

Towards a Golden Age of Science in Europe

Address on the occasion of the 20th anniversary of Denmark's

Danish National Research Foundation

Ernst Ludwig Winnacker, Ph.D.

Secretary General of HFSP, Strasbourg (France)

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We know of periods or era in human history which can be described as “*novi ordones seclorum*” or “Golden Ages”. The Dutch Golden Age, for example, describes a period in Dutch history, spanning the entire 17th century, in which the arts, science and culture reached their apogee. Thanks to freedom of speech and of religion, the Netherlands was able to attract the best and the brightest, those who had been persecuted elsewhere and who not only found safe haven in the Netherlands but felt particularly welcome there.

The US has experienced a “Golden Age for Scientific Research” since World War II. Thousands and thousands of scientists are attracted every year to the US to continue their education in its acclaimed scientific institutions - as postdoctoral fellows, assistant professors or as lecturers on short sabbaticals. I myself spent a wonderful and most productive time as a postdoctoral fellow at UC Berkeley from 1968-1970. Whatever one might think about the ranking of academic institutions, US-American universities are invariably found at the top. In the most recent ranking of the Times Higher Education Supplement, the US boasts 15 universities among the leading 20. Likewise with Nobel Prizes: since WWII, 70% of all Nobel Prizes have gone to the US. Not even September 11th 2001 has changed this, although immigration laws have been tightened considerably since then. The research accomplishments of Harvard University alone exceed those of entire countries, even those as large as Argentina.

What is it that makes these successes possible? What is it that makes the US so attractive to foreign scientists? Why has the US been such a magnet for almost all of us?

Among the determining factors for the enduring appeal of the US as a scientific Mecca are language, openness to foreigners, appreciation of individual performance, concern for young scientists and their early independence, a department system which fosters interdisciplinarity (at least in the most prestigious institutions), a way of distributing research funds which is competition driven, the existence of large foundations, and finally, a broad consensus in the scientific community about how to organize science and scientific excellence. Consequently, the outcomes of modern research in the space industry, the Biotech industry, on the internet or in computer technology can almost always be traced back to the US. The belief that science is necessarily cosmopolitan, together with a culture of “venture capital” gave rise to “Silicon Valley”. These essential ingredients have never really gained a strong foothold anywhere else in the world.

Europe, which lost its predominance in science during WWII, took more than half a century to recover, if we can speak of recovery at all. Instead of a single European Research Area, there are more than 40 National Research Areas, each with its own funding agencies and government programmes. Over time, this fragmentation became a real obstacle. It reduced competition, prevented comparisons and restricted mobility. All this led to a lack of critical mass and considerable mediocrity. Exceptions only prove the rule.

It is not that Europe hasn't tried. Encouraged probably by the establishment of a single market for coal and steel in 1951, a series of organizations for scientific and technological co-operation were established within an intergovernmental

framework. I am thinking of such organisations as CERN or EMBL, ESO or ESA. Yet, somehow their pan-European design did not impact significantly on their national surroundings. The University of Heidelberg, for example, was among the last to join the EMBL's international PhD program as a partner university. For too long these elite institutions were seen as a threat rather than an asset. It was not their fault. They may simply have appeared at the wrong time, probably too early, and thus failed to build a broader base for communication and cooperation within Europe. "In fact", as it was stated in a brilliant paper by the European Commission and its then Commissioner for Research, Philip Busquin, from January 2000, "In fact, the principal reference framework for research activities in Europe is national. The European research effort as it stands today is no more than the simple addition of the efforts of the 15 Member States and the Union. This fragmentation, isolation and compartmentalization of national research efforts and systems only serve to compound the impact of lower investment into knowledge". This analysis couldn't have been more shattering. But it eventually led to the creation of a truly pan-European research funding agency, the European Research Council, the ERC. The significance of this event cannot be overestimated. The ERC turned into one of the strongest cornerstones of our numerous efforts to improve the quality of research in Europe.

