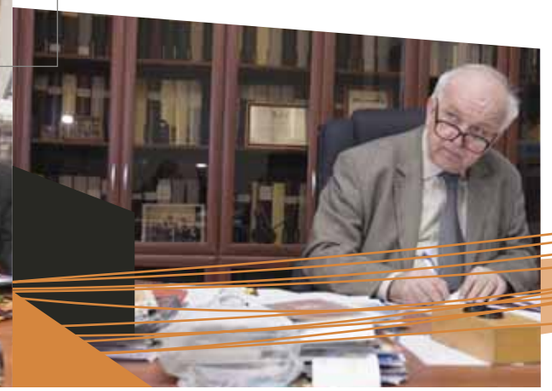
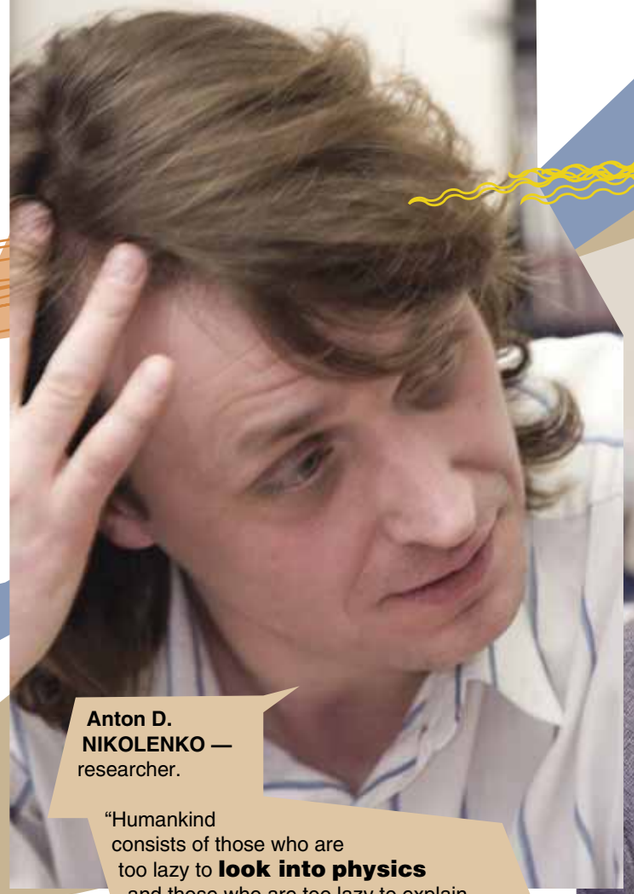


PICTURE STORY
BY V. DUBROVSKY

SCIENCE and SOCIETY from Physicists' Viewpoint

Humankind falls into those who are too lazy to look into physics and those who find it difficult to explain what it is about...



Anton D. NIKOLENKO — researcher.

"Humankind consists of those who are too lazy to **look into physics** and those who are too lazy to explain what it is about. The **exceptions gather** at **instituties** and **universities**"

Nikolay S. DIKANSKY — senior researcher, Corresponding Member of the Russian Academy of Sciences, Rector of Novosibirsk State University.

"**Fundamental education** is possible only on the grounds of **fundamental science**"

YEAR 2005 WAS DECLARED THE INTERNATIONAL YEAR OF PHYSICS BY THE UNITED NATIONS ORGANIZATION TO COMMEMORATE THE CENTENARY OF THE FIRST PUBLICATION ON THE PROBABILITY THEORY BY ALBERT EINSTEIN. NUMEROUS SCIENTIFIC CONFERENCES, EXHIBITIONS, LECTURES, READINGS AND WORKSHOPS WERE HELD DURING THE YEAR OF PHYSICS TO ATTRACT THE ATTENTION OF THE PUBLIC TO PHYSICS AND SCIENCE IN GENERAL.

IT'S NOT A SECRET THAT THE CURRENT ATTITUDE TO SCIENCE DIFFERS MUCH FROM THE PROFOUND REVERENCE CHARACTERISTIC OF THE MID-20TH CENTURY. THE THEN IMPRESSIVE SCIENTIFIC ACHIEVEMENTS HAVE BECOME AN EVERYDAY ISSUE: TECHNOLOGICAL NOVELTIES ARE PRODUCED ON A LARGE SCALE, AND YOU CAN ENJOY THE FRUITS OF SCIENTIFIC DISCOVERIES EVERY DAY. AT THE SAME TIME, IT IS DOUBTFUL THAT MANY OF THE EXPENSIVE BASIC-SCIENCE RESEARCH PROJECTS WILL PAY BACK IN THE FORESEEABLE FUTURE, AND SCIENCE IS OFTEN PERCEIVED AS A WAY FOR THE SCIENTISTS TO SATISFY CURIOSITY AT THE EXPENSE OF THE SOCIETY.

