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IN DEFENSE OF SCIENCE

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According to conventional wisdom Brazil, as a developing country, should sponsor a development oriented science; ask for generous cooperation coming from the developed countries; and emphasize the recent progresses of Brazilian science. In this short presentation I will not follow any of these routes. That science should respond to social needs is something that obvious, but not so simple as one could suppose, as I shall argue in this presentation. To ask for generous cooperation is useless. Developed countries are more concerned in keeping the scientific and technological advantage they have, than to transfer their know-how to the rest of the world. More important is that the scientists of the developing countries cooperate among themselves and with the developed countries, but always in equal terms and with mutual benefits involved. Finally, to speech about Brazil's modest but effective achievements is always tempting. After all, in the 80s Brazilian scientists used to publish yearly around 2.000 papers in the most quoted scientific journals; in 1988 we had almost 8.000 papers published. These are interesting themes, but in the opportunity of this World Conference on Science I believe that there is a task that is more urgent: to defend science.

Yes, in our time de defense of science and of the search for truth, the belief in reason and in scientific knowledge became, again, necessary. Science experienced enormous achievements in the twentieth century. Government expenditures with science are always increasing, particularly in the developed countries. Yet, I am convinced that it faces today a serious threat.

The Threat

The signals are clear: public confidence in science reached probably an all time low; science is being challenged by organized groups everywhere; and decisions that are supposed to be taken according to the scientific criteria, are, instead, being asked to

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follow political or moral criteria. There is confusion between ethics and science, between ethical problems involved in science, and problems that are in all respects scientific.

In past science was challenged by tradition and religion. But in those instances it was science against tradition, scientific method against revealed truth. The adversaries of science, although politically strong, had an enormous difficulty in fighting reason, since the belief in the human capacity of rational knowledge had become dominant.

In a second moment, the ethical consequences of scientific discoveries were in cause. When Alfred Nobel invented the dynamite, and, afterwards, in the middle of the century, after physicians came with discoveries that permitted the development of nuclear weapons, the critique was ethical: it was against the misuse of reason or of science, while science itself was preserved.

An Example: GM Food

Now is reason itself and its noblest outcome – science – that are being challenged. Science may still have prestige, but just as an abstract entity, or as a source of technological innovation. Given mounting relativism coupled with increasing public debate of scientific issues, scientists are often viewed as mixed up with their own contradictory theories and prone to error.

A good example of what I am saying is what is happening in relation to genetically modified food. There is an almost consensus in the scientific community that the individual GM food that was carefully scrutinized by a national scientific commission and declared safe will do no harm to health or the environment. Yet, what we see in many countries in Europe is NGOs and public opinion adopting a negative attitude toward GM food. As a British scientist told me: “in this case it is not the genetically modified food that are in question, it is science”.

Most environmentalists argue that nature is too complex and delicate to be grasped by scientists. Thus, they tend to oppose human intervention in the environment, even if the scientific community asserts its safety. Suddenly we come to a conflict between environmentalists and scientists – a conflict that neglects the fact that many scientists are actively working in developing scientific means to better understand and better protect the environment.

Scientists adopt their views on the predicted safety of a given GM food without claiming full certainty, which, however, seems to be required by their critics today, as it was demanded by religious people in the past. Many environmentalists oppose the new genetic technology more strongly than they oppose the agro-toxic substances which consumption is being consequently reduced, although there are no demonstrated perverse side effects involved. My explanation for that is that there is a kind of

ontological prejudice here: while agro-toxic products are spread out over the plants, GM organisms undergo a substantial change – a change in the being of that of the plant or of the food. The fact that changes are small, well known, and under control of the scientists turns irrelevant. The only relevant fact is the substantial or metaphysical change.

