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Michael Vasiliev presenting the speaker:
Boris Altshuler was a participant of the Seminar of Theordep in the Lebedev Institute during decades. In January 1969 he defended his PhD Thesis in this Hall, although he did not work here at that time. Andrei Sakharov was one of his opponents at this defence and since then they were in close contacts in different fields for 20 years. During 5 years, in 1982-1987, Boris Altshuler was enforced to work as a street cleaner – as a result of pressure by authorities for his assistance to Sakharov and other repressed dissidents. Andrei Sakharov after his return from exile suggested in the Academy of Sciences taking Boris Altshuler to the Lebedev Institute and beginning with 1987 he has been working in the Theoretical Physics Department.

Andrei Sakharov as a physicist in all facets of his life

Report at the Sakharov Memorial Session of the 4th International Sakharov Conference on Physics, May 18-23, 2009

Abstract

The main stages of life and activities of Andrei Sakharov are covered with an emphasize on his method of achieving the desirable non-trivial results. The analysis of Sakharov's plural works and deeds shows that his method in science, in designing nuclear weapons, in defending human rights, in manufacturing world security was one and the same: he always remained a man of exact sciences, a physicist, a construction engineer, an implementor. The visible result may be the figures at the end of a formula-saturated paper or release of a victim of political repressions – no matter: in any case it was a sort of scientific research, and special holism of Sakharov's mentality proposed the essentially unexpected steps to the solution which were at first often misunderstood or sometimes even shocking for his contemporaries. The epigraph of this Talk is Sakharov's motto: "Non-realized idea is not an idea yet".

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Non-realized idea is not an idea yet

Andrei Sakharov

Fig. 1 Sakharov Andrei Dmitrievich, 21.05.1921 – 14.12.1989.
Photo by Yury Rost.

1. Introduction. Necessity to prevent thermonuclear Doomsday.

Andrei Sakharov was one of the most outstanding personalities of the XXth century. A high-rate physicist-theorist and brilliant constructor, who has become an Academician at 32. “Father” of the Soviet H-bomb in 1950s and Nobel Peace Prize Winner in 1975. Famous human rights champion, non-formal leader of the Soviet dissidents whose non-violence opposition won after all over extremely violent communist regime. It is really a miracle of the history that Sakharov’s idea of the intimate connection of observation of individual human rights on the one hand and world security on the other proved to be working. Thanks to Sakharov’s public activities Mankind drew back from the brink of thermonuclear precipice. Sakharov not once repeated that nuclear balance of superpowers, menace of the guaranteed mutual suicide (so called Mutual Assured Destruction) was an important factor which prevented the Third World War. But on the other hand the accumulation of nuclear weapons made this balance more and more unstable.

Alexander Yakovlev, a former many years member of Politburo, one of the top Soviet leaders and Gorbachev’s ally in making “Perestroika” was asked in 1994 by nuclear scientists Yury Smirnov (the one who together with Sakharov designed most powerful in history 50 Megatons

bomb tested at Novaya Zemlya in 1961): “If all this fuss about possible thermonuclear Doomsday was just a propaganda, a fraud, and in reality situation was more safe and under strong control ?”. And very well informed Soviet leader said: "*I do not believe in mystical forces, though sometimes it seems to me, that some force stopped the most terrible. Mankind simply was lucky"* ([1], p. 340).

Sakharov understood well this unbelievably high level of danger especially because he knew people around the Soviet nuclear button and practically absolute disconnection of their Olympus with reality. In the book «My Country and the World» published in the West in 1975 he warns that Nixon-Brezhnev agreement on the limited antimissile defence may give to Soviet bureaucrats a free hand to begin the thermonuclear war (I explain: the agreement, discussed that time at the top level, supposed constructing rocket shields for two main towns in the USA and two in the USSR correspondingly). Sakharov writes about it: «*Terrible suspicion creeps into the soul against one’s will, a scheme becomes patterned in one’s mind that with such a system of defence the major part of the territory and of the population of the country is sacrificed to the temptation of obtaining a decisive advantage of the first nuclear missile attack with the relative safety of the Moscow officials*» [2]. Thus he had no illusions about these people and clearly saw that the precipice is here, nearby. To initiate the construction of more safe world relations meant to overcome the inertia of enormous bureaucratic system, and this was an extremely complex problem. But for creative people like those in this Hall: “the more complex – the more interesting”. Sakharov did his best to work out the solution of the problem.

And for Sakharov himself it was not a simple process to evolve to the understanding cited above. Happily he was capable of creative evolution - for thinking and rethinking again and again the seemingly evident things and phenomena. Igor Tamm said about him: “*He has a wonderful quality. He approaches any phenomenon anew, even if it has already been investigated twenty times and its nature has been established twenty times. He considers everything in such a manner, as if he has a blank sheet of paper in front of him, and, owing to this, he makes striking discoveries*” ([3], in the Chapter “Physicists about Sakharov”).

2. “Speaking horse”

The first “brick” (or the first “formula” so to say) in this rebuilding the world to its more safe “phase state” was evidently to make *those at the tops* listen to you. One of the visible miracles, really strange phenomenon, was the fact that for a quarter of a century Sakharov’s voice penetrated to the highest political levels of the USSR and other great powers, his opinion – which was just an opinion of an independent expert – was attentively analyzed, his views and actions were considered in the most important decision makings. “You are on the top floor of the power”, - remarked Lev Altshuler (my father, Sakharov’s colleague in the Soviet nuclear

weapons program from its very beginning, one of the founders of the study of condensed matter under extremely high pressures in shock waves and Winner of the American Physical Society 1991 Award in this field) when he visited Sakharov on 10 January 1987 - soon after Gorbachev brought him and Elena Bonner back from exile and invited Sakharov to take part in the top level disarmament discussions. And Andrei Dmitrievich immediately responded to this my father's remark: "I am not on the top floor. I am near the top floor, on the other side of the window". This Sakharov's metaphor is mathematically exact.

Fig. 2. Lev Altshuler and Andrei Sakharov, Moscow, 10.01.1987.

"Why did you send your "Reflections" abroad?", - Lev Altshuler asked Sakharov soon after New York Times published this famous Sakharov's document in July 1968 and a great scandal in the Nuclear Center and essentially above burst out. "I decided to appeal to those who is ready to listen to me", - was Sakharov's answer, also exact. The point is that a year before Sakharov wrote the non-public Letter[2] to the Communist Party tops with the ideas like those in the "Reflections on Progress, Peaceful Coexistence, and Intellectual Freedom" later published in the West altogether in 20 million copies. And he did not receive any answer. Thus Soviet leadership did not react at all and then he made his views public. Many people around him considered this step of super-secret Sakharov, as well as many other his steps, absolutely crazy. "Sakharov is a speaking horse, but not all horses can speak", - used to repeat Yakov Zel'dovich. "It is a violation of the Law of conservation of energy", etc.

However such marvelous "violations of the Law of conservation of energy" already happened before. Among the declassified documents of Nuclear Center Arzamas-16 (the Town of Sarov,

[2] Sakharov never mentioned this Letter of 1967 honestly observing its privacy; science historian Gennady Gorelik found it in the Archive of the Communist Party Central Committee and it had the stamp "*secret*" ([4], P. 263-268).

Soviet Los-Alamos, located 600 km. East from Moscow) there is the Conclusion of the important Commission which came to Sarov from Moscow in November 1950 – in the depth of dreadful Stalin's time. There are the following words in this document: "*Chiefs of Labs Sakharov A.D. and Altshuler L.V. must be dismissed from the leadership of scientific collectives because they contest against the marxist-leninist elements of Soviet science*" ([5], Vol. 2, Book 1, P. 73). All the leading scientists of the Nuclear Center, members of the Party or non-members like Andrei Sakharov and Lev Altshuler, were asked by Commission the same formal question "Do you agree with the politics of Communist Party?", and only two expressed their disagreement with crackdown of genetics made by Stalin in 1948. This instruction - to dismiss Sakharov and Altshuler was never fulfilled. The athorities did not touch Sakharov at all, but Altshuler was doomed to banishing from the Nuclear Center with, as it could be guessed, subsequent inevitable arrest. It was solidarity of colleagues, including Sakharov, which prevented the banishment.

Thus we – physicists must realize that we are real force, strong force. It was solidarity of the world scientific community which in another epoch helped to survive Sakharov and other repressed Soviet scientists-dissidents. I take a chance to express gratitude to everybody who made this salutary contribution at that difficult time.

In the book "Facets of a Life. Reminiscences of colleagues about Sakharov" [6] compiled here in Theordep of FIAN and published in 1991, Lev Altshuler writes that his and Sakharov's critical positions basically coincided but Sakharov went much further and globally deep in his critical review of the "first principles" of Soviet ideology. He also remembers there one real life episode which is quite demonstrative. It was in 1969, when they both already lived in Moscow, my father visited Sakharov to discuss some very critical Program of reforming the USSR which was printed illegally and which my brother brought him from friends. Sakharov already knew the document and they discussed it openly being absolutely indifferent to the inevitable presence of the KGB "third party" which taped and listened through the walls every word pronounced in Sakharov's apartment. But when Lev Altshuler began to speak about their previous work Sakharov stopped him: "*Let's change the topic. I have clearance for secret information. You do too. But the people who are listening to our conversation do not have this clearance. We shall speak about something else*" (Lev Altshuler, "Next to Sakharov", in [6], P. 50-51).

3. Igor Tamm. Niels Bohr and Arhimedes in Moscow. Vitaly Ginzburg.

Coming back to 1950s. Of course the reason why in Stalin's time Sakharov and Altshuler were not punished for their opposition to the Party Line in biology was in the Bomb which Stalin vitally needed. Actually Bomb saved then all Soviet physics which was planned to be destroyed after biology. The theory of relativity and quantum mechanics were attacked as "idealistic", "bourgeois", contradicting the Great Teaching of Marx and Lenin. Lev Altshuler remembered

Igor Tamm's great indignation concerning the article of the well known Moscow physicist Dmitri Blokhintsev (who was Theordep member and hence Igor Tamm's subordinate before the War) who published this sort of trash. Speaking about it at my father's place in Sarov Igor Tamm severely smashed a chair against the floor and almost shouted: "He knows that this is a lie, but he keeps writing it!" ([6], P. 48).

