

S. Kapitsa: "Becoming part of global science is very important for us"

Global plans to develop the innovation economy, such as those currently facing Russia, largely depend on the attitude of modern society towards science and scientists - especially in a country with such a glorious scientific past. We discussed this matter with Professor Sergei Kapitsa, Doctor of physical and mathematical sciences and representative of a famous dynasty of scientists. He was born in Cambridge, where his father and future Nobel laureate Peter Kapitsa was working in the famous Rutherford laboratory. Sergei Petrovich has been in charge of the country's largest physics department at the Moscow Institute of Physics and Technology and, as president of the Eurasian Physics Society, member of the European Academy of Sciences, knows better than anyone the problems of fundamental science in Russia and worldwide. He has been awarded prizes by UNESCO and the Russian Academy of Sciences for the popularisation of science with his television show, "The Obvious – The Incredible", which he has presented since 1973.

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In the 'Name of Russia' TV project you introduced famous Russian scientist Dmitry Mendeleyev and proposed using his scientific authority to create an image of Russia and its scientific and technical development. Mendeleyev ended up in ninth place on the list. Is this not a sign of how science's prestige has fallen in society today?

Mendeleyev was one of Russia's greatest scientists, but over these last few years we have left no real place for anything sensible and reasonable in television, cinema and literature. The journal "*Nauka i zhizn*", for example, was once a widely read and high quality popular science magazine with a circulation of three million. Now it has a circulation of only 30,000. However, it's good to see renewed interest in science programmes, in particular the Academy series of public lectures on the Kultura channel. I gave two lectures there myself. There is talk now of organising an educational advertising-free state channel that would help to raise people's intellectual level.

Is the media to blame, then, for science's loss of influence?

Amongst others. Our system of values is the problem. When scientists receive less than caretakers the best among them 'vote with their feet' and head abroad. First, scientists need to be able to earn decent money so as to have a normal existence. Second, we need to invest at least ten times more money into equipment, scientific exchanges and so on. Third, scientists need to see prospects ahead, see that they will be in demand in society.

Does Russia have a viable science policy?

No, the policy is not clearly formulated. Our science was perfectly viable in the past and the level of science teaching was very high. I was head of the physics faculty at the Moscow Physics and Technology Institute [MFTI] for 35 years and I know that our graduates were in demand all around the world. They were elite, world class specialists.

Why can we not restore this situation now? After all, there seems to be the political will.

There is not enough political will. Time is needed. We did everything we could to destroy the foundations of our science over these last decades. Look at Germany, after the war the country rebuilt its economy quite rapidly, but it took at least 50 years to get its science more or less back on its feet. They spared no money, and organised science very carefully. The Max Planck Society for Scientific Research played a big part in this work. But during the 1990s we forgot how to invest in long-term projects.

How can we change this thinking?

We need to start with political will, as you rightly mentioned. But we also need more funding for science and education. Funding for these sectors is again being cut now. There is no clear policy in place, and slogans alone will not change the country's scientific climate. Popovich, one of our first cosmonauts, died this summer. This was mentioned in the newspapers and on television. But on the same day criminal underworld figure Yaponchik was buried, and just recall how much airspace was devoted to that event.

Perhaps there are prominent figures in the science community today who could help to give impetus to a scientific revival?

We had many such pillars of the science community in the past. Now we have the two latest winners of the Nobel Prize in

physics [Andrei Geim and Konstantin Novoselov – ed]. They are both graduates of MFTI, my former students. They both came from the provinces. What's more, one from Nizhny Tagil and the other is from the North Caucasus, and made their own way without any connections.

They both said they would not return to Russia and work at Skolkovo even if they were paid millions.

Yes, because they understand what they would be coming back to. I spoke with Geim and congratulated him on behalf of MFTI, and I understand his position. I once spoke with Finance Minister Alexei Kudrin, and he asked me how much we should pay our scientists, I said as much as you pay them now in roubles, only in dollars instead. The situation with financing scientific projects is a little better, but this does not substantially change the situation. What we are talking about is quite simply normal working and living conditions.

