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THE FREEDOM OF SCIENTIFIC RESEARCH IN THE FACE OF POLITICAL AND SOCIETAL DEMANDS

THE FREEDOM OF SCIENTIFIC RESEARCH IN THE FACE OF POLITICAL AND SOCIETAL DEMANDS

ALLEA GENERAL ASSEMBLY, 18–19 APRIL 2016
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ÖAW

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FOREWORD

Freedom has always been at the heart of the human enterprise. Freedom to choose our own destiny, freedom while not infringing on other people's freedom. For science – understood in the all-encompassing sense of the German term Wissenschaft – and for scientists, freedom is an equally important, yet often contested notion. Science seeks to provide answers and often successfully responds to questions of societal relevance and concerning technological innovation. However, scientific findings by themselves do not provide judgement but merely state facts, and it is all too often the non-scientists, whether they stem from politics or other societal sectors, who interpret those findings inaccurately or even try to withhold or deliberately misrepresent their original meaning.

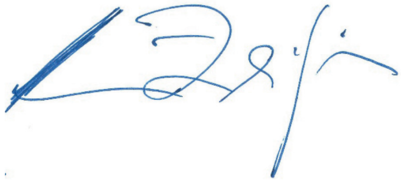
This issue of the series "Akademie im Dialog", initiated by the Austrian Academy of Sciences to accompany their public outreach activities, revisits the themes discussed in the symposium "The Freedom of Scientific Research in the Face of Political and Societal Demands", held in the context of the 2016 General Assembly of the European Federation of Academies of Sciences and Humanities, ALLEA, in Vienna on 18 April 2016, and makes the contributions available to the interested public.

The symposium's focus on academic freedom could not have been – and still could not be – a more suitable and timely topic. We just need to look around us and follow the news to see that our world is undergoing upheaval on a scale unparalleled for many years. In more and more countries, political leaders threaten the autonomous exercise of science. The effortless distribution of pseudoscience through social media and the like deeply challenges the integrity of "real" science and now more than ever it is vital to take a clear stand for evidence-based science, a fruitful exchange of knowledge and the full autonomy of the scientific enterprise and individual researchers, free from political, corporate or other undue influences.

Today, in our democratic countries we must also carefully observe what "democratisation of science and research" means. We have learned over the years how important it is to carefully respect our societies' needs for innovation as expressed by governments and their respective research and funding policies on the one hand and the need for autonomy of science and research on the other. We believe that most of our societies have found a reasonable balance. This balance must not be violated by interest groups who – in some cases – are striving for or are already having a major impact on research policies. Science and research flourish best if their framework conditions are defined long-term and do not follow short-term deliberations, desires or ideologies. Of course, science can react to issues arising in the short term, but its work cannot develop fully under constantly changing conditions and frameworks.

The speakers of the symposium at the Austrian Academy of Sciences have tackled a broad range of issues from a wide variety of different angles. Contributors include representatives of academies as well as young researchers and science publishers, covering legal as well as political and ethical expertise. All in all, an incredibly well-rounded selection which resulted in a day full of highly informative and insightful sessions. Our thanks, therefore, go to all of the contributors on the stage, but also to the audience who actively engaged with the panellists throughout the day.

Professor Anton Zeilinger



President of the Austrian Academy of Sciences

Professor Günter Stock

President of ALLEA

INTERPLAY OF FREEDOM OF SCIENTIFIC RESEARCH AND POLITICAL DEMANDS

SIR PETER KNIGHT

INTRODUCTION

During the 19th century we saw a gradual shift in the support for scientific research from philanthropic sources (including from ruling families) to government. By the end of the First World War we saw a new compact between the research community and government, leading to a substantial enhancement in organized support, the professionalization of research and the establishment of large research institutes with focused agendas. This came at a price: governments have always been persuaded of the economic as well as the intellectual value of research but increasingly they have taken a role in determining the directions taken by the research community. Mechanisms in place to protect intellectual freedom evolved (for example, the so-called Haldane Principle in the UK). Beacons of academic freedom offered exemplars of best practice: the Kaiser Wilhelm Institutes, morphing into the Max Planck Institutes in Germany, or the Humboldt Foundation spring to mind.

But as the scale of investment in research by governments increased, so did the expectation that this investment would yield an economic return. The phrase "knowledge-based economies" is now widespread throughout the world. So there is considerable debate now about the balance between what Sir Paul Nurse in his recent review of the UK research landscape termed "Discovery Research, Applied Research and Translational Research" and how this balance is determined, and by whom. Harmonious partnership between the providers of funding and the deliverers of research is an ideal we strive for, and yet often is far from the ideal.

I describe some of these tensions, and draw on my own experience working with UK governments as a scientific advisor. How best can the scientific community contribute to this debate? This note identifies some questions that I have encountered and provides examples of how they were addressed.

Most European nations have research councils, responsible for articulating a vision for the future, prioritizing areas for investment and delivering evidence-based decisions based upon peer review. Robust peer review is an essential ingredient in a healthy research ecosystem to support excellence, protect quality and to identify promise, but carries intrinsic risks, especially of continuing to support the status quo in established research areas beyond their natural lifetime and failing to identify new areas in a timely manner. We all know examples of initiatives that delivered the last word in a subject rather than the first! So what are good mechanisms for balancing science investments to protect those areas that continue to show great promise, while leaving adequate resources to enable new and innovative programmes to prosper? How do we ensure balance and use our research insights to enable governments including those of the EU to make decisions based on sound evidence?

SCIENCE AT THE HEART OF GOVERNMENT

I must stress that I am going to talk about my own personal experiences: I am a member of several UK government committees. But what I am going to say does not represent government opinion. It is my own opinion and I am going to talk about the generic issues embodied in my title and illustrate that with a number of UK-centric examples.
In the following I list a menu of topics I want to cover:

- What motivates scientists?
- What motivates governments? They are not the same thing.
- Discovery versus translation versus exploitation.

Those are various aspects we need to worry about. Evidence-based policy is a central part of what I am going to say. It needs to be distinguished from the lamentable trend of policy-based evidence. Then, of course, there is the changing global landscape, one developing at a challenging pace, where again I will draw some conclusions on balancing scientific freedom with economic demands.
As a start, I will draw on an excellent report from the Royal Society in London, "The Scientific Century", with an author team led by Sir Martin Taylor. This report illustrated for the tax payer and for our political masters what science has done for us, what it will continue to do, and what its aspirations for the future are. There are several things that Martin Taylor and his team identified: the things that science does (by science, I mean the generic nature of the intellectual endeavor, not just narrow physical sciences, biological sciences, medicine and so on, but science in its broadest terms), as well as the increase in the stock of useful knowledge. But they also identified some of the government imperatives including wealth creation, the creation of new firms, the supply of skilled graduates to be employed and so on. The balance here is quite critical.
That is the essence of my present paper. How do you balance these needs in terms of the investment in the scientific enterprise? Why does the government support science? One of the drivers that all of us as scientists have uppermost in our minds is the creation of new understanding of the way the universe works. To do that, we need resources that we obtain from the taxpayer, for the most part. So, government needs to be persuaded that such a route is desirable. Of course, one of the drivers for government is that science generates innovation and skills. So, if you put all that together, science resourcing turns out to be a complex process in which negotiations have to take place between the science com-

munity and government about the relative balance in generating new understanding as well as creating opportunities, jobs, employment and so on. In the UK, there is currently a very active dialogue about that balance that has been triggered by the Nurse Review, which has led to the creation of the new UKRI body responsible for science and innovation. Sir Paul Nurse, the immediate past president of the Royal Society was commissioned by the government to look at the UK research enterprise and how is it put together. A quotation from the Nurse Review:

> *Reform is needed to put science at the heart of government.*

I think that is a phrase we would all endorse. Paul Nurse admits that this might seem like a deal with the devil, and I'll explain why. There is a risk of putting government at the heart of science. What government wants to do and what scientists want to do often have shared aspirations. But not always. The harmonious interrelationship between scientific aspirations and government aspirations is critical for us. This balance is not a new concern. It has been going on right from the beginnings of the Reformation if not earlier. I quote Francis Bacon:

> *Science improves learning and knowledge at least for the relief of man's estate.*

That is a lovely phrase. Robert Hooke, one of the greatest experimentalists and one of the founders of the Royal Society, maintained that discoveries concerning motion, light, gravity and the heavens have helped to improve shipping, watches and engines for trade and carriage. You can see that even in the 17th century, people were already looking at the interrelationship between science and innovation, the creation of wealth.

Sometimes, there are examples where scientists may have a view that is longer-term than the short-termism that some politicians have. William Gladstone (who later became prime minister), at the time when he was our finance minister in the UK, visited the Royal Institution in London, in Albemarle Street, and chastised Faraday for moving into an area of blue skies research that led to the discovery of electromagnetism. He allegedly chastised Faraday because he felt that Faraday should be concentrating on their core program at the time, which focused on improving the lighting in coalmines. Faraday's purported response was this:

> *Why, sir, there is every probability that you will soon be able to tax it.*

So, foresight is sometimes an attribute of scientists. It is often an attribute of politicians as well. The appropriate harmony of those is what we are really concerned about.

EVIDENCE-BASED POLICY VERSUS POLICY-BASED EVIDENCE

Sometimes things go very badly wrong. The one example that I always like to quote is Lysenko and his work on the deformation of genetics and the Soviet Union, which persisted for many decades. 3,000 biologists were imprisoned or killed because of Lysenko's views, which were shared by Stalin. It very much became policy-based evidence.

Science has often been regarded as a *servant* of the state, something that was pursued quite actively between World War I and World War II, principally in the UK by J.D. Bernal, the very great crystallographer, who really did think that science should be the servant of the state. To fight back against this opinion, Michael Polanyi formed a society for freedom in science to defend science's ability to pursue the scientific enterprise for its own sake.

Now, what we have seen quite recently are growing attacks on evidence-based policy. Decision-making is at the core of scientists' and engineers' real concern: that decisions should be made based on evidence. There are lots of examples where things go awry: the link between tobacco and lung cancer and the way that the evidence was being deformed by the tobacco companies, especially in the United States; climate change, which has become a very challenging enterprise to work on in the United States; GM crops within the European Union is another example. Yet another concerned the effects of magnetic fields on health, which produced quite recent decisions that would have been ill-advised and could have led to the abandonment of MRI scanners. The effects of radiofrequency fields from cell phones on health is yet another example of controversy. These are examples where decisions were being made contrary to any proper scientific scrutiny and evidence.

So, if we look at decision-making and evidence-based policy, I would like to quote this wonderful statement from the UK House of Commons Science and Technology Committee, who reviewed scientific advice risk and evidence-based policymaking.

> *Government ministers should certainly not selectively pick pieces of evidence which supports an already agreed policy. Or commission research, to produce a justification for policy, so-called policy-based evidence making. Wherever there is an absence of evidence, or even when the government is knowingly contradicting the evidence, maybe for very good reasons, this should be openly acknowledged.*

That statement, I think, was the result of quite a lot of influence by the scientific community with our policymakers and our political masters, to make them understand the nature of evidence-based policy. It is an excellent statement.

THE PASTEUR QUADRANT

If you look at the way that scientists divide themselves up in terms of the applications or the fundamental nature of the work, I would like to use Donald Stokes' Pasteur's Quadrant (I have again taken this from the Royal Society Scientific Century Report). The Pasteur Quadrant concept is a somewhat artificial, crowd-sourced view of where researchers position themselves:

- in pure basic research (Bohr's quadrant)
- or in user inspired basic research (Pasteur's quadrant)
- in pure applied research (Edison's quadrant)

According to the crowd-sourced survey from a decade ago quoted in The Scientific Century, 60% of UK researchers fit into the Pasteur quadrant, the middle ground. There is not a great deal of variability among the disciplines. The scientific community is widely spread across the range of enterprises from "fundamentalists" to scientific entrepreneurs.

NEW KNOWLEDGE AND ECONOMIC RETURN

Let us look at what the government might think our scientific enterprise is all about. The government will say to a researcher that government wants to drive innovation from their generation of new knowledge. They want to understand how existing firms grow from new knowledge. The concern for many countries is to build the next Google, for example. How do we build our knowledge? How does knowledge lead to new companies? What enables the conversion of new insights into wealth?

In the UK, the concept of scientific freedom from direct government intervention is often described as the Haldane Principle. Lord Haldane during World War I built on experience with the Medical Research Council in order to build an Advisory Council, right at the heart of government, to support research. That led to the establishment of his department in government, which was the precursor of all our research ministries. He has a named principle associated with him, the "Haldane Principle" that government provides the resources for scientific research but that scientific peer review determines the particular and appropriate investment. He, however, never ever advanced that principle. There is nothing in Haldane's writing that suggests that he was the originator. I will come to the originator in a moment.

In the United States during the Second World War, President Roosevelt wrote to Vannevar Bush, in his Office of Scientific Research and Development, to say:

> *Given the tremendous advances during World War II in the application of science, what could he do in terms of recommending the future support for science?*

This led to the Vannevar Bush Report "The Endless Frontier". It is quite extraordinary that in 1944, in the midst of World War II, Roosevelt was already thinking of the way one would or could reconstruct the intellectual and scientific landscape. He was already talking about the war against disease and how government can aid research activities – aid, not support. And how would one then build talent and nurture skills. So already in 1944, many of the things that now concern our political masters were being articulated. There is a wonderful statement of values in "The Endless Frontier" by Vannevar Bush which I think all of us would like to sign up to:

> *Without scientific progress, no amount of achievement in other directions can insure our health, prosperity, and security as a nation in the modern world.*

This is the end of this Frontier Report. I note the fact that he used the word *insure*, not *ensure*. It has interesting financial implications. I don't think it was a typo.

How are the British trying to work out ways in which the scientific enterprise could be supported and coordinated? Let me come to Lord Hailsham, better known as Quintin Hogg. He was Minister of Science – and an interesting Minister of Science. And he said this:

> *The responsibility for industrial research and development is better exercised in conjunction with the research in the medical, agricultural and other fields on what I have called the Haldane Principle, through an independent counsel of industrialists, scientists and other eminent persons, and not directly by a government department itself.*

So, the Haldane Principle, which separates out decisions on the magnitude of financial support from the separate decision-making process on where scientific investment should be made, was never articulated by

Haldane, but by Hailsham in the 1960s. John Denham, a later science minister responsible for innovation, universities and skills, in 2009 stressed the fundamental element of Haldane remained valid, that the research community is the best place to determine detailed priorities, that the government's role was to set the overarching strategy, and the Research Councils are guardians of the independence of science. There's another set of statements from John Denham in a letter to *The Times* in 2007, with an interesting point he stressed: the need for international collaboration and the fact that nations cannot proceed alone, that they work effectively in conjunction with scientists from other nations.

MY UK EXPERIENCE

Let us look at some of the things we did to convince our government that scientific investment is truly important. What is expected of the science community? Part of the work is to make sure that we have the evidence that the investment in science produces the outcomes that we were claiming. If we make claims about where internationally we are leading in some areas but lacking in others, we must provide evidence. So, auditing and understanding the information is important. The reader can see from what I've already said that to maintain future momentum the scientific community needs to get much better engaged with government and, in particular, with the relevant finance minister.

One such in the UK was George Osborne, our recent finance minister, and in the last UK Government Spending Review, which allocates the resources to a number of enterprises, including science, he said this:

> *(…) we should ruthlessly prioritise those areas of public spending which are most likely to support economic growth, including investments in our transport and green energy infrastructure, our science base and the skills and education of our citizens.*

So immediately, the UK Finance Minister was identifying economic growth with scientific investment. He voiced the rather nice statement at that time that he wanted Britain to be the home of the next generation of scientists, including, potentially, his children. He was a major ally in terms of support for science, but with a clear steer that he expected scientific investment to improve economic performance.

When research councils have many projects on their hands, how should they best prioritize? What can they do to encourage the best ideas within a finite budget where many good ideas will lack funding? The only instruments that work, in my view, rest on peer review. Peer review committees, including ones that I chaired in the past, always have to look at ways in which adventurous research could be supported, enabling the community to do new things, focusing on excellence as identified through peer review.

A long time ago, I drew up a list of criteria for the Research Council I looked after. We spelled out the economic impact, because that was the way we persuaded our government to give us money.

- The need to understand risk. And whether, if appropriate, there will be an economic return as well as an intellectual gain.
- To remember that not all projects will work. Research doesn't guarantee an outcome. That's why it is called research.

- One needs to be able to say no to some projects, even though some of those projects may be perfectly acceptable and interesting, but maybe of less priority than others.
- Resources are limited. You must not, ever, think that you can spread the jam on the toast so thinly that everybody gets a little bit. So, you need to say no to science even though it's good science in order to protect outstanding science.
- You can't print money. It is best to say no quite early. But where is the breakpoint? Who decides?

Obviously to persuade government to produce additional resources, we must plan, prioritize, and demonstrate that you can stop things even though they are good but might be less good than those that are emerging that you want to do next. But the problem is when do you stop doing a project?

PUBLIC PERCEPTION

How does the general public perceive the value of investment in science and in learning in general? I wanted to quote the following from the BBC news website. Universities_UK, the liaison group of all the leaders of British universities, did a poll looking at people's perceptions of universities. 1/5 of those when asked for an estimate of the economic contribution of the sector guessed at 100 million pounds per year. A further 10% said that it was zero. In reality, universities in the UK contribute £ 31 billion each year directly to the economy. So, the mismatch between the public, who are paying for us, and what we actually do, is really worrying. A task for all of us is to do more. And it's very much a task identified by governments.