The foundation of the European Research Council owes a lot to Denmark. I am reminded of a conference in October 2002, organized by the Danish Research Council, the Swedish Research Council, ESF and the European Commission entitled "Towards the European Research Area: Do we need a European Research Council?" The conference was chaired by Mogens Flensted-Jensen, Vice Chairman of the Board of the Danish Research Councils at the time. Attended by most of the key players and stakeholder of the day, the conference

came to the unanimous conclusion that, indeed, we need a pan-European Research Council.

The then Danish Minister of Science, Technology and Innovation, Helge Sander, deserves enormous credit for setting up a high-level expert group in November 2002 in the context of the Danish Presidency of the EU, a group which was to study the scope and the perspectives for an ERC. Their report, together with several others commissioned at the same time from a variety of stakeholders, strengthened the case for a pan-European funding agency significantly, such that in February 2004 the Commission itself realized that it was time for it to get involved. It did, as we all know, and much faster than expected. By the fall of 2005, it was able to announce the 22 founding members of the ERC's first Scientific Council. This was an enormous step for the Commission because probably for the first time ever, it had to accept outside influence in its decision making processes. The Scientific Council was to be responsible for strategic issues, including funding instruments as well as the design of the peer review process, while a separate administrative structure was to be developed in order to execute the demands and the input from the Scientific Council.

This is not the moment to discuss the events which actually led to the initial call for proposals. Rather, it is important to realize that the ERC exists and that it has already awarded more than 2,500 grantees. Altogether, the ERC has developed into a success story. In less than five years it has gained a considerable reputation within the Scientific Community in Europe and even world-wide. Wherever you look these days, at annual reports of European Universities and research institutions, almost everybody proudly announces the number of successful ERC grantees which they have managed to mentor and nurse in their respective surroundings. In late September of this year a renowned German

newspaper devoted an entire issue to the subject “Research in Paradise”, describing the work of three ERC Starting grant awardees. It sounds too good to be true.

On a festive occasion like this, it may be worth trying to understand what really happened and what we have achieved in Europe so far. Where do we actually stand? Is this the ERA we need and which we all set forth to create about ten years ago? Have we reached the Golden Age already and, if not, what is it that is missing? In this respect, I would like to address three issues, the ERC itself, the relationship between the pan-European European Research Council with the national research councils and the relationship between science and society at large.

The ERC, even with all the glamour surrounding it, has not reached its full potential as yet. A task-force of which I happened to be a member, recently released a report which analyzed its legal, administrative and organisational structure. One of our main points of discussion was whether we should advise a change in the ERC’s governance and develop an entirely new legal structure for the ERC. There was indeed considerable pressure to ask for a far-reaching reform since the existing structure contained sub-optimal elements, including far too rigid supervision by the Commission. Oversight is always necessary, but the ménage-à-trois, constituted by the Commission, the Executive Agency and the Scientific Council, was a real nightmare. Nevertheless we refrained from such a drastic recommendation, realizing that while having some advantages in principle, it would imply too many uncertainties. Having sat in the eye of the storm during the transition from a directorate within the Commission to an Executive Agency, I could not bring myself to recommend another such exercise, even if it were handled more professionally than in 2007. Instead, we considered a number of far-reaching administrative improvements which will,

for example, terminate the ménage-à-trois. Albeit less ambitious, they will guide the ERC to calmer seas and permit it to mature.

I understand that our recommendations have become part of the Commission's proposal for the next Framework Programme, in which, among others, the budget of the ERC will be doubled. In a way, I am happy that they didn't get carried away, providing the ERC with even more money, since too rapid growth carries with it the danger of overstressing one's resources and even of complacency. I see no danger of this at present but these thoughts lead me to my second point, the relationship of the ERC to the national research councils.

This is an issue which could be seen as just as challenging as it is interesting since it distinguishes Europe from the US. There is no research council of Massachusetts or of California although some private foundations may be seen as to make up for this difference. Could the coexistence of a pan-European research council with national councils be turned into an asset, into added-value?