IN THE CURRENT SITUATION, A COMPREHENSIVE DIALOGUE BETWEEN THE PUBLIC AND SCIENTISTS IS MOST URGENT. SHOULD THE ESTRANGMENT BETWEEN SCIENCE AND SOCIETY BE OVERCOME, AND HOW CAN THIS BE DONE? HOW CAN THE LOST PRESTIGE OF SCIENCE BE RECOVERED? WHY SHOULD SCIENTIFIC KNOWLEDGE BE POPULARIZED AND WHAT ARE THE MEANS TO ACHIEVE THIS? THESE AND OTHER QUESTIONS HAVE BECOME THE SUBJECT OF THE ROUND TABLE THAT GATHERED TOGETHER SCIENTISTS OF THE BUDKER INSTITUTE OF NUCLEAR PHYSICS (INP SB RAS) BELONGING TO DIFFERENT GENERATIONS

A. D. Nikolenko: Society has got used to the fact that physics provides it with opportunities for exponential growth. Physics is a locomotive that never stops, and people do not pay much attention to it any longer. Thus, the prestige of physics and science on the whole has declined.

Here, in Akademgorodok, this attitude does not show yet. But as soon as you go somewhere else, even to the 'metropolitan' Novosibirsk, people are amazed to hear that you are a physicist. What does it mean: a teacher of physics, an electrician, or what?

N. S. Dikansky: Physicists, unlike experts in narrower disciplines, understand the fundamental laws of nature. Technical progress over the past fifty years was primarily achieved thanks to physicists and chemists. The high prestige of physics in the mid-20th century is attributable, to a great extent, to the development of nuclear arms, missiles, etc., which proved that academic science can be productive.

Physicists are usually blamed for creating weapons; however, one should look into the works of philosophers and "innocent" philologists. Many problems of the modern society are caused by humanists. However, this division is fundamentally conventional: the efforts of physicists and lyrists, chemists and biologists are aimed at the same goals and purposes.

A. M. Kudryavtsev: And yet physics is one of the most advanced sciences. The thing is that no other science can create clearer models of nature. The society, for example, has no such clear and objective development patterns — in particular, our national society.

I. B. Khriplovich: I believe that the current situation with science is not a new one. On the opposite, it is the situation after the Second World War that was extraordinary, when all world powers started the armaments race. Everybody wished to have bombs and missiles. A blessing in disguise...

A. M. Kudryavtsev: Generally speaking, previously — up to the 18—19th centuries — science existed under the patronage of rich people. Scientists and scholars were kept in order to make clever conversations and, at the same time, to bring some benefit.

I. B. Khriplovich: Many western universities are rich organizations with huge bank accounts, initiated by donations made by certain families. Thus far Cambridge has been much richer than Oxford only because as early as the 17th century it supported the Parliament rather than the King, which still tells on its financial status. At the same time, the situation with positions in science was traditionally quite complicated. It is amazing but the father of quantum mechanics Max Planck, who originated from an aristocratic German family and graduated from a university with honors, could not get a permanent position for many years, because there were no vacant ones.

E. P. Kruglyakov: Looking back into history, we should remember that these positions were not well-paid. Johannes Kepler said once that it was impossible to survive on a mathematician's salary. On the other hand, grandees demanded that he, as a mathematician, make astrological forecasts and paid him for this. He remarked once, "Astrology is a subject you should not waste your time on, but crazy people think that it takes a mathematician to do it."

A. M. Kudryavtsev: To sum up, we have agreed in principle that very few people should do science at the expense of the government.

E. P. Kruglyakov: This is not true. In the past, few people were involved in science, because science was in an embryo state. In addition, in these remote ages a man in the street could get from science nothing but funny toys. Today, the situation has changed completely. Science has become too broad to be encompassed by one person. In the 20th century it gave people electricity, radio, X-radiography and radiolocation, lasers and cellular telephones, nuclear energy, numerous new materials and medicines... Could a handful of scientists have produced such a wealth?

Edward P. KRUGLYAKOV — Counselor of the Russian Academy of Sciences, Full Member of the Russian Academy of Sciences, Head of Elementary Particles Chair at the Physics Department of Novosibirsk State University

"...The government has practrically strangled all **popular scientific publications**"

Andrey M. KUDRYAVTSEV — Secretary for Science, Candidate of Science in Physics and Mathematics, Assistant Professor of Novosibirsk State University.