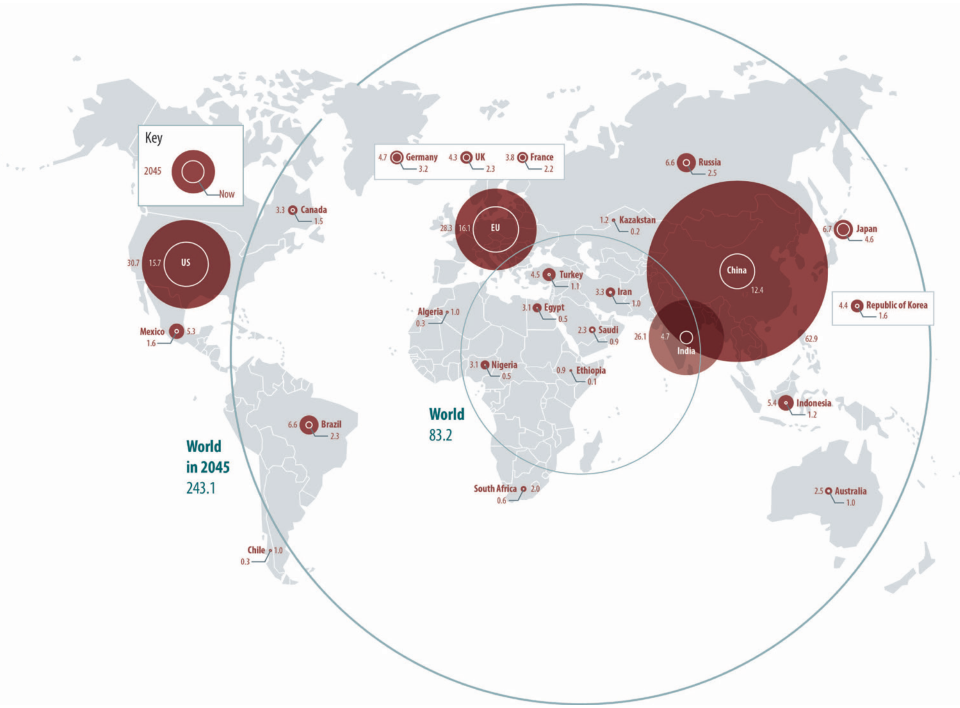


Fig. 1: Gross Domestic Product, expressed in US$ trillion at 2012 values. Source: UK DCDC MoD report „Global Strategic Trends – Out to 2045".

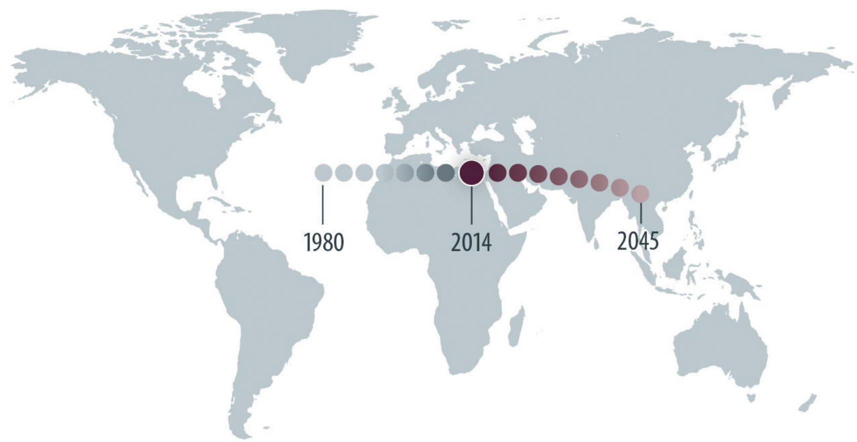


Fig. 2: Global economic centre of gravity shifting.
Source: UK DCDC MoD report „Global Strategic Trends – Out to 2045".

Many governments are now supporting the idea of a knowledge-based economy (again I quote from "The Scientific Century"). But, of course, the world is very much in flux. This diagram in what follows (Figure 1) is from the UK Ministry of Defence, from a report from DCDC which I have peer reviewed in the past (Global Strategic Trends):

What it shows is the expected change in the world GDP. If you look at the European Union, GDP was 16.1 trillion, and is expected to grow to 28.3 trillion by 2045. If you look at China, it was 12.4 trillion, and it's expected to rise to 62.9 trillion. And so on. So from this data, we see that the centre of gravity of economic outcome is moving east as China and India expand their economies.

In terms of geographical location, global GDP is moving east (Figure 2), and that's what's producing a whole raft of governmental initiatives to spur their local economy into growth and employment. For example, in the United States some years ago, the National Academy of Sciences was commissioned by Congress to produce the report, "Rising Above the Gathering Storm". Members of Congress were clearly worried about increasing world-wide competition. Such worries produce a growing nationalism in government support for science, which I find quite worrying. Scientists' intellectual endeavor is truly international. We have grown used to working with colleagues from around the world. For example, in the UK the proportion of national publications produced in collaboration with other countries has grown from 20% up to nearly 50% at the present time, all on a timeline of the order of a decade. The bottom line is that science is international. Yet we must realize that the scientific endeavor is a tiny proportion of the GDP. If science really is the driver of knowledge-based economies, spending just a few percent of national economies on science, and encouraging internationalism and the free exchange of ideas surely is an enormously attractive investment.

When the National Academy of Sciences report "Rising Above the Gathering Storm" was produced, there was a great deal of worry about China. I have often felt that it is worthwhile going back in history and reflecting on this. If we examine the various countries' share of the world GDP, and look back to the early years

of the 19th century, we would see that China and India had then about half of the world's GDP. So the worry about China taking over the world's GDP, in this longer view of the world, is not really surprising. You can see what the origin of the diminution of their share was in the 19th century: the Industrial Revolution. And now we are in the midst of a technological revolution that transcends these older geographical areas.
Other examples of governmental interference to some extent in the scientific community's priorities are the various large multidisciplinary initiatives ("Global Challenges") which governments such as that of the UK encouraged. Many are ones we all would want to see supported: global health, food security, and the like. Some are less obvious and connect to what are identified as drivers of new economic opportunity. Some of you will know that I was able to help persuade the UK government to invest € 500 million recently into quantum technology. How did we do that? The initial driver was the flash crash, where, through automatic trading, £ 650 billion was deleted temporarily from the New York stock market. Politicians demanded that we need to understand how to regulate it, and in particular how to time-stamp transactions so that an audit of who did what in what order was possible. What I and my colleagues did was to demonstrate the role atomic clocks could play in this regulation and from this came the realization of the potential of many new quantum technologies. In a sense this was a microcosm of the journey from knowledge to invention.

FINAL WORDS

Finally, I do believe it is important that we in the academy do not hype our subjects. I draw the reader's attention to the Gartner Hype Curves, which are crowd-sourced, showing a transition from an innovation trigger to what they call a peak of inflated expectations, then the trough of disillusionment and so on. I bet your favorite technologies are somewhere on that list. Hype is what we've got to avoid. Insight and foresight are things that we need to exploit and we, as scientists, rely on scrutinized evidence to get foresight right. The balance between politicians' expectations and scientists' aspirations remains a pressing concern for us all.

ACKNOWLEDGEMENTS

I would like to thank ALLEA and in particular the President of the Austrian Academy of Sciences, Professor Dr Anton Zeilinger for the invitation to give the Keynote Speech which led to this paper. I would also like to thank Sir Martin Taylor and my colleagues at the Royal Society for their report "The Scientific Century" which has heavily influenced my own thinking.

FURTHER READING

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2011–2013	President of the Institute of Physics (IOP)
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FREEDOM OF SCIENCE AND ACADEMIC EDUCATION

JULIAN NIDA-RÜMELIN

I will try to show that philosophy can be useful sometimes. The idea is to add a philosophical perspective to the context. There is convergence, but also some tension.

Let me begin with tension. There is an old conflict between idealist and pragmatist views on science. I have much respect for the pragmatist philosophy and the pragmatist view on politics, policy-making and science. I would like to mention John Dewey – his "Democracy and Education" is a wonderful book. On the other hand, we sometimes have to emphasize that the core of what we call science – the English term is somewhat ambivalent, because it excludes, for some, the humanities – including the humanities, is a specific ethos.

This is the first of my five talking points: epistemic rationality. Science obviously is both a specific practice, an (in idealist terms) search for the truth on the one hand, and a social subsystem, cooperating with other subsystems – such as the political authorities which also represent the taxpayer – on the other hand. The idea is that there are two, in Greek terms, ethe (plural of ethos). One is the ethos of rationality and the other is an external ethos of cooperation. The tension we speak of and discuss now is between these two ethe. I think it is quite important to understand why the first ethos is the essential one for defining what science is, and the second ethos is necessary, but always complementary.

In many Western states in the world there was, in the late Sixties and the Seventies, a very fervent discussion about politicizing science. In Germany, a movement of scientists evolved from that conflict. They propagated freedom of science, or verbally, "Freiheit von Forschung und Lehre". The idea was that it would destroy the core of the scientific ethos to instrumentalize scientific practice for social or political goals. The atmosphere became heated after a while. Remember, the Max-Planck-Institut, Starnberg, Jürgen Habermas, Karl Friedrich von Weizsäcker, the paper by Gernot and Hartmut Böhme "Teleologisierung der Wissenschaft" – that was the idea. How can we govern scientific processes in such a way that they reach certain social and political goals? By the end of this conflict, most of those with a profession in the scientific system tended to say that it would have been a real threat for science if this idea, the "Teleologisierung der Wissenschaft", had indeed been realized. We would have run into major problems, possibly even economic problems. Science probably would have lost its dynamics. I will explain this in more detail later. But first, I would like to address what epistemic rationality is.

My academic teacher was Wolfgang Stegmüller, a well-known philosopher of science of Austrian origin. He had, for most of his academic life, the idea that there is one discipline, and this is the philosophy of science, within which it is to analyse in detail what epistemic rationality is. In the mid-Seventies, at the time of Thomas S. Kuhn's "The Structure of Scientific Revolutions" and other contributions, he, like many, many other philosophers of science, underwent a kind of crisis. He concluded that maybe this undertaking could not succeed: after all, there is no clear-cut list of criteria telling us what rational belief in science is. What did we learn from this? Postmodernists learned that there is no rationality that is common to science in general. Others, including myself, learned that the criteria are quite different in the different disciplines, when we try to find out what makes rational belief in science.

In the meantime, we have accepted an irreducible plurality of methods, standards, and criteria. There is still a common denominator. If I may put it in philosophical, metaphysical terms, it is the idea we all, in the different disciplines, talk about: that there exists only one reality. Not several. Not hundreds. But one reality. And we try to find out how we can understand this empirical reality in the humanities. We have internal standards of epistemic rationality, internal to the discipline. But we also have something external in so far as the results of scientific research should fit into a general account of reality that overlaps with the disciplines. This is a kind of minimal realism that I propose at this point.

My second point is scientific autonomy. I start with Plato's Theaetetus Dialogue. The Theaetetus Dialogue might be the founding document of scientific autonomy. What is Plato saying in the Theaetetus Dialogue? He is speaking about truth. What is truth? And what are the means to reach truth? The result is simple. We can never be sure whether something is true. Rather, the fundamental basis is the giving and taking of reasons. That's all. We shouldn't play games. It is not about winning against somebody else; it is about finding out what is true. And we will never reach a final result. We will never know, finally, whether this or that is true. There is a last passage in this Theaetetus Dialogue arguing that now that we have defined what knowledge could be, that is, what truth could be – knowledge is first a belief that is true and second a belief for which we have good reasons. Well, we cannot be content with this result. For hundreds of years, philosophers have asked, "Why not? It is a good result!" And then Gettier in the 1960s in his famous article "Is Justified True Belief Knowledge?" showed why Plato was right. Even truth and being well justified is not enough for knowledge.

The idea is basically: what do we do in science? We try to find out what is the case. We are never certain. We should never try to have a fundamentum inconcussum, as the Romans or the intellectuals in the Middle Ages called it. There is no fundamentum inconcussum. It is all in flux, so to speak. But nevertheless, we try to find out what is really the case.

I think one really has to view the two challenges of autonomous science and freedom of science in this context. Political instrumentalization means that we take the fact that science is also a subsystem cooperating and competing with other subsystems of society as a starting point for evaluating science. The argument goes: taxpayers pay for your research, and so we have to know what the use is, what the output is, and how we can evaluate this output. According to this, we can then tell you, if you will receive these funds or not. Politicization means that in the last resort, it is politicians, who decide what the telè of science are.

Another version of instrumentalization is the economic version. Strangely enough, on the political spectrum, the first version was more on the left side of the spectrum and the second version is more on the right side of the spectrum, but both are wrong, in my opinion. If we indeed had a scientific practice that became primarily dependent on economic interests, then the ethos of epistemic rationality could not be upheld anymore.

Now I have a problem with the terminology, and since we are in Vienna, I may say this more explicitly. How to translate "Bildung" is a problem of terminology. I want to say "akademische Bildung". One translation is "academic literacy", another is "academic formation", yet another "academic sophistication" or there is "academic education" – these are all different aspects of one word, of the German word "Bildung". "Bildung" has something to do with "forming" – "Bild". The basic idea of academic literacy – now I take Humboldt, another idealist, after Plato – is a very bold idea: if young men (that was 200 years ago, no women at that time) become adults and, after they finish school and cooperate with researchers, professors, in search of the truth, a certain development of their personalities will occur as a result, such that this is not only useful if they decide to become researchers and scientists themselves, but also if they decide to become bankers or state officials or ministers or whatever. This is the bold thesis Humboldt put forward. The paradoxical result was, briefly, his development of the four faculties. Before Humboldt, universities had primarily been an undertaking to prepare for three professions: the lawyer, the medical doctor, and the theologian-priest. Then there was additionally the trivium, and, from the Middle Ages, the quadrivium, put together in the philosophy department, propaedeutics.

Kant then said that politicians, or at the time the King, can be held responsible for a good education leading to specific professions, in the same way as medical doctors or lawyers. The church is responsible in the case of priests. But these political powers have no authority at all when it comes to the search for the truth. This was the basic idea in Kant's "Streit der Fakultäten". That was his idea, and his followers also shared his idea in the next decades – Schleiermacher, Fichte and many others. Humboldt then tried to spell out what that meant for the institution of the university. This changed the relationship between the four faculties. Philosophy became philosophy including the humanities and the natural sciences, and later on the social sciences, and thereby became the core of the university instead of being marginalized as before. It became the core. Why? Because there, the search for the truth is the only goal, whereas the other three areas also have other goals. They also prepare students for specific professions. One remark on the Bologna reform. It discriminates between two kinds of university studies. One is oriented towards the professions and the other is oriented towards science and research, in German: wissenschaftsorientiert vs. berufsfeldorientiert. But this tiny change is a rupture with the Humboldt tradition of academic literacy or formation or sophistication. The one prepares students for specific professions. The others prepare them for a certain job, also a profession, but this is research. And there the Humboldtean ideal can survive, while it cannot survive in the other. I hold that this is quite dangerous, and, in fact, most universities didn't accept it. Even high-ranking political officials were quite angry that the universities in Germany, in Austria, in Italy and in other places didn't accept the basic philosophy of the Bologna process. In my eyes, we should all be glad that they didn't. Otherwise, we would have a real decay of quality, of academic literacy, academic formation.

Last remark. My wording will be a little polemical, because time has run out.

In philosophy departments in the United States, you will soon be hearing expressions such as, "You know that philosophy is part of the humanities in our understanding?" Philosophy is part of the humanities? Why? The humanities, as they developed in the United States, are not to be held as sciences anymore. Alan Sokol's notorious test, you might remember it from 20 years ago, presented an indication that there are problems with scientific standards in their search for the truth. Postmodernism destroyed a good part of the ethos of rationality. I think we cannot allow the humanities to go back to what the philosophy faculty was before in the Middle Ages and in early modern times: marginalized. Not in Europe, not in Great Britain, I also think not in the US, but that is another topic. And, if we do not want that development to take place, the humanities must retain this core ethos, the ethos of epistemic rationality. Some practices have their goals in themselves. We shouldn't expect philosophy and the humanities to contribute to economic growth; they are not relevant for the global job market, but important for a humane culture worldwide.

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Current Position

- Professor of Philosophy and Political Theory, Ludwig-Maximilians University Munich, Philosophy Seminar

Expertise

- Theories of practical reason
- Metaethics and (applied) normative ethics
- Political philosophy
- Rational choice and collective choice
- Epistemology and philosophy of language in their relation to practical philosophy

Qualifications

1989	Habilitation in Philosophy (supervised by Wolfgang Stegmüller)
1984	PhD in Philosophy (supervised by Wolfgang Stegmüller)
1975–1980	Undergraduate and graduate studies in physics and philosophy

Career

Since 2009	Professor of Philosophy and Political Theory at Ludwig-Maximilians University Munich, Philosophy Seminar
Since 2002	Honorary Professor of Philosophy at the Faculty of Philosophy, Humboldt University Berlin
2009–2011	President of the German Philosophical Association
2004–2009	Professor of Political Theory and Philosophy at Geschwister-Scholl-Institute for Political Science (Director 2004-2008)
1998–2002	State Minister for Culture and Media in the German federal government (G. Schröder)
1993–2003	Professor of Philosophy, University of Göttingen
1991–1993	Professor of Ethics in the Biosciences, University of Tübingen

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FREEDOM OF SCIENTIFIC RESEARCH FROM A LEGAL POINT OF VIEW

IRMGARD GRISS

INTRODUCTION

Article 13 of the EU Charter of Fundamental Rights (EU CFR) declares that "The arts and scientific research shall be free of constraint. Academic freedom shall be respected". There is no agreed definition of academic freedom within the EU. However, more than half of the Member States of the EU have protection for academic freedom and university autonomy written into their constitution. The other Member States, with the exception of Greece and Malta, have some specific legislation relating to higher education, which refers to academic freedom and/or university autonomy.
The constitutional protection of academic freedom may lead to the conclusion that there are no legal constraints to academic freedom. Such a conclusion would be premature. Like other freedoms guaranteed by constitutions, academic freedom is subject to legal constraints. But the question is not only whether there are legal or other constraints. Equally important is the question of whether there is a need for constraints and, if so, what constraints would be acceptable.

I want to demonstrate the following theses:

- Freedom of scientific research is, but should not be, limited by legal constraints
- Freedom of scientific research is threatened by monetary and private interest conflicts
- Freedom of scientific research needs an independent, institutionalised framework
- Freedom of scientific research should only be limited by ethical constraints

WHAT IS ACADEMIC FREEDOM?

Although there is no agreed definition of academic freedom, it includes at least the following aspects: the freedom to study, the freedom to teach, the freedom of research and information, the freedom of expression and publication, the right to undertake professional activities outside of academic involvement.[1]

[1] LERU Advice Paper, Academic Freedom as a Fundamental Right, 34.

