Science in Transition
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Why Science Does Not Work as It Should And What To Do about It

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To the reader: The views in this position paper are the product of lively discussions in four workshops, organized by the initiators of Science in Transition in the spring of 2013. The participants of these workhops are listed on the website. However, the responsibility for this position paper rests solely with the Science in Transition initiators.
Also, this position paper is not an end product, but a starting point for debate. This is the second version and after the November conference a revision will follow.

Translation: Han van der Vegt**.**

Introduction

Science has always influenced man and society, but there can be no doubt that, from the seventeenth century on, this process of mutual influence has gained momentum. Less and less, science appeared to be a individual intellectual quest. New ideas and concepts were coined within complex socio-political and cultural relationships. Moreover, science made its influence felt in a growing number of areas; this did not only concern texts but also nature, and soon, man and society also became object of academic study. National frameworks seemed less and less important. Science seemed without frontiers; at the most, governments and national idiosyncrasies influenced the way scientific developments could penetrate public life. Science was propelled by numerous discoveries, in the universe, at sea, in the workplace, in the laboratory, in society and in the library. These generated a dramatic increase in the quantity of information and brought about a knowledge revolution. The rapid changes had an impact on the university. It had to reinvent itself again and again, in the seventeenth century, around 1800, around 1900 and once more in the ‘70s of the previous century.

The concepts of science and social progress have long been intimately connected. Modern western society seems unimaginable without the benefits of science. Only with the arrival of the atomic bomb and with the environmental problems of the 1960s and ‘70s did the first doubts arise and did we learn that not all science automatically entails progress. Add to this that the organisation, funding and justification of the practice of science have become increasingly problematic, if only because of the enormous expansion that took place over the last few decades. As the central (although not the only) bulwark of science and as an institution of education and research, the university has had to deal with this at a large scale. To us, the “usefulness” of science is never in doubt, but the manner in which we organise it is. This implies questions such as: can we still be satisfied with the proficiency level of the large numbers of graduates we turn out? Is there something wrong with the admittance policy or is education the victim of the pressure to excel and to acquire funding?

And what is the situation in the daily practice of science itself? Has science not landed in hot waters due to issues such as climate gate, ash clouds over Iceland, and in The Netherlands the failed HPV vaccination campgain, the supposed conflict of interests in the advice about the purchase of vaccines against the Mexican flu (New Influenza A) and obviously the recent, much discussed cases of fraud. Do we pay sufficient attention to these problems? Certain aspects (fraud, plagiarism) are evidently wrong, everybody will agree on that. Thorough

reports have also been written about these issues. But apart from that, there are many matters we cannot directly call “white” or “black” but that are more or less “grey”: things are not exactly wrong but are somehow not entirely right either. If we are willing to look closer, these shades of grey are dominant. Do they, taken together, not indicate an essential metamorphosis of the practice of science? Is it not time to further study these changes and to analyse their consequences?

The issues that we put up for discussion here can hardly be called typically Dutch, even though this paper will focus explicitly on the conditions there. They occur all over the world and by now there is an impressive amount of literature available on the subject.

In this position paper, we will not pretend to give an exhaustive survey of all that literature. Neither will we be able to treat all the problems. On the basis of three paired themes: Image & Trust (images of science and trust in science), Quality & Corruption (Quality, Reliability and Impact) and finally Communication & Democracy (Information, democracy and influence of the public), to each of which a workshop was devoted in the spring, we think that we can deal with the most important issues. This paper will be concluded by an analysis of the problems regarding university and education. We are convinced it is wise to start with such a broad analysis. This will show us how problems have become entangled, which may help us to know better what we are doing once we start working on the introduction of improvements.

Images of Science

The idea that science offers security, guarantees indisputable knowledge and therefore deserves financial funding is age-old. When Darwin and the modern theologians put an end to the idea that science could solve moral conundrums and questions of interpretation, it was quickly replaced by a new and possibly even more effective motivation. Science turned out to be an inexhaustible supplier of imaginative and also directly applicable research results. Beginning with research into chemistry and electricity, science was to penetrate society ever deeper. The result of this process is well-formulated in the Young Academy's (branch of the Royal Dutch Academy of the Sciences) advice *Between Research and Society* from March 2012: "Science forms the basis of everyday items such as synthetic clothing and smartphones and contributes to the development of healthy food, the improvement of health care and the stimulation of language development in infants. Science helps us understand subjects that feature daily in the news: conflicts and terrorism, epidemics, economic crises, but also art forms and the weather forecast. Science is part of our culture and supplies us with new conceptual frames in our search for knowledge. Scientific data also forms the basis of policy making, for instance in the field of climate change, pollution, the desired growth of the economy and of traffic management."
Whoever reads this cannot but conclude that the penetration of science in society is complete. There is no field of human endeavour, whether it is living, working, caring or decision-making, about which science does not have a say. The science factory is not only part of a global industrial complex but also intimately woven into the service industry, into government and our private households. The idea that science offers unquestionable knowledge, and that only the kind of science that delivers such security is true science, is directly connected to this. Not only is this idea very stubborn, also is it being maintained by all means possible.
Each year, NOW, the most powerful Dutch research funding agency, organises the National Science Quiz in collaboration with a television broadcaster. The aim is to show the viewers what real science is really about. NWO is above criticism, certainly in the experience of the average viewer. And yet, there is something strange about this quiz. Of the hundreds of questions posed during the past 20 editions, nearly all demand an unequivocal answer. We may ask ourselves what this means. Should we conclude that for NWO, science is synonymous with the supply of absolute certainty and that on the basis of

that principle, a conscious choice was made from the spectrum of scientific practice? That society is wont to value the humanities and the social sciences less – after all, they offer less certainty – is easy to understand from this context.

But science history and science sociology of the last few decades have dealt summarily with the pretensions of the universal scientific method, with the capacity to distinguish effortlessly between good and bad data sets, with instant efficiency in unmasking worthless theories and a faultless knowledge of how to identify valuable scientific ideas. By now, we – and of course, the researchers themselves as well – know that behind the spotless battlements of this ivory tower, the real world of science is considerably more disorganised that is often thought – and hoped. Among themselves, scientists turn out to have very different opinions on problems and options and even belong to different "camps" or "schools". Some of them have no objection to rigging their data, others are borderline incompetent and still others accept money from the pharmaceutical or the nuclear industry. Scientific practice is nothing more and nothing less than a noisy market place where obscurity, flagrant mistakes and even discord, but also coincidence and disappointment engender creativity, innovation and democratic counterforce. Obviously, it is not our aim to put the practice of science in an unfavourable light. But this reality reflects badly on the public desire for infallible knowledge and especially on the incorruptible high priests who gather, administer and apply this knowledge.

