototype aquarium and other instruments. With broad smiles, they reported: “Oleg carefully considered the problema. Even if you could not come to the Institute to see the space hardware, there was no law preventing the space hardware from coming to your hotel to visit you!” So the addition of the amphipods (small shrimp-like crustaceans) we had proposed to the mini-closed system could proceed. Oh yes, another interesting twist: there was not enough time to officially get sanction for the somewhat changed space experiment. But the IBMP scientists who had a lot of control over Biosatellite experiments would simply deliver a payload that was different from the official manifest to the launch site. This incident gave me some insight into how Academician Gazenko and his institute scientists ingeniously accomplished their research goals despite a bureaucratic system which might otherwise entangle them in endless red tape. It gave me deeper appreciation for the remarkable achievements of Academician Gazenko and the Russian intelligentsia and scientific community who were able to achieve so much during Soviet times despite the system that officially controlled their activities.

Biosphere 2 might have not been possible, and certainly would have been delayed, without the generous support and scientific experience freely offered by the veterans in the field from Oleg’s IBMP and Josef’s Institute of Biophysics. They spoke from experience and in memorable terms. There was the telegram received from Dr. Shepelev just before John Allen became the first person to do a human closure experiment in our Biosphere 2 Test Module in 1988: “Courage my friends! Remember that the human is the most unstable element in the ecosystem.” And Josef Gitelson and Nicholai Pechurkin, Associate Director of the Krasnoyarsk Institute, who reminded us (contrary to most NASA engineers who are in love with technology and fearful of living systems because they can’t “control” life like they can machines): “Remember the golden rule of closed systems: life is reliable and technology can only be relied on to break down. The only question is when it will break down!” Russian researchers came to work at Biosphere 2, sharing their knowledge and experience with problem areas like medicine and internal human microbial biodiversity, such as Lydia Somova from the Institute of Biophysics. Oleg Gazenko, as the dean

of Russian space medicine and biology, made this cooperation possible because of his support of Biosphere 2.

During our two-year closure experiment, Academician Gazenko served on the Biosphere 2 Science Advisory Committee (SAC). He and Leonid Zhurnya came to Arizona for one of its meetings in January 1993. At the time, there was great tension both inside and outside Biosphere 2, as a power struggle was underway between those for and those against developing biospheric science. In the midst of this drama, Oleg's familiarity with Soviet power politics, born from decades of experience, came to the forefront. He advised John and the other owner/managers of Biosphere 2 to keep very thorough written records to protect themselves, especially useful in experiments involving humans. Carefully observing myself and the other biospherians from the outside, Oleg was certain that our mental and physical health was excellent, despite wild rumors to the contrary. He told the SAC that in his opinion, the biospherians had adapted well to life and environmental conditions inside Biosphere 2. He reassured John and the other Biosphere 2 managers that these frictions were nothing new – that sometimes it took years for cosmonauts to fully tell him what had really happened during their months-long stays on space station missions with just one or two companions. Oleg had seen it all. I had the great pleasure of visiting with him and John by two-way radio through the Biosphere 2 windows (see photos below).



John Allen and Oleg Gazenko come to visit the author inside Biosphere 2 during the two year Mission 1 closure experiment in January, 1993. Left – the three share the “biospherians handshake” and an inter-biospheric conversation.

The Biosphere 2 2-year closure came to a successful conclusion on September 26, 1993 – and I was delighted that Oleg and Leonid were on hand to join in the celebrations and planning for Biosphere 2's future. During this period, Oleg discussed his hopes for a Russian Biosphere

project. “Biosphere 3” might be another chapter in the comparative biospheric experiments that Biosphere 2 made possible. What Oleg suggested was that unlike Biosphere 2 which was designed to be as clean and healthy as possible, with its organic, chemical-free agriculture and biomes patterned on the tropical regions of the Earth – from rainforest to mangrove to coral reef ocean. Biosphere 3, by contrast, would be a polluted world (as Oleg was very cognizant of the terrible environmental damage done). The challenge would be to find ways of cleaning it up, and making that experimentally polluted mini-world healthy again developing new bio-remediation technologies.