In its Recommendation 1762, the Parliamentary Assembly of the Council of Europe[2] states that "academic freedom in research and in training should guarantee freedom of expression and of action, freedom to disseminate information and freedom to conduct research and distribute knowledge and truth without restriction" and that "history has proven that violations of academic freedom and university autonomy have always resulted in intellectual relapse, and consequently in social and economic stagnation".

Academic freedom is not a goal in itself. It makes it possible for universities to serve the common good of society through searching for and disseminating knowledge and understanding, and through fostering independent thinking and expression in academic staff and students.[3]

When discussing academic freedom, a distinction has to be made between individual and institutional academic freedom. Individual freedom is the freedom of the individual scholar to teach and research without interference whereas institutional freedom means the freedom of the academic institution from outside control.

An early example of the individual scholar's striving for academic freedom is Galileo Galilei. He questioned the dogmatic constraints and insisted that the Earth was moving around the sun (heliocentrism). He, thus, threatened the institutionalised power of the Catholic Church. Due to the very harsh sanctioning nature of the regime, he risked his life for scientific freedom.

Academic freedom has been subject to conflicts right up to the present day. The most prominent example is the criticism of evolutionary theory on religious grounds. It is still questioned and is even not taught in some schools in the US. Even Supreme Court Justices, such as the late Antonin Scalia and his peers, fervently argue about the accuracy of Darwin's evolutionary theory.

On the other hand, academic freedom is questioned because of the consequences that scientific discoveries may have. One example is gene drive. Gene drive has been proposed as a technique for altering the genetic structures of wild populations of harmful organisms, such as mosquitoes, to be less dangerous. Malaria, for example, continues to impose enormous health and economic burdens on the developing world. Novel technologies, such as genetic modification, reduce populations and therefore the impact of the disease. The positive result may only be short-term, as "selfish" genes could spread rapidly through successive generations and consequences cannot be predicted. Gene drive is the practice of "stimulating biased inheritance of particular genes to alter entire populations."[4] It is for the first time that man has such power over nature.

THESES

1. Freedom of scientific research is, but should not be limited by legal constraints

Academic freedom is just as important to society as the freedom of the press and freedom of expression. These three freedoms are closely rela-

[2] Recommendation 1762 (2006) of the Parliamentary Assembly of the Council of Europe (PACE), Academic Freedom and University Autonomy.

[3] LERU Advice Paper, Academic Freedom as a Fundamental Right, 33.

[4] *Windbichler N* et al., 2011, A synthetic homing endonuclease-based gene drive system in the human malaria mosquito. Nature 473:212-215.

ted to each other. One could say that the freedom of science is the "cousin" of the freedom of expression.

Publish or perish is a well-known metaphor for the pressure that scientists face today, but it also makes it clear that scientific discoveries need to be published in order to really exist. The freedom of publication is therefore essential to the freedom of scientific research.

History has shown that blocking scientific knowledge only delays its release. Many times throughout history, some things were forgotten at one point but rediscovered later. So one could say that censoring science is a waste of time; it only slows it down.

However, there are legal constraints to academic freedom. Prominent examples are stem cell laws[5] and regulations on the use of animals for scientific purposes[6].

Are these restrictions compatible with the right to academic freedom? Art 13 EU CFR does not provide limitations. But academic freedom is deduced primarily from the right to freedom of thought and freedom of expression. Art 10 European Charter of Human Rights (ECHR) protects freedom of expression. According to the jurisprudence of the European Court of Human Rights, this article also protects academic freedom.[7] Art 10 para 2 ECHR authorises limitations to freedom of expression and, consequently, also to academic freedom. The restrictions must be prescribed by law and be necessary in a democratic society.

The first condition, prescribed by law, is met by all legal constraints. The second condition, necessary in a democratic society, opens up a broad field of discussion. The discussions reflect traditions and values as well as religious and other beliefs.

2. Freedom of scientific research is threatened by monetary and private interest constraints

The tight financial situation of nation states has led to a growing influence of third party funding on research. There are two main challenges: the results of studies may be reported in a biased way. If science is subject to market economies, only those projects may be realised that are promising with regard to their anticipated revenue.

Let me give you an example of biased reporting. One of the most widely reported research controversies arose over the arthritis drug Vioxx, which had been featured positively in an article published in a scientific journal. The article reported the results of a study that was funded by Merck and was co-written by two company researchers. Five years later, journal editors reported that the authors had omitted key incidences of heart troubles, creating "misleading" conclusions about the drug's safety.[8]

The second challenge is reflected in the fact that research neglects diseases affecting the developing world, the poor or those that only affect a small number of people. As a result,

[5] In the EU stem cell research using the human embryo is illegal in Germany, Austria, Ireland, Italy, and Portugal.

[6] Cf. Directive 2010/63/EU on the protection of animals used for scientific purposes.

[7] Case of Sorguc v. Turkey, application no. 17089/03.

[8] https://www.washingtonpost.com/business/economy/as-drug-industrys-influence-over-research-grows-so-does-the-potential-for-bias/2012/11/24/bb64d596-1264-11e2-be82-c3411b7680a9_story.html.

"death is not distributed equally".[9] It is a fact that sponsors dominate the fields where research takes place, regardless of where the demand is most pressing for additional knowledge.
Another impediment to free scientific research is the working conditions of young scientists. Scientific work has turned into project work – Pre- and Post-Doctorates are given one fixed-term contract after the other until they run into the obstacle of forbidden chain contracts; collective contract agreements are especially problematic for Prae-Docs who *de facto* have all-in-contracts masked as 30h/week, those also partly include teaching hours.
Precarious working conditions may, most likely, not attract 'the best'. The best have better options.
Extreme competition leads to systematic disadvantages for women: The lower the wage group, the more women are employed there. Half of all students in the EU are women but their numbers decrease dramatically with every step up the career ladder -> phenomenon of the 'leaky pipeline' – women trickle away from research structures that are not adjusted to their needs.

3. Freedom of scientific research needs an independent, institutionalised framework

An important parameter of academic freedom is institutional autonomy and the internal governance of universities and other academic institutions. The UNESCO recommendations state that "The proper enjoyment of academic freedom […] require(s) the autonomy of institutions of higher education. Autonomy is that degree of self-governance necessary for effective decision making by institutions of higher education regarding their academic work, standards, management and related activities […] and respect for academic freedom and human rights. Autonomy is the institutional form of academic freedom […] Higher education teaching personnel should have the right to elect a majority of representatives to academic bodies within the higher education institution".[10]

With regards to autonomy, a distinction has to be made between procedural and substantive autonomy. Procedural autonomy is the power of the institution to determine the means by which its goals and programs will be pursued; substantive autonomy is the power of the institution to determine its own goals and programs. In recent years, governments in some EU states have given greater autonomy at an institutional level at the cost of the state. At the same time, university staff has been excluded from the decisions that control the development of the university, at least to some extent. Institutional autonomy, thus, is a necessary but not a sufficient condition for academic freedom.
More important than institutional autonomy, therefore, is self-governance. The traditional institutional protection for academic freedom is through the tradition of participation by faculty members in academic governance. But an important point has to be made. Expertise within a discipline and excellence in scientific work does not necessarily imply managerial qualities, and managerial qualities are a must.
With regard to the connection between self-governance and academic

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9 http://www.sciencenewsline.com/summary/2014040423320004.html.

10 Recommendation Concerning the Status of Higher-Education Teaching Personnel; Resolution adopted on the report of Commission II at the 26th UNESCO plenary meeting, on 11 November 1997.

freedom, the level of protection for the personal academic freedom of staff is likely to be high where the supreme decision-making body has a majority of faculty members. Conversely, where this body excludes academic staff or has a majority of external members, then the level of protection will be low.
In addition, all arguments that back the freedom of press and expression can be used in conjunction with the freedom of science. The scientific community needs a representative to defend the freedom of science, a sort of scientific advocate who takes a stand for the scientists in cases where scientists are mistakenly blamed. This was the case when Italian scientists were jailed for manslaughter because they had not predicted a deadly earthquake.

4. Freedom of scientific research should be limited only by ethical constraints

Ethics in science has increasingly become an important issue in democratic societies, especially following the rise of the modern life sciences. After important discoveries in the field of biology, ethical reflection on scientific work and its results has come into focus. The key question is: should we inquire into everything we are able to – regardless of the consequences?
Over the years, several non-binding frameworks and standards have emerged. Ethics commissions have been established on many levels. UNESCO is a leading player in this field. Its World Commission on the Ethics of Scientific Knowledge and Technology (COMEST) is mandated to formulate ethical principles that could provide decision-makers with criteria that extend beyond purely economic considerations. Information on science and ethics with a focus on European activities is provided by ethicsweb.[11]

CONCLUDING REMARKS

Academic freedom is as important as freedom of speech and should enjoy equal protection. But legal protection is not sufficient, not least because the rules on academic freedom allow for legal constraints. At least in the western world, academic freedom is primarily endangered by dependence on money. There need to be transparent criteria and transparent decision-making procedures on how funds are allocated. Universities and other academic institutions need both autonomy and self-governance. And there is a need for ethical standards to guide research and for ethics commissions to advise researchers on ethical questions which are inextricably linked with their work.

[11] http://www.ethicsweb.eu/node/589.

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Current Positions

- Honorary Professor for Civil and Commercial Law at the University of Graz, Austria
- International Judge at the Singapore International Commercial Court
- Member and Speaker of the Senate of the European Law Institute

Expertise

- Constitutional Law, civil law, commercial law

Qualifications

1975	LL.M (Harvard)
1974–1975	International Legal Studies at Harvard Law School
1970	Dr. iur. at University of Graz
1966–1970	Study of law at University of Graz

Career

Since 2015	International Judge at the Singapore International Commercial Court
2008–2016	Deputy Member of the Austrian Constitutional Court
1993–2013	Member and (2010-2013) President of the Supreme Patents and Trade Marks Board
2007–2011	President of the Austrian Supreme Court of Justice
1993–2011	Judge at the Austrian Supreme Court
1987–1992	Judge at the Court of Appeal, Vienna
1981–1987	Judge at the Commercial Court, Vienna
1979–1980	Judge at the Commercial District Court, Vienna
1976–1979	Candidate lawyer
1971–1975	Assistant at the Institute of Civil Procedure Law of the University of Graz

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INTEGRITY AND RESPONSIBILITY OF RESEARCHERS: ETHICAL VIEWS

MICHÈLE LEDUC

In France the work of ALLEA is highly regarded. Much attention is given to its investigations. We are familiar with the European Code of Conduct in Research Integrity where CNRS found inspiration for its recent reflections, in the context of the general concern about ethics in science, which is increasing all over the world.

My contribution will be very much along the lines of the previous one. I shall start with a few words about the position that I am in charge of at CNRS, one of largest research institutions in Europe. I am the current president of the Ethics Committee of CNRS (COMETS), which was created twenty years ago. I follow the tracks of the past president Jean-Pierre Bourguignon, who is currently president of the ERC and will report later today. COMETS is a sort of think-tank composed of twelve members of all disciplines, from hard science to humanities and social sciences, with a strong component of life sciences. We do not handle specific cases of fraud or misconduct but simply give advice to the CNRS direction and to the research personnel of the institution. Our mission is to develop a reflection about research practices and the principles that should govern the individual and collective behavior in the production of science. We formulate recommendations following analyses of situations that we have identified where ethics problems occur. COMETS is independent from the CNRS direction but reports to its president. CNRS is a public multidisciplinary institution ruling over 3000 research laboratories, most of them linked to the French universities. Thus the COMETS reflections concern a large population of scientific workers of the public sector in France.

One can wonder what induced CNRS and COMETS to worry about research integrity. Fraud is not that frequent and a large majority of researchers have a highly honest attitude towards their profession, where their freedom is very large but their responsibility equally large. Yet the media today focus more on cases of fraud, which thus propagates a damaging image of science in the public opinion. As for me, being a physicist, I was not especially aware of problems until I took charge of

COMETS. Then, from 2011 on, the committee noticed a net increase in open quarrels between research personnel and more conflicts between laboratory teams. Listening to reports provided by the CNRS mediator, we discovered the occurrence of several cases of fraud, such as appropriation of results found by others, plagiarism, alteration of data, creation of false results. It is not clear that frauds such as the fabrication and falsification of results or data have increased all that much, but plagiarism seems to be developing quickly in the internet age. Less serious than frauds but more frequent cases of misconduct are constantly reported, at the border line of fraud. They are called the "gray area" of deviation from research integrity. They concern a large range of conducts that should not take place in a laboratory but that frequently occur, as confirmed by recurrent enquiries. The list is long, varies from one culture to another, strongly differs according to disciplines, and also evolves over time. Most of the misconducts deal with the publication of scientific results: wrong attribution of authorship, omission of important contributors in the list of authors, "slicing" of results at the limit of self-plagiarism, omission of methodological details, insufficient statistics, bad archiving of data, misleading communication to the media, etc. We also noticed a frequent lack of mentorship of students and of young researchers by the group leaders, which is another kind of misconduct. Situations where ethics is questioned induced COMETS to analyze the changes in the way public research is conducted today. This seems to provide some keys for understanding the increasing departure from a strict respect of research integrity, which yet should be regarded as the crucial deontological basis for the researcher profession. The pressure on researchers significantly increased in the last two decades, as also mentioned in the previous presentation. A growing competition takes place, both at internal and international level. Group leaders and even postdocs spend more and more time answering calls from funding agencies, focusing on short-term pre-established programs, which, incidentally, constitutes a limit to their creativity. More and more time is requested for administrative tasks and for the evaluation of proposals, articles or the career advancement of colleagues. The time left for the real research work keeps shrinking. Another pressure factor is the methods used for the evaluation of personnel, both when they compete for a permanent position and/or when they ask for a promotion. Bibliometric indices are still common tools everywhere, even if they are currently criticized by the scientific academies. Consequently, there is a huge pressure to publish in reviews with a high impact factor, which are largely overestimated. The insecure situation of the young researchers in most disciplines increases the stress in laboratories, as well as the push for a scoop in the media.

There are several equally important reasons to care about research integrity, for which a working group at Science-Europe developed an argument. Research integrity safeguards the foundations of science and scholarship. It maintains public confidence in research evidence. It underpins continued public investment in research. It protects the reputation and careers of researchers. It prevents adverse impacts on patients, regarding how dramatic the consequences of wrongdoing in health research could be. It promotes economic advancements. And there is a damage, insufficiently recognized consequence of the lack of integrity:

it gives rise to the waste of resources, of time, of money, of talents, carrying potential human consequences which might turn out to be dramatic for researchers' careers.

It is significant that the number of retracted articles visible on the site *Retractionwatch* is going up much faster than the number of publications. Articles are retracted by the publishers once frauds or errors are discovered. Plagiarism is an increasing cause of retraction, now that adequate software can detect similarities between published texts. However, falsification of results is the first cause of retraction in some disciplines such as the bio and life sciences (*see figure 1*). This is the reason why more and more publishers in these fields request that the data are provided at the same time as the manuscripts. The concern over these problems spreads to all countries where research takes place. The first large international conference on research integrity took place in Singapore in 2010. It formulated four relevant principles – honesty in all aspects, accountability, professional courtesy and fairness, good stewardship of research on behalf of others. These principles were subsequently developed at further international conferences (Montreal in 2013, Rio in 2015, Amsterdam in 2017). Attendance at these World Conferences on Research Integrity is constantly increasing.

Fig. 1: Artist view of the frauds in scientific research (fabrication, falsification and plagiarism). Credit © Jochen Gerner.

In France, an extensive guidebook "*Integrity and responsibility in research practices*" was written and published by COMETS in 2014. A revised version was elaborated in 2017 to take into account the changes in the French laws regarding the deontology of public servants, as well as the increasing care for ethics at the European level. This new guide is now available on the CNRS website in both French and English versions. A copy of this 30-page booklet is now provided by CNRS[1] to all laboratory directors of all disciplines. It is also distributed to all newly recruited CNRS personnel, who are compelled to sign that they are aware of its content. All universities in France, through the Conference of the University Presidents, have participated in the revision of this guide book and

[1] See: http://www.cnrs.fr/comets/IMG/pdf/integrity_and_responsibility_in_research_practices_a_guide_05.12.16-2.pdf.

have now adopted it for their own institutions as a code of good practice in research. This is one of the tools in use for the training on research integrity of PhDs as well as senior scientists, now a national concern for the French Ministry of Research and Superior Education. Internet ethics lectures will soon be available, including video interviews and case studies. The main concern is now to develop an awareness campaign around such sensitive matters and try to change mentalities.

Problems may arise with the media when frauds in research are discovered. A recent example occurred in France in 2015, when falsification of results and data was revealed in a public laboratory in the field of biology. Several articles had to be retracted in turn, in spite of the very high reputation of the CNRS senior researcher in charge. Accusatory papers were written in large public newspapers such as *Le Monde* and *Les Échos* in France, echoed by others in the British and Swiss press. It was just another case of fraud, such as those that institutions usually deal with confidentially. For the first time, wrongdoing in science at CNRS was revealed to the public and created a shock, which, of course, is likely to damage the citizens' faith in research. On the other hand, it stimulated the research institutions to define clear procedures for whistler-blowers of misconduct in laboratories. It is remarkable that this case of fraud was revealed by a social network called *PubPeer*, which is an online scientific journal club, recently created as a forum of discussion on published articles. Research is now facing a world where social networks, blogs, home pages, tweets, etc. contribute to spreading news and comments about the scientific production. On the one hand, this enlarges the scope of research. On the other hand, it opens routes to reveal frauds anonymously, which can induce people to denunciate colleagues without a solid scientific basis. The Ethics Committee of CNRS is of the opinion that anonymous denunciation should not be encouraged and that there should be an institutional procedure protecting the deposition of the whistler-blowers.

Scientific research develops in the context of the relationship between citizens and scientists, in constant evolution over time. After World War II, the progress of science was considered the primary factor in economic and social development. In the 1970s, the notion of progress was reconsidered in view of new challenges, such as the environment, energy, health, and also the awareness of the limited resources of the Earth. Nowadays, there are mixed feelings about science in the public, from admiration, especially for the progress in medicine, to apprehension about the risks of the technological advancement. Researchers are facing a new situation that COMETS analyzed for CNRS. There is an urgent need to rebuild a relationship of trust between citizens and scientists. Two avenues can be considered, participatory science and renewed dialogue between science and citizens.