"I have a feeling that a crisis of basic science is approaching. Because the **general public ceases to understand** us..."

Iosif B. KHRIPLOVICH — principal researcher, Corresponding Member of the Russian Academy of Sciences.

"...The current **situation** with science **is not new**. On the opposite, it was the situation after the Second World War that was extraordinary"

SCIENCE FIRST HAND http://scfh.ru/en/papers/science-and-society-from-physicists-viewpoint/ May • 2006 • N 3 (8)

Vassily V. PARKHOMCHUK — Laboratory Head, Corresponding Member of the Russian Academy of Sciences.
"**Physicists** should **not** be produced on a **mass** scale"

TODAY'S SCIENCE IS TRYING TO COMPREHEND ITS ROLE IN THE SOCIETY AND TO CREATE NEW APPROACHES TO RESEARCH OBJECTS, METHODS AND OBJECTIVES. IN THIS COUNTRY, THESE COMMON TENDENCIES ARE AGGRAVATED BY REFORMS, CHRONIC LACK OF FINANCING, BRAIN DRAIN, AND LOTS OF OTHER THINGS...

Yury A. TIKHONOV — Vice-Director for Science, Doctor of Science in Physics and Mathematics, Assistant Professor of Novosibirsk State University.
"The **attitude to science** in general is very simple — it **reminds the notorious pig under the oak**"

Assisting Switzerland

V. V. Parkhomchuk: Recently I returned from Germany and can compare the attitude to science here and there. For example, in Russia you can hardly see any informative TV programs in the evening time. In Germany, lots of popular science programs — on the black holes, on astronomy, etc. — were on in the evening. I had an impression that there were much more programs of this type in Germany than here.

Obviously, the public should know and understand what scientists are doing. For example, INP developments are in demand mainly in the Western market, which values and buys our products. Most of our brainwork, handwork, and hardware goes to the West. This is the trouble of the Russian society, which does not understand that we can make a valuable contribution to the development of Russian science and technology.

Yu. A. Tikhonov: Our equipment operates in most Western research centers, naturally for their good, not for ours. Thus, we assist Switzerland and the USA, because our plants are good and quite cheap, much cheaper than if they were produced in these countries. This is an extremely irrational use of our national intellectual resources. Lofty statements are made on the governmental and presidential levels, but the deeds do not agree with the words.

The attitude to science in general and physics in particular is very simple. It reminds of the notorious pig under the oak, which did not care about the oak, but wished to have acorns. It's pure pragmatism: anything that does not pay back immediately, is simply neglected.

V. V. Parkhomchuk: Our President recently declared that in the nearest future Russia must become a world leader in energy technologies. The reality, however, is far from these expectations. For example, some time ago a Moscow research institute developed a novel power technology based on bituminous slate. In the mid-1980s two centers were set up, in Estonia and in Krasnoyarsk. Today, the Estonian Center is flourishing and visitors come to see it, while the Krasnoyarsk Center looks so decrepit as if it has been bombed, though the founding principles and technologies were exactly the same. Natural gas is extremely cheap in Russia, which makes technological innovations in this field economically unsound, and the government does not support them.

Yu. A. Tikhonov: Look at the charts illustrating worldwide funding of basic research, in particular, research in high-energy physics. You will see a slight reduction of funding in the USA and an immense reduction in Russia, which was once a world leader in this field and now can hardly be found in the chart... At the same time, there is exponential growth of funding in China and in Korea, the countries that had nothing to do with science in the past. It is noteworthy that these countries are now investing in basic research in high-energy physics and nuclear physics, which certainly will not bring any practical applications in the future 20-30 years.

People in this country probably argue as follows: everything needed to watch TV has been invented already, why should we spend money for science? Then, under the veil of restructuring science, its funding is tightened up. How can such an institute as INP survive getting nothing but the miserable budget funding? If we did not manage to earn money, the Institute would have been closed down long ago. We have managed to preserve the institute, that is, we have managed to stay in science; however, basic science, which is our raison d'etre, is treated like a toad under a harrow. You cannot even imagine what we could have achieved if the money we have to earn had been provided by the government. The equipment and plants we have at our Institute are nothing as compared to what we could have.

In science, one cannot predict anything. For example, accelerators are now used to simulate the processes immediately related to the organization of the world: How did the Universe appear? Was there a Big Bang? And we here, at the Institute, do our best to accomplish a huge contract on the supply of constituent parts for the accelerator that is being constructed in Switzerland. They say that science is international, but each nation wishes to do it within its own territory, because it is a basis for the national progress, for some applied works, etc.