The Causes

Why do we have this crisis? There are many possible ways to answer this question. If we look for immediate causes, scientific failures may be one. Scientists, for instance, failed to predict that the "mad cow" disease could be transmitted to humans. Thus, when a new, although unrelated, question emerged – the health and environment safety of genetically modified food and plants –, public opinion in Britain opposed to them, ignoring the broad scientific consensus that the duly approved GM food is safe.

John Durant proposed a more general answer: science is being challenged because everything is being challenged. Because citizens are increasingly better informed and engaged in reflecting about public and scientific issues. This is an interesting hypothesis, an optimist one, since it based in the belief that democracy and citizenship are increasingly strong. I hope he is right, although I do not share the correlation he makes between science and democracy. Durant spoke yesterday morning about the confidence crisis science is facing, and proposed to solve it as democracy problems are supposed to be solved: increasing public debate. I agree that policy problems that involve scientific knowledge should be subject to public debate. But a direct correlation between science and democracy makes no sense: democracy is the outcome of citizens' decisions, science is the outcome of scientists' research; the golden rule of democracy is majority vote, while for science what is crucial is the consensus of the scientific community.

On the other hand, if the progress of democracy involves more critical citizens, it also should involve citizens better informed. Citizens that found their views on data originated in solid scientific research. Thus, it is at least paradoxical that more informed citizens may contribute to the distrust in science.

Let us look for additional causes. The extraordinary advance science is undergoing involves increasing interference in our lives. Or, when this happens, political and ethical problems emerge. Thus, the very science that make us live longer, live better, live better informed, is the science that is being challenged. When science was just beginning, it could be well ignored by the people. Today this is impossible. One has to respond to science. To admire its achievements, to fear its misuse, and to doubt of science when, wrongly, we mix up its misuse with science itself.

Forth, a radical relativism is everywhere. In this century we moved from an arrogant neo-positivism, that made truth an easy prey of science, to a dangerous relativism, that downgrades science. Full relativism is today as detrimental to science as neo-positivism was in the past. It is arrogant and authoritarian to believe that scientists are able to achieve the definitive truth. Since Popper it is clear that our theories are scientific if they can be falsified and have not been so. Since Kuhn we know that the final scientific criterion is the consensus of the scientific community: theories are viewed as right as long as they are accepted by the more respected scientists in each branch of science. But Popper and Kuhn were not relativist. They never said that the search for truth is impossible, or that science essentially crippled. Scientists only come to a consensus after repeated experiments and/or after severe and methodic observation and reasoning. Some sciences are more precise or advanced than others are. Human or historical sciences will never be as precise as physical or biological sciences. When there is no consensus among scientists, when a given theory or explanation did not become consensual among the scientific community, the ideas that scientists express are just opinions. But when there is consensus, or a reasonable consensus, we are confronting scientific knowledge. We shall not achieve full truth or absolute certitude, but, thanks to science, we are far, far away, from absolute ignorance.

These four causes lead scientists to adopt a defensive attitude, which only worsens the problem, eventually consisting in additional causes for the threat science is facing. This defensive attitude is either expressed through a guilty spirit or through an extreme instrumentalism.

We can see the symptoms of a guilty syndrome everywhere, including in this conference. The fact that science was misused by national governments or by business enterprises does not make scientists guilty and compelled to explain. We may only feel guilty when we make mistakes, and scientists do make mistakes. But they cannot be made responsible for the way science was used, unless they are also involved in the application or the engineering of science. The decision of dropping the atomic bomb, the failures in managing the Chernobil nuclear plant, the use in agriculture and industry of aggressive technologies to the environment were possible due to the advance of science but were not scientific decisions. They were political or economic decisions taken by national governments or business enterprises – decisions that, if counting with the direct participation of scientists, this participation was marginal.

Instrumentalism

Finally, given this defensive attitude, scientists recur to instrumentalism. That is most likely the subtlest and worst threat to science. We live in an increasingly complex world system, where everything is interdependent. In this sense science is instrumental, it is part of larger whole. Yet the essential legitimacy of science is not in

its practical uses, but in enlarging knowledge. When this simple principle is forgotten and an instrumental view of science prevails, science ceases to be an autonomous and major endeavor, basic science is undervalued, scientists are subordinated to economic and political criteria. Science is in crisis.