In most cases, citizens do not really know what science really is or what scientists do. Certainly, a white coat is still inspiring but we may call it at least remarkable that, what with the enormous variation and expansion of research fields and collaborations of the last decades, the laboratory is still considered the most exemplary spot for scientific practice. This is a serious problem, because it gives rise to a distorted image of what science can, but more importantly cannot, accomplish.

To prevent citizens from hanging on to wrong, outdated or strongly romanticised images of science, the Young Academy advocated more attention for the process of scientific development. The thesis is defensible that it is even dangerous to maintain the mythical ideal of pure and certainty-providing science. Precisely this "enchanted view" is an ideal breeding ground for public misunderstanding and unjustified outcry at every instance when a debate touches upon something grey, something that implies a value statement. The outdated, obsolete image of science also maintains a mythical, moral framework in regard to science's independence.

That is why it is important that the public is better informed about the practice and the true nature of the scientific world. Modern science is a top sport and especially a team sport that operates at a high level and on the cutting edge. Let us leave behind the myths about science as the only place on earth where none but completely disinterested and exaltedly inspired people are making the most beautiful discoveries. Scientific knowledge is needed more than ever and we should not be surprised that its correctness and usefulness is under discussion.

Knowledge is the product of people who are neither infallible nor holy. There is uncertainty, and there are fierce differences of opinions, especially in the frontline of science, where new knowledge is being conceived. We should not cover up these discussions, but explain that differences of opinion must be filtered out in the practice of science, in order for a robust end product to develop. Science has always been like that and precisely this process makes scientific knowledge so strong. Science is a human effort, but a very creative and special effort, because through science we can change the world. A successful demystification of science takes the researchers back in the public sphere where they belong, in the midst of potential users of new knowledge. Such a knowledge offensive would eventually only increase the involvement of the public, of politics but also of business.

But involving the public does not suffice. Also in education at the university and equally in college, fundamental changes are needed. Every bachelor program should pay attention to the phenomenon of science and its adherent problems. Every student needs to have a basic knowledge of the often random divisions in the scientific world and should realise that, although veterinary science and classical languages are studying different subjects, they also share important fundamental traits. We should not forget that the university has from its inception been, and still needs to be, an educational institution. Up until the beginning of the twentieth century, when modern discipline formation began to drive the fragmentation of the university, there was still a strong awareness of the whole of available knowledge, the students all had the same basis and were all carriers of a common ideal. In the present day, the idea that working at the university implies a common mission is in jeopardy. We are gratified to see the revival of this classic ideal in honours programs and university colleges. But is it not sad that these insights are only taught to the “best” students, instead of being part of every student’s intellectual stock-in-trade, as they should be? Every student should also know that not only results count: “we have finally found the Higgs boson”, “the

North Pole ice cap is melting faster than assumed"; but especially the way in which these results are achieved and how scientists work towards that goal. This will presumably lead to a more realistic image of science, also for those who do not aspire to a career in science itself. For students in research masters and PhD programs, this applies *a fortiori*. It is stunning that ever greater numbers of PhD students receive their degree without having a clue about who is pulling the strings, who is funding what, what role special interest groups play and how their research subproject fits into the greater whole.

But the scientists themselves are also part of the problem. Many are still convinced of the profound wisdom of Germany's first Chancellor Bismarck's statement: "The less the people know about how sausages and laws are made, the better they sleep at night". Is the positive image not beneficial to all parties, they argue? It gives researchers the opportunity to do research in peace without constantly having to justify themselves. The high professional standard of researchers and the use of a scientific method approaching the ideal of scientific infallibility, coupled to the promise – which is moreover regularly fulfilled – of applications with great social, economic or medical use – should be sufficient guarantee. It is, in short, unwise to disturb the chicken with excessive intervention in the hatching of the golden eggs. On top of that, it would be politically inexpedient to give complete openness at a time when huge cutbacks are demanded.

We should interpret the reticence of field players of all disciplines to blow the whistle in this context. When dissertations disappoint, do we consult the PhD committees regarding our complaints? In practice, we seldom do. Is that because there is no reason to do so or do we let matters slide for the sake of peace, or for the sake of the financial interests involved? When publications and the underlying calculations do not add up, do we then raise the alarm or do we make a note in our mental check book about a favour given, to be repaid at a later date? Such a world does not explain why fraud is perpetrated, but makes it understandable how it is perpetuated.

Already in 1975, the French sociologist Pierre Bourdieu has pointed out the double standard prevailing in science. As a social activity, science is in this respect not different from other social systems. The gurus of science, Robert K. Merton, Robert P. Hagstrom and Michael Polanyi, who are still cited as great examples, represented science as an ideal community, as a group of people disinterestedly sharing knowledge to reach a higher goal. They did not fail to observe the intense competition aimed at acquiring individual renown and success, but in their opinion, this competition only contributed to the realisation of the

ideal of higher knowledge.

This paradox has always been much more problematic than the gurus and their present-day followers like to admit. Because of the immense expansion of the practice of science, this discrepancy has become increasingly visible. For science is also determined by elite behaviour, stratified according to position, alma mater, university, networks or résumé. Debates between suppliers of new and wayward insights are decided on the basis of the power and reputation of both the judges and the suppliers. Such matters were hardly ever mentioned by Merton and his ilk. Add to this that a considerable number of readers still interpret the writings of these authors, intended as normative, as a description of reality. Thus, the classic paradox spells problems for the rationality and objectivity of science. There is, as Bourdieu concluded, a consistent double standard in everything researchers do: on the one hand, they are driven by the "enchanted view", by the badly understood gospel of the gurus. For they have a common mission. In reality, it is a "field" in which dominant elites use their social capital to win economic advantages for their research groups and themselves. In scientific discussions, they resist new-comers threatening their position. After all, reputation is the only social capital researchers possess. In the behaviour of scientists, in their choice of subjects, their choice of mentors, in everything they do or leave undone, this double standard is visible, because everything is geared for upward mobility. To Bourdieu, science is not fundamentally different from other social games, with strict rules and standards about how to conduct the debate and how to communicate.