A. A. Ivanov: Another example is the international project of construction of the International Thermonuclear Experimental Reactor (ITER), which will last for decades. By the way, Russia is also formally involved. One day, to my surprise, I read in the Internet that jobs were created and Physics departments were opened at universities to train specialists to work at ITER. And this is done now, even though the project will start only in 30 years! Moscow researchers dealing with these problems are 60-70 years old. Who will work at the International Reactor in 30 years? We should start training specialists right now.

N. S. Dikansky: In my opinion, exact sciences, including physics, are taught in Western universities much less than in Russia. In principle, we do not need corporative universities. I don't think it was a good idea of the Russki Aluminiy ("Russian Aluminum") Company to set up the University of Aluminum. Mendeleyev's periodic system includes many other elements...

Aleksandr A. IVANOV — Vice-Director for Science, Doctor of Science in Physics and Mathematics

"**Life in science** is something special, it hardly depends on funding"

There is no social order for research...

A. M. Kudryavtsev: Let us look at the problem from a different, provocative angle, so that researchers do not seem to be innocent lambs downtrodden by circumstances. I mean, in the public eye, Russian physicists are in dire straits. To some extent, however, we are also guilty, and the roots of the current situation are in the past. Academic science has always been inert in putting research results in practice, and the scientific community has been distrustful and skeptical about the practical application of its achievements. Now we are reaping the fruits of this attitude. It is obvious that the technological revolution that happened 20 years ago and is still in progress in the West became possible largely thanks to the adequate response from researchers. If only we had reacted in a similar way and influenced the government...

Yu. A. Tikhonov: I completely disagree. Only we, Russian physicists, think that we should put something into practice, I have never heard about a Western physicist doing anything like that. None of them went into business. On the opposite, it was business that looked for some research ideas it could apply.

E. P. Kruglyakov: That is not exactly true. Colgate was a physicist, I met him. He consciously moved to business and, I believe, has no regrets about it. Today, thanks to the toothpaste advertisement, his name is known to everybody. Coming back to the issue of Russian scientists' guilt, I don't think it makes sense to argue about it. The government has special levers to stir up industry's interest in novel developments and inventions. One should mind one's own business.

N. S. Dikansky: A good example is that of Khrushchev, whose education was only three classes of a parochial school. Being in charge of the immense country, he formulated strategic objectives for the Academy of Sciences, and they were attained. Today our leaders have university education and academic degrees, but they are unable to formulate their requirements.

Our problem is that over the recent years we have been destroying everything we had. Within the same period, the Chinese managed to work a wonders. They rank first in coal production, producing almost six times more coal than Russia. They make cars, electronics, cell phones...

For some reason, leaders of one country are destroying everything, while leaders of another country are creating!

A. D. Nikolenko: Well, the Chinese are a world power because of their industry, outlook, and state structure... But their life standards leave much to be desired.

V. V. Parkhomchuk: Well, Chinese physicists for sure live better than we do. They obtain sufficient funding and produce new setups which are, in fact, an extension of our ideas that took us many decades of work. These ideas will be further developed in China, not in Russia. Actually, the life standards of Chinese physicists are quite appropriate. Professionals who are yet being trained in Russia (their level corresponds approximately to Russian mid-level researchers) get apartments of 100—150 square meters in densely populated China!

N. S. Dikansky: There is no social order for research. It has just started to form — the idea of setting up technoparks is an example. We must admit that we have lost a lot of time.

V. V. Parkhomchuk: I visited a similar center in China. They built a think-tank town on the oceanfront not far from Beijing: modern buildings, a huge university (much larger than Moscow State University) that trains young specialists for laboratories and companies. Every day boats come and take on board containers with cell phones and other electronic products manufactured at these enterprises.

A. D. Nikolenko: That's true, but China follows another trend of economic development: they seek to meet the demands of the industry. For example, there is a company producing cell phones; and on the basis of this company a research institute is set up to conduct applied research. In Russia, the situation is reverse: academic institutes exist already and we try to put their achievements in practice. In general, is it possible to develop on the basis of a research institute like INP a product that could be, figuratively speaking, "spread on bread"?

V. V. Parkhomchuk: Yes, it is. For example, we have made a series of industrial accelerators, which now operate in China, Japan, Korea, and Poland, but not in Russia. The question is why not in Russia?

G. N. Kulipanov: Also, we made about two hundred X-ray units for China. We often refer to the Chinese, but I don't think we should follow their example in everything. The development of the Chinese economy illustrates some useful truths, but they don't always apply in Russia, . We say the market will put everything in the right places, but let us take the example of industrial accelerators.

