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What can science do for Europe?

1. The secularization of science

In 1750 Jean-Jacques Rousseau published the ‚Discours sur les sciences et les arts', his prize-winning answer to the question posed by the Académie de Dijon: has the reconstruction of the sciences and the arts led to the purification or corruption of our morals?

Celebrating his 300th birthday this year, it may be worth to recall his conclusion, controversial and sober as it was: progress of science and the arts, in fact all progress of civilization, has added nothing to our sense of happiness. Progress is accompanied by the loss of innocence and ignorance of ‚natural man', as virtue is replaced by vanity, greed and luxury, resulting in the continuing corruption of morals.

How would the question of the Dijon competition be answered today? We would probably insist that the question of morals must be separated from progress of science. But this was precisely the point made by Rousseau: it cannot be done.

A contemporary Academy of Dijon would most likely frame the prize question differently. One on-line survey to which I was invited to respond was: Has progress in science and the arts changed our faith in science?

Contrary to Rousseau's time, we need not to revert to ancient Greek, Roman and other civilizations. It is sufficient to look back at the last four hundred years of our scientific-technological civilization that now spans the entire globe to grasp the enormous progress that has been achieved.

Although there is no lack of chilling numbers, pictures and facts that remind us of what still needs to be done, it is fair and correct to state that humanity on this planet, vastly expended in numbers, is better off than ever before. The astonishing transformation is can be grasped in the number of years we can expect to live well, i.e. our healthspan; falling fertility rates in unexpected places or the reduction of extreme poverty. Undoubtedly, the reasons constitute a complex mix. But we can confidently assert that they would *not* have occurred *without* science and technology.

But what about faith in science? Has it declined? How has it changed?

My answer may be surprising: faith in science has disappeared– and disappeared all for the better. Science is no longer seen as performing miracles, as the affinity of the German words *Wunderglaube* and *Wissenschaftsglaube* underlines. But this does not mean that society has turned against science, nor that former believers ignore science.

The disenchantment of the world, so ruthlessly brought about by science, does not halt before science either. Faith in science has been substituted by matter-of-fact

considerations which have turned science into an all pervasive and integral part of our lives. Science has been *appropriated* by society.

Depending on one's point of view, the loss of faith accompanied by a loss of a sense of wonder or, if you wish, the secularization of science, brings changes with it that are far more challenging than any comfort derived from faith in science. Some of these challenges are also more disquieting.

The first challenge arises from the fact that science has *de facto* become the only cognitive authority. In this capacity, it remains without competition. I am fully aware that seemingly contradictory examples exist, like the widespread creationism or climate skepticism in the US. While this is not the place for a deeper analysis, let me assure you that closer scrutiny supports my claim.

The scientific worldview has been thoroughly internalized by society. This is not to say that public scientific knowledge about the world is not incomplete or lagging behind, nor that scientific illiteracy is more widespread than we would like it to be. Yet, present societies have never before attained such a high level of education. However deficient we hold our educational system to be, it is science-based.

One reason for the internalization of the scientific worldview is entirely pragmatic: science and technology work. They deliver benefits that are here for all to see and to participate in. The latest biomedical achievements raise expectations of more and better to come. The latest apps on the omnipresent digital devices populating everyday life wet the appetite for more.

In fact, a spiral of heightened expectations arises from the sense of ownership of science that society has adopted. This is part of the challenge facing science today. Related to these continuing anticipations is to be clear what science cannot deliver.

It cannot give meaning to one's life. It cannot, and does not intend to shape our morals, as the Académie de Dijon called it. But as Science, rightly and wisely in my view, disclaims direct responsibility for moral improvement, Society in its newly acquired sense of ownership seeks to impose its own values on science.

As scientists we react with surprise and concern when confronted with an increasing demand to allow values to impinge on what we do. We often forget that science itself is based upon a value, that of free scientific inquiry. While we accept in principle that ethical standards should guide, select and constrain the vast possibilities that continue to be opened by science, we beg to differ when we encounter what seems excessive, ill-founded or simply too restrictive for allowing scientific curiosity to flourish.