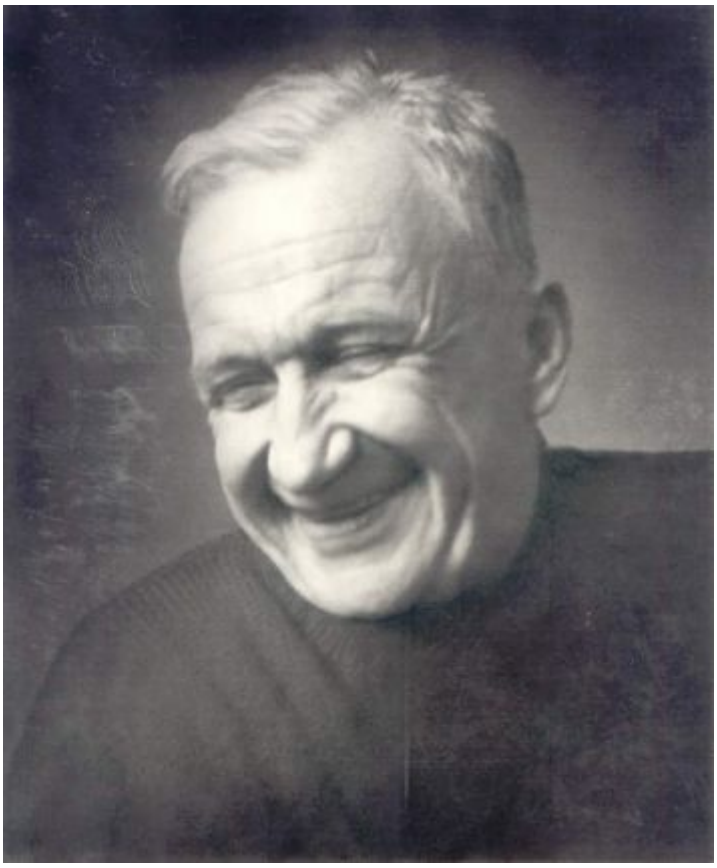


Fig. 3. Igor Tamm (1895-1971)

Igor Evgen'evich Tamm, Sakharov's teacher, Nobel Prize Winner in Physics (1958) and for many years Chief of the Theoretical Physics Department of the Lebedev Institute. In 1950 he and Sakharov moved from Moscow to Sarov to continue there the creation of the Soviet H-bomb. And then they proposed the "magnetic bottle" to hold hot plasma later developed by Lev Artsimovich and called Tokamak. Fusion is perhaps the most realistic direction to resolve the growing energy problems of Mankind. This Spring, in April 2009, the extremely expensive International project ITER targeted at constructing huge Tokamak was initiated, Professor Christopher Llewellyn Smith spoke in this Hall about it last Sunday, on 17.06.2009, in his Public Lecture organized by The Dinasty Foundation in frames of this Conference. Professor Bruno Coppi who also takes part in our Conference advocates another, supposedly more cheap and effective development of Tokamak called Ignitor. Thus we see that Sakharov-Tamm 60-years old idea is still young. I note that in 1950s Sakharov also proposed the implosive method of receiving the super-high magnetic fields called "Magnetic Cumulation". This direction was elaborated by Alexander Pavlovsky and now it is actively developed in Russia and abroad.

Fig. 4. Niels Bohr and Igor Tamm, Lebedev Institute, May 1961.

In Fig. 4 are Niels Bohr and Igor Tamm in the Theoretical Physics Department in May 1961 when Bohr visited Russia. It was a year before Bohr passed away.

During this visit to Moscow, on the 7-th of May, Niels Bohr, his wife Margaret and son Aage Bohr took part in the great Festival called "Birthday of Arhimedes" invented and organized by students of the Physical Department of the Moscow University. In the beginning of 1960 at the X-th Komsomol (Communist Union of Young People) conference of the Physical Department students passed the Resolution: "To establish annual festival – The Day of Physicist. The Day of Physicist is the day of birth of Arhimedes. To enact that Arhimedes was born on 7 May 287 B.C.". With this they fixed the day of annual Festival. It lasted during 10 years until the Communist Party authorities of the University prohibited it as "ideologically undesirable". It was a fantastic event in May 1961. I was there, and many of those who are now with us here at the Conference also were there among over a thousand students. There was a chariot (made from a properly decorated truck) on which Arhimedes (postgraduate Alexander Logginov) in an ancient Greek tunic and with a laurel wreath, speaking and singing through the loud speaker, accompanied by Niels Bohr, Lev Landau and Igor Tamm slowly drove around the building of the Physical Department. And there was a great students' performance on the steps of Physical Department. And in the evening of the same day, in the Big Hall of the Moscow University, quite an energetic and funny opera "Arhimedes" composed by students Valeryi Kaner and Valeryi Milyaev was performed. The overcrowded hall periodically exploded with laughter, and every time after it, just when the hall calmed down Niels Bohr's well heard laughter followed. Landau and Tamm translated him the joke into both his ears and when he caught it he could not help laughing as well, but there was a certain time delay. And this Niels Bohr's laugh-intervention provoked a new burst of laughter of all the audience. An unforgettable scene. The opera speaks about difficulties in creating the Unified Field Theory and in its main song there are

the words: “Electron rotates around proton / This thing is called Bohr’s atom”. Niels Bohr did not want to say anything at the event, but having heard the opera he changed his mind, went to the stage and said some warm words to the students underlining that Unified Field Theory surely will be created if efforts are as strong and energetic as this students’ opera. The next day he read to the students of the Physical Department a Lecture on contemporary physics, complementarity etc.

And of course at this Festival the most popular through decades and generations Anthem of physics students of Russia called “Dubinushka”[3] was performed. This Anthem was composed in 1946 by Boris Bolotovsky, at that time the third year student of the University and later member of Theordep of the Lebedev Institute during 60 years. He is among us here in this Hall.

You can see two marble plaques at the main entrance of the Lebedev Institute – of Tamm and of Sakharov. Both are from the Theoretical Physics Department.

Vitaly Ginzburg is another Nobel Prize Winner (2003) from Theordep of the Lebedev Institute. He is almost 93 now, he can not walk, but he is young and strong in his soul and brain. He was again elected a Chief Editor of Sov. Phys. Uspekhi recently. Already this year he gave impressive 30-40 minutes Talks dedicated to 90 years of Uspekhi and on some other important occasions. The Talks were filmed at his home and shown here in this Hall on the Screen. He is also quite active publicly. It was his initiative directed to President of Russia which triggered the State financing of creation of Lab on studying high-temperature superconductivity. And he recently raised his voice in defence of imprisoned scientists falsely accused by secret services in espionage.

4. Making bombs. Who “hardens” and who “directs”?

Fig. 5 shows young Sakharov and Ginzburg when here at the Lebedev Institute they, together with colleagues, worked out the first Soviet Hydrogen bomb based upon two ideas: the First Idea was Sakharov’s Sloika (to place needed substance in spherical layers, in Russian “sloi” – this was alternative to the dead alley Tube worked out by Zel’dovich) and the Second Idea was Ginzburg’s LiDochka (to use Litium – Deiterium mixture in the H-bomb core). Lidia is a woman’s name, Lidochka is the same girl’s tender name. In Fig. 6 you see these “tender” things. But perhaps it is not a joke since it is a good physics after all – as Enrico Fermi put it.

[3] “One who became physicist / he will be never sad again. / At the Phys. Dep. there is not life, but paradise. / Only physicists are the salt of the earth / all the others are sheer zeroes…”.

Fig. 5. Andrei Sakharov and Vitaly Ginzburg, late 1940-th. Courtesy Gennady Gorelik.

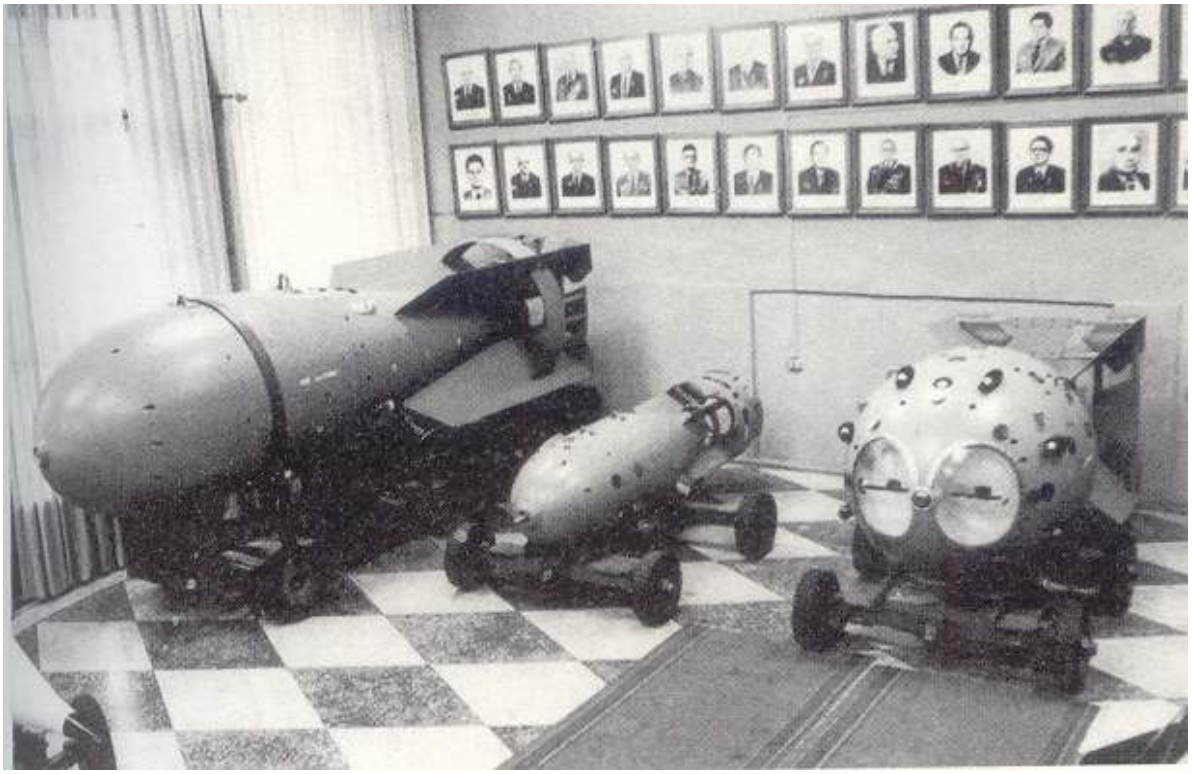


Fig. 6. Three bombs in the Nuclear Weapons Museum in Sarov:

