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A Frame for Science, Technology, Knowledge and Society.

The Challenges of the 21st Century

Foundations of modernity

We all agree that modern science was born somewhere between the 16th century and the 18th century. What is more difficult, by contrast, is to say exactly what was invented then. For some, it was a philosophical turning point, a change in the way people looked at things. For others it was the invention of artificial experiment, the increasingly widespread use of *experiment* to the detriment of *experience*. For others, it was an attempt to view the world through mathematics, limiting its ambitions in a sense by only describing numerical relationships between measurable entities. Finally, for others still, the essential thing was the interface with the world of technology and the relationship with the mechanical world and the world of machines.

In epistemic terms, this could all be summed up in a sentence. What modern science invented was a way of questioning the world, an operational and instrumental approach offering a way of coming to grips with the world, a means for man to become master and owner of nature, as the saying goes. You will note that this founding image of modern times is based on a double disjunction, between subject and the object, active and passive, between man and nature on the one hand and between truth and contingency, knowledge and opinion and in a sense between science and politics on the other hand. However, these two disjunctions are broadly what is in the balance today.

We also know that a second type of "revolution" occurred in the second half of the 18th century which was a political and a philosophical revolution and also a legal and economic revolution - the American and French Revolutions for example. This change had its origins in the secularization of the European powers which began in the 16th century, which Marcel Gauchet called the disillusionment of the world, echoing the words of Max Weber. During the 18th century, the merchant economy grew, there was also a consumer boom in towns and the rules governing intellectual property were rewritten, contributing to the development of free autonomous individuals who liked to consider themselves their own masters. This is when what Jürgen Habermas termed "civil bourgeois society" appeared, a world which provides a public forum for debate and which intends to be self-governing.

These two parallel revolutions, scientific on the one hand and social on the other, share some values such as equality, a call for rational debate and a duty to justify assertions. What they share is also a certain vision of progress, a Promethean vision and it was supporters of social change who drew science into the public and economic arena as a full participant in its own right.

However, the relationship between this new science and the deliberative order and dialogue is intrinsically contradictory. There are two reasons for this. Firstly, science claims to have higher knowledge and often to be the only one able to provide the truth. It therefore can easily set itself apart from or above the democratic discussion process. Secondly, this type of science usually manifests itself in technologies and in products which reach society via the market, i.e. without discussion, and these products can disturb the balance of nature, threaten individuals' lifestyles and lead to dissent.

From 1800 onwards, the links between science, technology, society and democratic control have thus been complex and organized on the basis of certain convergences, but also on the basis of what could be termed systemic tensions - and these remain more of a problem for us today than ever.

Industrial modernity, Nation-States and competition

A century later, the links between science, technology, economics, and politics are being redefined. From 1870 to the Cold War, science was the main focus for the development of economies and state-building, as well as for the semi-permanent wars being waged by Nations, particularly in Europe. My point is that the most fundamental sciences then became decisive for industrial development - as with underwater telegraphy, organic chemistry or radio - and also for defence policy and population management, which had not been the case previously. States started investing massively in research and higher education. They set up institutes (like the Kaiser Wilhelm Gesellschaft or the CNRS), national laboratories, metrological centres and industry followed suit.

This integration of sciences into the heart both of the state and of economic expansion was of course based on new opportunities offered by laboratory-based science. However, it also met the need to manage new technological systems which were inner-vating our society. In this new process of technological and scientific transformation of society, which occurred since the end of the 19th century, science and the state tended to live in symbiosis. More specifically, during this period science became a sort of alter ego for the state, by which I mean a way of defining the collective good, imple-

menting it, demonstrating the greatness of the nation and also of declaring a common neutrality. During this era, science became a benchmark institution because it offered a truth which transcended opinion. It became an anchor for public activity. It became an institution to which the state could refer for decision-making. Admittedly I do not doubt that the state did this when it suited its purposes, but in the process science became a powerful and persuasive institution in its own right, taking full advantage of this financing and symbolic influence.

When we look, for example, at 19th century literature, it is usually engineers who represent a science which knows nature and guides society towards progress. Let me clarify by referring back to a text from childhood, at least for the French among us, *L'île mystérieuse* by Jules Verne. This novel, as you might remember, is about the arrival of small group of runaways from the United States on an island they believed to be deserted - although Captain Nemo is in fact beneath it - and the means which they use to develop their colony agriculturally and industrially. Starting from scratch, they build a whole civilization. However, there is more to the novel than this. It is a description of the ideal polity envisaged by the scientist Cyrus Smith, the only person capable of saying what needs to be done and how to go about it. This polity which he builds on the island develops without any setbacks and technology is never found wanting. No negative impact ever comes from technical developments. The struggle to control nature progresses without any harmful effects - and no dialogue is therefore required. In fact in this book, there is no debate and in a profound sense there is no need for democracy.

What I would now like to demonstrate is how dangerous Jules Verne's model is and how this utopia will not help us to understand real problems, particularly those of the 21st century in which no player, whether it be science or the state, can claim to have the best and safest answer. Nowadays, we live in a society where science and technology play a central, decisive role, where the wonders of invention are being used in ever more sophisticated products. But this knowledge and these technologies have not to be alone in deciding for our future. The social sphere feels entitled to voice an opinion on the technological agenda and this is an inevitable development of our contemporary, democratic society.