Yet, science has to come to terms with these and other societal demands. It means to understand that the distinction between facts and values, so dear to scientists, is never as rigorous in practical life. Societal values themselves are often contradictory. They are subject to historical change. They need to be politically negotiated in the in-between-zone where science and democracy meet where neither is capable to impose its own terms on the other unconditionally.

Thus, and perhaps paradoxically, the replacement of faith in science by a sense of its appropriation through society and the status of science as the unquestioned cognitive authority, exposes science to closer critical scrutiny, confronting it with critical discourse that employs, at least partly, the rhetoric of science and its style of argumentation.

While the distinction between experts and lay persons is unlikely to disappear, the nature and boundaries of this relationship is rapidly changing. Experts will have to accommodate the fact that „society speaks back to science" – and that it is important to listen.

2. What remains unique about science?

Yet, amidst these and other far-reaching transformations (e.g. data) a sense of uneasiness persists. Is there not a real risk that something precious is being lost when science is opening up too much to society, be it in terms of volatile societal values or the increasing pressure for outcomes that have to demonstrate *a priori* a clear economic impact?

Does the public, and even more, do politicians know sufficiently well what is special, if not unique about science? Do they understand that there is a fine line to tread in granting the autonomous space that scientific curiosity needs if the goose that lays the golden eggs is not to be killed?

Much has been written and said about the necessity to cultivate what has been termed *public understanding of science.* But often an important dimension is overlooked, namely the understanding of science that policy-makers and politicians have.

Let me begin with one – unique – feature of science that ought to be part of this *political* understanding of science: its in-built long-term perspective.

Modern science began in Europe some four hundred years ago. It began with a relatively small number of people and their revolutionary ideas during a period which historians of science have dubbed as the Scientific Revolution. These ideas – and the specific ways of rooting them in novel practices of intervening and manipulating the natural world – where they were encouraged and rewarded, as John Heilbron put it, marked a beginning to which there is no end in sight.

These novel experimental practices spread from the controlled space of a laboratory far beyond. They began to underpin and merge with progress in the crafts in what later became known as the Industrial Revolution.

This long-term perspective and way of thinking comes with the ability to embrace temporary failure and apparent contradictions. It induces confidence that the production of new knowledge will yield practical results, even if it is impossible to predict what and when.

A long-term time perspective allows to mediate between past, present and future. By now, knowledge of evolutionary time scales – and the technology to do so – has enabled

us to go back in time and space to the beginnings of the universe and the origins of life on this earth.

Issues of sustainability of life on this planet, of eco-systems and ecological services, of cities that will continue to increase in numbers and densities and much more can only be addressed in a long-term, comprehensive way. Only long-term thinking is capable of coping with non-linear, dynamic systems and hence with the unexpected.

This is why we as scientists can confidently tell our politicans:
Trust us, when we speak about the usefulness of what may appear as useless knowledge.

How can European policy-makers and the general public be made aware of this powerful legacy and the potential it continues to hold?

It is important to carefully outline what science, meaning curiosity-driven frontier research, *cannot* do for Europe. It cannot deliver immediate results or products to succeed on the market. Frontier research, like innovation, is an inherently uncertain process. One does not know what one will find when working at the cutting edge and attempting to push into the territory of the yet unknown. Short-term economic impacts may always occur, but they are welcome by-products rather than the main deliverables that can be planned.

Nor will science create the much desired jobs, perhaps except for those who work in research organisations and universities. But it pioneers new ways of working, and hence provides models of future work places and working modes that will widely diffuse into society. These are an integral part of the knowledge society, requiring novel skills and knowledge that will in turn transform the ways a society produces its products. For example, developing more environmentally friendly and resource efficient use of natural resources. Or inventing and investing in services that are more responsive to human needs and better attuned to human interaction.

3. What can science do for Europe?

When V. Bush in the summer of 1945 presented his famous manifesto „Science – The Endless Frontier“, he laid the foundation not only for what was to become the NSF and US dominance in science and technology for decades to come. He also opened up the vision of the endless frontier that resonated deeply with post-war America.

° *Today, Europe has a young funding institution devoted to frontier research as bottom-up approach for individual scientists on the basis of excellence only, the European Research Council.*

It has shown that scientific excellence at the highest competitive level is an attainable goal for the 2600 ERC grantees funded so far, out of which almost 60% belong to the younger generation of researchers working in Europe.