1. *H-bomb – 1953 (Sakharov-Ginzburg "Sloika – LiDochka").*
2. *Soviet original A-bomb – 1951, two times less in size and two times more powerful than Fat Man (Lev Altshuler, Yevgeny Zababakhin, Yakov Zel'dovich, Konstantin Krupnikov).*
3. *First Soviet A-bomb – 1949 (exact copy of the American Fat Man thrown on Nagasaki).*

Soviet intelligence service received detailed information about the construction of the American A-bomb not from their professional residents but mostly from idealistic American scientists who with terrible risk to their life fulfilled their moral debt, as they understood it, to help to restore nuclear balance between two recent allies in the Anti-Hitler Coalition. The name of Klaus Fuchs is most familiar from them. The same feeling had Sakharov, my father, other pioneers of Soviet Nuclear Weapons Project: they did their best to restore the nuclear balance with the USA, to save Moscow from the destiny of Hiroshima and Nagasaki. I avoid making judgments and just try to outline their sincere views at that time. Actually it is easy to make judgments 60 years after events with all the knowledge about subsequent history. As Vitaly Ginzburg likes to repeat: "*I wish I was as clever yesterday, as my wife today*!" However many, many years later Yakov Zel'dovich said with sadness: yes we were happy that we managed to do it, but Stalin with A-bomb in his hands was able to begin the Korean War where millions perished.

Sakharov began to realize the other side of the medal much earlier – for the first time in 1955, after the successful test of the Soviet superbomb based on the Third Idea (in Sakharov's classification) – on the idea of two-step A-H construction with the use of radiation implosion. This is Ulam-Teller construction independently developed by Sakharov and his colleagues. Absolutely ungrounded is the periodically expressed[4] idea that this Soviet H-bomb was an intelligent-service produced copy of the American one. It is well established that Soviet leadership, although knew well about unordinary strong power of American "Mike" (tested on 1 November 1952) and of the Castle Series (from "Bravo" - 1 March 1954, to "Nektar" – 14 May 1954), but did not have the slightest idea about absolutely new principle of their construction. In his "Memoirs" ([7], P. 182-184) Sakharov remembers that at the beginning of 1954 there was strong opposition by their Minister Vyacheslav Malyshev to the scientists' proposal to go another, previously unplanned way – way of "Third Idea". This opposition would never take place in case leadership, including Minister Malyshev, had proper information from the intelligence service.

In this sense situations with H-bomb and A-bomb were directly opposite: in 1948-1949 Chiefs of the Project just said to scientists to develop less effective (cf. two models in Fig. 6) "American" A-charge because they possessed detailed information about its construction and they wanted to minimize the risk of failure. It's worth mentioning that most of the scientists did not even guess it. My father was strongly surprised when Yuli Khariton, Scientific Chief of the Nuclear Center, said in his interview in 1990 that the first Soviet A-bomb was a copy of the American one. Father said also that success of the 1949 test was practically guaranteed since the fission core of the bomb was made very close to the critical mass – to such an extent that when that time Minister Boris Vannikov (fat man with huge belly) approached the construction Geiger counters began to chatter crazily from neutrons reflecting from his belly.

[4] Like e.g. in "The Nuclear Express: A Political History of the Bomb and its Proliferation," by Thomas C. Reed and Danny B. Stillman, 2008.

And now about superbomb again. Fig. 7 shows Cover list of the Sakharov and Zel'dovich top secret ("*written by hand, in 1 copy, 16 pages*") Report to Yuli Khariton, dated 14 January 1954, on the idea of construction H-bomb with the use of "Third idea"; in the picture you also see the Central Square of the Town of Sarov with the bell-tower of the famous Sarov monastery.

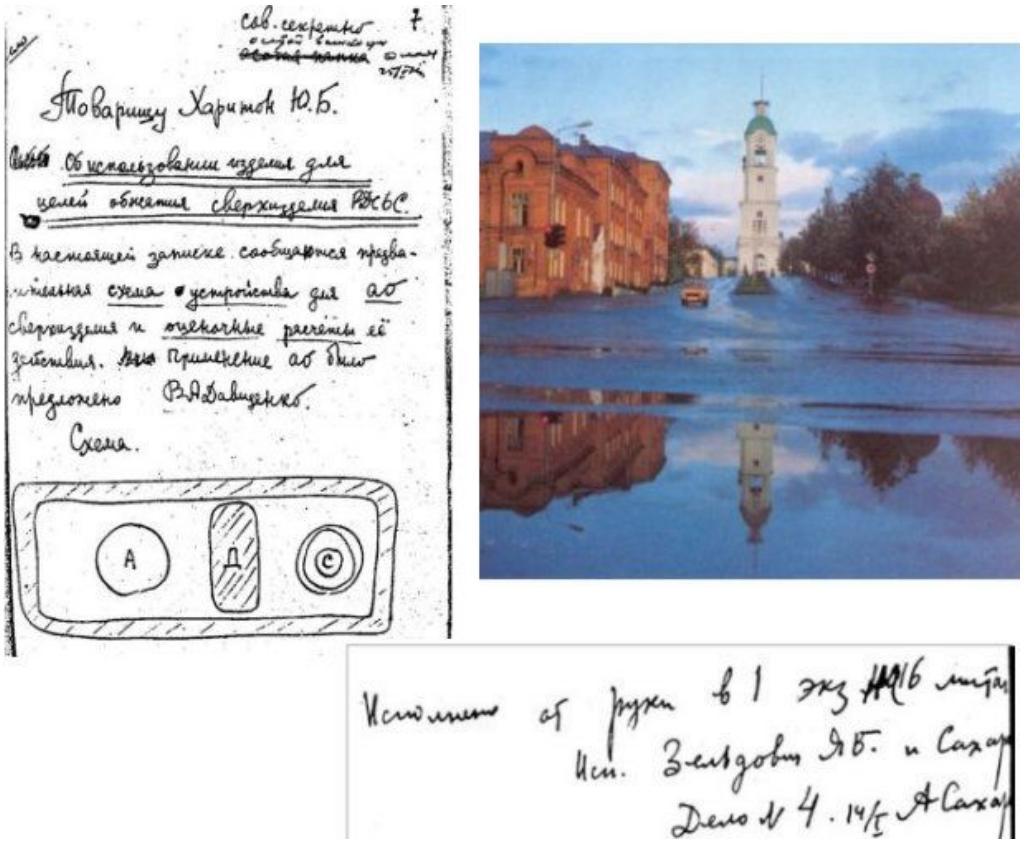


Fig. 7. Sakharov and Zel'dovich Report (14.01.1954) on the two-step (A-H) construction combined with photo of Central Square of the Town of Sarov.
Courtesy by Gennady Gorelik who designed this picture.

This device, contrary to A-bombs and to Sloika had potentially unlimited power. There was a banquet after the successful test of superbomb on 22 November 1955 organized by the military chief of the test Army general Mitrofan Nedelin, where Sakharov as a hero of the event was proposed to tell the first toast. And he said: "*May all our devices explode as successfully as today's, but always over test sites and never over cities*". These pacifist words made a shock. Sakharov remembered that "*the table was silent as if I had said something indecent*". Then Nedelin took the floor and said really indecent parable about old man and his wife who discuss who must "guide" and who must "harden". The reprimand addressed to Sakharov meant that you – scientists must "harden" (make weapons) and we shall "guide" (make decisions how to use them). Sakharov writes: "*My whole body tensed, and I think I turned pale – normally I blush. For a few seconds no one spoke, and then everyone began talking loudly…*" ([7], P. 194). It must be noted that M.I. Nedelin, already being in the position of the Commanding General of all Soviet Strategic Rockets Troops (RVSN) burned alive on 24 October 1960, together with about

100 subordinate to him high officers and specialists, at the test of new intercontinental missile; the tragedy happened because he ordered to do something in direct violation of elementary safety arrangements demands ([7], P. 195-196). The same they could easily do with the whole Mankind.

Fig. 8. Joke-model of the First Soviet H-bomb ("Sloika") with devil on it.
Done by Yuri Klintsov, Arzamas-16, 1953

Perhaps this nose, which in Fig. 8 devil shows supposedly to nuclear scientists, hints about the second side of the medal discussed above ?

5. Humor and Work

Humor (as in the Fig. 8) is a good thing but the product of creative work of scientists was surely quite serious. Professor Vladimir Ritus, many years Theordep member and participant of our Conference, said to me recently the "snapshot of memory" from the early 1950s when he worked in Sakharov's group in Sarov. The only copy of "Sloika" which they developed at that time was suspended in the Assembly-Hall of the Factory # 2 of Explosives where the bombs were finally designed. Vladimir Ritus said that from his visits to this Factory he most of all was impressed by the huge, more than 1 meter diameter, shining hemispheres of explosives placed without any special security protection in huge hangar, where also plenty of A-bombs ready for use were stored. And between them there walked around the Army or Naval officers - representatives of the weapons-acceptance commissions.