Should we consider the refusal to blow the whistle, the reservations in explaining how science really works, as a conspiracy of silence? Or can the maintenance of the myth of the enchanted view also be interpreted positively? For Bourdieu, myth and hypocrisy do indeed have a function. They keep the system together. They shape and bind the researchers to the rules of the game. To a certain extent, this is how science actually works. That we work for a higher goal, that is our story to the outside world, to society. That is why we believe each other and other people believe us. That Bismarck today has so many adherents seems nicely explained in this way. And yet, we are convinced that a serious error underlies this. Science does not work because the myth is still in the air, but because new results are filtered in hard-as-nails debates and tough competition. In the front line of science, a continuous battle of interests is being fought, where new knowledge is being tested but which also sometimes wrongfully halts progress or even

champions old knowledge for too long. In this frontline, the myth does not work. It appears to work in an (outdated) kind of historiography, in text books and in stories of earlier and long crystallised science. But even there, the myth propagates harmful misunderstandings in the public and in politics. For the myth cannot explain researchers' incompatible opinions on new discoveries, the role of money and grants, the excesses due to high pressure to perform and the dangers of interactions with commercial funders. Nonetheless, the question is justified whether transparency of the practice of science would actually solve any real problems or would possibly even cause damage. Is the public waiting for all this information, or worse, is the public even able to interpret it? Is transparency not an alibi for evil politicians to cut the researchers' budgets? Does all this transparency not put extra pressure on the scientist? Complete transparency is obviously not even feasible. A lot of implicit knowledge and certain professional skills can hardly be shared with people who are not committed to acquiring them and the difference between knowledge and insight is also an important obstacle. But that cannot be an excuse for the opposite, that is to say the maintenance of the mythical image of what science is. It is all a matter of equilibrium. We should show that uncertainties play a part, what assumptions are used and what divergent directions exist. And apart from that, we should show that researchers are driven by noble but sometimes less noble motives, how funding is achieved and how the agendas are determined. Obviously, not everybody is interested in all information – we will never be able to compete with soccer – but there are growing groups of people who want to know everything about different kinds of illnesses, climate problems and durability questions and they have a right to all the available information. Moreover, they show us that their trust is proportional to the amount of information they receive. No doubt, politicians will rise who will abuse the knowledge about scandals, mistakes and failures. What it all comes down to is that, in an open and democratic society, all information (with the possible exception of information that is a threat to safety) should be available to anyone. Scientists only have the right to tell the truth to politicians when they themselves have nothing to hide. And finally, is the university not the institute where open debates should take place and where students are supposed to learn critical thinking, in order to keep abreast with the information wave?

In this analysis of the various images of science, we have already encountered different aspects of the derailment of science. The reason we trust science is not the least of these.

Trust

He who wishes to deduce the position of the sciences from the public support they enjoy, can soothe himself to sleep with the fact that citizens have more faith in science than in politics, in the legal system or in the press. In recent research by the Scientific Council for Government Policy and the science policy think tank Rathenau Institute, respondents, on being presented with eight institutions were asked how much faith they had in them. This concerned: "science", "television", "the newspapers", "the unions", "the big corporations", "the government", "the House of Representatives" and "the legal system". It appears that science inspires the most trust. On a trust scale from 1 to 10, science on average scores more that 7. The government and the big corporations are both trusted least at 5.5. Faith in science (and other institutions) is lower among people with little education or people who score high for feelings of social discomfort. And yet, these groups still trust science more than any other institution. Also from the other questions, it appears that science enjoys great trust among the public.

Thus, there seems to be no lack of trust in science, even though we should be careful to read too much into the results of such surveys. There are more reasons not to attribute to much significance to the survey results. As we have just established so extensively, citizens have only a limited idea of what "science" actually means. Moreover, a number of clear dangers are lurking: conflicts of interest because of collaboration with industry or contract research for the government is strongly held against science. This regards fields strongly stimulated by policy measures of the last few years if not decades (valorisation), and successfully so. If politics were to have its way, the contribution of industry would only get bigger in future. That route may well endanger the public's faith in science.

In the '60s and '70s, targeted science communication was a perfect aid to maintain the standard arrangement between scientists and the general public. Now, this no longer works politically, and it is the consequence of two interconnected phenomena enhancing each other: on the one hand, the excess of information, which is moreover increasingly difficult to interpret, and on the other hand, the shifting relations of authority. Especially due to the virtually endless possibilities of the internet, and the diversification of the media, we are constantly bombarded with information, facts and insights, sometimes in the shape of separate ideas, but also in the shape of a stream of reports, articles and finds. The question has been

posed more often during the last few years: does last week's *Economist* not offer more information that the seventeenth-century citizen was given during his whole life? The global knowledge production is immeasurably large. In most disciplines, so many articles are published annually that no researcher has the right to pretend that he truly keeps up with current developments. The only way out is hyper specialisation, resulting in a lack of overview.

The information overload might still be manageable if the significance of all that information would be instantly clear. But of course, that time has long passed. Also the trust in experts is subject to erosion. Their advice is often contradictory. When a Health secretary decides in favour of vaccination on the basis of the advice of the Health Council, then there are always worried mothers, supported by just as many "experts" who are convinced that the vaccine supplied by the government has been infected with nanochips in order to advance the Big Brother ideal. The professional scientist who around 1900 would be raised on the shield of unassailability is nowadays front and center in many debates and must justify his position and authority at every turn.

Thus, the problematic relationship between the public and science has also become a matter of authority. The internet and democratisation not only increase the number of interpretation frames. They also shatter the relations of authority. They make them more horizontal, more aimed at negotiation than at orders. In such a society, it is an absolute necessity to re-establish expectations about what science and scientists are capable of. And we should explain that science is relative and fallible – that we acquire more and more knowledge but will never be finished, and – and this may be the most important aspect – that we do not always know exactly what we know.