This tendency to make science instrumental to something else, particularly to economic development, is present everywhere. It is not just a demand of civil society or of the economic system, but a risky strategy scientists adopt to gain legitimacy, as the draft of the basic document for this conference, the *World Declaration on Science and the Use of Scientific Knowledge*, well illustrate. The draft (June 3 version) correctly asserts in its Introductory Notes that:

> Many of these (new groups) are concerned with the environmental and other issues that science and technology are expected to address; some may indeed reflect a certain lay disenchantment and disregard for science, and a fear of the unforeseen or unknown consequences of some of its implications. The confusion about whom speaks for science amongst the many actors, and whose science can be trusted, can add to this public mistrust.

But which is the remedy that is proposed for that problem? The draft deals with many remedies, but I believe I will not be unfair to say that its main proposition is that:

> The progress of science can no longer be argued purely in terms of the search for knowledge for its own sake; it also must be defended – and increasingly so in view of budgetary restrictions – through its relevance and effectiveness in addressing the needs and expectations of society.

Science is supposed to be relevant for human needs, but should not be reduced to an instrument to these needs. The draft document is organized according to sections that have for titles phrases as “Science for Knowledge; Knowledge for Progress”, “Science in Society and Science for Society”, “Science for Peace and Development”. When we see that, when we accept that the legitimacy of budgetary appropriations depends on its practical outcomes, we have a signal that we are in trouble. That the advance of knowledge itself, that the search for truth, is turning, or already became, a secondary or subordinate objective.

Objectives and Criteria

But why am I so concerned with relativism and an instrumental view of science? Why I am insisting in defending the autonomy of science in relation to the ones that envisage to subordinate it to economic development and to the other that defy it in name of sustainable development? In a global world, where markets and competition became dominant in the domestic and in the international realm, are we not constrained to be practical, relevant, growth oriented? And in a world whose survival is being threatened by the violence that economic growth often does against

our common environmental patrimony, are we not constrained to fight for sustainable development?

The two last questions require a “yes” answer. But it is clear that the two answers will be contradictory one to the other. And they may be contradictory to the very objective of science: knowledge.

Historically mankind has defined some basic political and human objectives. The two first political objectives that became common to civilized societies were political order, as an expression of the power of the prince, and justice, as the form power was supposed to be exercised. With mercantil capitalism came forth a third political objective gained relevance: economic well being or economic growth. In the eighteenth century freedom or the civil rights were incorporated in the value system of modern societies. A century later equality or social justice came to the scene. Only in the second part of this century a last and major political objective was defined, sustainable development.

These are political objectives because they depend on the political institutions, and on the way nations are governed. The fact that they have been historically defined does not mean that they have been achieved, or that there is an irresistible tendency to their fulfillment. Besides the political objectives, we have some basic objectives that are not directly dependent on the political regime, but are essential to the human condition. Among them I would give emphasis happiness and knowledge.

The eight objectives are final objectives in the sense that they should not be subordinated one to the other. But, since they are often contradictory among themselves, are we supposed to organize them according to some hierarchical criterion? No. They are final. But they cannot be viewed as absolute objectives. When they are in contradiction what society has done was to make trade-offs among them.

In the case of science, however, such trade-offs are not needed. Science it is committed to a final objective, knowledge that, in principle, only can facilitate the accomplishment of the others. Thus, knowledge and science cannot be subordinated to economic development nor be challenged by sustainable development for an additional reason. Only its use can be subject to ethical criteria.