Participatory science is a means to bring science closer to the public. It involves amateur citizens in research activities such as the collection of data and even, sometimes, the joint formulation and interpretation of results. Methods for the collection of scientific data through internet by non-professionals are emerging. Amateurs can work with researchers and even participate in co-creation or co-design. The benefit can be mutual. On the one hand, when amateurs collect data, for example in the environment landscape or in the astronomical sky, they produce a large amount of results that would take too much time and be tedious if done by professional scientists. On the other hand, participatory training for amateurs is a very efficient method for developing rational thinking in the population through a direct apprehension of the scientific method. It is also a way to encourage a vocation for science among young people, which is rather problematic in France, as elsewhere. A recent example can be given by the French Museum of Natural History, which launched the collaborative project "65 million observers", where 65 million is just the total population of France. There are, of course, ethical concerns for the practice of participatory science – validation of the data, protection of the private life, rewarding of the contributions.

Participatory science is to be developed in parallel with more conventional means of spreading the scientific culture, such as conferences, science museum visits, opening of laboratories, science weeks, science-cafés, etc. It is part of the researchers' mission to communicate the results of their findings in a form understandable to their community and to the public at large. More encouragement and adapted funding should be provided to them by their institutions. Appropriate training could help, and young researchers should be rewarded in their future career if they spend time actively spreading the scientific culture. One notes that most European contracts include some percentage of the total funding for outreach. However, these efforts sometimes appear disappointing in terms of capacity-building of the citizens, in particular children. More cooperation with school teachers is mandatory, as they are the best go-between between the scientific world and the young generation. Better training of the scientific journalists in the press and other media is also a right way to go.

The dialogue between science and citizens can also be reinforced by joint discussions about the social impact of the fast and uncontrolled development of new technologies. A growing number of citizens hold an attitude of distrust towards advances in science and technology, perceiving them as mostly dedicated to the development of industry, beyond democratic control and unconcerned with public well-being. COMETS is of the view that researchers and their institutions need to listen to the public's questions on the impact of their choices and play an active role in helping the citizens in controversial debates. Researchers should communicate what they know and what the limits of their knowledge are, taking care to disconnect personal opinions from scientific knowledge. They should worry about the use that media and politicians might make of the expertise they provide. It is mandatory that their assessments on issues having a

Fig. 2: François Rabelais, French writer (1494–1553) who wrote the novels Pantagruel and Gargantua, in which one finds "Science without conscience is the ruin of the soul" (Wikimedia commons).

societal impact should be conducted in the absence of conflicts of interest, within an interdisciplinary and, if possible, international framework. COMETS considers it necessary to reflect on the forms that the public debate around controversial scientific questions should take. Yet it reaffirms the autonomy of the scientific sphere, where the intrinsic freedom of the researcher is only limited by his responsibility (*see figure* 2).

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Current Positions

- Director of the Institut Francilien de Recherche sur les Atomes Froids (IFRAF)
- Emeritus Research Director in Physics at the National Centre of Scientific Research (CNRS)
- Member of the Ethics Committee of CNRS

Expertise

- Atoms, Molecules and Optics
- Cold atoms and Bose-Einstein condensation
- Quantum technologies

Qualifications

1972	PhD degree in Physics (Paris University)
1961–1965	Study of Physics at École normale supérieure de Jeunes Filles de Sèvres

Career

2005–2017	Director of the Institut Francilien de Recherche sur les Atomes Froids (IFRAF)
2011–2016	Chair of the CNRS Ethics Committee (COMETS)
2007–2013	Member and then jury chair at the European Research Council (ERC)
2007–2009	President of the French Physical Society (la Société Française de Physique)
2001–2002	National Head of the Very Large Research Infrastructures Unit
1999–2002	Scientific advisor for Physics and Engineering at the French Ministry of research
1994–1999	Director of the Kastler Brossel Laboratory at Ecole normale supérieure
1993–1998	Director of the International Center of Physics at les Houches

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PERSPECTIVES FROM AND ON THE ERC*

JEAN-PIERRE BOURGUIGNON

You will not be surprised to learn that, as President of the European Research Council, I am passionately committed to the principle of scientific freedom. And, indeed, giving researchers at any stage of their careers space to develop their projects at their own full initiative is the raison d'être of the European Research Council.

The idea of funding research in this way is not a new one. In fact, many members of the European scientific community – myself among them and, I know, many of you – campaigned long and hard for a programme like ERC to exist precisely in order to go back to tried and trusted principles. The predecessor of today's Max Planck Society in Germany was set up in 1911 according to the Harnack Principle. Alfred von Harnack, the first President of the Kaiser Wilhelm Society, advocated the right of researchers to work independently of government or private requirements and unencumbered by bureaucracy. Around the same time, the UK's Research Councils were set up as autonomous bodies to be free from political and administrative pressures that might discourage research in certain areas. In 1939, Abraham Flexner wrote the famous manifesto entitled *"The usefulness of useless knowledge"*. It was the blueprint for establishing the Institute for Advanced Study in Princeton, later home to Einstein, Gödel and many others, and the model of several other institutes of this type in the world. And after the Second World War, Vannevar Bush made similar arguments in *"Science, The Endless Frontier"*, his 1945 report to the United States' President calling for an expansion of government support for science and the creation of the American NSF.

Traditionally, the European Union's research programmes have only supported collaborative research projects in applied or mission-oriented areas. This changed decisively in 2007 with the recognition by the Lisbon Treaty of research as a shared responsibility of the European Union. This allowed the creation of the ERC financing projects presented by single principal investigators.

The ERC is unique in the European Commission portfolio in two ways: firstly, it is its Scientific Council that has the full responsibility for allocating the annual budget and

* Data provided reflects the situation at the time of the talk.

organising the scientific evaluation; secondly, the ERC is based on the idea that researchers know best what they should research and how they should do it.

That is why the ERC supports scientists from anywhere in the world, of any age and from any field of research – including the social sciences and humanities – on the basis of the scientific quality of their project. There are no predetermined targets or quotas. The ERC provides substantial, long-term funding. The only prerequisites are that ERC-funded researchers must be based in Europe for at least 50% of their time and be willing to be adventurous and to take risks in their research.

And this, to me, is the real value of ERC funding. Secure funding frees researchers from having to be concerned with immediate impact; from thinking of the next publication; from worrying about what to write in the next grant application. It allows researchers to really focus on the core of their research, taking a long view. We believe it is the best way through which their work will lead to genuinely new knowledge.

The first ex-post study conducted by independent experts on the first 200 completed projects at the initiative of the Scientific Council shows that some 21% of the ERC-funded projects lead to radical breakthroughs, 50% to major scientific advances, giving an overwhelming 71% of very successful projects. 4% are evaluated as failed attempts by the ex-post evaluators. This is still good news as it shows that the selection panels did take some risks. The objective was to gain a global view of their contributions.

So the very base of ERC is scientific freedom and autonomy, the freedom given to the individual researchers who are funded, and the autonomy of the Scientific Council, which decides how the funding is allocated.

We are all too often confronted with the fact that the general public, and also policy makers, do not understand how science actually develops. People believe that if one puts enough resources into a problem, then it will be solved. I think that many have in mind something like the Manhattan or Apollo Projects of the mid-1900s, which were amazing accomplishments.

But these examples do not offer a general adequate model for how science can contribute to changing the world. On the surface, it might appear that curing cancer or tackling climate change can be amenable to a similar approach following a strategy chosen a priori. However, this resemblance is superficial. In both the Manhattan and Apollo projects there was a very tightly defined task based on underlying physics understood decades before the projects began.

This explains the limited impact of the "war on cancer" launched by President Nixon in 1971. His advisers reckoned they could find a cure in seven years, but curing cancer turned out to be much more difficult[1]. Even fifty years later, we have only a limited understanding of the full complexity of the processes involving abnormal proliferation of cells and the critical realization that we should not speak of "cancer" but of "cancers".

In a 2005 paper, the distinguished cell biologist Henry Harris suggested that there had been at least five "fashions" in cancer research since the late 1960s, and each one had eventually proved to be partially inadequate. Given that science proceeds by trial and error, it therefore seems unlikely

[1] What will President Obama's cancer 'moonshot' achieve? www.bbc.com/news/health-35988623.

that we could, at any one particular moment in time, identify certain major challenges and then "solve them" only by pouring in lots of extra resources.

This has not stopped President Obama from launching his own one billion dollar "National Cancer Moonshot" initiative "to eliminate cancer as we know it"[2] this year. The initiative "aims to bring about a decade's worth of advances in five years".

I think we can all empathise with and understand the motivation for this type of approach. And who knows, maybe we are now at a point where real progress can be made. But understanding must come before application, and we really do not know what we do not know. So one can fear that this approach has more political than scientific merit.

And we must remember that the most important scientific results of all often come about when scientists are not looking to solve any particular societal or technological problem. Look how CRISPR, this totally new approach to genetic engineering, was developed. Jennifer Doudna and Emmanuelle Charpentier, recognized as the inventors, did not assemble the molecules they use for gene editing. In fact, they stumbled across the CRISPR molecules in nature. Microbes have been using them to edit their own DNA for millions of years. CRISPR was first noticed in 1987 by Japanese researchers in the gene sequence of the Ester Coli microbe, but they had no way of knowing that they had discovered something so revolutionary. *"The biological significance of these sequences is not known,"* they wrote. It wasn't until 2007, after lots of work in different countries and with the development of more advanced techniques, that researchers realized that CRISPR formed a kind of immune system for microbes.

Doudna's lab began to work in this area because she thought the chemistry might be "cool". There was no particular goal, except understanding. It was only later that they started to see that CRISPR was in effect a programmable DNA-cutting enzyme, opening the way to a very practical use[3].

So you can see that nobody working on CRISPR set out to address a societal challenge or to develop a new technology. But, by seeking to understand the world, the inventors actually just achieved these potentially dramatic actions.

True scientific breakthroughs, like the introduction of general relativity or of quantum physics or the unravelling of DNA, change the whole framework in which everybody is operating. The wider community then comes to realise that this new discovery, or finding, or approach, is, in fact, extremely important. It needs to be discussed, analysed, reproduced and explored further, and sometimes for decades. It must be stressed and patiently explained that a fundamental part of the researchers' activities is to develop new concepts that become indispensable to create the groundwork for new research in the future.

So, in order for science to make truly influential innovations, funding cannot be short-sighted. To maintain a healthy research ecosystem, investing in long-term curiosity-driven research is therefore indispensable.

This approach is sometimes seen as idealistic, but to me it is not. It is actually a question of taking efficiency seriously. It may appear

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2 https://www.whitehouse.gov/the-press-office/2016/02/01/fact-sheet-investing-national-cancer-moonshot.

3 https://www.quantamagazine.org/crispr-natural-history-in-bacteria-20150206.

counter-intuitive, but one must accept the idea that one of the best ways to achieve results is not to look for them. Of course, one needs ambitious researchers having an open mind and a lot of flexibility about where their research is leading them to.

In a number of cases, it is actually pernicious to require a researcher to declare the impact or applications of his or her research before it is carried out. If one does, one should not be surprised that researchers will mainly propose what is immediately achievable or projects in "hot areas" more easily funded. In other words they will take less risk. The more priorities and targets assigned to researchers, the more likely we are to see incremental or fashionable research.

Of course, one cannot expect every research project to lead to a breakthrough, but I do believe that one needs to maximise the chances that somebody will get his or her hands on one of them.

The ERC philosophy is that applicants must be challenged often enough to demonstrate the ground-breaking nature and ambition of their scientific proposal. We want to know the extent to which the applicant is capable of creative independent thinking and of conducting ground-breaking research. In other words we encourage people to take risks. And I would like this approach to spread.

Unfortunately, I have some bad news for you. Spontaneously, the academic community is conservative, as the specialists we all are want to be taken seriously. We want to be viewed as carrying out a notable job. This is understandable but must be challenged.

I owe to Professor Zeilinger, our host today, an extraordinary example, because it is at the highest level, of the way risk taking is considered by scientists. The key document relating the story dates back to 1913. It is the nomination of Albert Einstein to the Prussian Academy of Sciences. Here is the quote: *"Dass in seinen Spekulationen gelegentlich auch einmal über das Ziel hinausgeschossen haben mag, wie z. B. in seiner Hypothese der Lichtquanten, wird man ihm nicht allzu schwer anrechnen dürfen"*. And the signatories are Max Planck, Walther Nernst, Heinrich Rubens and Emil Warburg. To see, 8 years after Einstein had proposed the mechanism of the photoelectric effect, one of his major discoveries of his 1905 *annus mirabilis* challenged almost as a blunder by four of the most prominent physicists of the time, is highly revealing. The more so because it is done by some of the founders of quantum mechanics for an effect which is now considered one of the pillars of the theory. Fortunately, the next sentence says: *"denn, ohne einmal ein Risiko zu wagen, läßt sich auch in der exaktesten Naturwissenschaft keine wirkliche Neuerung einführen"*.

To achieve the goal of a risk-friendly environment, the next issue is, of course, the design of the selection process. When you look for new ideas coming from a scientist, then of course they must be evaluated by experts. After what I said, it is clear that the process has to be closely monitored.

The decisive and key element to achieving that is the quality of the selection. This is why for every call (ERC makes 3 each year), it relies on around 350 high level, hand-picked scientists as panel members, and on around 2000 remote reviewers from all over the world.

Does the ERC deliver what it promised? I already gave you an insight into that earlier when I spoke about the ex-post analysis just conducted. Another angle for monitoring the results is provided by the detailed analysis performed by the agency managing the ERC of over 40 000 publications from ERC-supported projects in international peer-reviewed journals. What does it tell us? About one third of all ERC grantees have already published an article that ranks in the top 1% most highly cited worldwide, i.e. publications with the highest recognition and impact amongst the global scientific community. Note that they are also the ones watched by industry as sources of technological and social innovation. For ERC grantees, they account for 7% of their cited papers, an exceptional performance only comparable to that of fellows of the Howard Hugues Medical Institute. This establishes the dominance of quality over quantity. We can therefore be very confident that ERC-funded researchers are having a large scientific impact.

I am very pleased to report to you that in Europe, many countries have reshaped or are reshaping their research policy by creating new schemes based on the ERC model and philosophy of empowering researchers through a bottom-up approach. So ERC is contributing to making the idea of the necessity of free research understood and accepted.

But this is only one part of the story. Indeed, the idea that science cannot just be left to scientists and that science, not to mention technology, should be harnessed to societal needs has an equally long history that should not be ignored.

Today more than ever, it is the scientists' responsibility to argue for the support of fundamental research, to make the many different ways science contributes to society tangible, to show that taking the long view wins over an impatient approach looking for short-term results. It is our task, as individuals but also collectively, in particular through the organisations representing us such as learned societies and academies, to help the public and policy makers understand that a significant part of research must be organised using the bottom-up approach. For that, evidence of the legitimacy of such an approach has to be provided, based on many different examples. ERC has established the Proof-of-Concept programme for ERC grantees, who, while pursuing their research, see possibilities of getting closer to markets or societal needs. This is again done using a strict bottom-up approach and evaluated by specialists in knowledge transfer.

Appropriate care must be taken to make how the scientific method works properly understood by the general public and, in particular, by school children. In the age of the internet, this looks like it has become an easy task. I challenge this view, as the internet contains, next to wonderful pages, a huge amount of fake science presented in ways which make it difficult to distinguish it from solid knowledge when one lacks the appropriate training.

The only way out is a sustained effort by the scientific community, in close connection with the education community of course, to alert the next generation to these dangers. And the danger will not go away easily as some people and organisations are seizing these new opportunities to propagate their views with the purpose of winning zealots. They are ready and able to spend considerable amounts of money for that. Consider the number of websites defending creationism against all documented scientific evidence.

This shows that educating people to think critically and teaching them to cross-check sources is, more than ever, of the greatest importance. We must be, again both at an individual and a collective level, directly involved in this process. Without serious progress on this front, and contributions from the social sciences and humanities to understanding the process of forging belief, there are grounds to fear that rational thinking will be under serious threat, putting the development of science in great danger.

There is another front which must be brought into the picture, namely that of the relations between the scientific community and policy makers.

The initiative of the United Nations to set up the International Panel on Climate Change (IPCC) to gather information at the global level and to propose possible scenarios on climate change is, from this point of view, very remarkable. It not only assembled a critical mass of specialists from various disciplines for a collective task, but it did so while adopting a long view and establishing precise procedures for the production of reports. This did not prevent several lobbying groups from trying to impact the discussion by supporting a wide range of media challenging the role of humans in the process. The pressure was felt even inside some academies.

To say the least, the debate concerning the use of Genetically Modified Organisms (GMO) was not handled with the same efficiency at the international level. Most likely, the existence of immediate economic interests prevented this from happening. In many countries, and France is a good example of that, it proved impossible to separate the scientific issue of the impact of using GMOs on the environment from the economic question of the control that major firms could be winning on crops if GMOs were adopted. This is one instance where the scientific community has not been able to bring enough clarity to the issues and be heard by policy makers.

The efforts made by Carlos Moedas, European Commissioner for Research, Science and Innovation, to have the European Commission adopt a strengthened Scientific Advice Mechanism are to be commended. The involvement of distinguished independent scientists in assembling information and data for use at the European political echelon is, of course, a critical step. The fact that he was trained as an engineer and is genuinely keen on science is probably relevant here.

The direct involvement of active scientists in the production of advice at the highest level is, of course, excellent news, as there are not so many of us with this profile in the European Commission. Academies will also be involved in the process, as the result of steady efforts conducted by several of you. This is perfectly in line with the point underlying this speech, namely that it is a critical responsibility of ours to get involved and to look for such contacts rather than to stay cautiously away. There are conditions, though, to make such an involvement unambiguous: real independence and access to appropriate support are the key ones.