As for Russia's participation in global science, over the post-Soviet years our contacts with the international science community are perhaps even fewer than they were during the Soviet period with its censorship and ban on going abroad. But there is a new generation of young scientists who easily find their place in the global community: they know their work well, know foreign languages, and are ready to work effectively in any country around the world.

Today these people find a place abroad, but in the 1990s scientists were going abroad and ending up doing often quite menial jobs.

Foreigners can only go so far today as well. They won't be promoted to senior administrative positions, for example. Of course, in normal conditions, Russian scientists could go further at home than abroad. This is why scientists around the world work in their home countries, and travel abroad to attend conferences or spend two-three years doing internships in other countries. This is normal for scientists. Mendeleyev was sent to Europe at the state's expense in his time to train for a professorship. Everyone realised that this was a very talented man who had received an excellent education in Russia at the best universities of the time, and had to spend some time abroad too. In America, for example, there are now 150,000 Chinese students doing internships there, and the thing that stands out is that they return to China afterwards because they know they are in demand there.

How do you assess the Skolkovo project's potential to become a Russian equivalent of Silicon Valley?

This is taking things from the wrong end. The university should be at the centre of the project, as was the case with Silicon Valley. There used to be just farmland there, land that belonged to Stanford University. We also need to take decisive action. Under the current law 1% of GDP goes to science and this is far too little. During the Soviet period I worked on accelerators for medical equipment. This was a costly business back then too. Since then we have not built a single new machine, but have spent huge amounts of money buying imported equipment. We have good doctors now, but all of our equipment is foreign, from basic enemas to computer tomography equipment.

I sent the government a letter a couple of years ago on the need to begin production of the equipment that we designed on the basis of clinical research. The letter was signed by the presidents of the Academy of Sciences and the Academy of Medical Sciences – two trump cards, you would think. It was made clear to me that for a kickback of 20-30% I would be able to get the project accepted.

What about projects that the old research centres were working on, perhaps we should have started with them?

Of course. We had an excellent example – Akademgorodok near Novosibirsk, and the Fakel research enterprise in particular, which worked on innovative research. It was closed down in 1972 not because of theft, as the case was presented at the time, but because the specialists there showed that they could work 10 times faster and cheaper than what it took huge research centres years to do. They were a challenge to the whole way our science sector was organised, and there were influential political forces that had no interest in letting them continue.

Novosibirsk had a multi-profile scientific centre and a university to produce the needed specialists. There were young people there well acquainted with the latest developments and with the opportunity to put their knowledge into practice in a technology park format. This was all 40 years ago, and has all been lost now. But nonetheless, Novosibirsk came through the tough times better than Moscow, because it was universal. Most of the science towns, especially the defence industry ones, were built for specific purposes, and so could not survive once they were no longer needed. The science town in Dubna is one of the lucky ones because it was able to become multi-purpose and international. But the biological centre in Pushchino is in a dreadfully neglected state now, though biotechnology is very much in demand today.

According to OECD figures, for all the paltriness of scientific funding in Russia, more than 60% comes from the state, while in developed countries the bulk of funding comes from business.

Yes, but this is business on a different scale. We have only a few companies on the scale of Gazprom, say. I spoke with [Gazprom head] Miller once and proposed organising a modern university. This would have cost around \$100-200 million. He was enthusiastic about the idea and we discussed it in the Nikitsky Club and drew up a project for university of this sort on the model of MFTI. But three months later I was told that 80 universities around the country provide the company with all the specialists it needs. But this was a project to educate the elite of the engineering business.

Some big companies have corporate universities now.

It is a question of level. MFTI was built on Moscow's scientific potential. In the physics faculty I had 130 people working there from 17 different scientific institutions. My main task was to find good specialists and give them the chance to work. They do not have the same kind of teaching staff now as in the past. Rector Belotserkovsky was a strong figure and outstanding scientist, and Academician Kudryavtsev, head of the mathematics faculty, was too. I had very talented

people working in my faculty, much better physicists than I am. People would ask me why I brought in people better than myself to work there, but it was important to me to have the best scientists from around the entire Soviet Union. The whole institute was based on this approach. The rector reported to the Academy of Sciences, and every year we held faculty exams for the students, conducted by examiners from the institutes associated with MFTI. They would then give us their assessment of the teaching process and give their objective criticism and advice. The result we can see in these two Nobel Prize winners.