Anatoly Mal'skii, Director of this Factory # 2, was a huge, vivid personality with loud laughter and plenty of most interesting stories about the war-time etc. I remember him well since my father liked to converse with him and he was an often guest in our home. On 26 June 1953, the day of arrest of Lavrenty Beriya, Mal'skii made a practical joke which became a legend. Lavrenty Beriya was Minister of NKVD (later KGB), many years Chief of the Nuclear Project of

USSR, terrible personality, but at that time – second after Stalin (who died 110 days before the event, on 5 March 1953) and most respectable member in the divine hierarchy of the Soviet top power. Anatoly Mal'skii heard the announcement about the arrest of this "enemy of people" over the radio early in the morning, and coming to his workplace immediately went to the study of his friend Vasily Detnev, Beriya's representative in the Nuclear Center (who, as it can be seen from the recently declassified documents, wrote so many nasty reports to his Chief about scientists). Surely Detnev had a huge portrait of Lavrenty Beriya over his table, and he did not know yet about the latest shocking events. Entering the room Mal'skii asked: "Vasily Ivanovich, why are you sitting under this bastard ?". The effect was above all expectations. Later Malskii not once with great pleasure described Detnev's picturesque horrifying reaction.

They all were young and joyful. Sakharov, like Yulii Khariton and Yakov Zel'dovich, being most important for the State nuclear scientists was obliged to have a personal armed body-guard who followed him everywhere like a shadow (but not inside the apartment, they waited outside). One day in Spring, when there was high water in River Satis near Sakharov's cottage, and there were plenty of chaotically moving ice floes in the river, Sakharov suddenly began to jump from one ice floe to another. This was deadly dangerous. And his body-guard responsible for his life and security, being terribly frightened, began to run after him jumping over ice floes with a pistol in his hand and shouting a typical military guards' order: "Stop, otherwise I'll shoot you!" (Yu. Smirnov in [6], Pp. 591-619).

Fig. 9. Yakov Zel'dovich, Andrei Sakharov, David Frank-Kamenetskii, Sarov, mid-50-th.

In Fig. 9 we see these brilliant people when they created the superbomb. The photo was taken at the plot of David Frank-Kamenetsky's cottage in Sarov. When, much later, Stephen Hawking met Yakov Zel'dovich at some international conference he was strongly surprised to see a single person. He said (with his talking machine): "I was sure that 'Yakov Zel'dovich' is a sort of

nickname for a team of scientists like say Burbaky". David Al'bertovich Frank-Kamenetskii was also a very strong scientist. And they were very good people, with great sense of humor as well. Fig. 10, 11 show Sakharov's joke-pictures of these years.

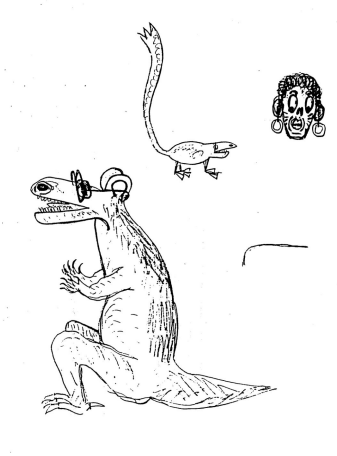


Fig. 10. Sakharov's joke-pictures, Sarov, 1950-th.

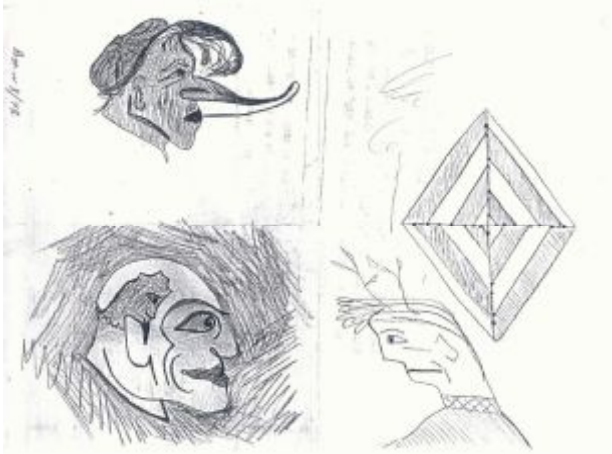


Fig.11. The same: self-portrait, Yakov Zel'dovich.

Jokes, including different practical jokes, was an everyday routine for scientists. Yakov Zel'dovich was # 1 in these adventures.

Also it is from this period the fantastic story about Sakharovs' absolutely special way of thinking which Yakov Zel'dovich said not long before his death in 1987 to Professor Igor Dremin, working in the Theoretical Physics Department. He is also here in this Hall. Their talk in the Editorial Office of "Uspekhi" began from the Zeldovich's note: "I can classify all physicist in the Soviet Union arranging them systematically. But I am incapable to find the place for Sakharov in this row". And to the Dremin's surprised "Why?" Zel'dovich said the following story. One day, in the process of constructing the bomb they came to the necessity of receiving one crucial figure. Since the State terms were short Institute was given a month to receive this figure. And because of its importance the assignment was given to two theoretical groups (one chaired by Zel'dovich and other by Sakharov) and two experimental groups, all of them were not informed about others. Only Zel'dovich knew that the work is fulfilled in 4 parallel teams. Zel'dovich said to Dremin that his group worked hard but did not manage to receive any definite result. Then after a month he came to Sakharov and asked about the situation in his group. Sakharov said that he himself contemplated and estimated and received some figure. Zel'dovich asked him to put down the figure on the blackboard, and closing it with a palm invited to the room the first experimental group also asking to write their result on the same blackboard. And also closed it with the second palm. Then the second experimental group was invited and they wrote their figure. When Zel'dovich removed his palms everybody could see that all three figures coincide. How Sakharov guessed the figure is an enigma. And it is not the only story of his miraculous

guesses. In this connection Zel'dovich used to tell: "my brain is a computer which works 10 times better than brain of ordinary man, Sakharov's brain is designed in some different way". And let us remember Igor Tamm's words about Sakharov and blank sheet of paper which I cited at the beginning of the Talk.

6. **One thousand years delayed crime and Moscow Test-Ban Treaty**

Fig. 12. Andrei Sakharov and Igor Kurchatov, Moscow, 1958.

In 1958 Igor Kurchatov, Scientific Chief of all Soviet Nuclear Weapons Project, asked Sakharov to write a paper about harmful biological consequences of the nuclear tests in atmosphere. Sakharov came to the conclusion that many thousands of people from future generations will inevitably die because of genetic damages produced by modern tests. And he began his dramatic struggle for reduction and total prohibition of the nuclear tests which make radioactive pollution of environment. His arguments were really strange: he insisted that death from cancer (because of the far off mutations produced by the modern nuclear tests) of some person one thousand years later is a CRIME perpetrated by those who today made this explosions; the fact of absolute anonymity of the perpetrator of this crime makes it even more serious and immoral. Nobody understood this Sakharov's logic. This logic shows that attention to the tragedy of one single person (no matter when and where the person lives), a sharp feeling of responsibility for this tragedy was an essential facet of Sakharov's personality. Later this deep spiritual position became the mile stone of his human rights activities.

And this resulted in the famous August 5, 1963 Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water. The point is that in the Big Politics like in tennis

you must “catch the ball” – catch the moment of the intervention. All these topics were actively discussed in the Theory Department of the Nuclear Center, and some moment in mid-1962 Sakharov’s colleague in creating H-bombs Viktor Adamsky (he regularly read *Bulletin of the Atomic Scientists* which they received in the Nuclear Center and attentively followed the events) drafted the Proposal to the Soviet tops with the idea to cut out from the test-ban negotiations the highly problematic topic of the underground nuclear tests. Sakharov liked the idea and approached with this proposal to their Atomic Minister who said it to Soviet Leader Nikita Khrushchev, who in turn used the idea as the profitable “political ball”. As a result there are no polluting nuclear tests during 46 years. (See in more detail in [7] P. 224-232; [4] P. 229-231).

However earlier – in 1961-1962 Nikita Khrushchev was strongly irritated by Sakharov’s insisting proposals to decrease the number of Soviet nuclear tests in atmosphere. Sakharov’s failure to persuade Khrushchev to cancel one of two H-bombs’ duplicate tests in atmosphere was a great blow to him which resulted in essential turn in his general understanding and general position: *“It was the ultimate defeat for me. A terrible crime was about to be committed, and I could do nothing to prevent it. I was overcome by my impotence, unbearable bitterness, shame, and humiliation. I put my face down on my desk and wept. That was perhaps the most terrible lesson from my life: you can’t sit on two chairs at once…*” [7], P. 229.

Sakharov told me that on one of these dramatic days Khrushchev summoned him to the Kremlin. When Andrei Dmitrievich entered his study, Khrushchev did not invite him to take a seat, but stood up in front of him and began to speak angrily: “Who are you, you don’t understand anything, imperialists will eat us up…”. Becoming more and more excited and angry short Khrushchev stamped, went read and almost shouted. Tall Sakharov listened silently. This reprimand continued for a number of minutes, after that Khurshchev said sharply: “Go away”. When Sakharov went out the room he encountered face to face with Leonid Brezhnev, that time one of the top Party leaders, who after the Coup in October 1964 took the Khrushchev’s position of the First Leader of USSR. Brezhnev knew Sakharov very well, and according to Sakharov’s words while he was walking along a very, very long Kremlin corridor Brezhnev went after him repeating and repeating about his most deep respect for Sakharov (when Khrushchev was dismissed he was accused among other things in ignoring the opinions of scientists). Yes, they all at the “top floor” knew him well, but he stayed “on the other side of the window”.