Today's world: science, liberalism and 'civil society'

The main historic tensions which I have been mentioning since the start of this lecture have not disappeared. On the contrary, they are even more pronounced today because technoscience has developed its ability to intervene to an extraordinary

degree, because their negative impacts seem to have increased, because the liberal economy has regained influence and has altered the traditional balance between open science and private science, and because members of civil society are asserting their rights and their desire for autonomy more clearly than ever before. What I would now like to do is to take a few minutes to specify what these recent changes are and to indicate what we will be faced with in the future.

Firstly, the dominant science, disciplines and values in the scientific arena have changed. In the 20th century, up until the 1980s, physics set the standards for good science, steered political decisions and made its symbolic mark on society. Since the 1980s, it is primarily the life sciences, biotechnology, which have taken over this role, and these sciences can recombine and optimize biological material and human material. Scientific practice has also been restructured through the use of IT and large-scale simulation, as is the case in the study of climate change. New scientific fields have emerged focusing on the issue of equilibrium on earth, risk management, biodiversity and ecological engineering issues. All these things are extremely new compared with the great scientific discoveries of the past. However, the social and political consequences of these changes are enormous. These changes are unprecedented. One needs only to think of human cloning, which will inevitably be a very sensitive issue in the near future.

The second aspect brings a second change – the emergence of a new political and moral knowledge economy in recent years. We all know that the rules governing production and finance have changed in recent years. Overall, power has shifted, in a word, from managers to shareholders. Politically speaking, we have moved from a universe that was regulated within the framework of balanced nations through elected bodies defining priorities collectively to worldwide, if not global, systems, regulated in very varied areas of governance by a large number of players - large corporations, the World Bank, agencies of all kinds, a plethora of NGOs, etc. At the end of the day, this whole system would seem to be in a permanent state of flux, of constant change without any stable landmarks - in contrast, perhaps paradoxically, to the feeling of predictability and balance which existed in the Cold War era.

The result is a extremely vague but nevertheless persistent feeling of uncertainty. This shift which can be termed global, liberal, and predominantly financial, was accompanied by a transformation in the way in which knowledge is produced, in particular, but not exclusively, in universities. More and more interested parties have become involved in the research field. Venture capital, pension funds, NASDAQ, start-ups and business lawyers are all now decisive factors in American universities, for example, alongside the military and the state, of course, which have not disappeared. They

have assumed a decisive role when it comes to steering research - the form which it takes, what is studied and what is forgotten.

For its part, industrial research has freed itself from the territorial boundaries of universities and populations. Localisation of industrial research is now established on a global scale according to potential and opportunities. There have been significant changes in research within companies too. Innovation processes have changed. Product and generic brand design, and less R&D (Research and Development), have become the cornerstone of innovation. Research more often than not has become an outsourcable parameter, as they say today, except in some sectors such as the pharmaceutical industry. Finally, definitions of the rules of property, intellectual property and patents, have been radically modified since the 80s. This has led to a fragmentation of knowledge on the one hand and to forms of monopoly and legalization of knowledge on the other hand. In short, a new political and moral knowledge economy has established itself at the heart of what are often incorrectly termed knowledge economies or societies.

Finally, the one last change which I would like to mention is that of society itself. These changes are visible in the composition of society, with the virtual disappearance of blue-collar workers in developed countries for example, as well as changes in subjectivity, morals, lifestyles and relationships with authority, especially scientific authority. It could be said that our societies have become radically heterogeneous and that what we are dealing with is greater individualism in the choice of path and benchmarks and in a variety of forms of self-fulfilment - hence the decline in the power of traditional institutions such as school and the family. These changes were accompanied by a huge rise in inequality, a new-found harshness in social relationships, a greater polarization between the loss of opportunity for the most disadvantaged, at one end of the spectrum, and a reappraisal of social and financial success at the other. The corollary, moreover, is a possible decline in the appeal of poorly paid research positions.

Science in Society, Society in Science: How to pose problems today

The consequences of these changes vis-à-vis science are numerous and it would be irresponsible in my opinion to ignore them. Firstly, the belief in beneficial and controllable scientific progress has been eroded. The decisions of experts who work in isolation from the world are challenged. These changes which all become widespread, have been accelerated by the speed of technological renewal, from GM crops to biotechnology for humans, and by environmental crises and lack of transparency in new modes

of governance. Environmental NGOs and patient groups have grown in number. Laboratory associations have appeared, flouting official certification procedures. They undertake monitoring and checking campaigns. And complaints are systematically filed with the courts. As we all know, whether we like it or not, they are here to question the fairness of scientific or political choices.

I would also like to emphasize that the Web leads to alternative forms of training and alternative relationships between knowledge and its evaluation, to alternative ways of producing and consuming science. The Web, which is radically polycentric, excludes hierarchical channels for disseminating knowledge and therefore undermines the authority of science.

