Studia Humana
Volume 13:2 (2024), pp. 41—45
DOI: 10.2478/sh-2024-0010

The Past and Future of High Technology

Abstract: This interview was given in 2008 by Arkady Zakrevsky (1928–2014), Corresponding Member of the National Academy of Sciences of Belarus (1972), Doctor of Technical Sciences (1967), and Professor (1969). He stood at the origins of the birth of cybernetics in the Soviet Union. He proposed the programming language for logical tasks LYaPAS, on the basis of which a series of computer-aided design systems for discrete devices was created, and methods for implementing parallel algorithms for the logical control of interacting processes. Some monographs: *LYaPAS: A Programming Language for Logic and Coding Algorithms* (N.-Y., L.: Academic Press, 1969; with M. A. Gavrilov); *Boolesche Gleichungen: Theorie, Anwendung, Algorithmen* (Berlin: VEB Verlag Technik, 1984; with Dieter Bochmann and Christian Posthoff); *Combinatorial Algorithms of Discrete Mathematics* (Tallinn: TUT Press, 2008; with Yu. Pottosin, L. Cheremisinova); *Optimization in Boolean Space* (Tallinn: TUT Press, 2009; with Yu. Pottosin, L. Cheremisinova); *Design of Logical Control Devices* (Tallinn: TUT Press, 2009; with Yu. Pottosin, L. Cheremisinova); *Combinatorial Calculations in Many-Dimensional Boolean Space* (Tallinn: TUT Press, 2012); *Solving Large Systems Logical Equations* (Tallinn: TUT Press, 2013).
Keywords: logic, computer science, Soviet Union, technological breakthrough.

Andrew Schumann: In the USSR, mathematics was very strong. Many foreign scientists studied Russian in order to read the originals. What are the reasons for such a powerful tradition?

Arkady Zakrevsky: Mathematics was more or less politically ignored, although formal logic, for example, was pursued. But in general, mathematics was relatively free, since it is difficult for the uninitiated to understand. There were good mathematicians in the USSR, quite at the level.

Andrew Schumann: Is this due to the fact that pre-revolutionary traditions have been preserved?

Arkady Zakrevsky: I cannot tell you. Something must have been preserved. Mathematics teaching was good both at school and at universities. We could even say that it was better than now.

Andrew Schumann: How can we explain the fact that mathematical schools were concentrated in the periphery — in Siberia, for example?

Arkady Zakrevsky: Tomsk has long been the centre of science in Siberia. It was there that the first Siberian university opened; its 130th anniversary was recently celebrated [*A. Sch.*: it was in 2008]. I looked at its history, and there were many people who were deported. They were not allowed to work in Moscow, and these were prominent scientists. Then, science there was well funded. The salary was one and a half times higher than in other places. I myself studied in Tomsk, then had a fellowship at Moscow State University. I can say that in Siberia there was a more working environment. There is more entertainment in Moscow, but in Siberia students came to study and had nothing else to do.

In Tomsk, there was less "roof", as they say. Usually, before entrance exams, parents fuss, somehow try to help their child, try to talk with teachers. When I arrived in Tomsk, I was amazed that there was nothing like this in the entrance exams. Applicants came from all over Siberia, but they did not bother the admissions committee. It seems to me that the enrolment was quite objective. I remember some Georgian arrived. He asked how much it cost to enrol: "For us it costs 5,000, and how much for you?" They laughed at him. I was lucky to study there.

Andrew Schumann: Was the organisation of science in Tomsk also freer?

Arkady Zakrevsky: Perhaps, yes. Philosophy was pressing — it was necessary to study the history of the party. It's quite boring; they asked us to take notes and stuff. But our philosophers were also quite free. One of our teachers then went to Moscow and became the director of the Institute of Philosophy there.

I liked that it really was a university. Not a technical one, but a university with philologists, historians, biologists, mathematicians, physicists, chemists... All the students communicated, and this helped. For example, my philologist friends advised me on what to read. They knew where some interesting article appeared. And overall, the atmosphere was good.

Andrew Schumann: Why did the development of mathematics in the country not lead to a technological breakthrough?