I am fully convinced that continuing this investment in the years to come through H2020 is a strong signal of political will to invest in Europe’s future which will bear fruit.

Science continues to surprise us. It brings forth the unexpected. In creative environment serendipity, this uncanny ability to recognize the significance of phenomena or connections one has not been looking for, is enabled to flourish. With the ERC well established, we can expect the production of new knowledge to provide the fertile ground for radical, science-based innovation in Europe.

But this is not all. Science has more to offer, at a global scale and for Europe in particular.

° *Science can infuse a long-term time perspective into other policy domains.*

Its practices and epistemological core have lost nothing of their validity as first articulated in the 17th century. What began with the European Enlightenment has become globalized today and keeps the scientific enterprise going. Almost all policy domains today contain a scientific and technological dimension which can benefit enormously from a more integrated and long-term policy perspective.

° *Science can help to boost confidence and to create trust into what research can achieve.*

The inward-looking and myopic self-reference that many concerned observers associate with the current preoccupation of the European financial and economic crisis threatens to overtake everything else.

In terms of scientific and technological achievements, publications and even funding, Europe still compares favourably with its competitors. The repeated allusion to the European paradox, i.e. that Europe generates a surplus of ideas which it is unable to take further to market, is based on an outdated linear model of innovation.

But Europe seen from outside and afar has a dismal image. Given its excessive self-preoccupation, Europe is either ignorant or oblivious to it. Yet, the political will exists to invest into Europe's future: into education, research and innovation, both at national and European level.

As with any image the question how well it reflects reality is secondary. Images are products and projections of our collective imagination that guide our action.

Science must again become the dynamic force shaping the (self)image that Europe projects towards a fragile future. Science is about curiosity and ideas and the inexhaustible creativity to make them work. It is about people and institutions. It is about a sense of play that makes science and technology a world-transforming activity.

° *The readiness and capability to include the social science and humanities as an integral part of Wissenschaft is urgent, timely and possible.*

In continental Europe the prevailing idea of science is still the inclusive sense of *Wissenschaft*. One of the dreams of the Enlightenment was that science would provide a model of how consensus in conflict-ridden society could be achieved. This dream had to be given up, but the complexity and messiness of today's problems make it mandatory to make a fresh attempt.

It helps that science is widely perceived as being part of European culture. A sense of our common humanistic past can be recuperated, while opening it up towards the world outside of Europe that acknowledges Europe's historical entanglements.

° *Last, but not least, European science can take the concept of scientific citizenship a decisive step forward.*

We are at a junction where people – citizens – must become our strongest allies again.

Digital media and communication and information technology offer new opportunities for doing so.

They do so through initiating new modes of convergence between the arts and the sciences.

Crowd-sourcing and other experiments in citizens science lower the access barrier. They involve the younger generation through technologies they already master while putting it to new ends, thereby transforming them into participants of research itself.

Science leads by example in dealing with its most precious resource: people as talented individuals. Like in sports where top achievements rest on a solid and broad mass movement, based on identification of talent, optimal training and refined coaching, all within a system of fair competition that appeals to millions of spectators and fans.

The Olympic Games, soon to begin, have succeeded where science lags behind: female participation which has risen steadily in sports. Women made up 20,7 % of the athlete pool at the 1976 Summer Olympics in Montreal, 34% in 1992 in Barcelona and 42,4 % in 2008 in Beijing. London will see many new records, include the percentage of women athletes.

Bringing back the public as our strongest ally also means to take the policy discourse of ‚transformative research' serious. People are willing to transform, but nobody likes to be transformed. They can be persuaded to innovate, but shy away from becoming the losers of innovation. People take risks, if they can see that these contain real benefits *for* them and as defined *by* them.

To conclude: what science has to offer to Europe is what I call *Research as a way of life.* This is an attitude as well as a set of practices. It is an ethos as well as a societal project. It can infuse and the education system and diffuse beyond. It can inspire the creation of new kinds of jobs that are based on research while generating new research. At present, this is the best that science can give to Europe.

Science alone, even at its very best, cannot save Europe. But a Europe that accepts *research as a way of life* no longer will need to be saved.