The true challenge of a successful science policy is to find a satisfactory balance between the two basic approaches of research: bottom-up and top-down. This is not an easy question as the answer depends on the context in many ways: domains concerned, funding mechanisms used, strategic management structure empowered, …

As we know, in many countries, more and more researchers are affected by a decline in resources devoted to basic research. So my plea is that, at times when cuts are considered, we scientists fight for a minimum level of funding going to bottom-up basic research. There is plenty of evidence that not giving researchers enough freedom curtails the possibility of unexpected developments, which are vital for the future. It is, indeed, our responsibility to make all stakeholders understand what it takes to make the contribution of scientists serve society in the best way. It requires that the researchers be supported in all their diversity, be they involved in the natural sciences, life sciences, social sciences or humanities. Most of all, they must be given time and freedom to explore new knowledge, because it is the only way in which science can truly flourish.

I am convinced that the ERC has a specific role to play in this respect because of the scientific impact it has already achieved and the extraordinary mobilisation it has triggered. It has already empowered more than 4000 young researchers across all disciplines, a milestone, while representing only about 1% of the overall support given to research in Europe. It must continue to develop even further, the point on which I want to conclude and call for your support.

Last year, through many channels, the scientific community expressed its opposition to taxing the ERC budget to contribute to the European Fund of Strategic Investments. Academies played their role in the decisive mobilisation which, in the end, successfully prevented such a cut.

Some politicians may be tempted to introduce similar cuts at the time of the midterm review of Horizon 2020. At the invitation of the Budgets Committee of the European Parliament, I presented the view of the ERC Scientific Council concerning the budget needed by the ERC until 2020. This document is available on the ERC website. To consolidate this view, the Scientific Council suggests that an independent review of what ERC has achieved so far and what it takes to make it deliver its promises until 2020 be set up. By doing so, it is just taking up a recommendation made by the independent body that reviewed ERC at the midterm of Framework Programme 7. Your support for and engagement in such an initiative can prove critical.

Further, the preparation of the next framework programme is coming up very soon. Its general architecture will be proposed by the European Commission at the latest at the end of 2017. It should be an exceptional opportunity, beyond guaranteeing the ERC an appropriate budget, to reach a new stage for its development, recognizing its indispensable independence, freeing it from all unnecessary bureaucracy, strengthening the capacity for action of its governing body, the Scientific Council, and giving it the long-term visibility it needs to continue to impact positively on national policies for the support of research. Steps in this direction have to be taken very soon. Your contribution and your support in this decisive endeavour are needed and warmly welcome.

JEAN-PIERRE BOURGUIGNON

Current Positions

- President of the European Research Council
- Directeur de Recherche émérite at CNRS
- Professeur honoraire à l'Institut des Hautes Etudes Scientifiques, Bures-sur-Yvette, France

Expertise

- Differential geometry
- Mathematical aspects of theoretical physics

Qualifications

1974	Thèse d'Etat in Mathematics at the University of Paris 7
1966–1968	Engineering degree at École Polytechnique

Career

Since 2017	Member of the Portuguese Academy of Sciences
Since 2016	Honorary Member of the Deutsche Mathematiker Vereinigung
Since 2014	President of the European Research Council
Since 2005	Honorary Member of the London Mathematical Society
Since 2002	Member of the Spanish Royal Academy of Sciences
Since 1996	Member of the Academia Europaea
1994–2013	Director of the Institut des Hautes Études Scientifiques (IHÈS), Bures-sur-Yvettes
1986–2012	Professor of mathematics at the École Polytechnique
1995–1998	President of the European Mathematical Society
1990–1992	President of the Société Mathématique de France

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POLITICAL INFLUENCE, SOCIETAL DEMANDS AND THE EXPECTATION OF ECONOMIC RETURNS:

THREATS OR POSSIBILITIES FOR RESEARCH?

LÁSZLÓ LOVÁSZ

Let me start with something rather commonplace. In terms of motivation or driving forces there are two types of research – basic research, which is "curiosity-driven" or "bottom-up", and applied research, which is "agenda-driven" or "top-down". These pairs of phrases don't mean exactly the same, but they are closely related. We all know, and we heard it in the previous talk, that it is crucial to strike a healthy balance between these two types of research, but we are also aware of how difficult this task can be.

One of the difficulties is that the two types of research work on entirely different time scales. Basic research often takes years or even decades to complete. In contrast, applied research is seldom pursued for decades, as the parties who order and finance it would usually expect results within weeks. The industry or the government will not be satisfied with an answer that goes like, "Give us 15 years and then we might be able to solve your problem."

This uncertainty is also connected with the fact that results in basic research are unpredictable. However, once they are obtained, they are published. In applied research on the other hand, the goal is set, and often, when the results are obtained, they are classified or patented. These results only contribute to the general information pool of society with a substantial delay, if they ever do.

Let me mention another critical difference. Examples of top-down problems include global warming, migration, cancer, water supply, biodiversity, self-driving cars and many other goals, problems and questions that society poses. Everybody in our societies understands that these questions are important. People even expect scientists to provide answers, or at least partial answers to them. However, typical questions in bottom-up research are far less obvious: how can certain bacteria survive under extremely adverse conditions in hot springs? Can we improve the error term in the prime number theorem? Or a question from social sciences: did the Hungarian army requisition bells from Catholic, Orthodox or Protestant churches in Transylvania to cast cannons during the 1848/49 revolution? The challenge already starts with convincing society that such particular questions are meaningful, that the answers are useful and, above all, that there is value for society in spending money on research on such questions.

Eric Lander, an advisor of US President Obama (who is also a mathematician), presented a wonderful talk at a math meeting, where he called basic research "the miracle machine". He makes the point that if one computes the *expected* reward or return on investment in basic research, it is infinite. He even presents statistical evidence for this. He describes several examples; one of these is that when biologists tried to understand how bacteria can survive as mentioned above and what kind of biochemical mechanism is at work there, this led to the discovery of the PCR procedure. Today this method is extremely important, its applications range from medical practice to basic research. So, a phenomenon we don't understand is interesting *because we don't understand it*, and not because the problem itself is directly linked to any foreseen application.

Another example is evolution. Everybody thinks of evolution as happening on a time scale of millions of years. Even if we understand the mechanisms, we cannot influence them (perhaps a little bit, if we think of breeding dogs and other animals). Yet, there are evolutionary procedures that happen on a much shorter time scale, such as the development of bacteria that are resistant to antibiotics, which have evolved over a few decades. No one questions that these are threatening and, indeed, it is extremely important to understand how these evolve. The study of the evolutionary procedures will hopefully lead to new methods of fighting these bacteria in a comparatively short time. So, understanding evolution better could save the lives of many of us.

The prime number theorem, the example I mentioned earlier, reveals another lesson for unpredictability. Prime numbers are very central objects in mathematics. Hardy, an excellent mathematician in Cambridge and one of the leaders of early 20th-century mathematics, was a pacifist and a rather pessimistic person. He said that he was working on number theory because no one had ever discovered any warlike purpose to be served by the theory of numbers, and it seemed unlikely that anyone would do so for many years. And he added that he considered every real-world application to be potentially a military application, so he preferred not to have any real-world applications. We all know today that questions about primes are the basis of cryptography, computer security and cyber war. So, we should be very careful about making predictions about the inapplicability of basic research.

Finally (and I don't want to go into the details of this complicated story), there is the example of the Hungarian freedom fight against the Austrian Empire in 1848/49, which happened while there was also a Romanian freedom fight going on against the Hungarians. This complicated situation led to the casting of cannons from bells, which has since become a legend in Hungarian history books. It turns out that most of these bells were requisitioned from Orthodox churches, which happened to be Romanian churches. To learn about the different angles of such historical events could play an integral role in advancing reconciliation between nations. Even such seemingly "inapplicable" questions could have far-reaching positive consequences if followed up.

Coming back to the complex interfaces between different research communities, let me give you another strange example, showing that even within the field of basic research, people can have completely different attitudes. I recently served on a grant committee. The question came up of whether the amount granted might be reduced, perhaps to 60% of the requested amount. There were two very strong views on that. Biologists, supported by medical doctors, chemists and experimental physicists were arguing along the lines of: "How could it be? You must plan your project carefully. If you are willing to accept a smaller grant, you will not be able to complete your project, and so you should not get anything." Meanwhile a mathematician or maybe a historian, a philosopher, or a theoretical physicist could easily disagree with this view, saying: "Why not? I want to get enough for my salary (if that's part of the grant), for conference participation, perhaps a laptop. I promise I will study good problems, but I don't know what will be at the center of my interest in four years. If I can pay more PhD students or postdocs, I will happily introduce them to research, but their number is not crucial for my work." As you can see, even we scientists have very different approaches to funding and to answering social challenges.

Now, of course the central question is how to connect the two kinds of extremes, basic or bottom-up research and applied or top-down research. There have been many attempts in one particular direction: I think all countries have tried to develop their own system for channeling basic research to applied research and to innovations. Some of these systems work, some don't. Incubators and venture capital are possible vehicles. My question is how to approach the problem the other way round? Society comes up with many questions: global warming, social conflicts and so on. We can, of course, announce projects or calls for applications relating to these questions, and we will surely see applications for funding. But how do we bring these to the level of the intellectual challenge experienced in curiosity-driven research? To the level where researchers not only want to achieve a certain goal but where they cannot sleep until the question is answered, as is often the case with curiosity-driven research. I don't know the answer. How to orient bottom-up research to support top-down goals? Maybe this is a dangerous question. Bottom-up research should be entirely unfettered. Nevertheless, it might be necessary and hopefully possible to get the bottom-up type of research to support progress on the above social challenges. How to kindle the curiosity of researchers for questions that are already relevant for society? How to allow sufficient time for basic research to work on such pressing problems? To find an answer to these questions is perhaps even more important than to find good mechanisms for the utilization of basic research results.

Let me tell you about a few examples of exceptional places where such mechanisms did work well. These were industrial research centers in the United States: Bell Labs, the IBM Research Center and, a place where I had the opportunity to work for a few years, Microsoft Research. Let me list some of the discoveries that came out of these centers, motivated by demands from applications: transistors, Unix, C and interior point methods for linear programming at Bell Labs; fractals, information complexity and graph spectral theory at IBM; topological quantum computation and graph limit theory at Microsoft. These centers had basic research teams doing their own basic research, but through regularly meeting people from applied areas, they also got engaged in special problems already relevant for applications. The slogan used at Microsoft Research was: "You have to keep your door open." If somebody comes in with a question related to applied research, then you must listen to this person. You can say, "No, sorry, I don't know anything about this, it's not my topic," but you should at least pay attention to the question. And this approach worked brilliantly in many cases.

Let me add that sometimes different theoretical and applied branches of science work so closely together that one cannot draw a line between them. Applications and their theoretical foundations often develop hand-in-hand, like physics and mathematics in the 18th century, or computer science and certain branches of mathematics (discrete math) in the 20th century, or biology, chemistry and several other sciences in the 21st century.

To address some of the issues raised above, the Hungarian Academy of Sciences has launched a few long-term, strategic research programs in an attempt to involve basic research in answering questions of immediate social relevance. We have selected a few themes that society deems important now, and most probably will regard as critical in ten or twenty years' time. We have started research programs in areas like the methodology of education, or the Kodály method of music education, which some of you may be familiar with. The future of water management is another example. It is a broad interdisciplinary topic with many obvious challenges we have to face and resolve very soon. Currently, the research behind these areas is not working well enough in Hungary. So, I hope that a new model which would include the work of scientists engaged in basic research questions, and would bridge the gap between basic and applied science could bring new results.

A few words on politics and research. Politics is often accused of limiting opportunities for research. In the US, for example, some senators regularly try and force research to work only in the top-down way. Lamar Smith is a recent example. William Proxmire was an example from the 70s or 80s. He even introduced the "Golden Fleece Award", which ridicules basic research. One of his favorite examples was the sex life of screwworms, which are a kind of pest. It has since turned out that understanding the sex life of screwworms actually led to the development of new procedures for pest control, which today save billions of dollars a year in agriculture! (This is one of the examples which I took from Eric Lander's talk.)

Occasionally the argument goes the other way: "The Academy should stick to science. Don't interfere with politics." I don't want to name the politician from whom I got this remark. In a small country, there is another, seemingly logical, argument: "We completely understand that basic research is very important, and the results of basic research will bring about new developments in science. But let others do it! Why spend money on basic research in a small country like ours? If the US doesn't spend more money on basic research, then basic research worldwide will be hit. But what difference, if any, will the funding of basic science in Hungary make? Why don't we focus on our own needs, on applied research?"

My answer to this is: it is essential to be part of a community, since this allows us access to the best channels for obtaining timely and reliable information. And perhaps more importantly, the students who take part in basic research projects are thereby being educated in the best technologies, theories and methodologies, and therefore, even if they eventually end up researching potential applications of science or innovation, they will be better equipped to do that.

Let me now conclude with a couple of ideas on how ALLEA could contribute to some of these issues. First of all, facilitate the exchange of ideas between science, politics, and society! I am happy that the European Union has started a science advice mechanism. I think we should all give our support to it so that the EU can do it right. This is less trivial than it sounds, some people are skeptical and some believe that it will not work well. We should make sure that it does.

I am quite unhappy with our university programs, where preparing the students for interdisciplinary research is poorly done. I would very much like to see encouragement for students to be open to others, to listen to other researchers. American universities are somewhat better from this point of view than ours, because in their undergraduate programs they usually have a broader variety of subjects that students are exposed to. Our universities should work together to develop curricula that support both multidisciplinary and applied research better.

I am a great supporter of research centers, such as Bell and IBM, in Europe, which bring together basic research and agenda-driven research. They could also be a powerful tool for answering questions that come from governments or from the European institutions. Without their own basic research institutions we cannot guarantee that the answers to socially relevant questions have intellectually firm foundations.

LÁSZLÓ LOVÁSZ

Current Positions

- President of the Hungarian Academy of Sciences
- Professor at the Department of Computer Science of the Eötvös Loránd University

Expertise

- Combinatorial optimization, algorithms, complexity, graph theory, theoretical computer science

Qualifications

1977	Dr. Math. Sci., Hungarian Academy of Sciences, Budapest
1971	Dr. Rher. Nat., Eötvös Loránd University in Budapest
1970	Candidate of Math. Sci., Hungarian Academy of Sciences, Budapest

Career

Since 2014	President of the Hungarian Academy of Sciences
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UNDER PRESSURE! INVESTIGATING ACADEMIC FREEDOM

STEFAN HORNBOSTEL

The term "academic freedom" evokes different associations – not only constitutional guarantees for the freedom of teaching and research (as in Germany), but also the – to this day – continually renewed standards by scientific societies, such as the 1940 Statement of Principles on Academic Freedom and Tenure by the American Association of University Professors[1], or Max Weber's lecture "Science as a vocation" from 1919.[2]

These cases show how historical experiences of political intervention have been taken up by science. In this regard, the guarantee of scientific freedom results in functional division: the freedom of teaching and research is assured for all scientific needs. The scientist as a citizen, however, is burdened with restraint: "When they speak or write as citizens, they should be free from institutional censorship or discipline, but their special position in the community imposes special obligations"[3].

Yet, the clear demarcation between science and the society it is surrounded by already showed an interloping in the 1940 Statement of Principles on Academic Freedom and Tenure: on the one hand, it emphasizes the problematic role of money ("…but research for pecuniary return should be based upon an understanding with the authorities of the institution"), while on the other, it respects potential ideological or religious beliefs of the institution ("Limitations of academic freedom because of religious or other aims of the institution should be clearly stated in writing at the time of the appointment")[4].

Academic freedom is undoubtedly a right that, contested and repeatedly fought for throughout the history of science, is ultimately responsible for enabling the creation of new knowledge. But are the existing defi-

1 1940 Statement of Principles on Academic Freedom and Tenure: https://www.aaup.org/report/1940-statement-principles-academic-freedom-and-tenure (07.03.2017).

2 Max Weber, Science as a Vocation: http://www.wsp-kultur.uni-bremen.de/summerschool/download ss 2006/Max Weber - Wissenschaft als Beruf.pdf.

3 1940 Statement, No 3.

4 1940 Statement, No 2.

nitions of academic freedom still working? In the hundred years that have passed since Max Weber's lecture, science has undergone a fundamental change: it has seen an enormous rise on a quantitative level, and it is strongly connected with economy and society. Today, researchers are supposed to raise funds, procure evidence for (political) policy-making, and organize research with societal impact. The consequences of this development are not only a stronger dependency of industry and society on scientific findings, but also, conversely, a higher pressure on science to include societal interests and norms in its secured sphere. This holds true for the individual researcher as well as for higher education and research institutions.

In this respect, it comes as no surprise that the topic of academic freedom has received a lot of attention over the last years, e.g. in the context of research funding and the ever-rising share of research grants, with a special regard to the assumed external influences on science by funding from the industry sector or private organizations, as well as the changing demands for the governance of universities or certain policies like gender equality. A strong focus has, however, been put – by the media and by academia itself – on the development of the freedom of speech at universities and the restrictions it encounters by a new – possibly misinterpreted – sense of political correctness that finds strong support, particularly at American and British but also German universities.

In a climate where classical literature is banned from classes because it may contain descriptions of sex, violence etc., where professors are victims of aggressions because of their controversial professional views, or guest lecturers are disinvited because they may promote provocative positions, some see academic freedom and the freedom of discourse deeply threatened – by internal as well as external pressure.[5, 6] The introduction of codes of conduct, "trigger warnings", and "safe places" at many US universities can be interpreted as an overreacting obligingness from the authorities, embodying a culture of paternalistic intervention by eliminating room for controversies and individual decision-making. This conduct, indeed, set limits to academic freedom. In the UK, as a (counter)reaction to these tendencies, the Online magazine "spiked" launched the Free Speech University Ranking (FSUR) in 2015 which surveys British universities with regard to "campus censorship" and ranks them using a traffic-light system.[7]

But how do we define academic freedom today? Can we still follow interpretations such as the *1940 Statement of Principles on Academic Freedom and Tenure* that still breathe the spirit of

5 A fact that former US President Obama commented emphatically on the occasion of the Howard University commencement ceremony in May 2016: "(…) So don't try to shut folks out, don't try to shut them down, no matter how much you might disagree with them. There's been a trend around the country of trying to get colleges to disinvite speakers with a different point of view, or disrupt a politician's rally. Don't do that – no matter how ridiculous or offensive you might find the things that come out of their mouths." Link to video: https://www.youtube.com/watch?v=_K4MctEmkmI&t=4s (02.03.2017).