7. Pure science

In mid-60-th Sakharov, in parallel with his nuclear weapons work, returned to pure physics. In his first paper from this period published in 1965 he put forth the idea of primordial vacuum quantum fluctuations as a source of a non-uniform distribution of matter in later cosmological epoch [8]. The interest to this work was strongly revived 10 years ago with COBE and

subsequent experiments - to see it it's sufficient to dial words "*Sakharov oscillations*" in Google. There is an enormous number of references. Yakov Zel'dovich and Rashid Syunyaev developed the idea later, Rashid Syunyaev made the Plenary Talk here, on the first day of the Conference. And it must be appreciated that in their first work of 1970 Zel'dovich and Syunyaev honestly referred to pioneer Sakharov's paper of 1965. This was not trivial since at 1970 Sakharov already was a "political pariah" and the authorities did their best to eliminate references to his name in any published materials.

This Talk is not a review of Sakharov's scientific achievements. I just name several. I already said above about "magnetic bottle" and Magnetic Cumulation. In 1967 his two "pure science" classical papers were published: on the possibility of the Einstein gravity action being induced by quantum vacuum fluctuations [9], and explanation of the barion asymmetry of the Universe with "crazy" idea of instability of proton [10] – naturally introduced 12 years later in GUT.

It is worthwhile to note that his paper "Cosmological transitions with changes in the signature of the metric" [11] (1984) written under most difficult conditions in the exile, is also often referred to as a pioneer one - at this conference in particular.

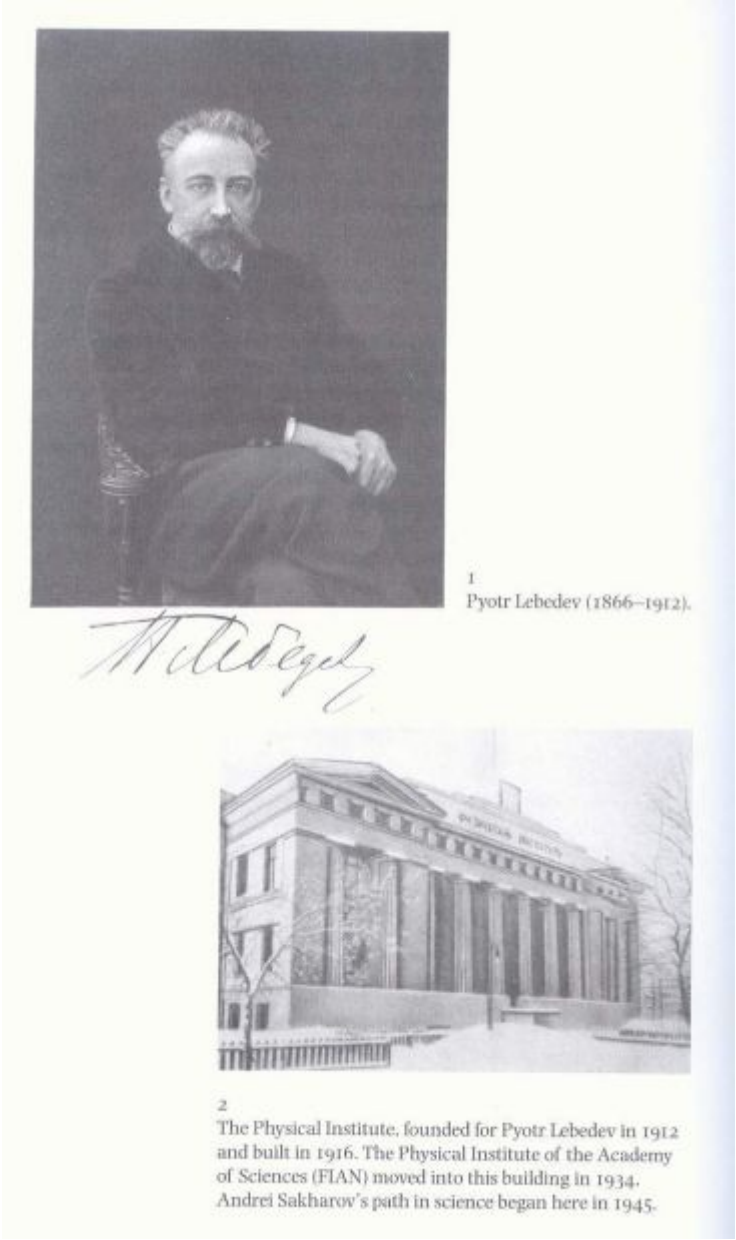
Who knows, perhaps another Sakharov's paper [12] (1986) written in the exile where he studies the processes of quantum evaporation of black miniholes will be strongly demanded soon. I mean not once repeated "crazy" idea of possibility of observing black miniholes at LHC. In their comments to paper [12] in Collection [13] Igor Novikov and Valery Frolov say that the results of [12] indicate new possibility of observing Dark Matter through its influence upon evaporation of black miniholes. And Valery Rubakov in his comments in [13] writes that "this article is aimed at distant future since it proposes perhaps the only possible tool of direct experimental studying of processes at the energies which can not be reached at accelerators, up to Planck scale"; Rubakov also underlines that in [12] the interesting task of calculation of probability for the production of strings and monopoles by black miniholes is considered.

In more detail one may study Sakharov's scientific work from the Collections [13]-[15].

8. Pyotr Lebedev, FIAN, Klavdia Vikhireva, Elena Bonner.

There were many threads which connected Sakharov with the Lebedev Physical Institute which was founded on 28 April 1934. Less than a month ago FIAN's 75 anniversary was celebrated. The building in the Fig. 13 was built by Russian philanthropists for Pyotr Lebedev after he, because of inhuman behavior of Tzar authorities, was enforced to leave the Moscow University in 1911, and his Lab was destroyed (see more in [4], P. 3-15). Unfortunately Lebedev himself could not use this building since he died in March 1912. At that time he already was nominated

to the Nobel Prize 1912 for his discovery of pressure of light, but Nobel Prizes are not given posthumously. The same pressure of radiation but many times stronger Sakharov used half a century later as a tool of implosion to compress the core of the hydrogen bomb. The elementary Lebedev's device is placed behind the glass in the study of Director of Lebedev Institute, one floor below.



1
Pyotr Lebedev (1866–1912).

2
The Physical Institute, founded for Pyotr Lebedev in 1912 and built in 1916. The Physical Institute of the Academy of Sciences (FIAN) moved into this building in 1934. Andrei Sakharov's path in science began here in 1945.

Fig. 13. Pyotr Lebedev (1866-1912) and FIAN in 1934. Courtesy Gennady Gorelik.

Sakharov came to FIAN in 1945, worked here until 1950 when he moved to Sarov, and returned here after he was expelled from the Nuclear Center in 1968. In March 1969 his first wife and mother of his three children Klavdia Vikhireva died from cancer. I was at the funerals. It was a tragedy.

Fig. 14. Sakharov and Klava with friends and children, Sarov, 1950-th.

Sakharov was deeply depressed after her death. Then Professor Evgeny Feinberg from Theordep, he passed away 4 years ago, came to his place and asked to write an official request for the position in FIAN. Sakharov wrote something absolutely non-formal on a piece of paper, it was submitted and he returned here.

Simultaneously his human rights activities and contacts developed. He met Elena Bonner on this ways, they got married in January 1972.

Fig. 15. Andrei Sakharov and Elena Bonner.

This was a happy meeting of two. Sakharov not once said that Elena Bonner's activity in helping concrete people directed him from more abstract and general schemes to the importance of protection of individual rights.

Now I stop for a while and give the floor to Elena Bonner's daughter Tatyana Yankelevich, who has just come from the airport and who will speak on behalf of Elena Bonner. I'll make only two short notes in connection with Elena Bonner and Sakharov's physics:

1) Elena Bonner remembered that once in the mid 70-th they had an evening walk under the dark sky full of stars. Andrei Dmitrievich asked: "Do you know what I like most of all ?". And himself answered: "Background radiation".

2) Recently in the interview Elena Bonner was asked to characterize Sakharov shortly. And she said the downright truth: "He was a physicist".

And to present Tatyana Yankelevich I must add that all historically important Sakharov's victories would be impossible without proper support and proper pressure on the political circles of the West and through it on the Soviet political circles. This was to be organized by somebody. Everything important in this world is done not by systems but by individuals often acting on their own. The organizational center of support of Sakharov from abroad were Tatyana Yankelevich, Elena Bonner's daughter, and her husband Efrem Yankelevich who unfortunately passed away two months ago. We all of course express to Tatyana our deep condolences in connection with this loss.

Tatyana Yankelevich greets the Conference
on behalf of Elena Bonner and reads her Article
"The Interregional Deputies Group and Andrei Sakharov".

9. Comments to this Presentation: Sakharov's last year.

Commenting Presentation by Tatyana Yankelevich I point out that so called Interregional Deputies Group (IDG) of democratic MPs described by Elena Bonner was created at the time and after the First People's Congress in June 1989 most known with Sakharov's dramatic speeches there (see Fig. 16, 17).

Fig. 16, 17. Andrei Sakharov speaks at the People's Congress, Michael Gorbachev at the background. Moscow, June 1989.

Elena Bonner writes about Sakharov's last days which were marked by the difficult realization of his initiative of the all-USSR 2-hour Political Strike with demand to cancel the Article # 6 of the Soviet Constitution proclaiming the Ruling Role of the Communist Party.

Nevertheless the Strike was announced through Western radio and through democratic activists and it was really conducted all over the country, there were tens of thousands of telegrams and letters of support, the flood of them came also here to the address of the Lebedev Institute. On 11 December, three days before his unexpected death, Sakharov spoke at this 2-hour Political Strike in the Levedev Institute – see. Fig. 18. Crossed "6" at the poster means the main Strike's demand – to cancel Article # 6 of the Soviet Constitution.

Fig. 18. Andrei Sakharov at the 2-hours Political Strike in the Lebedev Institute. 11 December 1989. Sakharov initiated this Strike throughout the USSR.

Sakharov brought the boxes of thousands of messages of support of this demand to the Second People's Congress and publicly gave it there to Gorbachev, who was not happy about it and made some angry reprimand to Sakharov. It was on 12 December and all the country could see the scene on TV. After Sakharov's death on 14 December in the evening people said that he died because of Gorbachev's reprimand, but it is absolutely childish explanation. Sakharov surely could not be upset with such a trifle. When he died he was alone in the apartment with the outer door which was never locked. Official Medical Conclusion said the truth: he died because his heart stopped. But it did not answer the question "Why did it stop?" To my mind Sakharov's death at the age 68 is a history enigma which will never be revealed.

