Science, State and Society … 121009

It looks like always in the shadow is the point, that science is a specific field of human activity whose distinctive features are **search for and study of the Novel** (things, ideas, laws, etc). The Novel here means something absolutely new that has **never** been known before. What follows from the point?

First, if mankind wants to know (to use, to figure out, etc) something new (like, for example, electricity, X-rays, or mobile telephone), than sooner or latter some people arrange themselves into a group with an aim to search professionally for the Novel. The people are scientists. Their field of activity is science. It is obvious that the **scientists are normal members of the society** like any others, for example, businessmen, miners, drivers, workers, etc. The society allows them to do science having in mind the future profit for the whole society. Therefore, the interests of the scientists in the fields of their activities are indeed interests of the whole society. Due to general differentiation of labor the scientists obviously know better (than anybody else) what to do right now in science (like in medicine only doctors know well how to save a life).

It is very pity that scientists today are put in a position where they have to make excuses to do professionally science, as it doing science is something not serious, not profitable, useless, a sort of entertainment and wasting state's money.

In particular, concerning the hullabaloo around the recent (2009) start-up of the Large Hadron Collider (LHC) at CERN, the following should be stressed. First, in the assumption that there is no a specially arranged action, the “aggression” against the LHC is an indication of a low education level in the society, when people have lost the ability to comprehend critically what "drops" on them from the TV, newspapers or the Internet. It looks like a testimony of well-organized mistrust to science and scientific labor. This is an example of how the population can be transformed into zombies by the mass media. In fact, it is shown, “who is the master in the house” (show business), what is prestigious to do, and what is not. Second, it is obvious that physicists could **not** be guilty of spending money for creation of the LHC, simply they have no such money at all. The money is given by governments. Therefore, it means that science is really necessary today. Furthermore, in the light of the world financial crisis, the sum of money which countries have spent for the LHC (8-10 billions Euro during 10-15 years) is absolutely ridiculous in comparison with that spent today for overcoming this crisis (500 billions Euro for stabilization fond, supporting the bank system, etc).

Of course, as in any human activity, there are some “bad boys” in science. Nevertheless, how honest scientists do their job, how much their work is in demand in the society are both the questions not of science but the society (its educational level, its

priorities, its law obedience, etc). When the society (via mass media) enters the “inner space” of science (advising the scientists what to do and what not to do), one easily concludes that the society suspects its scientists of unprofessional and dishonest behavior. This outlook on science should be changed, because it doubts the **absolute priority of honest labor**.

Leaving aside some exceptional situations when the state directly asks national scientists for help, the only thing the society must require is the honest professional work of the scientists.

Science is obviously divided into fundamental (or basic) and applied science. Fundamental science looks for and opens new laws and properties of Nature. Applied science uses the known laws and properties of Nature for practical purposes. As a rule, applied science deals with concrete and rather practical problems of everyday life. Practice is the criterion of truth; therefore in the field of applied science a solution of a problem is correct only if the solution really solves the problem. If somebody (being very rich or very influential, etc) insists on a wrong solution, practice will sooner or latter inevitably take “its own” correct solution. Fundamental science is much more complicated because practice is “too far” from being able to choose the correct solution.

Indeed, since there is no market mechanism for assessing the quality of scientific work when there are no obvious results from which the overall effectiveness of the work can be immediately judged (for example, nobody will buy bad footwear), the state control over the effective (or even honest) use of state resources should be permanent and specialized. But, since any external control of efficiency can never be rather qualified (specifics of work is built into the work), requirements to the quality of performers and to their personal state thinking repeatedly increase in science. To make a “good” scientist is a duty of the society and the state.

Furthermore, in the light of a probably approaching world accident, for example caused by a change in the climate, or a change in the polarity of the magnetic field of the Earth, or an approaching asteroid, the irresponsible waste of the state money and intellectual resources (in fundamental science as well), takes the form of an unjustified crime against our grandchilren. To whom it is given much (scientists, for example), they must do much. It is their social duty to provide the future of the nations.