Outside of Biosphere 2 on “re-entry day”, September 26, 1993. From left: John Allen, Sylvia Earle, marine biologist and then head of NOAA, Robert Hahn, Director of Communications for Biosphere 2, Jane Goodall, chimpanzee researcher, Harold Morowitz, professor at George Mason University, Leonid Zhurnya and Oleg Gazenko.



Oleg Gazenko presenting me with the Yuri Gagarin Commemorative Medal for International Cooperation in Space and the Environment, October 1993 at Biosphere 2 after re-entry from first closure experiment.

In the years after Biosphere 2, we continued to work with Academician Gazenko and the Russian space community. Through Galina Nechitailo, we were able to grow out some Mir space station wheat seed (the first crop plant grown from seed to maturity in space conditions) in our “Laboratory Biosphere”, a small closed ecological system facility we built in 2000 at our Synergia Ranch ecotechnic property near Santa Fe, New Mexico. Together with Nicholai Pechurkin, I helped add to the COSPAR space science meetings a session devoted to Closed Ecological Systems and their Earth and space applications which has continued to this day. We also organized with the cooperation of Academician Gazenko a 4th international conference on Biospherics and Closed Ecological Systems which was held at the Linnean Society of London in 1996. The third meeting had been held during the 2 year closure experiment (which might be termed the first “inter-biospheric conference” since I and other biospherians participated and gave talks through video linkups from Biosphere 2). At the Linnean Society, we shared some of the most striking findings from the Biosphere 2 experiments and at the same time, Japanese researchers shared their excitement in the progress of their own facility, the Closed Ecological Experimental Facility (once called “Biosphere J”). In the hall where Darwin’s first presentation of his and Wallace’s new theory of evolution were made, all the participants keenly felt the truth

that the newer generations of scientists “stand on the shoulders of the giants who came before them”.



John Allen and Yevgeny Shepelev in London at the 4th international conference on biospherics and closed ecological systems, held at the Linnean Society, 1996.



From right: Nicholai Pechurkin, Lydia Somova of the Institute of Biophysics, Krasnoyarsk with Mark Nelson in the Linnean Society main hall under the portrait of Darwin during the 1996 conference.

Oleg and Leonid participated in the Institute of Ecotechnics' 2004 Noosphere conference at the Les Marronniers conference center in Aix-en-Provence, France. Appropriately enough, despite his concerns with the challenges facing the world and his beloved Russia, Oleg presented a visionary talk on "the contours of Noospheregenesis" and shared his unique historic perspectives on humanity's first steps into space and our adaptability and future evolution.



Speakers photo from the 2004 Institute of Ecotechnics' Noosphere conference at Les Marronniers conference center, Aix-en-Provence, France (full list of speakers and titles is available at <http://ecotechnics.edu/2004.html>). Oleg is seated 2nd from the left and Leonid is standing next to John Allen, third from the left.



Oleg Gazenko and Leonid Zhurnya speaking at the 2004 Institute of Ecotechnics' Noosphere Conference, Aix-en-Provence, France.



On the grounds of Les Marronniers, 2004: Oleg, left with Deborah Snyder, IE director and head, Synergetic Press. Standing, on left, Oleg's grandson (name?) and Leonid Zhurnya.



Mark Nelson with Oleg Gazenko in the study of his Moscow apartment, September, 2006

These have been just a few memories and one aspect of a truly remarkable human being. One whom my colleagues and I have been honored to count as a dear friend and fellow explorer. When one contemplates the storied career and accomplishments of Academician Oleg G. Gazenko in the context of his vision for the future of humanity's journey to the Noosphere and our explorations of the cosmos; one is reminded of the saying: "We do not wait for the future, we create it". Or as an ecotechnic toast goes: "Repair the past, prepare the future!". Oleg Gazenko was one of those rare men: a future-creator always in the compassionate service of life.