Before 1990, INP produced over a hundred of them; they were mainly installed in the former USSR republics, and only few were exported. Since 1990 another hundred of accelerators has been produced, of which only three are in Russia; the others went to China, South Korea, Japan, the USA, and Europe. This means that our accelerators are high-quality and cheap. Today, Russia is buying some products (for example, high-strength polyethylene film) made at our accelerators in China. Why won't somebody in Russia do it? The market doesn't put everything in the right places; in many fields a definite state policy is required.

Gennady N. KULIPANOV — Vice-Director for Science, Full Member of the Russian Academy of Sciences.

"When **an impotant problem** arises, which can be solved **only by physicists**, the public will realize that they are indispensable...»

Anton D. NIKOLENKO

"Heaven forbid us from being in demand for inventing bombs, new armaments or guns. On the other hand, inventions were often a way to solve a problem. One should choose between **a quiet life without problems or rapid development**"

No city withstands if there is no righteous person in it...

G. N. Kulipanov: They speak a lot about the role of the state in the development of the economy and science, but the role of an individual is also important. If we look back at the history of the Siberian Branch of the Russian Academy of Sciences: Lavrentiev, Khristianovich, and Sobolev were the first to realize that science should go beyond the bounds of Moscow and Leningrad, where it had been focused. Khrushchev, who should be remembered with gratitude along with Lavrentiev, signed the Resolution on the Establishment of the Siberian Branch of the Russian Academy of Sciences in 1957. Another person who played an important role in the history of the Siberian Branch was Slavsky, who was the Minister of the USSR Nuclear Industry for many years. It was under his supervision that Akademgorodok was built in four years, which now seems incredible . These are the people who determined the future of the Siberian Branch; the future of science; the development of Siberian natural resources; and, eventually, the future of the national economy.

A. S. Lakhtychkin: Society is made up of individuals and individuals are part and parcel of the society. They are interrelated as an egg and the hen. What did Galileo need for research? He took a bullet, climbed a tower, dropped the bullet, picked it up, and dropped it again. He could do this all alone. Now science is very much like industrial production: huge facilities served by hundreds of people.

A. D. Nikolenko: The point is that only those who have a good understanding of research can do it, while researh managers should understand both management and research. Such specialists are precious few, and there's no school you can go to become a research manager. People who are good at research popularization are a rarity; history knows only a few.

G. N. Kulipanov: Today we spoke about statesmen as managers. In actual fact, a high-level professional, be it a physicist or a chemist, is almost always a good manager. One of the main achievements of the Siberian Branch over the past 50 years is scientific research schools set up by outstanding personalities. We say: Boreskov's school, Trofimuk's school... The institutes that were headed by outstanding personalities continue to be successful today. In our institute, such an absolute authority was G.I. Budker, who created not only new scientific fields but also the algorithm of work of the entire institute, the Round Table. An outsider might only see people sitting around the table, drinking coffee, and talking without an agenda; but in fact it is only thanks to the Round Table that the institute still exists and fuctions properly. Thanks to it, young researchers can communicate directly with the Board of Directors, and it is very important for a leader to look young scientists in the eye and see light or disappointment.

K. V. Lotov: They say, "No city withstands if there is no righteous person in it." I did not have a chance to meet Budker, but if he had not been succeeded by Skrinsky, we could have easily fallen apart. It is good to have competent managers and talented people, but there also should be a righteous person.

Aleksandr S. LAKHTYCHKIN – senior laboratory technician, student of the Physics Department of Novosibirsk State University.
"Science is an activity investments in which take long to pay off. This is why, if any abrupt changes occur in the country, **investments** in science are unlikely"

Konstantin V. LOTOV — senior researcher, Candidate of Science in Physics and Mathematics, Assistant Professor of Novosibirsk State University.
"Our task is to **preserve scientific schools** to have a growth point for the future. There are people in the country who are responsible for arranging that everything runs smoothly. But if they do their job badly, this is not a reason for us to do the same"

Science is done by mavericks

INP'S ARCHIVE PHOTOS SHOW YOUNG AND HAPPY PEOPLE UNITED BY COMMON IDEAS AND GOALS. THEY HAVE MANAGED NOT ONLY TO MAKE IMPRESSIVE CAREERS BUT ALSO TO CONSTRUCT A CITADEL ABLE TO PROTECT THEIR FAVORITE OCCUPATION FROM THE OUTER WORLD, WHICH IS NOT ALWAYS FRIENDLY. THE RESULT IS THAT TODAY, AS BEFORE, WE CAN SEE YOUNG AND ENTHUSIASTIC FACES AT INP. THE QUESTION IS WHERE THESE PEOPLE COME FROM — IN OUR PRAGMATIC TIMES, ALMOST 50 YERS AFTER THE "RENAISSANCE" OF PHYSICS?