Organising science is a very difficult thing. It's said that running a team of scientists is like trying to keep a herd of cats. You can sheep or dogs in a flock or pack, but not cats. In our faculty each 'cat' could walk by himself, and it all worked very effectively, though we had a large number of scientific 'toms'.

With such ambitious state plans and grand talk of modernisation, why is it that here people talk of a surplus of people with higher education in Russia?

We really have produced too many economists and sociologists. There are not enough people with engineering and natural sciences degrees, and those we have go abroad. No one needs our economists and sociologists abroad, and we do not need them in such large number either. An IT education costs around \$2-3 million per graduate, and this represents a budget of billions for universities. By letting our specialists go abroad we are helping other countries' budgets, and what's more with live goods.

Can Russia develop science through the kind of innovative clusters based around institutes and universities as is common in the West?

This requires systematic work, funding, and human resource mobility. Scientists in America change their area of activity approximately every seven years on average. I have worked on physics, geophysics, and demographics, among other things, over the course of my career. Most scientists have seen little beyond the walls of their own institutes, though they have the chance to travel abroad now. This is one of our higher education system's misfortunes. The situation in the provinces is even worse, with home-grown specialists the only source of new people for the scientific communities there.

You were born in Britain and spent your childhood there. Your father worked there with some of the twentieth century's great scientists. How did British society view fundamental science?

I visit Britain often and take part in scientific events there. It was there that I began working on demographics during the transition period, as it was something that did not require a lot of money. The British retire at 65, though by this point many people can continue earning some money by acting as a consultant. Pensioners in Russia, especially former science sector workers, are doomed to a beggarly existence. Another important factor in Britain is that young people there go to other towns to study and start their adult lives in a new group of people, and this teaches them independence and mobility in life, study and work. Also there is a huge network

of institutes and funds supporting various areas of research, and any talented young person can realise their scientific ambitions.

Taking into account our country's specific situation, what would be the optimum balance between the public and private sectors in your opinion?

That's hard to say. The private sector accounts for not more than 5-10% at the moment, but it is interested in quick profits. The tax system and other levers for influencing the private sector are also in the state's hands? So it all depends on the environment created for business.

The Large Hadron Collider project at CERN, where many Russians are involved too is also an example of how Russian science can integrate into the global science community. Could a similar global-scale project be based in Russia?

Becoming part of global science is very important for us. The older generation is not adapted for this – they do not know foreign languages. Young people are ready, but so far this has been a one-way street. There are 700 Russian scientists working at CERN, which is making a huge contribution to global science and offers an outstanding example of cooperation. We actually did try to build a similar machine in Serpukhov in the 1980s. The tunnel was dug, but we did not get any further. The Americans also tried to develop a similar project in Texas and buried \$3 billion in it, you could say. But in the end the project was carried out by CERN, with American and Soviet – later Russian – scientists taking part. Many of the components were made at our plants, and some components from the never completed Serpukhov project were even used as well.

Applied science is the engine for taking the results of fundamental science into industry, but applied science in Russia has been left to fend for its own survival. In the electronics sector, for example, we see what success the Southeast Asian countries have had in this area, especially China. Could we make use of the Chinese experience at all?

All areas of science are interlinked, but there needs to be mobility of minds, people, and capital. I was at Stanford at the end of the 1980s and remember having an important conversation with Mr Hennessy, the rector, who said that there were 40,000 Chinese students at the university at that time, working hard and learning all they could about modern science. But there were only 100-200 Soviet citizens, and he said this was not good, because this way we would not learn anything and they would not be able to offer us anything. I passed these words on to our ambassador in Washington, and this conversation was later passed on to Gorbachev. That was 30 years ago. Now people say that American universities are a place where Russian professors teach Chinese students.

Maybe we don't need a Silicon Valley, we need a Graphene Valley instead, and could leapfrog a generation?

This discovery could indeed open up unique new opportunities, and it was right that it won the Nobel Prize. Incidentally, all of the academicians and scientific elite in Novosibirsk's Akademgorodok live on Zolotodolinnaya (Gold Valley) Street, and so we already have a Gold Valley at least. **B**