6 In Germany, the examples of Herfried Münkler, professor for political theory at the Department of Social Sciences at the Humboldt-Universität zu Berlin, and Jörg Baberowski, professor at the Department of History at the Humboldt-Universität, reflect tendencies towards a restriction of the free academic discourse.

7 http://www.spiked-online.com/free-speech-university-rankings#.WLgeaPJc7EQ (02.03.2017).

the "ivory tower"?[8] The changes in science and the demands for societal relevance of science are considered in this perspective just as little as the role of the scientist as an advisory expert, a function that is judged very differently from different perspectives. While some emphasize the importance of professional scientific intervention[9], others deeply mistrust scientific expertise.[10]

Following three basic questions (Freedom for whom? Freedom whereof? Freedom for what?), this text will take a closer look at the obstacles that may oppose academic freedom and discuss their significance for science and society.

Freedom for whom? In the 1960s/1970s, the subjects were easily defined, since this prerogative was only attributed to the professors, the mandarins at universities. The organization itself was more or less an "interest organization", a compound of individuals. Nowadays, there is a clear shift from the individuals to the organization with the organization having a much stronger legal position. As a consequence, the subject of academic freedom today is not only the individual researcher but also the organization that carries out research. Today, we essentially witness a working organization which becomes apparent, for instance, in the deep involvement of organizations in funding processes.

Freedom whereof? This question is probably the most complicated. What are the problems? Does the dilemma lie in external steering influences from politics and industry or maybe in academia itself? Do the problems result from the changes in governance at the universities that we call "New Public Management" or from the funding system?

Academic freedom is not an end in itself, but includes the demand for freedom from external steering influences. The aim is quite clear: the self-governance and self-regulation of science. However, the question remains whether there really is a strong external influence coming from politics or private money that forces scientists to do things they do not want to do. The problem is associated with the new forms of governance. A little over 20 years ago, New Public Management was introduced in most European countries and caused two problems. Firstly, New Public Management is focused on the output of research. Results need to be measurable, hence the expansion of numbers of publications, citations, Ph.D. students and more. Secondly, this development sends a signal to (young) researchers that some practices are more desired, potentially more effective in the competition for reputation, than others. This effect is obviously noted by a lot of scientists and may lead to the development of specific, not always preferable customs. The interplay between the need to measure and the effects it produces is not limited to the scientific community, but also stretches into the broader public and concerns e.g. the visibility of the rankings and ratings that, for the most part, have been established within the last 20 years. These rankings, however, are not just an internal information process. They not only inform but also influence the broad public, creating visibility for organizations that, ideally, coincides with reputation and (measurable) outcome. Reputation for academic

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8 1940 Statement of Principles on Academic Freedom and Tenure, in: Policy Documents and Reports 3 (AAUP, 1984).

9 See e.g. Kocka, J. (2001): Interventionen. Der Historiker in der öffentlichen Verantwortung. Vandenhoeck & Ruprecht: Göttingen.

10 See e.g. European Commission (2010): Special Eurobarometer 340. Science and Technology, Report, p. 42.

organizations is thus not only gained in the internal processes but also on a broader public stage. The former Research Assessment Exercise, now Research Excellence Framework, is an example of ranking in the UK, a system that assesses the quality of research in higher education institutions by means of metrics and peers. An article by Linda Butler and Ian Mc Allister from 2011 analyzed the process of evaluation of university research performance using metrics[11] which showed that the results from expert (peer) judgement and metrics hardly differ. Even though the use of metrics is highly contested among scientists, as a matter of fact, there are a lot of cases that demonstrate that the difference between peer judgement and metrics is hardly distinctive – either because the peers follow the metrics or the metrics are as good as the peers. What has changed distinctively in the past years, however, is the percentage of third-party funding (research grants either from state or private institutions) that is needed to finance research.

[11] Linda Butler / Ian McAllister: Evaluating university research performance using metrics. In: European Political Science 10 (2011). p. 44–58.

In the German case there was a vigorous increase in the percentage of third-party funding for research within only a few years. The relationship between basic and third-party funding continually drifted apart. Between 1998 and 2010, basic funding of higher education institutions increased by about 23%, third-party money by more than 100%. This shift dramatically changed the conditions for research. Yet, the share of third-party money for research that includes funding from industry remains rather stable at around 20% (with a slightly declining tendency). Since the share of industry funding remains unchanged, there is no indication that the industry sector puts in more money and consequently becomes more influential. What changes is the share of the public money that is not basic funding, but comes via programmes, very similar to what we know from research funding by the European Commission. The discussion about the influence of money on science and academic freedom should, therefore, center less on the amount but rather concentrate on the question of its context. This trend is also reflected in the development during the past 20 years towards encompassing funding programmes such as the German Excellence Initiative. There is a tendency in science towards big collaborative programmes that mean a lot of constraints for the individual researcher: bargaining processes with departments, politics, funders, and so on. The barriers for scientists to conduct their research without restraints seem to rise continuously.

Following one legal interpretation of the German Excellence Initiative, this kind of programme addresses academic freedom by discriminating against scientists who are not funded: excluded from the provision of funds, they experience less appreciation of their work than those scientists that are part of the programme. This discussion, regardless of its interpretation, was also picked up by the DFG, the German Research Foundation. Years ago the DFG stated that "we are running towards a problem. The excessive competitive pressure for third-party money and the necessity to gain money via these channels produces problems, because it takes us away from the core business of science – the research."[12] Given that

[12] See Prof. Dr. Matthias Kleiner, Talk at the DFG New Year's Reception, Berlin, 16 January 2012.

the chances of getting a grant today are less than 30% in Germany (in the US the share is even lower), the amount of time and capacity it takes to eventually fund a project is substantial. The researcher has to engage in writing several proposals that also require reviews – and the system is running short of reviewers. The shortage of reviewers is a considerable internal problem of the science system, because the number of reviews needed is still on the rise, not only for allocating research funding but also for evaluating publications. Additionally, the NPM establishes more and more evaluation procedures for which peers are needed as well.

What can be done? Is stronger reliance on private foundations the solution? The development over the past decades shows a noticeable increase in new private foundations, many of which promote philanthropic goals and are occasionally backed by enormous budgets.[13] As attractive as these institutions seem and as much as the aspect of charity deserves support, it should not be forgotten that these foundations have their own, very distinct missions. They are not places that scientists can go to and say "I need some money for my research". No, these foundations have a well-defined agenda and a clear idea of what they want to fund and what not.

What do these circumstances mean? Is external money a problem in general? Probably not. The task is rather to find the right balance between basic funds, long-running funds, short-running funds, and so on. Besides, not everything that followed the introduction of the New Public Management is negative: today the number of autonomous organizations is much higher than before. Still, critics state that the individual autonomy of scientists is lowered and that thematic choices are fewer than 20 years ago. The prosecution of unorthodox methods and perspectives, the need to carry out research in bigger collaborations with other scientists, and, of course, the dependence on third-party funding as well as the results of evaluations are just some of the disadvantages of the NPM governance regime, following this line of reasoning.[14]

Freedom for what? A rather new problem is the requirement for the usefulness of science for society. The United Kingdom first introduced this idea in the funding process and, to this day, the question of how to evaluate proposals in this regard remains unanswered – there are no metrics in this field. Also, the reinforcement of the links between society and science is not generally supported: in 2014, Günther Stock critically remarked that "in the 20th century we already painfully experienced what it means when science and research are exclusively put into service for so-called societal demands."[15] This point of view, though, disregards three important aspects: science has always been connected to societal demands. If science was only able to react to scientific demands,

[13] The Bill and Melinda Gates Foundation had an endowment of US $ 44.3 billion as of 31 December 2014. http://www.gatesfoundation.org/Who-We-Are/General-Information/Financials (03.03.2017).

[14] Uwe Schimank (2014): Von Governance zu "authority relations": Wie sich Regelungsstrukturen dem Forschungshandeln aufprägen, in: René Krempkow, André Lottmann, Torger Möller (HG.): iFQ Working Paper 15, Völlig losgelöst? Governance in der Wissenschaft, iFQ: Berlin, 19f.

[15] Günther Stock, President of the Academy of Sciences and Humanities In Berlin, „Festsitzung" – Leibniz Day, 28 June 2014.

the concept of scientific innovation would indeed suffer. What is more, if science remained a self-referential endeavor, it would not only lack innovation but also entail further negative consequences such as scientific misconduct (falsification of data, plagiarism etc.). And last but not least, the argumentation also overlooks the difficulties academia has itself. Just to give an example: Stefan Hell, winner of the Nobel Prize for chemistry, had an idea that was not compatible with the mainstream in his field of research. His idea of an optical microscope did not match the general ideas and this made it highly difficult for him to find an organization that would carry out his research. In this case, not an external force but academia itself was mainstreaming the research.

Another fundamental aspect in the debate about academic freedom is the role of the public. Two dimensions are particularly important: the media and public opinion. Scientific journalism has changed a lot over the last 10 to 15 years. Today, it is no longer a kind of "court press", but a more or less investigative critical journalism, that, as politics shows, changes the relationship between science and journalists. Furthermore, the example of citizen science shows how the public takes an active part in science and science production. More importantly, the public consists of voters, tax payers, and users of science, and, in this regard, they are crucial in all those bargaining processes. To investigate their opinion on science and its role for society, the European Community carried out a survey in 2010 with questions such as "Would people in Europe support science even if there is no immediate benefit?" And wonderfully enough, in most countries the majority clearly agreed. The only exception to this unanimous picture was Austria. However, the answers to the question whether the public can trust science gave quite a different picture. The question asked in the survey was if one should trust scientists to tell the truth about controversial scientific and technological issues. Between 72% and round about 40% of the interviewees replied, "We can no longer trust scientists to tell the truth about controversial and technological issues because they depend more and more on money from industry". The question "Should there be (legal) limits for science?" led to even more interesting results: of those people who expressed an interest in science, 46% stated that scientists should do whatever they want. Only 29% of those respondents without any interest in science shared this view. Some people even believed that scientists were dangerous.[16]

The last part of this contribution is dedicated to academic freedom at universities. As mentioned before, there is a trend, especially in the US and in the UK but also in Germany, towards a kind of political correctness coming from the students and partially from professors and university governance that dictates what you can and what you cannot talk about in a classroom these days. Terms such as "*microaggressions*", "*trigger warnings*", and "*safe spaces*" are preventive measures introduced at many universities in the US to avoid any kind of emotional discomfort among the students. What was introduced as a tool to cope with a heterogeneous student body has peaked in an absurd situation where a free academic discourse is no longer possible and where universities are no longer places for the exchange of controversial thoughts.

To conclude, the obstacles for academic freedom are obviously

[16] Special Eurobarometer 340, 25.

manifold. They result not only from external but also from internal reasons and the lines are sometimes blurred. All the more reason to be careful: science needs friction, science needs discussion. As Schleiermacher already noted in the early 19th century, the freedom of a society is strongly connected to the freedom of science.[17] A thought that – in times with high record numbers of scientists and journalists in jail – has not lost any of its relevance.

[17] Friedrich Schleiermacher: „Denn je mehr sich der Geist der Wissenschaft regt, desto mehr wird sich auch der Geist der Freiheit regen (…)“, in: Sämtliche Werke. Dritte Abteilung. Zur Philosophie. Erster Band, 1846, Reimer: Berlin, 605.

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OPENNESS IS A SCIENTIFICALLY AND SOCIETALLY RELEVANT PART OF A PUBLISHED ARTICLE'S QUALITY

JAN VELTEROP

I came bearing no gifts, no research results, no data – just some questions, some metaphors and some opinions, some of them my own, in the hope that they could inform the discussion about scientific communication and the communication between science and society.
When I speak to scientists about communication, the very first thing I very often hear is: "all very well, but does it have quality?" Especially when I am talking about things like open access and preprint servers, people will ask about quality, often, though, without being able to give me any clear idea of what they mean by quality.
When talking about published articles in journals, openness is rarely seen as an actual *quality* of the literature. When people do talk about quality, it is often what editors and the peer reviewers of a journal deem to be quality, whatever that means, however arbitrary it is, however subjective it may be. And we all know that it can be. Are our editors and reviewers right about quality? Perhaps not so right as one might think. A not insignificant number of articles are retracted after publication in a peer-reviewed journal. It is difficult to get precise numbers, but if one follows Retraction Watch[1] – a website tracking retractions as a window into the scientific process – for a while, one gets a good idea of the scale of the problem. Figures 1 and 2 illustrate the retractions and errata of the last few years as recorded in PubMed. They are, of course, not comprehensive, as PubMed only covers the life and medical sciences.

1 http://retractionwatch.com.

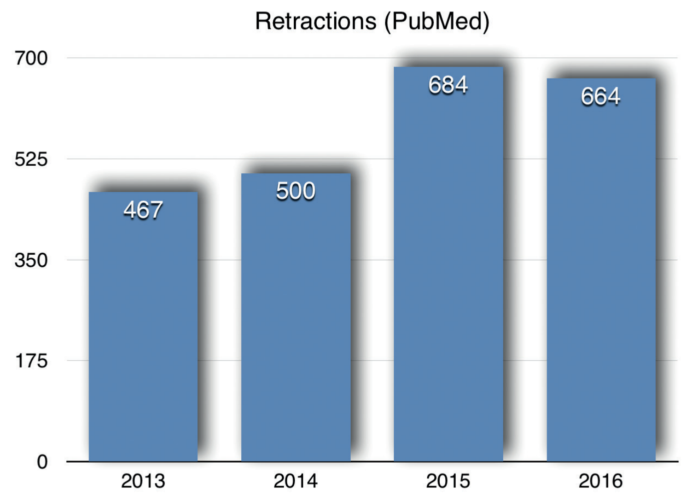

Fig. 1: Retracted articles as recorded in PubMed – data from Retraction Watch.

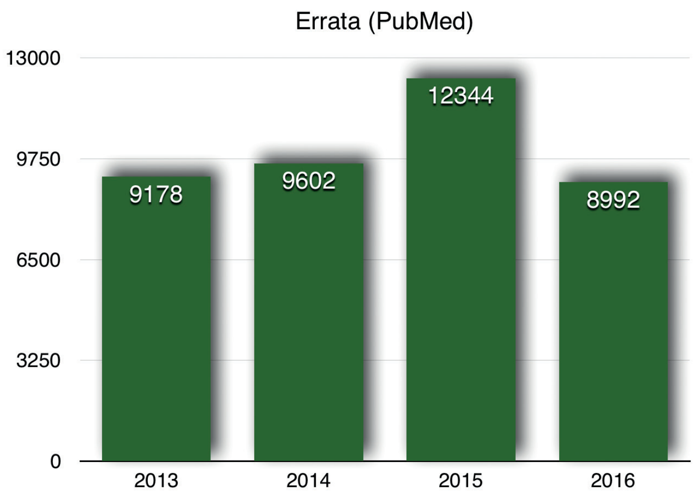

Fig. 2: Errata as recorded in PubMed – data from Retraction Watch.

The number seems to grow, even proportionally to more than the number of articles being published (though somewhat more slowly of late). Retractions have apparently even increased in the order of tenfold between 2001 and 2010, whereas the number of articles grew approximately fourfold in the same period. These numbers are from PubMed, so only cover the life and medical sciences, but it seems a fair assumption that the proportion of retractions relative to the number of articles published is not dissimilar in other disciplines (although there may be exceptions).

The interesting thing is that there seem to be relatively more retractions from journals that are deemed to be of the highest quality. Or, more correctly, the journals with the highest perceived prestige. That is a problem, I would have thought, since the association most people have with those journals is one of quality. In reality, high prestige journals are keen to publish articles with spectacular results. Curt Rice puts it in this way: “The most prestigious journals have the highest rates of retraction, and fraud and misconduct are greater sources of retraction in these journals than in less prestigious ones."[2]

An article being published in a prestigious journal is not the same as it having high quality. In fact, results can be spectacular precisely because they are statistical outliers. What we see is that when the reported experiments are subsequently replicated, the results often look less spectacular, even if the evidence is still valid, a process most likely caused by 'regression to the mean'.[3] Yet it is precisely the spectacular nature of statistical outliers that is so attractive to a high prestige journal. Quoting Curt Rice again: "it is to some degree logical that you see these things, because statistical flukes are quite often very nice and very unusual. This increases the odds of being published in one of these major journals."

A particularly disastrous example of an article published in a prestige journal and then retracted, was the now infamous Andrew Wakefield paper, in which autism and other disorders in children were associated with vaccination.[4] Unfortunately, it was published in what is usually seen as a quality journal: The Lancet. That gave it credibility and false authority, as a result of which it received much publicity, also in the lay press, and consequently there is still a sizeable anti-vaccination movement, particularly in the United States (the new president, Donald Trump, has even toyed with the idea of establishing an official commission on vaccination safety – which was, however, not enacted at the time of writing this). According to a 2015 report by the Pew Research Center[5], as many as about one in ten Americans thinks vaccines are not safe. Wakefield's results could not be replicated by other scientists and his co-authors withdrew their support for the study. After conducting an official inquiry, a tribunal of the British General Medical Council concluded[6] that Wakefield acted dishonestly and irresponsibly. The Lancet retracted the paper, and Wakefield was struck off the UK medical register with a statement that he had deliberately falsified scientific results. The Pew report also mentions that "by then, however, the damage had already been done. Many people in the US and Europe still believe that vaccinations cause illnesses and conditions including autism in children. Despite official medical advice that says vaccines are safe and vital, many parents still worry about inoculating their children." To a large degree this can be blamed on the prestige accorded to Wakefield's article by The Lancet.

If you are searching for retractions on the internet, you will come across

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[2] Curt Rice, *Why you can't trust research: 3 problems with the quality of science*. Blog post, 6 February 2013. http://curt-rice.com/2013/02/06/why-you-cant-trust-research-3-problems-with-the-quality-of-science/.

[3] Jonah Lehrer, *The Truth Wears Off*. The New Yorker, 13 December 2010. http://www.newyorker.com/magazine/2010/12/13/the-truth-wears-off.

[4] Andrew Wakefield et al. *Ileal-lymphoid-nodular hyperplasia, non-specific colitis, and pervasive developmental disorder in children – Retraction notice*. Article originally published in The Lancet, Volume 375, Issue 9713, 6–12 February 2010, Page 445. http://www.sciencedirect.com/science/article/pii/S0140673697110960.