I. O. Orlov: These people are the result of natural selection.

G. N. Kulipanov: We have them thanks to the Physics and Mathematics School, Novosibirsk State University, and early-stage training directly at INP.

V. V. Parkhomchuk: Our institute is not unlike an ancient convent whose postulants had to complete a rigorous introductory course.

I. O. Orlov: In fact, it works as follows. Everything starts at the Physics and Mathematics School or at the Physics Department of the University. University entrants are told that it is not easy to study at the Physics Department. Thus, those who start doing it have a kind of vector in their mind: that's hard but interesting, so I will do that. Then the selection process goes on, and the young scientists you can meet in the "cellars" of INP have already passed several more steps. Those who are bored with science or who prefer dollars to science do not come here or come and go.

N. S. Dikansky: In the West, they believe that science is done only by people who are a bit crazy, far out, so to say, because there are lots of better paid jobs. Indeed, you should be very much interested in the subject.

K. V. Lotov: Formerly physics and science in general were not only your favorite occupation, but also they gave you a proper social status, apartment and salary. Now that these privileges are gone, only enthusiasts stay in science.

I. O. Orlov: These are the people who got involved in science at an early stage of their personal development, which is most probably predetermined genetically.

G. N. Kulipanov: Interestingly, the number of smart University students remains the same even though competition varies from 6 to 1.8 entrants per one student position. Those who are admitted are genetically predisposed to do science, and their number doesn't depend on the competition. Another interesting fact: two Corresponding Members of the Russian Academy of Sciences and the wife of one of them, Doctor of Science and a Dean at the University, have all come from the same village in the Gorny Altai. They managed to achieve this thanks to our Physics and Mathematics School and University.

Il'ya O. ORLOV — senior laboratory technician, graduate student, Assistant of the General Physics Chair at the Physics Department of Novosibirsk State University.
"**Interest in science** is most probably **genetic**"

Yury A. Tikhonov: "It's the process of doing science that makes the people engaged in it HAPPY. The process itself is very interesting, you see?"

N. S. Dikansky: There are some problems related, in particular, to the tuition fee. But the main thing is that we have managed to preserve the Physics and Mathematics School as an educational structure.

E. M. Baldin: The level of present-day students of the School has become much lower. As an old teacher, I can see this.

K. V. Lotov: The area around which the graduates of the Physics and Mathematics School and of the University used to go to work has narrowed. University graduates used to go all over Siberia and the Russian Far East, some even went to the European part of the country; whereas now all smart graduates are engaged by the Novosibirsk research institutes whose employees teach at Novosibirsk State University. That is why we have these young people at our Institute, too. However, we cannot any more provide graduates for Krasnoyarsk or Tomsk, for example. Even our Institute has started to lack young scientists because of the decreasing number of University entrants.

N. S. Dikansky: We still have lots of students from other cities, up to 50%.

E. M. Baldin: Less than ten years ago, most students of the Physics and Mathematics School were from other cities; and only two or three students were from Akademgorodok. Now many of those who come to attend the Summer School course wish to stay and study here, but they cannot afford the tuition.

N. S. Dikansky: We give some discounts, Olympiad* winners are admitted tuition-free. You stress that now one has to pay to study at the Physics and Mathematics School. But otherwise who is going to pay, if the government refuses to do that?

A. S. Lakhtychkin: The government plans to set up a technopark and invest a lot of money in it. At the same time, it cannot afford to support the Physics and Mathematics School. Isn't it strange?

N. S. Dikansky: First, it is not the case. The current plan for the development of Akademgorodok and University suggests an expansion of the Physics and Mathematics School. Its premises, including dormitories, will double. Thus, it is not fair to say that nobody cares about the School. But tuition will not be reduced, education always costs money.

** The Olimpiad is a regional or all-Russia competition held among schoolchildren in school subjects (physics, mathematics, biology, Russsian language, etc.)*

Evgeny M. BALDIN — senior researcher, teacher of the Physics and Mathematics School.
"Ideas are unlikely to exhaust, in contrast to their authors and carriers. **This resource should be able to renovate"**

I. O. Orlov: The students who wish and can and study well should not pay.

A. S. Lakhtychkin: I think that Russia can afford three or four tuition-free schools, because it is the idea itself that is important. Young people should be sure that if they have the desire and abilities to study, they will be able to do it.

N. S. Dikansky: But then there should be a credit-granting system, a kind of target training. A company interested in having a University graduate should invest in his tuition, and the student will naturally commit himself to work for this company in the future.