Arkady Zakrevsky: Management was not smart enough. This is related to the economy and the general management of the state. A good example is computing, when at a serious level a decision was made to close all research and copy IBM — technologies, machines, and so on. At the initial stage of development, Soviet computer technology was quite competitive. The same BESM (БЭСМ) series machines... There were about six companies that competed with each other in this area. Similar to how the design bureau made airplanes under Stalin. There were about eight of them. They competed, and when the war began, aviation was at the same level. And the computer technology was shut down. Arguments: we need to save money, take what has already been done. As a result, some organisations, universities, and firms closed. We jokingly called Soviet computers Stolenscope [Дралоскоп]. You can do mathematics yourself — you sit at the table and work; there is literature. And technology is impossible without support.

Andrew Schumann: What was the future fate of the people who worked in this field?

Arkady Zakrevsky: When the Research Centre for Electronic Computing (НИЦЭВТ), the organisation that managed computer technology, was created in Moscow, they recruited people, but many theorists did not go there because they did not like it. It had to be done from here to here. Like here in Minsk at Integral, people began to simply copy products. This work is also quite difficult, but unpromising. You will always be in the rear, and you will be controlled. They can plant some

information so that they themselves do not work. This is not entirely reasonable. The countries of Southeast Asia also copied, but they also did something themselves. Take Japan, Thailand. Somehow they were stimulated from above. We were not. Due to, in a sense, incompetent leadership, or maybe worse, because Western companies were interested in this.

Andrew Schumann: Can we assume bribes?

Arkady Zakrevsky: Of course, it is possible. This is a common thing, and a person is not ideal, as they say. Therefore, mathematics gives great freedom. Literature, paper... Now computers have appeared, you can study algorithms. Conduct experiments and so on. It's different with technology. I decided to do a technical thesis in Tomsk. It was dedicated to the digital correlator. This is related to signal reception, detection, recognition. There is such a concept as "process correlation", their connection. Analogue devices were made; they calculated the correlation coefficient. I became interested in this topic in my fourth year of study. The correlator is digital, like a computer. Back then, everything was done with lamps. I was studying and getting something from Moscow. I defended my diploma, and then I decided to quit because it was very difficult to get parts. You are no longer engaged in science, but in ensuring your work.

Andrew Schumann: If the USSR had the opportunity to develop independently, would the technology be of a completely different type?

Arkady Zakrevsky: This requires enthusiasts who know how to do something, and some kind of help. In computing, everything comes down to electronics, microelectronics, technology.

Andrew Schumann: Does modern Belarus have any prospects for a technical breakthrough? Or does the management of science here have the same shortcomings as in the USSR?

Arkady Zakrevsky: There are teams, and everything depends on them. When you have a good microclimate, you can do something. But everything is relative. If you compare it with Ukraine, it gets even worse there. Managers are not always competent. We are being eaten up by bureaucracy. Less time is spent getting results, and more time is spent on endless reports. The Yogācāra school of Buddhism believes that there are two logics: one for oneself, the other for others. When you use your own, the results come out faster. Explaining to someone else is tedious and very time-consuming. And if you have to explain all the time, development stops.

Andrew Schumann: Why has no theoretical logic been formed in Belarus?

Arkady Zakrevsky: I myself worked on applied problems. There is a problem, and we need to solve it. This is the main thing for me. Then you somehow justify the decision, and theoretical results appear. I like it when you are not given a topic from such and such a branch of mathematics, as is often done in term papers and dissertations, but when you delve into the problem yourself, understand it, and find methods for solving it. To do this, of course, you need to become familiar with different areas.

Andrew Schumann: This is probably how the most difficult problems are solved?

Arkady Zakrevsky: This is the right approach. This, of course, requires a somewhat broader outlook. To know where to look, what to apply. This is what the great scientists of the past did. Let's say Gauss was working on the problem of ship stability. Ships capsize when there is a strong storm. They must be designed to be stable. To explain the problem of tides, a competition was even announced. The winner did this for a whole year. We need a good mathematical theory focused on solving understandable problems. But it happens, of course, in different ways. Let's say the theory

of conic sections. When it developed in Ancient Greece, everything was quite abstract. Geometers did not deal with logistics, that is, trade mathematics. But then it turned out that the theory of conic sections is needed to explain the movement of planets and other things. Newton used them.

A lot of work is done like this: delve into some theory, but this does not translate into practice. Most work is done by analogy. There is such and such work, and we need to do a similar one. I myself sometimes liked to find a publication devoted to an interesting topic. From my point of view, it can be bad, done wrong. But this is the impetus: come up with something better.