All these objectives are part of the ethical or value system that civilized societies have been developing through the centuries. They establish criteria to human behavior. But it is important to clearly distinguish the ethical from the knowledge criteria. Here, instead of many objectives political or human objectives, we have a binary classification. Problems involving science that are just scientific, requiring scientific criteria to be judged, or are problems that are ethical. In order to direct personal behavior as well as public policies, ethics has to be combined with science, normative rules with knowledge, but it essential to distinguish the problems that are eminently scientific from the ones that are rather ethical. For instance, when scientist

are asked if a given GM food is safe or not, this is a scientific question demanding scientific expertise; when, on the other hand, it is asked if is admissible to engineer human clones, this is an ethical problem requiring ethical criteria. We also could ask – although the question seems to me a bit strange – if a GM food that is safe still is not ethical; what we cannot do is to dispute that that GM food is safe using for that our ethical criteria.

For given purposes we can distinguish knowledge from scientific knowledge. Certain types of knowledge are common to all citizens, other require scientific capability. In the later case the assessment by scientist is essential. Some public policies depend on a scientific assessment; all depend on the knowledge and the ethical criterion.

These are simple ideas, but not easy to put in practice. When we see science being challenged by environmentalists or transformed into an instrument by politicians and the scientists themselves, we see the importance of clearly distinguishing the scientific criterion, from the ethical criterion. Science and ethics are not contradictory. They just belong to different realms – the realm of the "to be" and the realm of the "should be". Thus they are different, and this distinction should always be present to each one of us. To ignore or to oppose science in name of a given ethical principle, or in name of beliefs that have no support in science, is to go back the times of obscurantism.

Conclusion

If I am warning against an instrumental concept of science, this does not mean that I disregard its importance for economic growth. If I oppose radical environmentalism, this does not imply that I underestimate the threats that are posed over our world. In science and in technology rests a major part of the hopes of the developing countries to revert the tendency to increase the gap between them and the developed countries, and the hope of the whole world of reverting the forces working for against the environment. If we are able to absorb and adapt technology to our needs, we may change these trends.

Given the historical significance that probably this *World Conference on Science* will have in the future, the Brazilian delegation assumed an active role in several domains – an active and critical role. This conference is asking for a "new commitment", for a "new social contract with science" - a commitment or a contract in which we will "pledge for the betterment of the poor, and for a sustainable development". I have nothing to object to this except the world "new". Have we not been doing that? Or have we, scientists, been working against the poor and the environment?

We all know that science and technology has been misused. We know that the distance between the rich and the poor countries is just increasing in the last 50 years. We know that the environment has been used and abused. But we should also know that this happened because national government and business enterprises were and are involved in protecting their own interests, not because scientists were successful in their scientific research.

I am not saying with that the scientists are saints. They are not. But it is a non-sense to look for main causes of the injustice and the privilege that are dominant in our world among us. We have our commitments. We may improve them. We may discuss among ourselves the relevant ethical questions that involve our profession. But the ones that need "new" commitments are the national governments and the business enterprises that compete in the world market – not us.

The caveats that I presented here about turning science instrumental may be too obvious. I hope they are. But since the world we live today is a post-modern world, is a world where science and knowledge reached high heights, while, in the same time, doubt or uncertainty about everything became so widespread, some basic values have always to be reasserted and defended. One of them is science. When science is just made instrumental it immediately loses part of its legitimacy, and easily becomes target of open or concealed attacks.

My distrust on a broader cooperation between developed and developing countries may be pessimistic. I hope it is. But what is important for the developing countries is to count with their own capacity of developing science and technology, out of their own endeavor and self-commitment. Developing countries are learning the hard way to take care of themselves in a more effective way. Higher education and science can help them feel secure in following their own advice, can help them to learn from their own mistakes, and to have always clear for themselves that science only makes sense when the one who dominates it is able make good use of it.

For sure we, scientists, in the developed and in the developing countries, have to be modest, our scientific propositions need to be careful, we should never ignore our shortcomings or avoid internal and external critique and debate. But this should not lead us to make science relative or instrumental. In any of both cases we are failing to defend it – and we know well that science is a patrimony of mankind.