Second, the Novel (in the form of knowledge, a device, a service, a material, or world outlook, etc) is NOT at all a feature of today (otherwise it would not be the Novel), but it is exclusively the **feature of Future**, therefore science is a unique field of human activity where the main task is to test, forecast, create and protect the future, (in general) the future of the whole mankind. We are forecasting the future almost every day, for example, when we are deciding how to spend our salary. It is clear that this work is absolutely necessary for any

normally developing (social) organism (like family, society, or country). It is also obvious that not all plans can be completely fulfilled.

Concerning the time scale in the question of usefulness of science for people, one should not only think of short-term personal benefits. It should be borne in mind that “the people” is not only we today, but also our children tomorrow, and our grandchildren the day after tomorrow and far after-after tomorrow. For sure, they will use our scientific results. Therefore, if there are no direct profit (profit for today) it is not the reason to believe that profit will never occur. Experience shows the opposite: science was born very-very long ago, and since it was not destroyed during the long and difficult human history and still exists, it means that science is necessary.

Fundamental science has the **third** unique and very distinctive property. The subject of its study (being Novel) is always beyond the border of current knowledge — in the zone of completely «unknown», therefore an honest “mistake” and a negative result obtained are both rather natural and acceptable outcomes of research and are very important motives for further more sophisticated study. There are many examples when unexpected, **«wrong» results** of an experiment became, after rethinking, a discovery (like the atomic nucleus). In other words, due to its Novelty, the negative or «wrong» result is a rather acceptable (of course not welcomed and not planned in advance) situation in fundamental science, it is a normal stage of its permanent and positive development.

In particular, this is a reason to stress again why it is very important for science (supported only by a state budget) to have **honest, respectable scientists.**

On the other hand, the right to a (honest scientific) mistake is directly connected with truth. One (very obvious and accepted by everybody) truth transforms with time into a wrong point of view (change-over from Ptolemy to Galileo). Furthermore, any theory is only scientific reflection of our current understanding of the World around us. Therefore, by definition (or construction), it is not exact, not final and not comprehensive. New data and new observations (not available in advance) inevitably change our understanding and bring us to a new and more adequate theory, which will include the old theory as perhaps a very important but nevertheless particular case.

Particle physics is the science of the **most fundamental** laws of Nature. Studying sub-atomic particles and forces binding these particles, it gives us the clue to the understanding of the laws that govern our Universe. To some extent, it is included in the basis of almost all natural sciences. It deals with the structure of matter and in this sense continues the tradition of the most advanced physics in the past. Particle physics is looking for the knowledge without which one cannot think about further human interaction with Nature. Here, as Bruno Pontecorvo said, unexpected discoveries must be, and the question

of practical application of the results of the research (say, at some high-energy accelerator) in the economy is an almost illegal question. Indeed, if we knew the practical application of the research in advance, we had already known the answers to the scientific questions that we ask now, and there would have been no need to conduct the research, create the accelerator, etc.

The **forth** important consequence from the Novel status of science is a requirement for any authority (if it does care about the future of its country) that it should care about the proper development of the national scientific potential. To clarify the point consider an analogy.

One has no doubts that a state defense capacity requires sizable state expenditure (financial, material, intelligence, etc). It is obvious that the army should be adequately supported, trained, armed with up-to-date equipment, etc. Everybody agrees that one should not expect any quick, real payback on the investments in the army (to say nothing about any profit). Furthermore, it would be very plausible if this payback on investments will never occur, due to the fact, that this payback (the primary goal of an army) is direct destruction of the enemy's manpower and materiel on the territory of the state during a war. It is far beyond the obvious that nobody will ask for such payback on the investments for his own country. Perhaps it looks like a paradox, but modern fundamental science resembles very much an army that is not involved in a war (when the army does not kill enemies). Both science and the army are human activities very specific and at first glance very expensive for the state. What is the common here between them?

It is seen from above that science and the army both work for the future. Furthermore, the state (if it cares about defense) should spend money for science and for the army permanently without dreaming about any quick profit. The army should be in good shape (due to training); science should be abreast with developments. The profit direct or indirect, eventually comes. Therefore (from financial point of view) science is a kind of army which protects the state in the specific field of high intellect, at the border of the unknown. It is clear that the victory is not only a result of the battle skills of generals and solders, but also a result of the skills and knowledge of scientists and engineers, who can create (or unarm) a new kind of weapon (which can easily nullify the war talent of a general). There are other similarities between science and the army. Both, while solving their inner problems (for example, creating laser weapon, or remote control of equipment, etc), very effectively push forward technology, industrial production and so on, with a result in the form of practical by-products for everyday usage (IP telephones, internet, etc). It is worth noting that science can easily survive without the army, but not vice versa. Besides science and the army one can put, perhaps, in the same category education and partially culture (partially, because today

culture looks like show business).