And yet, we can conclude that the public trust in science may not be unlimited, but is at least and up to now robust. Illustrative in this respect is the research on the initiative of the British House of Lords, into the trust in science after the BSE scandal (mad cow disease) of the1990s. After a short dip, trust appeared to be eventually unshaken. The reason why trust in science shows ups and downs but structurally remains intact is possibly due to something else. Has science not become a central part of our philosophy of life, without which we cannot interpret the world around us? That is not to say that scientific statements can do without empirical underpinning. But it does mean that the reasons why we trust in science are not based on concrete empirical statements, but on expectations independent of science itself, that are different from one person to the other and show different degrees of commitment and

subtlety. And as a result, trust in science can be compared with trust in political ideologies and especially in religions. There also, scandals do not lead to a breach in trust, as was demonstrated with the amply publicised waves of sexual abuse in the Catholic Church. A lot is to be said for the statement that science has a central place in western thought (even with its opponents) and thus has acquired a nearly inviolable position. No one would say that we can do without it. All the same, this does not mean that we can now lean back and relax. It is very well imaginable that a quick accumulation of scandals could lead to an irreparable breach in trust. It is also not implausible that a science plagued by "affairs" would be less attractive for exactly those talented students who could truly advance the project of science. It is not easy to establish when such moments are about the take place. Vigilance is therefore necessary and here also, the first step is the creation of an image of scientific practice that corresponds with reality. The paradox is that vigilance can only be informed by science. In secular society, we have no other resort.

Quality

The question whether science delivers value for money is heard everywhere these days. The neighbouring countries are investing fervently in higher education and research but in the Netherlands, the government doubts whether such an investment is wise and whether the government should take the initiative. For the pleas for more resources to be convincing, the quality of the research results delivered for this extra financial effort should be above any doubt. The question about what this quality constitutes can be answered in different ways. Up to now, the debate, informed by a series of recent cases of fraud, is especially about the question whether research is conducted without any data rigging. But in quality research, much more is at stake. Ideally, quality should be derived from subject selection and from the actual impact the research results have on the observed problem. Currrent assessment methods create numerous problems.

Assessment and supervision of research are predominantly based on short-term 'bean counting': we count and measure publications and citations and most of all check the so-called impact factors of the journals in which the publications appeared. To a large extent, these impact factor scores determine a researcher's career, but only haphazardly correlate with the real significance of his research. Slightly exaggerated, we could say that thousands of the articles written and published at Dutch universities during the previous season may be methodologically sound, but we cannot be sure that all of this research really was high priority. It may just as well have been produced in order to deliver a quickly publishable product. In short: the bibliometric system currently used in the Netherlands and increasingly in other countries is not suitable for the assessment of knowledge production, for it does not recognise its value to colleagues and/or public stakeholders . This is hardly surprising. The early "scientometricians" led by Derek de la Solla Price and Robert Merton were looking for a method to trace scientific information faster and to give the researcher an impression of his work's reception. And yet, the scientometric method has developed into research management's instrument of choice, resulting in the hardly subtle bean-counting.

We are only at the beginning of the development of new models that may be able to bridge performance measurement and the extent to which those performances make a contribution to real scientific progress. The problem becomes even bigger when we take into account that an increasing part of scientific information exchange takes place outside of the customary channels of journals and books: raw data are shared, so-called nanopublications are developed

and then there is a whole array of self promotion systems such as blogging and microblogging which are all much faster, opener and more informal. For the social sciences, the humanities and also for the design sector, the Royal Netherlands Academy of Arts and Sciences published crucial reports that not only pay ample attention to the social significance of research but demonstrate that there are no functional "one size fits all" systems, however much managers appreciate these for their mostly delusive administrative unity. They cannot accommodate the large disciplinary differences. In many faculties, the systems proposed in these reports are now slowly being implemented. It would be most efficacious if not only each individual researcher would be assessed by these systems but if he would be seen as part of a group that needs to meet the standard as a whole.

Improving quality assessment of researchers' and especially research groups' "track records" is of immense significance because this assessment does not only look back, but more pertinently determines the future in that they influence the distribution of research funding by university managers and other influential funders. All parties, researchers, managers and funders now aim for risk reduction. They all, but particularly the latter, are on a treadmill, in constant need for appealing ("sexy") results of their grants in order to jump-start their next collection campaign. New 'grassroots' stakeholders funders such as the Aids Funds or Kika for cancer research make strong demands abut the research they subsidise. This not only applies to basic research and its promises, but also means that clinical research should lead to improved treatment or prevention. Charity funds will follow their suit.

But the funders, the government and other shareholders will have to realise that there is more to research than the publication of high impact papers, and that scientific findings need time to prove itself in the real world. That means that these funds (public and private) must also be ready to commit to long-term and risk-bearing research.

Knowledge institutions must be able to use their own intramural funds for risky long-term research of which the assessment and funding system now shies away. There needs to be more room for research aiming to answer complex questions. That is bound to yield less "top" publications within the next four years, but it gives better opportunities for results that can truly benefit patients, citizens and authorities.

This problem, of faulty, inward-looking assessments performed in a mechanically quantitative manner, is now also recognised internationally. Among other things, this has led to the decision to treat impact factors more circumspectly in the assessment of research. In Great Britain, an approach is defined for an integral research assessment in which, apart from the

value of research results for colleagues, also its significance for possible users outside science must be made plausible. To this aim, the idea of hybrid fora, mixed committees of researchers and public users, was proposed. Dutch research organisations are developing a similar method.

This has implications for career development and talent management. Managers of knowledge institutions will have to aim for diversity to offer opportunities to a different kind of researcher working for a completely different résumé and a different career, both inside and outside academia. Up to now, talent management was primarily driven by prestigious personal grants, but those are for the elite and are therefore hardly useful to the majority of researchers. In our present system, which, especially in the life sciences, is rightly referred to as a "PhD factory", we educate students who subsequently have scant chances of a satisfying research job or a decent academic career.

And where does this idea – shared by researchers all over the world – come from that far too few PhD students are being educated? For her recent book, titled *How Economics Shapes Science*, American economist Paula Stephan analysed the PhD factory thoroughly and established that the system is untenable. She arrived at the conclusion that the various players maintain the idea of a shortage of PhD students for different reasons. Firstly the authorities, nationally, but secondly also the universities that are awarded for student numbers, diplomas and PhDs, incentives that have turned out to be perverse. Thirdly, the leaders of the research groups. PhD students have over the last thirty years been turned into cheap work forces performing most of the (mostly very basic) research work, often without knowing the contours of the large edifice they help building. At some faculties, the situation is decidedly less bad, although external funders force researchers in that direction. It is therefore in the interest of the tenured scientific staff to get as many as possible PhD students and postdocs in their department. The production of publications, their quality and quantity, is to both the university and the tenured staff an important criterion for the acquisition of national, international and internal funds. It determines the policy regarding tenure jobs, PhDs and professor appointments, but also the odds of obtaining sufficient research grants. The greatest risk is the orientation solely on numbers, on external characteristics instead of on content, that leads to a new hierarchy between managers and administrators on the one hand and researchers on the other.