Andrew Schumann: There are purely theoretical results that do not reach practical implementation...

Arkady Zakrevsky: Yes, a person buries himself like a mole into some problem, feels comfortable because he understands that he alone understands it. It's good if he knows where to apply it. If you don't know, interesting results are often lost. But the theory also pursues some goals.

Andrew Schumann: The lag of science in the countries of the former USSR is growing. Can we say that it will continue to intensify?

Arkady Zakrevsky: Now the situation is unfavourable. Previously, scientists from the republics interacted well and met in different places. The Baltic states — all three countries — and Georgia and Armenia participated there. There was also someone from Central Asia. Ukraine, Russia, Belarus interacted. There was a common environment. This will also develop further — where to go.

Andrew Schumann: Have these ties in the countries of the former USSR weakened now?

Arkady Zakrevsky: They have weakened somewhat, but they are there. Let's say there are good contacts with Estonia, Kharkiv, and Poland. But it's not the same as it was before. Nowadays, it's worse with conferences — it's more difficult to participate in them due to the high fees. The next conference is planned in Spain: the registration fee is 500 EUR, excluding travel and accommodation costs. We do not have the organisation that will pay for this. Recently, I travelled at the expense of the fund, and more often I made an agreement with the host party. They paid because they were interested in me. Previously, conferences of Gavrilov's School were located anywhere, and the costs were very low.

Andrew Schumann: Do electronics have any prospects at all? The gap in practical implementation will also widen.

Arkady Zakrevsky: They have been working on quantum computers for a long time, but I have no information that working ones have already appeared. It's more on a theoretical level, although there seems to be some prospects. If it works, it will be a huge leap. A friend of mine in South Korea worked for two years on such developments. Then he moved on to another topic: robots in the theatre, when they perform, they sing. An interesting direction is developing.

Andrew Schumann: Can we talk about the absence of a qualitative leap in technology?

Arkady Zakrevsky: No. I have a dacha 30 km from the city. We once dreamed of putting a telephone booth there so we could contact home. Now you are lying in bed, and before going to bed you are talking to your son, who is calling from America. This is a qualitative leap. In general, a leap is a transition to digital technology. TVs are now being switched over; telephones have been switched over a long time ago. Previously, because of the crackling noise, it was not clear what the interlocutor was saying.

Andrew Schumann: What about the development of computer technology? Quantitative indicators are growing — the amount of RAM — but it is probably impossible to talk about a real qualitative breakthrough. The technology remains within the same theoretical framework as it was 20–30 years ago.

Arkady Zakrevsky: Remember, as philosophers taught: quantity turns into quality. It really does transfer. New opportunities appear, new technologies. Some time ago, I had a typewriter — now, why do I need it? How many typists have lost their jobs, disappeared as a class? Previously, this also developed quantitatively. Everything was improved, and then it was thrown away. So what? They flew to the moon, also a new achievement.

Andrew Schumann: They didn't fly anymore.

Arkady Zakrevsky: But that's what they're doing. At one time there was a competition to see who would be the first to reach the moon. It didn't work out for us then, and then this idea faded away somewhat. Although they competed well, Gagarin was still the first to fly into space. Much is also explained by the fact that our main attention was paid to defence equipment; it was somewhat cut off from household equipment. Then it turned out that they are on the same foundation — computer technology in both.

Andrew Schumann: Is there a possibility for the emergence of a fundamentally different technology? For example, not on electrical circuits, but on something else?

Arkady Zakrevsky: It is possible on light — on photons, quanta. It is possible in the biofield. It would be interesting to make equipment for recording dreams; it would be in demand. You can make a library of dreams, haha. It's not that fantastic. In all the fantasies of past years, radio communications somehow did not figure particularly prominently. The invention of radio is one of mankind's greatest achievements.

Andrew Schumann: Why do Soviet mathematical schools lose their positions over time?

Arkady Zakrevsky: Young people must work. Now she pays more attention to making money. Many people leave to find a better place. There are also all sorts of schools there.

Andrew Schumann: There are very powerful schools that are not weakening. Like the logic school at Stanford.

Arkady Zakrevsky: Maybe there is. It depends on the students, and on the organisation, and on the microclimate, and on politics — on support. Schools must exist somehow. Gavrilov's School was understandable to everyone, everyone gathered... Interaction, communication, contacts were important. This requires space. Space with a scientific idea, information space.