In some academic circles, perhaps not in this auditorium, I have observed and continue to do so on a fairly frequently basis, a tendency to disregard these new realities and to think of them as superficial, temporary or abnormal, or as something which scientific culture and technology will cure. There are often fairly similar assessments in economic and political circles, terrified by the GM crop episode and by what they see as the unfounded technophobia of our age or a rejection of progress.

This reductive approach is a mistake in my opinion, a refusal to take into account more complex challenges and realities involving all sorts of people, including the most creative and educated, and is something which can only become more widespread. It is also too simplistic to talk of distrust of science or even more so of the emergence of a new irrationalism. Actually it is predominantly the success of industrial techno-science and the enthusiasm it arouses which are in the balance, not science itself or science as knowledge. My feeling is that these attitudes are actually a sign of great maturity.

One can moreover put forward the point, which is obvious to anyone when you have studied two and a half centuries of history, that caution (or 'sustainability') is often the direct product of popular rejection of the negative effects of progress. Challenging negative consequences of progress leads and has led the judiciary, administrations and producers to redefine standards and to invent more protective and cautious standards. As a result, it is important to listen to society when it speaks, because it often functions as an effective warning system.

Normative Attitudes to Guide Reflection and Action

So how should we proceed? How should we frame our thinking for the future? Firstly, by recognizing that the world is inherently complex and that there is no simple recipe. By recognizing particularly that historic ten-

sions which I have mentioned between the market-driven innovative approach and the willingness to address problems through dialogue, between techno-industrial change and negative environmental or social impacts, or between the individualistic approach of self-fulfilment and the need for common legislation will not disappear. Paraphrasing the great philosopher, Paul Ricœur, I could say that a democracy is not a political regime without contradiction or conflict, but only a regime in which solutions are open and can be negotiated. In a democracy, a conflict is not an accident and it is not a disaster. Paul Ricœur continues: "It is the expression of public good which cannot be decided on scientific grounds. Political discussion is inconclusive". By which he means there is no logical conclusion "even if it might lead to a decision."

These facts that I have mentioned should not prevent us from acting, even though they should inspire caution. I would like to make four simple propositions, some of which refer to what has already been said in this auditorium.

First I think we should recognize as a truth and as a vital necessity in normative terms the variety of values, human plans, and knowledge, bearing in mind what Heinz Wismann said yesterday morning. I suggest we should campaign on behalf of this radical diversity, to actively maintain this biodiversity of knowledge and values, because it lies at the heart of democratic life and guarantees that we will adjust better in the future. Scientific knowledge will certainly remain the hard core of the galaxy of knowledge but it will have to learn to be modest once more and to be wary of *hubris* (pride and excess in ancient Greek) which is often a feature of its relationship with producers of technology.

This first move presupposes learning to listen to dialogue and engage in it – and this is my second proposition. Or to put it another way, it involves realizing that there are still a lot of things which we do not know and which science does not know, learning not to be too self-focused and studying the blind spots in our constructs which other people sometimes correctly point out. However, we must not be ecumenical and - this is where it gets really complicated - we have to realize that power and clearly understood interests will necessarily disrupt this dialogue. The dialogue could be manipulated, for example. There are many examples of this over the last three decades. It is essential that everybody should take part in the conversation and decision-making when it is acting as communal training vehicle, but it has to be protected constantly because it is weak in the face of ordinary power relationships and its success is always extremely fragile.

Therefore, beyond the often over simplistic discourse of good governance, it is necessary - and this is my third proposal - to learn how to make choices again, to under-stand once again the need for choices

and the difficulty of making them. We must not simply engage in discussion in the hope to reach consensus, as that is quite rare, but in order to learn the importance of a decision made in full knowledge of the negative effects which it cannot fail to have. Choosing and deciding is by definition painful. We are rarely ever in a win-win situation and choice often means recognizing the negative consequences of that choice and then spreading them out. Adapting successfully to climate change, for example, will necessarily have a price and consequences for certain lifestyles. Unless, in keeping with the traditional understanding of progress, we still believe that quasi-magical science will always find an answer absolving us of any real duty to adapt, which I believe would be an illusion.

Therefore, we have to relearn how to organize dialogue and make choices. But especially, and this will be my last point, we have to learn how to think in broad terms and to try to tackle the most difficult problems and offer inventive solutions. We do not simply need to clarify procedural solutions to be implemented, although I do emphasize that we need to review them systematically and make them available, but we also need to generate substantive solutions rather than procedural ones. I would like to raise two difficult issues purely to illustrate this. What is the nature of our relationship with diseases and death, given that increased spending on health is unsustainable in the long term and will soon exceed our revenue? This is quite clear if we plot the graph. Secondly, how do we view common property? For instance, is the air common property? Is biodiversity common property? Is knowledge common property? What about our view of common property and how to define it in legal terms, since evidence would suggest that we cannot think through some of our problems without it.

I will end my thoughts here, well aware of how trivial they are and especially of the extent to which they repeat what has been said in previous discussions. I hope, however, that we have been able to see eye to eye one or two points. Thank you.