The national research councils have always been supportive of the ERC although in the very early days some scientists cautioned against the danger of attribution, the danger, that if the ERC were successful, national governments, especially in times of limited resources, might be tempted to reduce support for their own national councils and transfer it to the ERC. National councils thus would turn into second class citizens, B-teams in a way, while the ERC attracted all the glory. For the moment, these critical voices seem to be silent. In their respective responses to the Commission's Green Paper on Horizon 2020, the forthcoming Framework Programme, many councils, in particular the Nordic ones, have been fully supportive of the ERC. Not only that. They have realized, together with their governments that in a global environment top-notch national

research capacity is a key prerequisite not only for individual countries but for the entire continent. Thus, many have started to reform themselves, increase their competitiveness through the development of new funding instruments, like research clusters and centres for graduate education, through programmes for early-career and female scientists and through the opening up of their peer-review process. Some countries, like France, have even created their own research council, from scratch as it were. Germany's initiative for excellence forced a complete reorganization of the DFG's peer review system. Since most scientists of any standing turned into applicants, conflicts of interest suddenly abounded and could only be taken care of through the addition of international reviewers.

It appears that a quest for internationality is the driving force behind most of these efforts. It is easy to argue that science is international but another matter to implement and live it out. Nevertheless international collaboration is on the rise, as a report of the Royal Society found earlier this year. International collaboration increases the impact of scientific papers and permits scientists to keep in touch with world-wide activities, thereby avoiding the isolation of national systems in times of globalization. The recent establishment of Niels-Bohr professorships by the Danish National Research Foundation certainly is in line with this observation and deserves our respect and gratitude.

In this spirit, many research councils are organizing "how-to-apply" courses for their national researchers to raise interest in ERC applications and most of them are curious to see how their researchers fare in an international competition like the one offered by the ERC. Apart from the Human Frontier Science Program, there is little or no opportunity to test one's standing in such competitions. Some research councils consider success in ERC competitions as such proof of excellence that they even provide special funding for those applicants who made

it to the ERC reserve list even if their projects were not supported for lack of funds.

One issue which is discussed intensively but regarded as somewhat of a “hot potato” is that of the mobility of researchers. Mobility is not an eligibility criterion of the ERC selection process since it is not necessarily related to scientific excellence, but ERC awardees are free to move with their funds to any research institution within Europe. As a result of this newly gained freedom, researchers, not surprisingly, often choose the best institutions and surroundings for their work. 50% of the early-career awardees thus work at only 41 institutions, mainly in the UK, the Netherlands, Switzerland, Israel and, increasingly, France and Germany. This turns into a serious problem not for the winners but the losers, in particular institutions in the EU-12 member states which acceded to the EU only in 2004 and 2007, and for some of the associated countries like Turkey, for example. The numbers from the last Starting Grant call could not be more revealing. Of 498 grantees, only six went to these member countries, their institutions simply being too unattractive in a free market system. This must and does create considerable frustration. *In-extremis* you could argue that the ERC is an institution designed to funnel a lion’s share of its funds from poorer to richer member states. I have no doubt that talent is distributed evenly around the continent. These shortfalls therefore must be a reflection of precariously low levels of investment in scientific infrastructure, both before and after the fall of their socialist systems. In fact, there is a difference of a factor of ten and more between R&D investment in these countries and those of the old EU-15.

How can we make the scientific community in these countries identify with a future European Research Area? How should we deal with this issue which overshadows many other efforts to improve the European Research Area and

which, in the long run, could even threaten it? First and foremost, this problem can only be addressed on a national level by the governments concerned through changes in their budgetary priorities.

But there is more than money involved. Structural deficits in their research systems abound and lessen the effects of proper R&D investment. The role of the old academies is dated, even obsolete, and many of the new member states have been able to start building up appropriate, competitive research councils only quite recently, if at all. The ERC itself would be endangered if it were forced to introduce quotas, for example. I have therefore advocated that the national research councils take the scientific communities from eastern member states under their wing and develop an intelligent system to open their competitions to scientists from these countries. The idea is that councils from smaller countries would deal with smaller communities and larger councils would interact with larger communities so that together their respective success rates would only drop marginally. Participating countries would pay matching funds, not right from the start but after two to three years. This would serve as a financial and structural incentive at the same time, as in Germany prior to unification when the German Democratic Republic was still autonomous and the DFG opened its doors to scientists from the East. I have obtained only modest enthusiasm for such a proposal, resistance mainly on the grounds of legal arguments. In principle these arguments are not insurmountable; it just requires a culture of “good citizenship”. Apparently we have a single market in Europe for Bordeaux wine but not yet for researchers. I personally feel that banks are less of a systemic risk to Europe than absent research systems, at least in the long run. Admittedly though, it is here where science reaches out to and meets politics, European politics at the highest level.