E. M. Baldin: For basic science, this scheme will not work. No commercial company in its right mind will invest in science. To care for the future of the nation is the prerogative of the state, not of the students. Those who have the potential to advance science — in particular, basic physics — are precious few, and if only the well-to-do are sifted among Russia's not too rich population, there will be nobody left wishing to do science.

A. S. Lakhtychkin: When a young man enters the Physics and Mathematics School, he cannot be sure that he will be an excellent student. He has a grant, begins his studies, gets a satisfactory mark for the semester, then for the year... and it's over. Half a year or a year went down the drain, and the student is in debt for a large sum. For country people the sum is enormous, they would have to slaughter all their pigs.

A. V. Kuzmin: I have a question. If we introduce grants and loans for education, this will be very much like the Western system. Will we then differ from the West and in which way? Is it worthwhile to have this system at all?

G. N. Kulipanov: It is evident that we have a problem with tuition, which reflects the actual situation in our country. There is nothing particular or unexpected in it. It's just another problem to be faced and solved.

N. S. Dikansky: The labor market is strongly deformed now. IT companies have hired almost all information scientists; the technopark will also absorb physicists, chemists and biologists. The leadership of the Siberian Branch of the Russian Academy of Sciences should find a way to solve the problem.

A. S. LAKHTYCHKIN
"I was not a winner of the regional Olympiad, came only seventh. However, at the Physics and Mathematics School I took the second place in physics. And if I had been given up as a hopeless case?"

A. A. Ivanov: In fact, it is not bad that new opportunities are emerging. Academic institutes may be in a worse situation, but the young will get an opportunity to choose. Still some number of "crazy" people will stay with us, in basic science.

A. D. Nikolenko: Less tough competition at the entrance exams to the University Physics Department reflects, to a certain extent, the declining prestige of science on the whole. This situation is largely attributable to the absence of an order from the state. Fifty years ago we had clear directives, we knew we were serving the Motherland, and this was the priority; hence, the high prestige of science. Now these times have gone. Many politicians say right words about the development of science but, at the same time, do very strange things. And immediately, according to the law of conservation, the interest of the society decreases.

Alexandr V. KUZMIN — senior laboratory technician, undergraduate of Novosibirsk State University.

"**Science** is like a huge **dinosaur**. The brain is small, and the body weighs many tons"

Science is like a giant dinosaur

PARADOXICALLY, THE HIGH PRESTIGE OF PHYSICS IN THE 20TH CENTURY WAS LARGELY ATTRIBUTABLE TO THE CREATION OF UNPRECEDENTED WEAPONS OF MASS DESTRUCTION. NUCLEAR POWER CHANGED RADICALLY WAR STRATEGY, POLITICS, ECONOMY AND, ABOVE ALL, PEOPLE'S MENTHALITY. WHAT REVOLUTIONARY DISCOVERIES OR RESEARCH DIRECTIONS CAN BE EXPECTED IN THE NEW MILLENNIUM?

A. D. Nikolenko: When schoolchildren whom we show around the Institute ask this question, I usually say that I have no answer but can give lots of historical examples illustrating the issue.

N. S. Dikansky: If we try to evaluate what is being produced now, we should recognize that mathematics is coming to the foreground. Take information science as an example. However, in my opinion, a major breakthrough in science in the nearest future will be in biotechnology, the complex science combining biology, chemistry, and physics.

K. V. Lotov: Undoubtedly, something completely new will appear. By "new" I mean that it cannot be predicted. What can be predicted is not new any longer.

I. O. Orlov: If this question had been asked a hundred years ago, the predictions would have been completely different from what actually happened. More than a hundred years ago Faraday said about the electric engine, "It is obvious that nobody will use the engine, because every fool knows that zinc is much more expensive than oats."

I. B. Khriplovich: People say that when Faraday, the founder of the electromagnetic field theory, demonstrated the deflection of a magnetic needle near a conductor with a current, he was asked: who might need that? The answer to this reasonable question is known: you'll find a way to apply it...

V. V. Parkhomchuk: We can speak at length about various applications of scientific discoveries. This plant can be used to treat cancer; and that plant can produce high-quality polyethylene. There are lots of research trends still in the embryo state, and we can see the way they may develop in five years. But is it possible to predict what happens in 50 years?

For instance, do you know what 80 % of our Universe is made of? This is dark energy or dark matter. We cannot see it and do not know what it is.

A. V. Kuzmin: Science is like a giant dinosaur. The brain that leads it is soooo small, and the body is so huge.

K. V. Lotov: But, in contrast to the dinosaur, it is not easy to say where the brain is... We know where it is today, but where will it be in ten years? This is why it is important to maintain the whole body, because any part of it may turn into brain tomorrow.