The property of pushing forward essentially belongs to fundamental science. For example, solving its own inner problems (search for the Higgs boson, supersymmetry, new phenomena and laws of Nature) modern particle physics generates and uses absolutely new products and by-products (Internet, Grid, high-precision devises, unique technologies, etc). It is these by-products which will be, perhaps not immediately but inevitably, in great demand and drastically change the quality of human life.

It is well known that fundamental science **unites nations.** Indeed, besides obvious high cost (for one country) joint researches do not allow someone to be far ahead in the race for new knowledge. Working together, national scientists (unconsciously or intentionally) watch one another. It is some kind of highly intellectual investigation. In underlies the mutual weapon control. It is more important that only at a **global international level**, as a common defender, science is capable of giving mankind a chance to survive on our planet Earth in the conditions of Space, cold and constantly concealing threat in itself, unknown and absolutely indifferent to us. To understand and to foresee its surprises it is necessary to develop science, especially international one. In particular, the ATLAS Collaboration, working nowadays at Large Hadron Collider (CERN), is a good example of a future international organization for successful solution of problems of common interest, including global ones.

Now we can give answer to the question – why does a State need basic science?

Modern science, in particular physics, chemistry and biology, allows a state to keep track of developments, in particular in the field of the unknown (from which surprises for national defense can arise). Therefore, a high level of fundamental science development allows the state to have a chance to take correct decisions right in time (or in advance). The intelligence one should also be able to understand correctly.

Basic science produces knowledge, which sooner or later produces a practical output, in particular (unfortunately) in the form of new weapons. Since one never knows in advance when this will happen, one must keep his finger on the pulse. Science is the future in the protection of the homeland, the safeguard against any military surprise from a potential enemy. Science allows its State to claim: "We are the first to discover something"; "We are the first to go to space", etc. This all speaks of the state's power, which again improves security and stops the potential unfriends. For such a discovery the state will spare no money.

As already noted, fundamental science, addressing its internal problems, allows us to improve our quality of life and to increase our economic potential. Spin-off products of high-

energy (particle) physics systematically lead to technological breakthroughs, such as the creation of new forms of medical care, medical and not only medical diagnosis; synchrotron radiation sources for the needs of applied research and industry, unique hadron beams to treat various diseases, including cancer and so on. Particle beams, originally created to study depths of the Universe and its laws, are currently able to treat deeply located tumors inaccessible in other ways. Detectors, initially aimed at the search for and discovery of tiny subatomic constituents, are coming into use in medicine to study, for example, processes of human metabolism, etc.

Basic science supplies qualified personnel for industry, technology and education and constantly creates new jobs. It systematically opens completely new, unknown fields of applied science and technology, enriches them with new ideas, provides new tools and methods for research, etc. It is the basis of modern education. Currently, almost the entire every day life in the developed countries, as demonstrated by the transport, communications, agriculture, education, medicine, defense, the scope of employment, is the result of timely investment of funds in various kinds of research, education and training of scientists and engineers. The entire human experience has convinced us that the fundamental research is the real source of the discoveries which change our understanding of the reality and the reality itself (by means of new things, materials, services, etc).

Today, we live in conditions which were created through **new** cardinal changes in technology, economy and society. It is important to stress that these changes are direct results of the fundamental research. Furthermore, science is **the only** source of the changes. The rapid development of physics has made it possible for us to understand and to learn how to use electricity and magnetism, radio waves, sound and light, the structure and properties of atoms. Our growing knowledge of Nature was translated in such necessary by-products as radio, television, X-rays, transistors, radar, laser generators, electrical current, computers, and, in general, any electrical devices.

In general sense basic science directly deals with scientific truth and with laws of Nature, creates a modern (progressive) outlook on the world, and allows one to understand the place of a man in the world, properly educate him as a worker and a citizen, etc.

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