There is yet another important element. Nobody aspires to become a scientist for the money. In business, at the bank or the stock exchange, you can always make much more than at a

university, and often with less effort. Recognition of their work is still an important motivation for researchers, but, Stephan shows, income plays a growing role. Top researchers are paid more and there is an active transfer market for scientists who try to improve their salary "plus benefits" and the facilities at the workplace. In her research, she concludes that researchers' motivation to lead their own research group one day can explain the dynamics, organisation and pathology of present-day academic research.

For students, the system is equally disadvantageous. They enjoy the thrill and challenge of scientific research, they receive an allowance (grant) or salary as PhD students, depending on the national system, and therefore do not weigh their options or overestimate their own chances of reaching the goal of their education: to become an independent researcher. Universities and department heads hardly inform the students about their long-term career perspectives, for, as Stephan states, they have no interest in discouraging students to begin PhD research. PhD students are in a rat race and most of them are willing to work their tails off, also later as postdocs, to build credit to acquire their own research grants. PhD students and postdocs are the labourers who do the majority of the work and have only a limited number of years to capitalise their meagre credit. This is what Latour and Woolgar have called "the credit cycle of science". The consequence is that huge numbers of postdocs are being parked in temporary positions offering scant perspective on one of those positions as research leader they once coveted. You could compare it to the path someone has to travel to become a partner in a consultancy firm or lawyer's office. Even though there are considerable differences between the faculties, the pattern is more or less recognisable.

In 2008, the average age at which a researcher in the USA acquired his first independent large starter grant was 41.8 years. But the number of dropouts is unfathomably large. After mostly more than 10 years of temporary contracts, they are forced to look for a career outside of research. But for that, they have been trained too one-sidedly and they have similar one-sided work experience. They are seldom fit for education, they are scarred by deep disappointment. Comparatively, society has invested too much in them. In short, our resources to assess quality are far from perfect and tell us little about the value of the research results for society or for the progress of science itself. Moreover, because of a one-sided orientation on the PhD factory, the university is in danger of not fulfilling its true calling, risk-bearing long-term research.

Reliability and corruption

Last year, reliability was a hot topic. Certainly, the incomprehensible fraud of sociologist Stapel or antropologist Bax may be an exception, but "sloppy science" or even "bad science" is much more frequent. The extreme reaction to fraudsters seems like a surgical effort to cut out the affected tissue as soon as possible, in the hope that the infection is not systemic and that the rest of the body is still healthy. This is an illusion. The committee investigating Stapel's fraud had the idea that this might concern a system failure. In its report on honest science, the committee failed to consider an important cause for the rise of sloppy and bad science. Already in the '60s and '70s of the previous century, with their rapid expansion (big science) and institutionalisation of scientific research, visionary authors and administrators warned for a lowering of informal social pressure and control, for a tsunami of data and publications and an excess of shoddy science. They saw the rising influence of strategic behaviour, driven by all sorts of professional but also unscientific interests that had nothing to do with the advancement of science. In the year 2013, we know that these predictions have largely been proved true. We struggle with questions that are a consequence of system failure in scientific research at several levels. How can we, under the present excess of information, keep a perspective on the good and relevant science? How can we prevent the system from clogging with "irrelevant rubbish" and me-too research? How can we reduce and regulate strategic and politically correct behaviour?

Aiming for the production of articles in (top) journals and numbers of PhDs awarded and the dwindling contribution from scientific funds and private parties has created unprecedented competition across the whole of the university. Science is indeed founded upon economic principles and marketing, and there is competition for the best jobs, grants and awards. The personal interest of the researcher does not automatically correspond with the higher goal of science. This yields many meagre, sometimes bad, sometimes even fraudulent publications which do not serve science, but which scientists need to advance their careers.

Notwithstanding the beautiful aspects, science has become a normal profession, with a normal remuneration on which researchers are wholly dependent. Researchers are not exempted for life, and are not financially independent "gentlemen" – if ever they were. A career must be planned and to that aim, in the current system visible results need to be presented each year. Publications and other relevant output constitute the credit to acquire the next direly needed grants.

Not only does the system put pressure on the individual researcher, science has also become a large-scale enterprise which needs large sums of money to maintain a technologically high-quality infrastructure. In this context, professional conflicts of interest have become a nearly natural business risk. These mostly do not concern personal gain, but interest in acquiring grants and the opportunity to publish in the right journals, determined by committees and boards often containing competitors, or involvement in the assessment of projects and articles. Professional conflict of interest can also involve deeply personal scientific convictions about subjects in the discipline. But in debates, these are often presented as if they possess absolute, independent scientific quality. In this respect, we may think of the recent HPV debate, where the scientific preference of the epidemiologists tended towards screening, while the preference of a vaccine researcher and a gynaecologist tended towards vaccination. In this case, everyone made a personal scientific evaluation in complete honesty.

Apart from that, there is enormous pressure on the collaboration with private parties, sometimes involving big financial interests that, if matters are not strictly arranged, could put undue pressure on the researchers concerned. Here also, personal gain hardly ever plays a determining role, but the department and the research group often have huge interests in desired publications and continued research funding. Researchers can become co-owner of a start-up bio-tech company operating on the basis of their research. Sometimes, they are even working for both such a company and a public institute. Research is then conducted with the support of the company or of other grants, in collaboration with the institute. For the two partners involved, the research results can take on a very different meaning and effect. When matters have not been arranged thoroughly beforehand with the administrators involved, this can have serious personal consequences.

Is the enormous growth of the number of medical PhD students – the consequence of complex agreements between commercial stakeholders in for instance the pharmaceutical industry – not a perfect example in this respect? Is the decision to have future specialists first finish their PhDs not inspired by the conviction that a future internist cannot do without his PhD for the proper execution of his profession? All of this shows a measure of financial dependency upon external parties, the dark sides and risks of which can only be minimised through strict agreements beforehand and severe daily supervision.