Politics however is not only about leadership but also legitimacy. This leads me to the final point of my discussion, the relationship of science and research to society-at-large. Research is not an exercise carried out in isolation. Who presents the results of scientific research to the public and how is this done professionally? At least since the time of Max Weber, we are used to the idea that society supports research for two reasons, out of an innate curiosity in the natural world around us and because we expect a social dividend, that is, a contribution to the well-being of our societies. There is little doubt that the Grand Challenges of our times, such as global warming, the dwindling of energy supplies, water and food, the problem of ageing societies, of public health, pandemics and security, require sustainable solutions. The scientific community is expected to contribute to the development of these solutions one way or another. There is without a doubt no linear relationship between investment in basic research and commercial success. It may never happen or it may take a long time. Excellent research is thus a necessary but insufficient condition for innovation. Despite these uncertainties, emerging economies invest in their science base at an unprecedented pace. The European Commission has obviously recognised and taken up this challenge. I thus commend it strongly for its holistic approach towards basic research and innovation. It links the two but it doesn't raise the wrong expectations. While serendipity remains decisive, the Commission limits itself to optimizing opportunities which foster creative processes for innovation, that is the transition of research results into jobs.

Opportunities mean money but also require a great deal of patience because the science behind the Grand Challenges is complex. Complex is not the opposite of simple but rather describes processes which are more than the sum of their parts. I am talking about the human genome, the human brain, the climate, the dynamic system earth with its volcanoes and earthquakes, even financial markets. Just as one can sit in front of a Bloomberg channel for days or weeks

without getting rich, the understanding of complex systems requires a completely new kind of science, one that is often interdisciplinary and abounding in risk for the investor. Biology is a good example and is indeed particularly pertinent because it does not only deal with energy and matter, and their transformation, as physics and chemistry do, but also with information. A mountain, after all, cannot be cloned, as Sidney Brenner once observed. It took quite a while to discover the molecular basis of biological information. This is the reason why, after a long Cinderella type of existence, while it collected only specimens, organism and molecules, Biology has only now become quantitative, trying to relate its molecules to their function. This process has barely started. The “Human Genome” generated a lot of hype in 2001 when it was sold as the answer to all biological questions. It turned out to be only a beginning. Although “synthetic biology” is the catch-word of the day, nobody has been able to make a set of molecules arrange themselves spontaneously into a living cell. How synthetic can “synthetic biology” ever become? It is extremely difficult to convey these challenges to an interested public. If we oversell ourselves too often, people will eventually run out of patience with us.

One of the most difficult aspects of this is the communication of risks and uncertainties in predicting the outcome of complex processes. Recent examples of how new public scrutiny requires an even more careful assessment of risks are controversies concerning the International Panel for Climate Change and the earthquake in Aquila, in Italy, in April 2009. The IPCC, as it is abbreviated, has been accused of using different standards in its reports on how to understand uncertainties in climate change. Since its judgements affect climate policy and potentially involve enormous amounts of money, the IPCC’s analyses must be made not only on the basis of the best evidence available but with the best risk-assessment techniques possible.

A similar problem is at the heart of a court case in Italy against Italian seismologists who have been charged with manslaughter as a result of negligence in conveying correct information about the probability of a major earthquake. The earthquake took place in Aquila in April 2009, killing hundreds of people. According to the charges, the seismologist confused prediction and probability with preparedness, neglecting for example, the miserable state of buildings in the city of Aquila.

The question for me as a member of a small committee which reviewed the IPCC statements for the UN Secretary General and as someone interested in complexity is how one can best interact with the public to explain the prediction of rare, extremely rare events, events which however can result in an extremely high cost to life and property. Best intentions are not enough; the matter cannot be taken seriously enough.