[5] Pew Research Center report, *83% Say Measles Vaccine Is Safe for Healthy Children*. 9 February 2015. http://www.people-press.org/2015/02/09/83-percent-say-measles-vaccine-is-safe-for-healthy-children/.

[6] As reported by David Gorski in Science-Based Medicine, 1 February 2010. https://www.sciencebasedmedicine.org/andrew-wakefield-the-panel-is-satisfied-that-your-conduct-was-irresponsible-and-dishonest/.

quite a few journal names that are familiar. They are familiar because they are widely known as prestigious ones. The Retraction Watch site, which I mentioned before, keeps a close eye on retractions, monitoring them throughout the scientific realm. But it is unlikely Retraction Watch catches all fraudulent articles, let alone articles with 'merely' deep statistical flaws, mainly because they are not all retracted. Chris Hartgerink, a researcher who studies bias, error and fraud in scientific publications, concludes that "the scientific system as we know it is pretty screwed up" (in an interview with Stephen Buranyi).[7] In the same article, Buranyi also points to a 2009 study by the Stanford researcher Daniele Fanelli, who concludes that "it is likely that, if on average 2% of scientists admit to have falsified research at least once and up to 34% admit other questionable research practices, the actual frequencies of misconduct could be higher than [what is often reported]".[8]

So, is quality illusionary? Is believing in the quality of scientific publications on the basis of their prestige just a bureaucratic necessity in the scientific 'ego'-system? After all, quality is often associated with a high *Impact Factor*, which is based on a simple count of the average number of times articles in a given journal are being cited, and impact factors are important for researchers to indicate the importance of the publications they list on their CVs.

The following citation is often attributed to Einstein though it may well be apocryphal: "Not everything that can be counted counts, and not everything that counts can be counted." Nature, a journal you will all know, seems to agree that research assessment rests too heavily on the inflated status of the impact factor. One of its editorials in 2005 carried the headline "Research assessment rests too heavily on the inflated status of the impact factor."[9] Nature doesn't necessarily seem to do irony when advertising their impact factor very, very prominently, though (Figures 3 and 4).

Fig. 3: The heading of the Nature web site at the time the editorial[9] was published (2005).

Fig. 4: Prominent display of the Nature impact factor eight years later, in 2013.

7 In an interview with Stephen Buranyi, *The hi-tech war on science fraud*. The Guardian, 1 February 2017. https://www.theguardian.com/science/2017/feb/01/high-tech-war-on-science.

8 Daniele Fanelli, *How Many Scientists Fabricate and Falsify Research? A Systematic Review and Meta-Analysis of Survey Data.* PLOS One, 29 March 2009. http://dx.doi.org/10.1371/journal.pone.0005738.

9 *Not-so-deep impact – Research assessment rests too heavily on the inflated status of the impact factor.* Editorial, Nature, 23 June 2005. doi:10.1038/4351003b. http://www.nature.com/nature/journal/v435/n7045/full/4351003b.html.

Clearly, the impact factor seems to still play a very important role. Even an impact factor of lower than one is considered worth boasting about by many a researcher. Apparently, there are even pseudo-impact factors, that have been invented by whatever organization that cannot count on the ISI Journal Impact Factor by Thomson-Reuters.[10]

With regard to this impact factor, I like the metaphor of a feather, falling into the Grand Canyon. Paraphrasing Don Marquis[11] *("Publishing a book of poetry is like dropping a rose petal down the Grand Canyon and waiting for the echo.")*: "The impact factor is what you hear if you drop a feather into the Grand Canyon and wait for an echo." Of course, this is a slight exaggeration. But the notion of impact really is quite incoherent. According to Stefan Collini, professor at Cambridge, that is because it "rewards the sensationalist and second-rate [...] and risks turning academics into door-to-door salesmen for vulgarized versions of their increasingly market-oriented products."[12]

Looking at the distribution of citations to papers in any journal, one is likely to find that most articles have only a small number of citations, even in the high-impact-factor journals. A relatively high number of citations for a single article can – and often does – substantially skew the impact factor. As a result of this skewed distribution, that single oft-cited article is, of course, vastly underrated by the impact factor, and the majority of hardly-cited articles are vastly overrated. Yet, as soon as you get your paper published in a high impact factor journal, you have that high impact factor associated with your paper, even if you get zero citations. This is the reason that Vincent Larivière et al. have proposed that citation distributions in journals are published as well, and not simply the impact factor, thus giving insight into the citation performance of individual papers, which cannot be inferred from the impact factor.[13]

Are citations themselves indeed the right sort of measure for quality? If that is the big question, the answer must simply be 'no'. You cannot conflate impact and influence with quality. As Lea Velho puts it: "To conflate impact/influence with quality [...] is to assume perfect communication in the international scientific community. [...] citation patterns are significantly influenced by factors 'external' to the scientific realm and, thus, reflect neither simply the quality, influence nor even the impact of the research work referred to."[14] In other words, quality cannot be described by the impact factor as we know it.

But the impact factor is still widely seen as a mark of quality, as very important, even though an article's 'quality' is routinely assessed by just a few people: the peer reviewers, at the point of publication. Usually

10 Mehrdad Jalalian, *The story of fake impact factor companies and how we detected them.* Electronic Physician, April-June 2015. doi: 10.14661/2015.1069-1072. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4477767/.

11 Don Marquis, novelist, poet, journalist. https://en.wikipedia.org/wiki/Don_Marquis.

12 As reported By Matthew Reisz in *The core connection*. Times Higher Education, 7 January 2010. https://www.timeshighereducation.com/features/the-core-connection/409838.article.

13 Larivière et al. (2016), *A simple proposal for the publication of journal citation distributions.* bioRχiv preprint, 11 September 2016 doi: https://doi.org/10.1101/062109.

14 Lea Velho, *The 'meaning' of citation in the context of a scientifically peripheral country.* Scientometrics, Vol. 9. Nos 1–2 (1986) 71–89.

there are two reviewers and there is the editor. The reviewers are sometimes chosen rather randomly, probably more often than you would like to believe. The correlation of a particular reviewer's evaluation with 'quality', as measured by later citations of the manuscript reviewed, is low.[15] This raises questions as to the importance of reviewers' judgement. Some suggest that downplaying the impact of peer reviews can have beneficial effects, if referees should decide only whether a paper reaches a minimum level of technical quality. Osterloh and Frey propose[16] that within the resulting set, each paper should then have the same probability of being published. This procedure should make it more likely that unconventional and innovative articles would be published. If you were to make the probability of being published 100% once a paper has reached a minimum level of (technical) quality, you essentially have the method used by so-called 'mega-journals' such as PLOS One.[17]
Though the PLOS One approach is getting some following, it is by no means the prevailing method. Is it in the nature of science to just keep on counting and to infer quality from the quantity of citations? Or is this really a case of academic managerialism, to keep the assessment of researchers simple and straightforward (albeit at the expense of fairness and accuracy)?
I would like to use a metaphor: nicely polished marble slabs or hardcore rubble, which has more quality? That question is not as easy to answer as it might seem. What would a building do without a foundation of hardcore rubble (or something equivalent)? So what about the 'edifice' that is scientific communication (some would locate it adjacent to the Ivory Tower)? The 'hardcore rubble' foundation of that edifice may well need a matrix of all those articles that inspire people but are not necessarily of the highest quality themselves, yet lead other researchers to more ideas or to a better assessment of the scientific 'lay of the land'. Those 'low quality' articles are vastly undervalued in my view.
What are we doing about it? There may possibly be technical solutions to the problem of scientific communication, which really is not doing what it is supposed to do. The default focus always seems to be on technical solutions. However, we really need *sociocultural* ones. We need to reconsider what we mean by quality and how to assess it.
Let me use another metaphor. Clothes make the man – an old expression. But is that really the case any longer? Can you really tell the socio-economic status of people by their clothes? Young people wearing jeans with tears around the knees have perhaps paid a higher price for their trousers relative to intact ones, because tears are the fashion. Wearing immaculate clothes is no longer a sure sign of socio-economic status, and that is certainly true for wearing jeans. Maybe what we need is something that I might facetiously call 'jean therapy': we should judge on the 'substance' of the wearer, and not on his appearance. If we translate this to science: the journal makes the scientist. If you have a Nature or Science or Cell or The Lancet 'label'

15 Starbuck, W. H. (2006). *The production of knowledge. The challenge of social science research.* pp. 83–84, Oxford University Press.

16 Margit Osterloh and Bruno S. Frey, *Input Control and Random Choice Improving the Selection Process for Journal Articles.* September 2011, University of Zurich, Department of Economics, Working Paper No. 25. www.econ.uzh.ch/static/wp/econwp025.pdf.

17 *Criteria for Publication*, PLOS One, http://journals.plos.org/plosone/s/journal-information.assessment.

attached to your paper, you've made it. It is not even about the journal, really. It is all about the *impact factor* of those journals. I prefer to think of those 'labels' as 'ribbons'. Just ribbons. To pin on your lapel. In reality, though, it is the scientists' articles that make the journal.

The 'ribbons' provide incentives, of course, but I think they are the wrong ones. Napoleon had interesting things to say about that (although likely apocryphally). "You can offer people money and they wouldn't risk their lives for it. But give them a ribbon, and they do anything you want them to do."

Carry that over to the scientific realm, and – somewhat unfairly, perhaps – it translates as "no rational scientist would put themselves at risk for principle, but offer them the possibility of being published in a prestige journal, and there's no limit to what they'll do to jazz up their results."

It's these ribbons that scientists are after, and they are willing to do almost anything to get the right ones, to get a paper in Nature, to get a paper in Science. Should that desire – or maybe even the *need* for ribbons in the 'ego'-system and the hierarchical and career structure of science – be allowed to hold proper knowledge-sharing hostage? This ribbon-based economy causes delays in publication, after all, and often enough accessibility barriers such as publishers' paywalls. It also makes it very difficult to publish material outside of the journal system that awards these ribbons. Is it really worth it? The scholarly world is literally paying billions of dollars every year, collectively, in terms of subscriptions, licences and article processing charges.

Maybe we can think about a different type of incentive – an incentive based on contribution to societally relevant services for science that is independent of an impact factor. With such incentives, we might achieve more emphasis on collaboration than on competition. It seems that competition between researchers can sometimes be quite destructive to proper communication and sharing of knowledge.

Rankings are seen as important in science, and as such, achieving high rankings forms part of the incentives for researchers. There are rankings on journals or individual researchers, universities, even whole countries. Is 'katataxiphilia' ('*the love of ranking*', from Greek *κατάταξη* = *classification*, *rank*) impeding knowledge exchange? And if we rank – if we really believe that we need to rank – should we not rank on different things? Should we not reward people for collaborating rather than for competing more? Competition can have some very nasty side effects. One example I could mention here is parachute research. *Parachute researchers* are "scientists from wealthy nations who swoop in when a puzzling disease breaks out in a developing country. They collect specimens, then head straight back home to analyze them. They don't coordinate with people fighting the epidemic on the ground – don't even share their discoveries for months, if ever. Sometimes it's because they want to publish their results – and medical journals prefer exclusives – and sometimes it's because they can make a lot of money by coming up with copyrighted treatments for the disease."[18]

Does that really help with solving the problems of tropical diseases? Probably not. In the circumstances of those diseases, openness is a crucial

18 Nurith Aizenman, 2 April 2016, Goats and Soda, NPR podcasts. http://www.npr.org/sections/goatsandsoda/2016/04/02/472686809/scientists-say-its-time-to-endparachute-research.

quality, scientifically as well as societally highly relevant. There is an urgent moral imperative – in any case with regard to medical research of this kind – for far more openness than we have now. The whole point of scientific knowledge, of the *knowledge sphere* around the world if you wish, is to disseminate it so that whoever needs it can take it in. So why are we still using the model of 'journals' for our primary communication, even though our modern technology, the internet, doesn't require them anymore and even though the publishing process can introduce quite a delay? Is it because journals give us the 'quality' rankings researchers so crave?

There are, however, alternatives: measurable, and reasonably objective article qualities that are independent of journal rankings. Having proper statistics, for instance; adhering to standards and ethical norms; properly supporting any conclusions by the data being presented; written in intelligible language without unnecessary jargon and according to reporting guidelines that are standard in the relevant community. And I would like to add to that an article's openness, which is easy to measure. Openness to its maximum degree, with reusability and data mineability. There is a way by which this openness can be measured: the Creative Commons Attribution Licence.[19] With this licence – which is granted by the copyright holder, in most cases the author – attribution is the only thing that is compulsory. Scientists and lay people alike can otherwise distribute and reuse the articles in any way they like.

Sometimes the argument is brought against openness of scientific information that "there isn't a public for this material because it is too specialized in both its wording and its content." Martin Eve, referring to his own predicament, dealt conclusively with that argument in his blogpost 'Open access in a time of illness', demonstrating that the meaningful impact of scientific information certainly does exist outside the narrow area of the discipline involved.[20] Openness can hardly get more societally relevant than this.

[19] The Creative Commons Attribution Licence (CC-BY) https://creativecommons.org/licenses/by/4.0/.

[20] Martin Paul Eve, *Open access in a time of illness*, 7 April 2016, blogpost. https://www.martineve.com/2016/04/07/open-access-in-a-time-of-illness/.

There is a final point I would like to make, before giving a hint as to where we might find a solution to the current lack of openness. And that is the point that if evidence-based scientific information remains largely hidden, it might make too many people think that all the junk science they do find on the internet may be the final word, simply because it is openly accessible and evidence-based information often is not. Hiding proper scientific information behind paywalls also gives a very powerful, but wrong, signal that scientists do not really want the general public to know what researchers are doing. That is scientifically, morally, and societally objectionable.

As for the hint for a potential solution, I am convinced that the geniuses of science communication are the so-called *preprint servers* (such as Arχiv, bioRχiv and the like). They do not pronounce anything about the 'significance' of articles posted on them. They just enable open sharing of research results. The importance, significance and quality of an article are very difficult – probably impossible – to determine at the point of publication, and will only emerge over time, after any experiments have been replicated, after the broader discipline community has reached a consensus. Preprint services are only concerned about the inherent qualities of what is being presented, such as the measurable article qualities I mentioned above. And after posting articles, they then allow the wider community to peer-review and comment on those articles, openly and transparently. The need for 'ribbons', where necessary, can be satisfied in a separate, parallel procedure that involves journals.[21]

Finally, a reminder. The World Wide Web was invented for freely sharing academic information; Tim Berners-Lee's whole ethos was about that. Unfortunately, it seems that science is about the last realm that uses the Web properly. This is a situation that urgently needs to be remedied.

[21] Jan Velterop, *The best of both worlds*, 13 June 2016, SciELO in Perspective (blog post). http://blog.scielo.org/en/2016/06/13/the-best-of-both-worlds.

JAN VELTEROP

Current Positions

- Open access/open science advocate
- Retired science publisher (Elsevier, Academic Press, Nature, BioMed Central, Springer)

Expertise

- Scientific publishing, particularly open access publishing
- Peer review procedures/peer review reform
- Semantic analysis of (biomedical) scientific literature – extraction of significant assertions in the form of 'nanopublications'

Qualifications

1975–1978	PhD (not finished) in Marine Geology /Geophysics at Utrecht University
1966–1974	Geology/Hydrogeology at Leiden University (Doctorandus)

Career

Since 2014	Retired from employment but active as an independent open access advocate
2009–2014	One of the initiators of the Concept Web Alliance, director of two scientific semantic start-ups: Knewco and AQnowledge
2005–2008	Director of Open Access at Springer Science and Business Media, Guildford
2000–2005	Managing director BioMed Central, London
2001	Participant and signatory of the Budapest Open Access Initiative (BOAI)
1999–2000	Managing director Nature, London
1993–1999	Managing director at Academic Press, London
1990–1993	Director of Twentsche Courant (Dutch Newspaper), Twente
1978–1990	Science publisher at Elsevier, Amsterdam

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https://en.wikipedia.org/wiki/Jan_Velterop

SCIENTIFIC FREEDOM & YOUNG RESEARCHERS: A PERSONAL VIEW FROM THE HUMANITIES

JULIA BUDKA

In the following, I will give a very personal perspective on “Scientific freedom & young researchers”. I therefore have to start with some biographical data, trying to keep myself short. I am an Egyptologist and archaeologist and have studied in my hometown Vienna. In 2004, I went to Berlin for a researcher position (University Assistant) at Humboldt University. Eventually I returned to Vienna, first for a teaching position and then with an ERC Starting Grant and the START Prize of the Austrian Science Fund in 2012. In 2015, I was appointed as Professor for Egyptian Archaeology at LMU Munich. Thus, in my personal vita, I have experienced several systems and situations which are all relevant for my talk today.

As a student, I enjoyed a traditional “Magisterstudium” with much freedom and little time pressure. My professors and supervisors were always open-minded and the topic of my MA thesis came from participation at an excavation in Egypt. A traditional “PhD programme” followed, again with much freedom and few restrictions. In my research position at Humboldt University, initially funded by a scholarship, I was lucky to have a very liberal boss who granted many opportunities. With a teaching load of 4 hours, I enjoyed a number of years with great flexibility. Coming back to Vienna for a teaching position (6 hours), I encountered large BA classes mostly of “minors” and almost no Egyptology students, making teaching more challenging than anticipated.

Apart from the university positions, I have also experienced being the Principal Investigator of a major grant at a research institution without a teaching load. I will not go into detail about how beneficial this was for my writing output! However, it is, of course, needless to say how much I enjoy teaching and that it is of prime importance.