Many thousands of people came to bid farewell to Sakharov. Top people of the State, beginning with Michael Gorbachev, took part in the Ceremony. Photo 19 shows the funerals on 18 December 1989.

Fig. 19. Funerals of Andrei Sakharov. Moscow, 18 December 1989.

10. Sakharov, Teller, Reagan, Mitterand

I must say that I share sadness expressed in Elena Bonner's strong Article read here by Tatyana. The same demand which was a motto of the named above December 1989 political strike in Russia was two weeks earlier proclaimed in Czechoslovakia and it brought to the streets hundreds of thousands demonstrations, as a result the Government had resigned, the Rule of Communist Party was over and a democratic page in the history of the country was opened. Contrary to this in Russia this Sakharov's initiative was not supported even by most of his nearest democratic partners.

Russia throughout all its many centuries history is a cemetery of good proposals and unrealized expectations of a better society. And nothing refuting this tragic universal rule happened so far. This does not mean however that this will not happen in future. As Sakharov put it: "*The future is unpredictable, and more than that - because of quantum laws it is not determined... It is created by all of us step by step in our infinitely complicated interaction*". And it is just the place to present Edward Teller's words: "*Sakharov was an optimist. A pessimist is a person who is always right but gets no enjoyment from it. An optimist is a person who believes that the future is uncertain and does his best to bring about an improvement*" ([6], p. 637).

Sakharov and Teller met only once in Washington in November 1988 at the 80th Teller's anniversary. They had only 40 minutes between Sakharov's airplanes, which they used to discuss their different views upon SDI[5] – see Fig. 20.

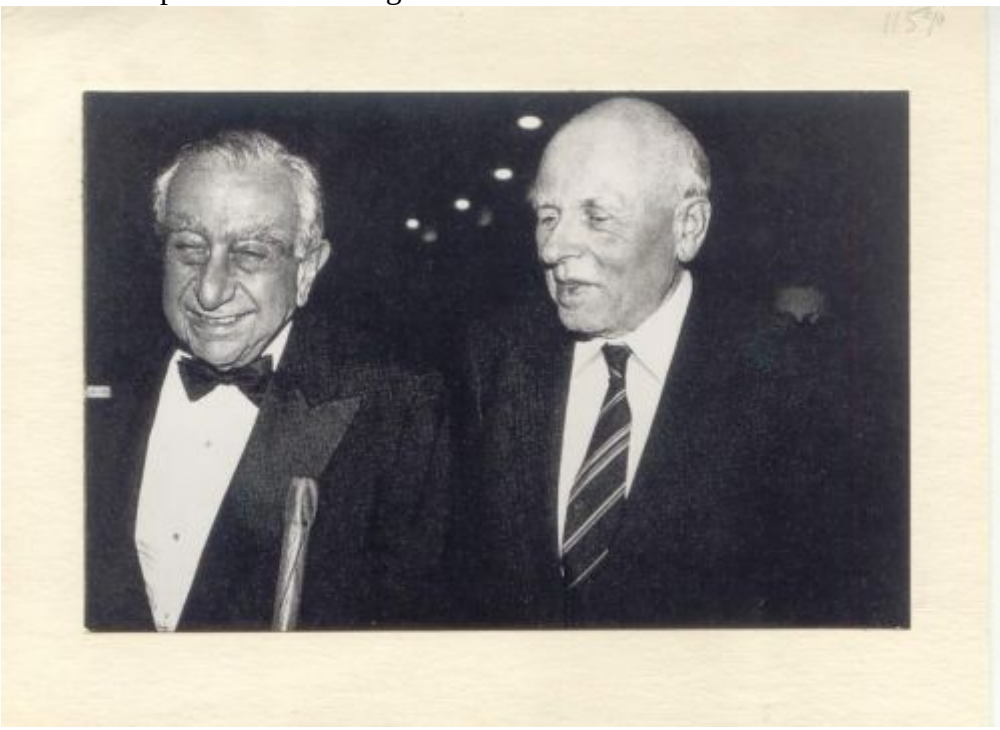


Fig. 20. Andrei Sakharov and Edward Teller, Washington, November 1988.

[5] Strategic Defense Initiative.

It was the first in Sakharov's life trip abroad. At the end of December he came back to Moscow and soon came to the weekly Seminar here in the Lebedev Institute. And colleagues asked him to tell about his journey. It was extremely interesting 2-hour story. Sakharov said in particular about his meeting with the US President Ronald Reagan, they discussed disarmament problems, Sakharov expressed his motivated disagreement with the Reagan's SDI program etc. Professor Boris Bolotovsky asked Sakharov: "Andrei Dmitrievich, are you sure that Reagan understood what you said?". And Sakharov answered: "It does not matter at all. I deliberately spoke slowly so that the assistants could have time to put down my words, because only written stuff is analyzed afterwards". This is an approach of a real scientist, a constructor.

And it is absolutely impossible to forget the described by Sakharov picture of his and Elena Bonner's reception by French President Francois Mitterand (Elena Bonner did not accompany Sakharov in the USA but joined him at the European part of his tour). Sakharov said that they moved over Paris with escort of presidential motorcyclists, and when they came to Elysees Palace Mitterand with his spouse met them at the gate. They saw the long staircase leading to the Palace covered with red carpet with two lines of guardsmen along it with broadswords at their feet. And the very moment when Mitterand and Sakharov with their wives – four of them in line - made their first step on the staircase guardsmen suddenly raised their broadswords up. Sakharov said that it was very impressing and quite solemn, and he asked Mitterand "Why such a ceremony?". And French President turning towards him answered: "You are the Guest of Republic!". I remind that this was in December 1988.

11. Exile. The universal tool of "implosion" and Prince Rupert's Drops phenomenon. Intuition and self-preservation instinct. Three general features of Sakharov's approach.

And about 9 years earlier, on 22 January 22 1980, Sakharov was arrested in the street, on his way to Seminar in FIAN, taken to airplane and sent to the exile to the town of Gorki, 600 km. East from Moscow, 100 km. North from the Nuclear Center where he worked for many years. This exile lasted almost 7 years. There were many dramatic events during this period. They are described in Sakharov's "Memoirs" [7] and in Elena Bonner's book "Alone together" [16].

Immediately after the exile there was enormous pressure on Theordep and FIAN with a demand to dismiss Sakharov. But the authorities failed. Colleagues made a sort of difficult "Italian strike" insisting that the Academician, according to the rules, has no obligation to come to the workplace and can not be fired for "not coming", etc. That time Chief of Theordep Vitaly Ginzburg did his best to persuade Party tops to permit theoreticians to visit Sakharov in Gorki. Finally at the beginning of March 1980 top USSR authorities agreed to it all. Surely it happened because of enormous pressure from abroad, first of all pressure by the world scientific community. But "internal" unwillingness of colleagues to obey the authorities' demands played

also a crucial role. Thus the needed result was reached with implosion, i.e. with pressure from different directions to the same point - like in construction of the atomic or hydrogen bomb.

This sort of “public implosion” was not once used at that time to save people. This is an example how it worked, I showed this demonstrative picture (Fig. 21) speaking in 1991 at the First Andrei Sakharov Conference on Physics.

Fig. 21. Implosion creates miracles. December, 1981.

It was December 1981 when Sakharov was in exile in Gorky and when he and his wife Elena Bonner declared the mortal hunger strike with the only demand – to let the girl Liza Alexeeva go abroad to her fiancé – Elena Bonner’s son. Liza was not their relative, she had nothing to do with State secrets and she was not a dissident. But she was made by the merciless authorities a sort of hostage of Sakharov’s activities. It was really a dreadful situation. And after 17 days of the hunger strike they won – they did not die and the authorities permitted the girl to go abroad. But this miracle happened only due to the collective effect of plural support, of the enormous efforts aimed at one point on all sides. And this seemingly smallest case actually was the most important brick in the building of a new and safer world. Because letting this girl out from the USSR was absolutely against the rules of Soviet system. And when this enormous system was enforced to behave against its laws it was like in Prince Rupert’s Drops (or “glass drops”) where breaking

off the smallest tip changes the structure of all big crystal. (The transparent description of this event from the global point of view is given by Harry Lipkin in his reminiscences "Andrei Sakharov and the Weizmann Institute", [6] Pp. 450-451).

This was Sakharov's approach clearly formulated in his Nobel Lecture: the observing of the individual human rights, insisting on elementary humanity is the best guarantee of the world security. Rulers and Governors who violate rights of their own people are dangerous to the whole world; non-interference into internal affairs in the human rights issues is unacceptable. It sounds elementary but paradoxically the most elementary things prove to be most difficult for understanding. Sakharov emphatically advocated this approach being a teacher, a researcher and sometimes an object of the seemingly mortal self-made "probe experiments" so to say. We know these cases from the history of science when a researcher inventing new vaccine makes the first probe injection to himself. Then there are two options: if his idea was wrong he dies, if not wrong he survives and millions survive after him. Sakharov not once performed dangerous steps – mortal according to common views. And survived. In this way changing the world.

The brilliant illustration of this Sakharov's approach was given by member of Theordep Professor David Kirzhnits[6] ([17], P. 40). He compared steps and actions of Sakharov with the feat of the World War I Russian pilot Konstantin Artseulov. This pilot had an intuitive idea about the mechanism by which an airplane may emerge from the fatal tail-spin, which nobody had been capable to do before. To test the idea and to demonstrate its correctness Konstantin Artseulov, the first in the history of aircraft, purposely dropped the plane into a tail-spin in sight of hundreds of observers (committing, as everyone was sure, a demonstrative suicide at public), and safely came out of it. With this he created a technique saving the lives of hundreds of pilots. (David Kirzhnits told me that he knew Artseulov and that this famous test-pilot did not escape Stalin's camps). According to Artseulov it was necessary to operate unnaturally: not to resist the plane's deviations from the course but, on the contrary, to increase them in contradiction to the self-preservation instinct, to make the plane fall even more steep, and by that to gain the speed at which the subsequent exit from a pique is possible.