There will never be a European Research Area to speak of if this problem of independent scientific advice is not addressed and solved. I personally believe that this is not necessarily a task for research councils but rather for scientific academies. The model from the US is the National Academy of Sciences, founded and chartered by Abraham Lincoln in 1863. It is highly respected and publishes hundreds of position papers every year, ranging from A like “A National Strategy for Advancing Climate Modelling” to W like “Women in Science and Engineering: A Guide to maximizing their potential”.

In Europe the situation appears rather uneven due to historical circumstances. The Royal Society in the UK has an exceptional and highly deserved reputation. Germany has been able to boast of a National Academy of Sciences only in the last three years although the Leopoldina is even older than the Royal Society. In many member states the research councils have taken over the efforts of

informing the public of scientific positions. However they are in a sense burdened with a strong conflict of interest. As President of the German Research Foundation, I made considerable efforts to defend a scientific position on human embryonic stem cells, for example. Nevertheless, it was always clear to me that if it came down to it, I would not have been able to hold out against a government which supported the institution I was heading with billions of Euros. Thus the intention of the present Heads of European Research Councils to set up an office for science communication in Brussels, although planned with best intentions, could be seriously flawed. “Science Europe”, the Founding Assembly of which took place exactly a week ago on October 21st, may be able to speak up in matters of funding policy and EU programs but even this remains uncertain, in particular because organisations actually carrying out research do not seem to be part of this exercise. They may yet join it.

Instead and foremost, we have to strengthen the voice of scientific academies in Europe and world-wide. Instruments like the European Academies of Science Advisory Council or the Inter Academy Council, a loose conglomerate of European academies or of the 15 most important national academies in the world, respectively, should thus help serve this purpose. They deserve our strong support. Science is global and thus requires at least a European if not a global voice in order to be heard and understood, a voice which is as independent as possible.

To summarize: The quality of any research area basically depends on the proper balance between cooperation and competition. They are inseparable from each other like two sides of the same coin. In the past, competition, that is competition for grants or for academic positions, was largely organized on a national level. Previous Framework Programmes of the European Union provided few incentives, if any, for competition, at least for competition

between individual researchers. Framework Programmes were designed to foster cooperation between European researchers, and as such were commendable, for two reasons: they proved that high-quality partners for research do not only exist overseas but that ripe and tasty fruits can grow in the neighbour's garden, ie in Europe as well. Moreover, cooperation is indispensable when it comes to addressing the Grand Challenges, as I have tried to explain. Cooperation thus should be strongly encouraged between national research councils also, since they are the obvious mediators for such endeavours. Indeed I compliment the national councils on many of their recent activities including the simplification of review processes and the possibility for researchers to take their grants with them once they move within Europe. In the end, however, it is competition which counts because it permits comparisons, because it exposes the true quality of individual researchers and research institutions within a research area, and thus promotes scientific excellence. In this sense, supranational research councils, like the HFSP or the ERC represent real break-throughs because they broaden the competitive base of research systems.

So, have we already reached a Golden Age of Science in Europe? Can we maintain this newly regained strength in Europe? Can we really transfer the ideas of excellence, transparency and internationality into other programs of the European Commission and of its member states? I have tried to explain that we are on our way, with strong initiatives both on national as well as federal levels. The Golden Age however will remain a moving target since science evolves and since others are competing with Europe in the same area for the best heads and the best organizational structures.

On our way towards a European Golden Age of Science, I am reminded of a story by the American author David Foster Wallace which I cannot deprive you of in this context. Two young fish swim in a lake early in the morning with no

particular purpose in mind. Along comes an elderly fish wishing them a polite “Good Morning”: He then asks them: How is the water today? The two young fish continue their morning swim without any comment until one of them stops and asks: What the hell is water?

“What the hell is Europe?”, I would like to ask. For far too long we have ignored the value of scientific excellence at a supranational level. It is represented by many players these days, not the least of them the ERC. But I hope to have shown how a European Research Council is dependent on the efforts of the national research councils as well. Excellence has to be everywhere. The Danish National Research Foundation is among the leaders in this effort. *Ad multos annos!*