V. V. Parkhomchuk: In the 1930s, the first micrograms of a radioactive substance that spoiled photoplates were obtained. Today, France produces 85% of its electricity from nuclear power.

A. A. Ivanov: Where have these electric bulbs come from? A hundred years ago, they didn't exist and nobody could imagine anything like that. We could still live with a candle, drink kvass and intellectualize.

In fact, science does not influence the society directly, but through education and certain ideas. Basic science is just a necessary condition for the existence of a normal society.

E. M. Baldin: Everything the society uses is, literally speaking, applied "waste" of basic science. The future is unpredictable, but it goes without saying that if there were no basic science, we would not have many of the things we use in our everyday lives.

Konstantin V. LOTOV

"We, who were born in the USSR, have a lucky time: we began to live "then", survived *perestoika* and are living under capitalism now. This is a ***unique experience*** that you can hardly get in other circumstances"

The public no longer understands us...

A. M. Kudryavtsev: Shall we drop applied science and speak about the world order? A hundred years ago, people knew much less about it than they do today. Nowadays science has reached such a level that an ordinary person cannot understand what the scientists are actually doing.

In mechanics, it was always possible to explain the object of your research. "I wish to study what an oxygen atom is composed of, and why it behaves in that way or another," etc... Everything that is clear to present-day schoolchildren is clear to the public. But as soon as we go to the world of elementary particles and the weird conservation laws that work in it and that are not easy to explain, the following question arises: why should we study all this stuff at all? I don't believe that a popularizer of science (including us, if we wish to establish a dialog with the public) will be able to persuade anybody using specific examples. A general approach is needed. What is our purpose? To be equal to God or to find out why he created everything? In my opinion, basic science is approaching a crisis, because the public ceases to understand us.

THE THEORIES, MODELS, AND CONCEPTS USED BY MODERN SCIENCE ARE SO HIGHLY SPECIALIZED THAT THEIR UNDERSTANDING REQUIRES GREAT EFFORTS AND A LOT OF SPECIAL PREPARATION. HOWEVER, IT IS WELL KNOWN WHAT SHOULD BE DONE IF THE MOUNTAIN WILL NOT COME TO MOHAMMED...

E. P. Kruglyakov: Let us first mention that immediately after the collapse of the USSR the state practically strangled popular science publications by cutting their funding. Znaniye ("Knowledge") Society, whose educational role was very important, ceased to exist, and is just starting to revive. The first steps to regenerate popular science publications were made at the Siberian Branch as well: we printed the first dozen of books.

I. B. Khriplovich: The American popular science literature, known to be not worse than the Russian, is published by private publishers. I don't make judgments whether that's good or not, I just ascertain the fact.

We can have many grievances against the old system, but our old-time popular science literature was at the level of classics. However, the government stopped supporting it, and it was gone. I think that what survives is normal, and we should strive for the norm. Government's support is necessary, but ideally such literature should pay its own way.

E. P. Kruglyakov: In 40 years this problem will be settled. But so far we cannot afford to buy science popular books at the prices acceptable for the Americans.

A. M. Kudryavtsev: The problem that worries me most is not money... What's most distressing is that the public, except for a certain part, has become indifferent to spiritual matters: no national idea, no ideology...

It is noteworthy that sociologists repeatedly remarked that Russia's population consisted of at least two different groups. One of them, the intelligentsia, was oriented towards the West, studied languages and science. The other was peasants, or the bondmen, if you like.

In general, these two categories still exist. When I was a child, I lived in Petersburg, in a proletarian district. About half of the pupils of our class did not care about museums or theaters, whilst the other, inquisitive half, was interested in everything. In Akademgorodok, the situation was very different: you could hardly find somebody who would miss a premiere.

In the Soviet times, the focus was on the educated part of the society — the intellectual elite, and it was believed that this was good for everybody. However, in the epoch of freedom and democracy, it has become clear that half of the nation, as before, does not care about spiritual matters, but they have to pay taxes to support scientists.

I come back to the statement that science is financed by the government. This means that there should be some education and enlightenment to prevent the society from running wild and from losing the technologies available. The state should play the role of a tutor and use some structures to popularize science.

A. S. Lakhtychkin: I watched a talk-show, in which people were discussing a problem for about twenty minutes; then came the turn of a Member of the Academy who produced a piece of paper with a couple of numbers — and that was the end of the dispute! I said this to illustrate the importance of engaging researchers at the top level — in the government, for example — because they can understand what happens in the society. Then maybe our problems will be solved?

The Editors are expressing their gratitude to A. M. Kudryavtsev, E. M. Baldin, and journalist A. V. Louchanskiy, for their help in arranging the Round Table