Many actions of Sakharov also seemed to contemporaries completely unnatural and in contradiction to the self-preservation instinct. Like e.g. at the first in the life of the top secret scientist press-conference for foreign journalists in Moscow on 21 August 1973 where Sakharov said about supermilitarization of the USSR, about its aggressiveness and great threat of this "evil" to the whole world, explaining with it his main idea: without inner democratic reforms and observation of human rights in the USSR economical *détente* will prove to be extremely dangerous. And he stayed alive although nobody could understand "Why?". Even now it is a question for historians.

[6] Kirzhnits David Abramovich (1926-1998).

In my Opening Word at the Sc3 here in FIAN in 2002 I, rather symbolically, described three «dynamical characteristics» of Sakharov's way of thinking and implementing the ideas:

1) His holism ("ability to count to two"), i.e. ability to see the problem as a whole, to see "the other side of the medal", which is a difficulty for many.

2) Second feature of Sakharov's mentality, evidently crossing with the first one, may be called «a permanent feeling of possible personal error». It was a surprise for everybody, also for me at the beginning of our acquaintance, - Sakharov did not like to argue, to answer back. For him a conversation was just a chance to reach better understanding of the problem. He was a very attentive listener, but quite often he did not say a word in answer; it was evident that while listening to the interlocutor he thinks, perhaps reconsiders something "from a blank sheet of paper", - as Igor Tamm put it. Sakharov writes in «Memoirs»: «*My statements on general issues are often tentative, meant to provoke discussion, and subject to revision. I agree with Leszek Kolakowski when he writes*: **"***Inconsistency is simply a secret awareness of the contradictions of this world… a permanent feeling of possible personal error, or if not that, then of the possibility that one's antagonist is right"* [7]. *My only quarrel,* - continues Sakharov after this quotation of Kolakowski, - *is with the word "inconsistency", which I would replace with one that conveys my belief that intellectual growth and social awareness should combine dynamic self-criticism and a set of stable values… I am not a professional politician. Perhaps that is why I am always burdened by doubt about the usefulness and consequences of my actions. I inclined to the belief that a combination of moral criteria and unrestricted inquiry provides the only possible compass*.**»** ([**7**], pp. 579-580). Sakharov's statements, beginning with 1968 "Reflections…", possess unordinary strong convincing effect just because they are not prophetic ones, because he does nor argue but tries to find truth together with the reader, presuming "the possibility that one's antagonist is right".

3) And he was a professional constructor in all. After Sakharov came to a certain conclusion he thought about the implementation, which of course demanded plenty of additional ideas – see the epigraph. That is why his articles finish as a rule with some calculated concrete figures, and in all other fields of activity the concrete visible result was to be constructed. And in doing it he acted most resolutely, with use in necessity of the "Artseulov method" described by David Kirzhnits (see above).

12. "Beast in a skirt" and return to Moscow.

The history event during Sakharov's exile was his Open Letter "Danger of Thermonuclear War. Answer to Professor Sydney Drell" (1983, see in [7], P. 664-670). In this Letter Sakharov supported President Reagan's military plans directed against Soviet "Empire of evil". Sakharov

[7] Leszek Kolakowski, Toward a Marxist Humanism (Grove, 1968), p. 24.

logic was quite simple: if the West wants to reach real nuclear disarmament – then the West must be strong. And more general dialectics: *difficulties provoke reforming*. Soviet overwhelmingly influential military tops really believed (mistakenly - as it became evident later) that Reagan's programs will soon make all Soviet nuclear power an unnecessary garbage. And because of it they supported the reformer Michail Gorbachev in his difficult struggle for power at the crucial Party Meeting in April 1985. This was the beginning of "Perestroika", soon superpowers came to the table of real nuclear disarmament negotiations and Ronald Reagan came to Moscow to the Red Square.

This Sakharov's Letter to Sydney Drell was not understood by the part of the American scientific community which opposed Reagan's politics ("…*President Reagan's "Star Wars" speech of March, 1983, was such an anathema to the federation's*[8] *goals and positions*…", - Professor Jeremy Stone in [6], P. 625); nevertheless these colleagues tried to help Sakharov in his desperate struggle in exile. As well as SOS (Scientists For Sakharov, Orlov And Shcharansky) Committee, The Committee of Concerned Scientists, and many, many other foreign scientists in the USA and all over the world who were not involved in the questionable "peacemaking" politics, but just followed elementary motives of humanity and solidarity. - Which is the best and direct way to world security according to Sakharov's main Message summed up in his Nobel Lecture.

And this assistance was vitally needed. In the USSR Letter to Sydney Drell inevitably made angry Soviet most terrible hard-liners. After the Letter was published in the West at the beginning of July 1983 the great anti-Sakharov and anti-Bonner campaign was initiated. Actually it was Elena Bonner who managed to smuggle the Letter from Gorki, and she became the main target of slandering propaganda which principal position was simple: Sakharov is a sort of feeble-minded child governed by this monstrous woman – agent of imperialism and of Zionism.

It is quite curious to read the transcript of Session of Politburo (top body of the ruling USSR pyramid) of the August 1985 where Gorbachev proposed to yield to Sakharov's half a year hunger strike and to permit his wife to make the bypass heart surgery in the USA. I must explain here that in May 1984 Elena Bonner was also locked in Gorky. With this the "mousetrap" shut finally and Sakharov's isolation from the outer world became absolute. To accept this situation obediently would be a sort of suicide for him. Also at this time Elena Bonner already had severe infarction and the treatment when every doctors' step was directed by KGB was impossible. Thus authorities did not leave him any option but to struggle. To save his wife's life Sakharov went on one (in 1984) and then another (in 1985) many months excruciating hunger strikes with the only demand – let his wife go for medical treatment abroad.

[8] Federation of American Scientists (FAS).

Thus when they – top Soviet leaders, those with their finger on the nuclear button in particular, – discussed in the August 1985 Gorbachev's proposal they characterized Elena Bonner as "agent of imperialism full of spite", "beast in a skirt". "This is a real face of Zionism", - said Gorbachev supposedly pretending to please this gang. But he managed to insist on his proposal, Elena Bonner got permission to go abroad for the bypass operation and Sakharov stopped his 6 months hunger strike. It was in September 1985. This victory also was a sort of breaking the tip of Prince Rupert's Drop. And surely Gorbachev would be never capable to pass this salutary decision without great pressure from abroad. Important contribution in this campaign belongs to Elena Bonner's son Alexei Semenov who on 25 August 1985 began the unlimited hunger strike before the Soviet Embassy in Washington; he stopped it only in mid-September after US Congress passed the tough Resolution in support of Sakharov. In this situation not to give in to Sakharov's demand would mean to hamper the Gorbachev's already appointed meetings with Mitterand and Reagan.

In June 1986 Elena Bonner came back from the USA and they both were again locked in Gorky until the famous telephone call by Gorbachev in December 1986. On 23 December Sakharov returned to Moscow after 7 years of exile, and on the same day he came here to Theordep to take part in the weekly Tuesday seminar.

Fig. 22. Returning from the exile. Early morning at the Moscow railway station. 23 December 1986.

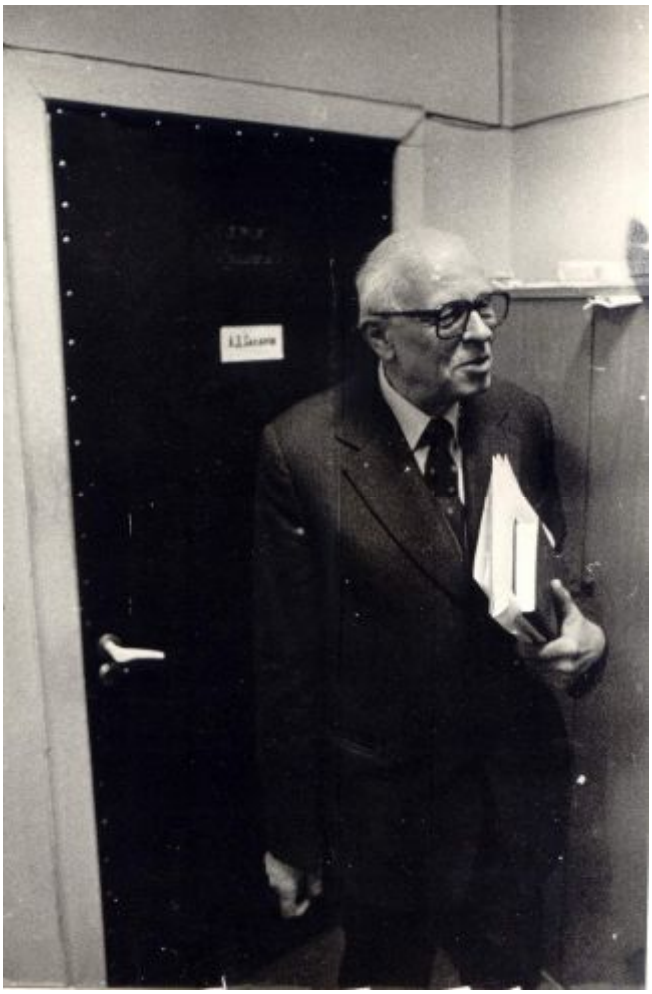


Fig. 23. Before his door in Theordep. December 1986.

The sign “A.D. Sakharov” on the door of his study was preserved in Theordep all long 7 years of his exile. We made now in this study a sort of memorial presentation of photos, and there is also a retro-table which belonged to Igor Tamm and later was inherited by Sakharov.