Researchers thus can have all kinds of personal motives that influence the amount of trust put in their research results and the way these are communicated. In many cases, these will also be the basis of their personal scientific considerations, but sometimes, economic factors play a

part. In recent debates about for instance HPV and H1N1 vaccination, about a Dutch national effort to battle dementia, and about the promise that cancer might become a chronic disease, , colleagues and the public can clearly hear the conflicting value judgments from the individual researchers resonate in the discussion. These debates are therefore only concerned with purely technical-scientific arguments, on the question whether things are ethically properly handled. There is nothing wrong with that. Actually, it has never been otherwise, but people should be upfront about that. When one hears researchers speak at conferences, in public or in the media, one should always consider why they say what they say. Honest reporting to public about different and often divergent considerations at the basis of important scientific decisions and strategies is therefore of the utmost importance.

Communication

In the course of the twentieth century, public funding of research expanded hugely, especially after World War II. As already established, this did not induce fundamental doubt among the public that enabled all this research with tax resources. The Cold war, the restoration and the appealing results covered up all doubts in advance. But from the 1960s on, we see the demand for justification rising, primarily as a result of the rapid democratisation. This concerned especially matters such as social relevance, economic use and – in the period of the war in Southeast Asia – also the military significance of all of this research. Was the science community maintaining the war machine?

Against this background, we should see the rapid rise of science communication as a para-scientific trade. Science communication officers served to give science's claims the stamp of reliability, to inform the public and especially to convince it that the large sums of tax money were well spent. How many fundamental breakthroughs in cancer research are not announced annually by the hard-working science communications people? The problem is of course that the public has little choice. In the end, there is no market for scientific research where comparative commodity studies can be performed. The laboratories and research locations of scientists, as well as the meeting rooms where the distribution of research resources is decided upon are possibly the least accessible places in the world. Even the financial markets show considerably more transparency. The efforts of science communication departments are seldom aimed at showing what is really going on.

The developments at the universities are also important here. There is a transformation taking place here from communications to marketing. Typical in this respect are university websites, intended to advertise the quality of the own institution. Universities and faculties hardly ever indulge in a critically informative conception of their task. The gradual decline of the university press has further accelerated this process. Moreover, it appears that it is very hard for newspapers to bring science news without the aid of communication departments. Reporters are often working against the clock and hardly have any resources for thorough research. The public, that for the most part seems to demand appealing and easily palatable success stories, is glad to be served accordingly by the commercial newspaper moguls. Even though periodically, heroic efforts are made and even though there are favourable exceptions, we may ask ourselves whether we should expect the press – as it is presently organised and funded – to debunk the "enchanted view" and to educate

the public with a more realistic image of science.
Radio and television also yield a discouraging spectacle. As long as editors, fail to show the least understanding of the practice of science, there is little hope of improvement. Asked why science receives so little attention, they often give their standard repartee that science is no more than one of the opinions around. On the radio, a number of serious broadcasters are making decent programs, but their budgets are steadily diminished because the heads of the broadcasting companies think the public is primarily interested in a mix of exotic trivia and attractive television personalities.
In this light, it is hardly surprising that many prominent scientists, documentary makers, museum conservators and science journalists – sometimes unconsciously, sometimes rushed by the necessity of finding funding – keep opting for the perspective of infallible science. A few years back at the IDFA festival, a decent documentary was premiered, devoted to the now Nobel prize winning Higgs boson. As is well-known, the Higgs boson is an at present unproven, invisible particle that should explain how all other elementary particles have mass. In 1964, Peter Higgs got the idea that this process missed a link. By means of the enormous particle accelerator built by CERN over the last ten years, scientists hoped to demonstrate this missing link and to prove Higgs's theory. For four years, film makers Hannie van den Bergh and Jan van den Berg followed scientists in their quest for the Higgs boson. But the film – and that is what makes it attractive – is not only about science, but also about passion and imagination. The film ends with a fiasco. At the crucial moment, the particle accelerator crashed and in the documentary, the Higgs boson is not found.
It is flabbergasting that next the makers miss a great opportunity. They could have shown to great effect that the road to new scientific insights is paved with disappointment, ineptitude and sheer bad luck. Instead, they end on an up-beat discussion about how the goal will shortly be reached. The myth of infallible science must be maintained at any cost. And yet, the public should be educated in this respect, especially if we wish to involve society closer in the determination of research priorities.
Maybe it's time that research institutions and universities start helping the media. When neither the public nor the commercial media see the advantage of critical information and an independent science press has no economic basis, researchers should organise their own opposition. There are many options. Use alumni networks, connect to people and groups that have an interest in your research and try to involve them in a dialogue. It would be advisable to reform the university departments of science communication to that aim.

Democracy and Policy

An important point of departure of the Dutch Academy of Sciences advice *Trust* is that trust is determined by two factors "(1) that science does good things and (2) that it does these good things well". While until now, the discussion has revolved around the second part of this premise, now there will also be attention for the first part. As may be inferred from the above, not only is good communication to the broad public a necessity, but public and stakeholders need to be involved in establishing the research agenda. Both elements are of eminent importance for good relations and trust between science and society.

We can no longer be content to deliver the standard plea for preserving independent fundamental research, for which public money should be freed in blind faith, because then "innovation will work out all right in the end".

In our opinion we should, to stimulate greater involvement of the public and the stakeholders in the decision-making about the direction of research, be inspired by the work of the American philosopher Philip Kitcher and his principle of "well-ordered science". If science is no longer a small-scale cosy hobby but an institutionalised capital-intensive public activity, then, says Kitcher, in a modern democratic society, we should treat it that way. Even fundamental research is not value-free and should be involved in the debate about the science agenda. Do we pursue the proverbial next Higgs boson or a malaria vaccine or do we want more research into alternative energy and climate change?

About the need for a greater role for society (and thus certainly not exclusively for politics) in the establishment of research priorities, much has been written, but there is little practical experience. The real interfaces between science, policy and society have yet to be constructed. It is absolutely not our goal to have the science agenda determined by plebiscite. We are very much aware that problems abound and solutions are far from easy. We only have to consider the above-mentioned problems surrounding information overload and erosion of authority to be convinced of that. In this field, there is much to be considered and still more to be done. The Dutch Academy of Sciences should take the initiative. Point of departure should be the advice to work primarily pragmatic and not automatically to depart from society as a whole but to search for groups of the public directly involved in the effects of scientific and technological research.

This pragmatic approach and the search for segments of the public especially affected by

specific problems, has had its impact in the way scientific research is deployed for the benefit of policy. The assumption that research can with certainty predict the effects of government interventions may be an illusion discarded decades ago. And yet, the fact that science is an indispensable guide to supply at least a rational foundation for certain policy decisions is still very much valid. But the playing field in which scientific advice to the authorities functions has all the characteristics of a mine field.