Finally, now as professor with a teaching load of 9 hours, I am confronted with a very small number of Egyptological BA & MA students but lots of "minors" attending the Egyptological classes out of interest or for other reasons. Structured PhD programmes and graduate schools as part of the German *Exzellenzinitiative* are the current means for writing a PhD thesis in our field at Munich.
The one example that best illustrates the freedom I enjoyed during my PhD and my time in Berlin is a Viennese monument. By sheer coincidence, I was asked to have a look at the hieroglyphic inscription of the well-known obelisk in the garden of Schönbrunn Palace. I turned this into a research project, received a small grant from the city of Vienna and produced a monograph[1] – a monograph I never intended to write but which actually became my most frequently read and cited work of all!
The research on the Schönbrunn obelisk – research beyond the common borders of Egyptology and into a field previously unknown to me – still has special meaning for me. I am very grateful for this coincidence in life; it was completely unexpected and unplanned, but very rewarding. Maybe this can somehow illustrate how much potential there is in things we are just curious about, even if they do not fit into our general agenda and outlined plans.
As an Egyptian archaeologist, I, of course, routinely do archaeological fieldwork in both Egypt and Sudan. I was lucky to be funded by both the ERC and the FWF; that my project AcrossBorders[2] has some quite "fashionable" research questions was definitely not a disadvantage. With a strong interdisciplinary approach, we are investigating within my project the settlement patterns and daily life in ancient Egypt. Here, we are focusing on identities and the appropriation of Egyptian culture in towns set up in modern Sudan. Last but not least, we are working on a site endangered because of planned dams in Sudan. Because of the inter- and multidisciplinary approaches of modern archaeology, I believe that my discipline is generally quite fortunate in the current funding policy within the humanities. Quite a number of START and ERC grants were awarded in the last few years to archaeological projects.
However, I do see a danger for fundamental research on a very broad level: humanities with less "fashionable" topics have little chance of acquiring funding. Disciplines with less focus on technical trends/applications of new methods are equally disadvantaged. Several examples, also from my field, illustrate that excellent proposals get rejected because they are not "relevant" enough. In general, long-term planning is almost impossible nowadays as the majority of research is third-party-funded – but long-term planning and job commitments are essential for fundamental research.
Altogether, some disciplines are already confronted with a difficult situation for the next generation of young researchers. Therefore, I would like to focus on some aspects of current PhD programmes, highlighting the bright and dark sides as I call them. Currently, there are an increased number of funded PhD positions in fields like Egyptology and archaeology in Europe – within the framework of ERC grants, in

1 Julia Budka, *Der Schönbrunner Obelisk: Symbolik und inhaltliches Programm des Hieroglyphendekors*, Beiträge zur Ägyptologie 21, Veröffentlichungen der Institute für Afrikanistik und Ägyptologie der Universität Wien 103, Vienna 2005.

2 For more information see http://acrossborders.oeaw.ac.at/.

German *Exzellenzclustern* and here especially in graduate schools. Most universities offer structured PhD programmes with a very clear and strict time schedule. On average, the students are now faster in getting their PhD than in the old times. All of this sounds very good and positive.
But is it really? Well, I do see a dark side here: very often, within the projects/framework that I have just mentioned, there is no free choice of a PhD topic. The topic must "fit in" – the candidates very often write on subjects in research areas they were not as interested in so much as the funded PhD position.
And since there are not enough positions available for young post-docs, what good is an increased number of young researchers with a PhD? What becomes of all these young people finishing a PhD in the minimum of time?
Finally, I do think that all of this contributes to the quite high Brain Drain that Austria, Germany and other countries are currently facing.
You may call me old-fashioned but I strongly believe that in the humanities and science in general, motivation and enthusiasm are essential for high quality work, innovation and, last but not least, for the commitment to stay in the field. If you do not enjoy your time as a student – not even during the PhD – why stick to a discipline or to academic life in general? Current drop-out rates seem to indicate that this is indeed the case.
Of course, I do not want to end with negative perspectives. Therefore, here are some thoughts on how to brighten things up. First of all, I believe we have to talk about it – within the scientific community, with the public and also with the funding agencies. There are certainly problems and challenges and we have to name them. Meetings like this current ALLEA assembly are good occasions to do so.
I think interdisciplinary approaches and exchange about these problems across common borders of fields might help as well. I see the need to encourage and support young researchers despite the fact that they have to study within a BA+MA+PhD system. This system works perfectly fine for quite a number of disciplines, but certainly not for others. I personally will try to be as flexible as possible within this BA+MA+PhD system (as a teacher, a supervisor, a mentor, and a scientist). We should try to enforce the positive elements and advantages for students of the current system, keeping the fulfilment of partly unnecessary restrictions and regulations to a minimum.
Last, but not least, I think we should fight for specific regulations for individual disciplines in order to prevent major problems in the future – we need young researches to have at least partly similar possibilities and free choices to those we used to have just a few years ago. To give one example, it is becoming more and more difficult to bring students to excavations in Egypt and Sudan during their BA and MA studies because of strict timelines and regulations at universities. It is difficult, but since it is essential for the field and the individual future of these young scholars, one has to find solutions.
And therefore I would like to end by completing the opening quote "Freedom is just another word for…" as follows: "Freedom is just another word for nothing else I'd rather do." Science needs freedom, curiosity, and the unexpected moment. Scientists have to fight for this, despite limited funds, the Bologna agenda and the omnipresent discussion of academic excellence and main stream research topics.

JULIA BUDKA

Current Position

- Professor for Egyptian Archaeology and Art History, Ludwig-Maximilians-University Munich

Expertise

- Archaeology of the 2nd and 1st millennium BC, in particular ceramics and settlement archaeology, funerary culture and mortuary architecture

Qualifications

2007	Dr. phil. in Egyptology, University of Vienna, Austria
1995–2000	Study of Egyptology (Major) and Classical Archaeology (Minor), University of Vienna

Career

Since 2015	Professor for Egyptian Archaeology and Art History, Ludwig-Maximilians-University (LMU) Munich
Since 2015	Member of the Young Center (CASY) at LMU Munich
Since 2014	Member of the Young Academy of ÖAW
2014–2016	Member of the Academy Council of the Austrian Academy of Sciences (ÖAW)
2012	START grant of the Austrian Science Fund
2012	ERC Starting Grant
2003	ÖAW PhD fellowship (DOC-programme)

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ACADEMIC FREEDOM: CHALLENGES, THREATS, EMERGING ISSUES

ROBERTA D'ALESSANDRO

There is no single definition of academic freedom, just as there is no single definition of freedom. In a 1997 document regarding higher education teaching personnel[1], UNESCO defines academic freedom as follows: "academic freedom, that is to say, the right, without constriction by prescribed doctrine, to freedom of teaching and discussion, freedom in carrying out research and disseminating and publishing the results thereof, freedom to express freely their opinion about the institution or system in which they work, freedom from institutional censorship and freedom to participate in professional or representative academic bodies. All higher-education teaching personnel should have the right to fulfil their functions without discrimination of any kind and without fear of repression by the state or any other source." Furthermore, according to the Principle of the Universality of Science as formulated by the ICSU Committee for Freedom and Responsibility in 2014, freedom includes freedom of movement: "Academic freedom also requires mobility, freedom to interact with colleagues and travel to any destination related to research and academic work"[2].

Thus, academic freedom is about carrying out research and disseminating research freely; expressing one's opinion freely; it is being free to move around without restrictions, and so on. In what follows, I will try to demonstrate that there is no place on Earth where academic freedom is completely granted. Not in institutions where academics have to work under political regimes that force them to comply with religious/secular norms. Not in institutions where academics are free to work on whatever they want, but are unable to access sufficient information because of political restrictions or simply because of poor infrastructures and resources. Not even in institutions in the so-called First World, where academics are, in principle, free to work

1 http://portal.unesco.org/en/ev.php-URL_ID=13144&URL_DO=DO_TOPIC&URL_SECTION=201.html.

2 https://www.icsu.org/cms/2017/04/Academic_freedom_ICSU_CFRS_principle_document.pdf.

on whatever they want, except that they don't receive funding if what they want is not part of a scientific agenda which is defined according to criteria that often have little to do with science.

BREACH OF ACADEMIC FREEDOM IN AUTHORITARIAN REGIMES

Academic freedom is often at risk in authoritarian regimes: scientists who wish to perform research in areas that are believed to be against the law, or on topics that are prohibited because they go against the political beliefs of the government, often risk their freedom.

Iran. One interesting anecdotal case is that of Omid Kokabee, a young Iranian PhD student studying physics at Austin, Texas. During a visit to his family in Tehran in 2011, Omid was accused of "gathering and colluding against national security" and incarcerated. After being acquitted of this accusation, he was charged again with "communicating with a hostile government" and "illegitimate/illegal earnings", and sentenced to 10 years in prison. In an open letter, Omid Kokabee stated that the true reason for his imprisonment was that he refused to cooperate with the Iranian military.
Kokabee's incarceration triggered protests across the globe. Nobel Prize winners, human rights associations, associations for civil rights, and academics from all over the world wrote several letters to the president of Iran, without success. After 3 years of detention, in which Omid was granted very little contact with the outside world, and which he spent working on his research in jail, his health started seriously deteriorating. He was finally diagnosed with kidney cancer. After that, he was released on parole, with the obligation to check in every 2 weeks[3]. His main fault was refusing to collaborate with his own government, refusing to work for the military.

UAE. Other countries have similar stories: Nasser Bin Ghaith, an economist from the United Arab Emirates, was arrested in August 2015 accused of "publicly insulting the UAE". According to Scholars at Risk, "Bin Ghaith is also accused of violating article 29 of the UAE's 2012 cybercrime law, which provides for a maximum of 15 years in prison for publishing material online with 'sarcastic intent' or to 'damage the reputation' of the state or its leaders[4]." In Dr Bin Ghaith's case, too, there have been international calls asking for his release and for a just trial. Since the date of his arrest, Bin Ghaith has been held in incommunicado detention and not been allowed to see his lawyer. On the date of his first trial, he declared that he had been tortured in prison. International observers have also been denied entrance to court during his trials. At the moment, no further information is available regarding Bin Ghaith.

North Korea. Last year, a North Korean scientist, Dr Lee, defected to Finland. He declared that he could no longer bear being forced to carry out chemical experiments on human subjects. We have a very limited picture of atrocities in North Korea;

[3] More details on Omid Kokabee's story can be found here: https://www.aps.org/programs/international/rights/omidkokabee.cfm; https://www.iranhumanrights.org/2016/04/omid-kokabee-cancer/; http://freeomid.org/; and on many other sites.

[4] https://www.scholarsatrisk.org/2016/10/uae-speech-charges-violate-academics-rights-nasser-bin-ghaith-held-incommunicado-9-months/.

the country is so closed to the outside world that most information about research in that area is hearsay. Dr Lee declared that, among other things, human beings, particularly those affected by some serious impairment and health issue, are often used as subjects for trying out chemical and biological weapons. He could not work in such an environment any longer.
These are only three examples, possibly the best known among human rights activists, exemplifying the restrictions on freedom in authoritarian regimes. Detention, inability to communicate with lawyers or with the outside world, no access to a just trial, torture, and even death are unfortunately much more common than we might expect.
This is the most extreme kind of infringement of the basic freedom of researchers, but there are other very dubious activities that are being carried out by several governments, which are just as alarming as the cases discussed above, and which are much less easy to pinpoint.

BREACH OF ACADEMIC FREEDOM IN COMPLEX POLITICAL SITUATIONS

Turkey. It is no secret that the political situation in Turkey is currently very complex. The president, Recep Tayyip Erdoğan, has established a number of measures to fight terrorism and ensure internal stability. Turkey faces many threats, and this has had serious repercussions on research in the country. Last year, some scientists started a petition against the Turkish ban on scientists from Turkish Kurdistan. This call was followed by some very restrictive measures, trials, and firing of the signatories. The Turkish government maintains that this was an act of justice and of safeguarding public security. Following the coup, because of the state of emergency, President Erdoğan ordered the closure of 1,043 schools, 1,229 foundations and associations, 35 medical institutions, and 19 unions, as well as 15 universities[5]. While students have been relocated and have not suffered too much as a result of these closures, researchers have seen their academic freedom very heavily impacted.

Palestine. The conflict between Palestine and Israel has created monsters; among them, the heavy restriction on the import of chemicals into Al-Quds university. According to some direct reports, all chemicals that could potentially be employed for manufacturing weapons are blocked at the Palestinian border and cannot reach the university. Chemists lack infrastructures and raw material; hence the quality of their research has been impacted, and their research freedom heavily restricted. Furthermore, visiting scholars cannot get a permit to stay for longer than 3 months, and the faculty is forbidden to go to the other part of the university, which is in Jerusalem.
The European Convention of Human Rights, Chapter 10, states that freedom of expression, of religion, of conscience, and of thought must be subject to those restrictions that are necessary to safeguard public safety[6].
The question is: where do you draw the line?

[5] https://www.theguardian.com/world/2016/jul/23/turkey-erdogan-closure-of-1000-private-schools-gulen; http://www.universityworldnews.com/article.php?story=20160722211654519.

[6] http://www.echr.coe.int/Documents/Convention_ENG.pdf.

BREACH OF ACADEMIC FREEDOM ON IDEOLOGICAL GROUNDS

Freedom of research can also be breached on ideological grounds.

Uzbekistan. In 2015, the then Uzbek president Islam Karimov decided to close all political science departments, with the subject described as "Western pseudo-science"[7]. After the president's death, no change has been made to ensure the reinstatement of political science researchers in the country.

Venezuela. It is well known that the situation in Venezuela is particularly serious. With regard to research, an education law was enforced in Venezuela in 2009, allowing the government to take full control of universities; the government even decides which subjects are offered at which university, and in which university a student should enroll. In February 2016 it was established that university programs should comply with government guidelines; parallel government-friendly associations were created in addition to the traditional university ones (such as the Association of Rectors). Parallel universities were created too, like the one for the armed forces, which has about 250,000 students. Old universities do not receive any subsidies[8]. Chemistry, physics, and biology have been abolished from secondary schools.

RISKS AND OPPORTUNITIES

Compared to the situations mentioned above, the research environment in so-called "Western" countries looks like heaven. To quote Noam Chomsky, though, "the system is optimal, but not perfect"[9]; that is, the system is optimally designed given the economic situation, and the limited amount of funds. But it is not perfect.

In recent years, many governments have decided to assign the bulk of research finances to external agencies, which are in charge of shaping research plans in the countries involved (in agreement with governments) and allocate funds based on merit. This is also the approach adopted by the EU, with the Horizon2020 program being based on the two pillars of innovation and excellence. These systems aim at ensuring a transparent distribution of resources, a distribution that is made according to measurable and comparable parameters.

There are, however, many risks in the system, which I would like to mention briefly.

EXCELLENCE

This is not the right venue to discuss criteria for establishing excellence. Suffice it to say that excellence is a relative concept. It is relative to the research plan (or research agenda) of the country, it is relative to the fashion of the time, and it is relative within the field of study.

The Netherlands. As an example, take the Netherlands, which features one of the best research funding agencies in the world, the NWO (Nether-

7 https://www.theguardian.com/world/2015/sep/05/uzbekistan-islam-karimov-bans-political-science; the original law (in Russian) can be found here: http://www.ozodlik.org/a/27220389.html.

8 http://lat.wsj.com/articles/SB11086101672415843360004581516863881609144?tesla=y (in Spanish).

9 Chomsky, Noam. 1995. *The Minimalist Program*. Cambridge, Ma: MIT Press.

lands Organisation for Scientific Research). As in many other European countries, the EU2020 target of 3% GDP for research has not been met[10] in the Netherlands. Governments are forced to come up with strategies for allocating funds; some years ago, the government of the Netherlands identified nine "top sectors" in which to invest[11]; a National Research Agenda (NRA) was established in 2016, identifying research areas and topics in which to invest[12]. The NRA is built around 140 key questions, to which scientists are invited to provide answers.

Researchers outside these key sectors, or not working on the topics identified by the NRA, are left with very little research funding. This means that even if they are excellent in their own field, they risk not having enough funding for research. Researchers working on the topics identified by the NRA are also encouraged to work in cooperation with industry or in clusters, in order to improve their impact. This means that their freedom is also somewhat limited: it is limited by the existence or otherwise of industries that want to invest in their research; it is limited by potential profits.

Research is thus steered by the government, according to criteria that are not always the same as those adopted by researchers when identifying research questions. Of course, there is no infringement of personal freedom in the Netherlands and everybody is free to work on the topic they wish. But the question I wish to raise is: how do we ensure that the research questions identified by the government are the same as those identified by researchers?

SOCIETAL IMPACT

To complicate things, the NRA's 140 questions, rearranged and merged, were asked by all sectors of society: citizens, schools, researchers. Everyone was invited to pose a question, which researchers were then invited to answer through their research. Societal impact is very important in all funding frameworks. It is perhaps worth reiterating the question asked above: who should decide what question researchers should answer? Who should identify the issues that are worth investigating? Researchers, or laymen?

Japan. Societal impact has also informed the reformation of the higher education system in Japan. Last year, the Japanese government announced that all Humanities faculties needed to restructure themselves and their research objectives so that they would conform to the needs of society. After many protests, the Humanities have been reinstated as disciplines in many universities[13]. The pressure to conform to governmental guidelines regarding societal relevance is still very high.

INNOVATION

The other potentially dangerous concept informing all Western research agencies is "innovation". Research must be innovative, it must create progress. It shouldn't be something that one has already worked on.

If the search for innovation is one of the main criteria for obtaining funds, this means that no researcher is free

10 http://www.vsnu.nl/en_GB/f_c_onderzoeksfinanciering.html.

11 https://www.topsectoren.nl/.

12 http://www.wetenschapsagenda.nl/national-science-agenda/?lang=en.

13 http://www.mext.go.jp/en/index.htm.

to continue his or her research topic after the end of a project. A problem that one has already explored once becomes an old problem; it is not innovative research. Expertise on a particular topic risks getting scattered, fragmented, interrupted. Once again, there is a discrepancy between the concept of research that researchers work with, and the one adopted by governments.

So, what is the path to true academic freedom? Well, first: recognize the symptoms; acknowledge that there are several ways in which freedom is impaired, and work to overcome them. Then, appeal to international peer-pressure; when working under a regime, ask for help and support from the world research community. As a researcher, try to be heard. Never stop explaining, and never give up the fight. The road to freedom is very long: we all have a responsibility to follow it, until the very end.

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Qualifications

2004	PhD in Linguistics, University of Stuttgart
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COVER
A section of the ceiling fresco of the festive hall of the Austrian Academy of Sciences, venue of the ALLEA General Assembly 2016, represents the former faculty of philosophy. It depicts the Roman Pyramid of Cestius and the columns of the Temple of Vespasian at the Roman Forum, as well as measuring instruments used for the exploration of the earth and the study of the stars.
Photo: ÖAW, Klaus Pichler

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