13. Photos with colleagues. Theordep, Matvei Bronstein, quantum gravity and Stalin’s purges.

In Fig. 24, 25 we see Sakharov among his colleagues at the Theoretical Physics Department. I pay attention to the presence of Professor Yakov Alpert, many year scientist-refuzenik, chief of the Jewish scientists-refuzeniks’ non-official Seminar, he lives now in Boston (“refuzenik” was called a person who was refused by Soviet authorities to leave the country). His presence in FIAN in 1987, when “Perestroika” was on the march, was not a surprise, but I take a chance to inform that during all the difficult years different “suspected persons” (like another famous scientist-refuzenik Naum Meiman or street-cleaner – author of this Talk) had a possibility to visit weekly Theordep Seminars in the Lebedev Institute.

Fig. 24. At the Seminar in FIAN, 1987.
First row: Andrei Sakharov, Vladimir Fainberg, Yakov Alpert.
Second row: Anatoly Shabad, Anatoly Nikishov, Vladimir Ritus.

Fig. 25. At the Seminar in FIAN, 1987:
Evgeny Feinberg, Andrei Sakharov, Vladimir Fainberg, Yakov Alpert, Efim Fradkin.

Following photos 26, 27 are taken at the IV International Seminar on Quantum Gravity (Moscow, May 25-29, 1987). You may see at Fig. 26: Bryce deWitt, Andrei Sakharov and Yakov Zel'dovich. And at Fig. 27: Stephen Hawking and Andrei Sakharov.

Fig. 26. Bryce deWitt, Andrei Sakharov and Yakov Zel'dovich at the Quantum Gravity Seminar, Moscow, 1987.

S. Hawking and A. D. Sakharov at the International Seminar on Quantum Gravity, Moscow, May 1987
photograph by A. I. Zelnikov

Fig. 27. Stephen Hawking and Andrei Sakharov, the same.

Also in 1988 Sakharov took part in huge A.A. Friedmann Centenary Conference in Leningrad (now Saint Petersburg), 22-26 June 1988. He presented there the Review Talk “Baryon Asymmetry of the Universe” (Pp. 417-421 in [15]) with his own illustration of the Galileo Galilei experiment – see Fig. 28. I remember Stephen Hawking active participation in this Conference, and also him with his wife and children on a boat trip over Leningrad.

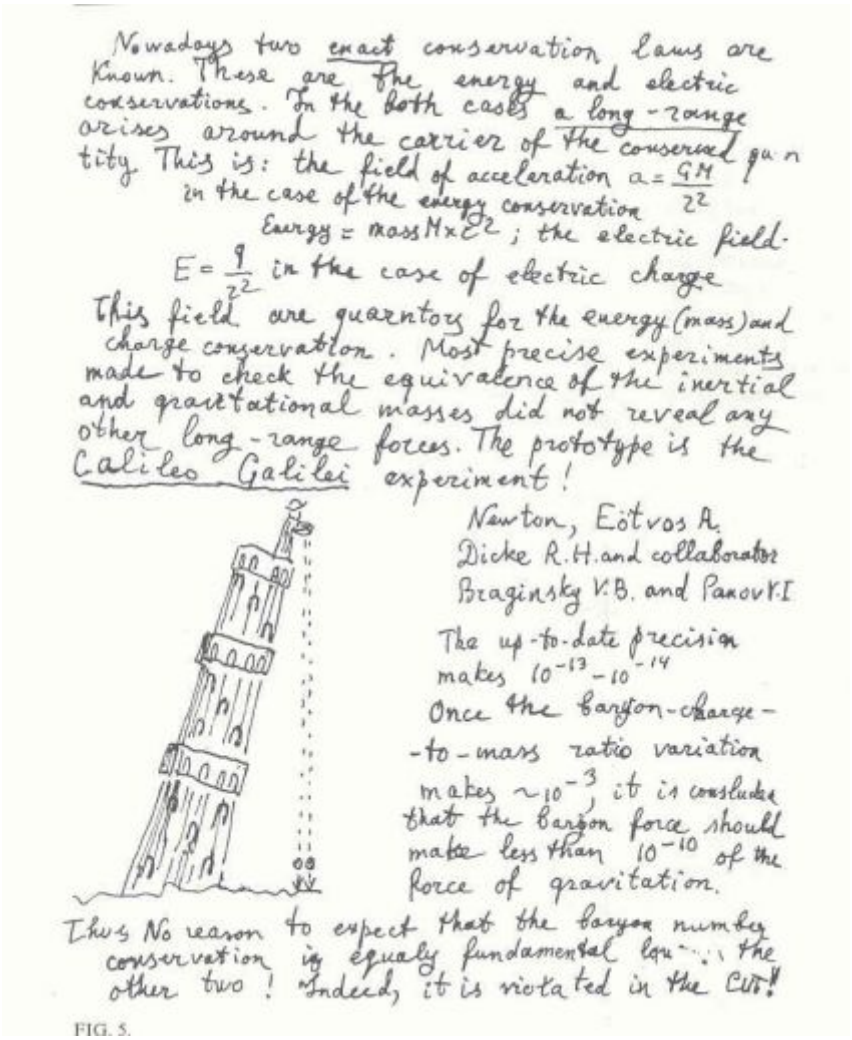


FIG. 5.

Fig. 28. Glileo Galilei experiment at the Pizan tower depicted by Sakharov for his Report at the Friedmann Centenary Conference, Leningrad, 22-26 June, 1988.

Now, speaking about quantum gravity, Theordep and peculiarities of Russian history the name of Matvei Bronstein must be said. This name was already mentioned at the Conference in discussions. In Fig. 29 is the photo of Matvei Bronstein shortly before he was arrested on 6 August 1937 and shot dead in Stalin’s jail on 18 February 1938 at the age 31. He worked at the Lebedev Institute, in the Theoretical Physics Department.

Fig. 29. Matvei Petrovich Bronstein (1906-1938). Last photo. Courtesy Gennady Gorelik.

In 1938 young Sakharov just finished school and entered Moscow University. Surely he did not know Matvei Bronstein, but much later he knew well his wife, his widow Lidiya Chukovskaya, a well known writer and courageous dissident, friend of Sakharov.

Bronstein's works on quantum gravity were published in mid 1930s. His ideas on necessity of reconsidering the concepts of space and time, possible refuse from Riemann geometry when gravity is quantized were really pioneer ones. These papers and Bronstein's ideas, being absolutely forgotten, were revived by Gennady Gorelik (review [18] and previous publications beginning from the one in the 1992 Issue of *Einstein Studies*). Gradually Bronstein's works entered the "reference fund" of modern physics; they are discussed in two major "Quantum Gravity" reviews published in 2004 (one by C. Keifer and another by C. Rovelli, see Ref. 65 in [18]). Lee Smolin writes in 2006: "A few people already understood this in the 1930s. Probably the first PhD thesis ever written on the problem of quantum gravity was the 1935 dissertation of the Russian physicist Matvei Petrovich Bronstein…" Smolin also names another pioneer of quantum gravity "brilliant young French physicist Jacques Solomon" who was killed by the Germans in 1942, and concludes: "I have worked on the problem of quantum gravity all my life and I learned of them only while finishing this book" ([19, P. 85]).

It must be added that in Stalin's times almost everyone had a victim of repressions either in the family or in the close circle. However practically everyone considered their personal tragedy a result of some rare tragic mistake. And society was misinformed to such an extent that nobody could imagine the mass scale of "mistakes" when millions of innocent were repressed. Matvei Bronstein was one of millions milled with this well done and self-consistent system of extermination of people not demanding any (logical, legal) "external" justifications for the

arrests and killings. Young Sakharov was not an exception in this blindness ("I was largely ignorant of the crimes of the Stalin era" [7], P. 272). In his "Memoirs" he writes about his astonishment, already in 1966, when he first read the documentary research presenting the general picture of disaster, which surely was one more reason for him to reconsider critically the "first principles" of the Soviet system.

14. Conclusion. Don't be occupied with political games when barbarous deeds are committed. "This is the miracle of science"

It is interesting to note that problems of Sakharov's attention were as a rule of a huge scale, let it be construction of H-bomb, stages of evolution of Universe or future of Mankind. And he miraculously felt the "painful points" of the problem, the "small" which crucially influence the "big", and concentrated upon this "small" problem. And with all his life activities he proved that the "key" to solution of heavy problems of Mankind is in the observation of the individual human rights, of the primary moral principles when every ideology and political step is in mandatory way checked against the simplest criteria of humanity, sympathy, fairness. In other words: don't be occupied with political games when barbarous deeds are committed.

Concluding I repeat the main thought of the Report: Sakharov's mentality, his method in science and in solution of problems of human society were the same, in all fields of his plural activities he remained a man of exact sciences, a physicist, a construction engineer, an implementor. And it won't be the exaggeration to say that he worshiped the science, admired it, which is also obvious from two quotations below.

In his Lecture "Science and Freedom" (so called "Lion Lecture") at the Annual Congress of the Physical Society of France in Lion, 27 September 1989, Sakharov said in particular:

"*In about 10 years the XXth century will be over… This was the century of two World Wars and of many "small wars" which took the life of millions. This was a century of the unseen before in history genocide. A few weeks ago I, together with 5 thousands compatriots, stood near the open grave where re-burial of victims of Stalin's terror was performed… And at the same time the XXth century possesses the feature which I consider extremely important. The XXth century – is a century of science, of its great breakthrough…*".

In August 1989, completing his second (and last) book of Memoirs, Andrei Dmitrievich wrote on its last page:

«*Of course the end of the work on this book creates a feeling of a boundary, a summary. Paraphrasing a line of A.S. Pushkin: "Why does an incomprehensible sadness trouble me secretly?" And at the same time – a feeling of the powerful flow of life, which began before us and will continue after us. This is the miracle of science. And although I do not believe in*

the possibility of rapid creation (or creation generally?) of an all-encompassing theory, nevertheless I see gigantic, fantastic achievements in the course of even only my own life and expect that this flow will not dry up, but, quite the reverse, will expand and branch out…» [20].

Fig. 30. Andrei Sakharov. 1981.

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