Scientific conclusions are never definite. It is increasingly the subject of a discussion that is highly divided and quickly becomes politicised and polarised. Studies into economic benefits versus safety risks, harm or damage to the environment of for instance carbon capture and subterranean storage, the placement of UMTS towers, the relation between the extraction of natural gas and earthquakes and the perspectives of fracking for the extraction of shale gas or of vaccination campaigns show a two-fold collision. On the one hand, there are the scientific controversies about the assumptions, estimates and possibilities to get a perspective on the effects; on the other hand, there are divergent interests, insights, values and opinions. Notwithstanding the presence of an advice system in the Netherlands operating between science, politics and policy, there is no *deus ex machine* that can decide such discussions. Many people are repulsed by the idea of radically democratising and politicising science, because they think democracy means majority rule. Methods needs to be found to keep the competition of good ideas active in surroundings where science gives conflicting answers and the political landscape can be fragmented.

University and education

Those who wish to conclude that the problems outlined occur especially in the exact sciences, are mistaken. In the humanities, the social sciences and the law and social administrative faculties, similar matters occur, although at a smaller scale, and involving less money. The problems may look different but are essentially the same. Also in the social sciences, there are grave doubts about the standard quality assessment on the basis of impact factors and citation analyses. There is also much debate about the need to discuss the factor of social relevance, apart from scientific quality. The reporting model from the sciences cannot be prescribed forcibly. The book – which hardly has a role in physics and medical science – is indispensible for the social sciences. In the humanities, the same opinions are voiced. In reports of the Dutch Academy of Sciences devoted to quality indicators for the humanities and the social sciences – as discussed above in the section Quality – solutions have been investigated with some success.

There are also differences. The faculties of humanities and social sciences distinguish themselves from the science faculties by the larger numbers of students they turn out. At Utrecht University, more than 60 percent of the students belong to the faculties of the humanities, social sciences and the faculty of law, economics, administration and organisation. Things are not much different elsewhere. This has been the case for decades and there are no reasons to expect changes in the near future. These faculties make visible that the supply of a high-quality scientific education is a central role of the university. Much is to be said for the statement that the turning out of capable graduate students is the main valorisation of the university. Universities themselves seldom take this view. Utrecht University has for instance a valorisation paragraph on its website, but there, only valorisation of *research* is discussed. This may be the central problem of university education: regularly, lip service is being paid to its importance, but the real focus is on research. Research makes money and wins renown, but it is impossible to become a (top) professor through brilliant education performances. Seen in that light, the annual competitions for "education professor of the year" are a mere band-aid. The quality of the core task of education is threatened across the whole of the university by at least three developments: the overrating of research, the dissolving of the connection between secondary education and the university, and the lack of funding for the ideal "Higher education for many".

The hypothesis that the explosive growth of the university in the '70s has started the problems

in education is interesting. It seems certain that, from that moment on, the university elite set out on remarkable process of social abdication. It may go too far to qualify the loosening of the ties between university and society as a modern version of Julien Benda's *Trahison des Clercs*, but there are striking similarities. The members of the elite expressed their personal doubts regarding the national and civil education mission of which they themselves were the product and that had become contested during the '60s. This mission entailed the training of capable teachers, physicians, lawyers, civil servants, intellectuals and researchers for government and business. The graduates of that era had a solid background in what in the classic university had always been considered the core of university education: reading, thinking, writing, speaking and a critical attitude, integrated in professional training. The sciences and medical science had always been more research-oriented, their abdication took place gradually, but here also, education was increasingly deemed less important; especially if our criterion is the amount of time professors devote to the training of students. Would it not be advisable to use the time now devoted to the production of superfluous articles for the improvement of the students' education?

At the faculties of social sciences and humanities, the abdication took different forms. Here also, research had always been performed, but had been closely linked to individuals. Moreover, research was usually connected to education, while research production was modest. The enormous growth of the scholarly staff at the faculties of humanities and social sciences, the result of the increasing demand for education, automatically led to a huge rise of the research capacity – each staff member was regularly granted 40% research time. Both internal university developments and the pressure of new external science organisations have ensured that research in social sciences and humanities increased in scale from the end of the '70s on; eventually, research began to dominate the lives of professors and lecturers completely. If before that time, they were firstly responsible for education, these days, the emphasis lies on the supervision of PhDs and postdocs, while their reputation depends upon the latter task. Because the research leader is held in higher esteem than the education professor. A modest nuance is in order here. For the social sciences, the ever more complex social relations might well justify an extra research effort. But our point here is that, through the increasing emphasis on research, the equilibrium in the humanities and the social sciences is distorted. And that is not all. Within the university, the hierarchy between the faculties is established by the same research criterion. Is it strange that the humanities and the social sciences try to emulate the sciences? Nowadays, they are assessed according to their research

performance. To this aim, also in the faculties of humanities and social sciences, reporting was introduced from the end of the ‘70s on. Education impact was measured only much later, and moreover, in education, for a long time there was no client awareness. The students came anyway, and always in great numbers.

Research performed at the faculties of humanities and social sciences had another peculiarity. For instance, the social sciences have increasingly been cut loose from national issues. Research questions are derived from *international* debates, and researchers are judged on the extent to which they contribute to an *international* debate. The international focus is refreshing – and as a criterion for intellectual quality even indispensable, – but as *societal* sciences, the social sciences have lost the connection to the national agenda. Should that national base not be reinstated as a supplier of problems to be investigated? That does not mean that the international connections should be severed in turn. For there is not a single principal objection to contract research – and neither is there for the sciences. Collaborations with societal partners should have high priority. The faculties of social sciences and humanities do not yet have their PhD factories, but this is only a matter of a difference in scale, not in nature. Here also, the balance between government funding, funding by the scientific funds and private funding needs to be re-established.

In the humanities, we find something similar. Here also, the international standard is the norm, and that is sensible. There can be no doubt that in this way, countless interesting research questions can be formulated. But is it not strange that the use of so much humanities research is never discussed? Put differently: how much of this type of research does our society actually need? Certainly, the level of humanities research has risen appreciably during the last few decades, but is society holding its breath for the results of all this research? Obviously, for a limited part of it, a direct societal justification can be found, but there is no natural limit. It is not to be expected that such a debate would yield an unequivocal answer but that should not prevent us from holding that debate. The number of scholarly publications has become so large that nobody can keep up with his own discipline. Moreover, a large part of the research results is only relevant for tiny groups of colleagues. To cleanse our guilty conscience in this respect, we have given the concept of valorisation a very unsavoury meaning. In our daily practice, what does valorisation actually mean? We tell ourselves our research is relevant because we have, after having shamelessly promoted ourselves, been able to shine for a full 2 minutes and 17 seconds on a coast to coast talk show. Does this awareness not force us to a reconsideration of the kind of research we should want to do? Does this not

demand a better (not necessarily economic) justification. Should each tenured university professor constantly be doing research? When the regular research time of a university professor is lowered, this should not be taken as a punishment of the person concerned – because of a lack of performance – but as a restoration of the balance between education and research; out of recognition that an education career may well have more social significance. Each professor has a right to a reasonable amount of research time. But should we not leave the big research to a small elite of high-quality, strictly selected researchers? This pool should be refreshed regularly. Each staff member with convincing plans should be able to compete for a position, while the researcher should also regularly appear in the class room. For it is a bad idea to sever the connection between education and research. That would land education in a vacuum.

The net effect of the above-described developments – the discrediting of the teacher's profession and the championing of research – is that the faculties of humanities and social sciences which up to then had fulfilled a central function in university and society, have since fallen victim to a similar system failure earlier experienced by the science and medical science faculties. With this difference, that in the case of the humanities and social sciences, it has led to a damaging social marginalisation.

The social abdication of the university elite around 1980 also took another form. This was the severing of the ties between secondary education and university. This development has also contributed to the increasing social isolation of the university. As from the 1970s , more and more voices across the whole of the university were raised that the teacher's profession should not be considered the graduates' natural destination. Were they not suitable to fulfil all kinds of socially useful positions? Those other professional opportunities had always been there, but from now on, it was considered in good taste to paint the teacher's profession as an option for failures and twerps. In the debates surrounding the introduction of the two-tier structure for university education around 1980, this development reached its conclusion and the teacher's profession definitively disappeared from the perspective of the university.

But it is too simple to blame this development completely on the university. Dutch education reform in the 1960's created a new second-grade teachers' training for secondary education. The government's enthusiasm for cutbacks, no longer wanting to pay first-class teachers for anything but the highest high-school classes, did the rest. However, the university never made any serious effort to stop this process.

The consequences of all these political decisions and social trends have never been seriously investigated; but two of them are hard to deny. Firstly, the quality of the new generations of students has clearly fallen. That did not happen overnight. There were still many academics working in secondary education, and it has taken decades before their share in the teaching staff had decreased significantly. In our time, the problems become apparent to their full measure. Secondly; the growing divide between university and secondary education is very harmful. For how can teachers who have never seen the inside of a university class room or a university laboratory adequately prepare their students for university? During the last couple of years, more initiatives are undertaken to enhance the education level of the teaching staff across the board – from primary to secondary education. The Finnish situation is here the inviting example. But this is a problem that demands prompt study and a thorough approach. Society owes this to future generations.

The dwindling quality of secondary education is not the only factor putting university education under pressure. The mission to attract as many as possible capable students to university – however justified in itself – has severely shaken the university system from the 1980's on. There was much in the quality and the intensity of university education that needed to be improved, and this was energetically undertaken during the last decades. One might rightfully ask whether we haven't crossed a limit in the last years. Universities are forced to employ ever cheaper teaching staff for the strongly increasing student numbers. Just as in research, a growing group of temporary and cheap education personnel is supervised by an ever smaller (because expensive) group of tenured professors. Young university academics are thus stuck between the Scylla of research, with increasingly high requirements, and the Charybdis of education, which demands increasing amounts of time. And all of this within systems in which time is assigned, supervised and accounted for in decimal points. Do young teachers and researchers and the university itself not have a right to a consistent and transparent trajectory and career policy?

Even though many excellent initiatives are taken, in this field, there is still a world to be won. And this is not about holding faculty boards accountable for the failing system. They have been put in an impossible position, and have to accommodate an increasing number of students on less and less resources – all while maintaining or even improving quality. Is it not about time that we admit that the ideal of higher education for many has met with disaster? The ideal in itself is noble enough, but the way we have tried to realise it is wrong. Older generations of professors have always held that the quality of the students leaves much to be

desired, but for the first time these days, there is good reason to doubt the level of the graduates. The trouble many graduates have in finding an appropriate job cannot be denied either. This friction on the job market is of course connected to the now years-old economic crisis, but is also the result of the fact that many do no longer reach the required academic level. Here also, the government plays a decisive role. Whoever thinks a university is a factory in which the production of ever growing numbers of graduates automatically justifies the ever falling cost price per unit, should not be surprised to have delivered, instead of first-rate *philosophische Köpfe*, second-rate *Brotgelehrte* ('real thinkers' versus 'paid thinkers'). That is the clear-cut distinction between graduates, as made by Friedrich Schiller on the eve of the great university reforms around 1800. Now, more than 200 years later, Schiller's distinction has acquired new relevance. The perverse financing incentives established by the government in order to enhance the university's efficiency have indeed had the noxious effect for which we were warned on their introduction. We are at a cross roads: the government contribution needs to go up, the tuition fees must rise considerably, or with equal government effort, the *numerus clausus* must be enforced. There is no time to wait.

Conclusion

Is the university in crisis? It is much too easy – and also not very productive – to use this much abused label for the current situation. But systematic reflection on the problematic changes experienced by the universities is very much needed. We should reflect upon a multitude of themes: university's function in society, the role and extent of industry connections, quality assessment and internationalisation – to name but a few. But it would be very unwise to outsource such reflection to a think tank of civil servants or – still less preferable – to turn it into a university sub-discipline. The debate about the task of the university is first and foremost the shared responsibility of all those who work and study there: of scientists, scholars, students and of all the supporting sectors.

We started out on the note that the university has had to reinvent itself constantly: in the seventeenth century to accommodate the consequences of the Scientific Revolution; around 1800 with the introduction of the Humboldt education and the science model; around 1900 with the large-scale introduction of science and medical science education and research; and in the 1970s with the introduction of the principle of higher education for many, the development towards large-scale research facilities and the growing involvement with industry. Once again, we are on the eve of great changes. In the previous pages, we have tried to outline the problems demanding resolution. We have not yet supplied a blueprint for a new and more sustainable university. But we hope to have given you sufficient material to start a fruitful discussion about the future.

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