

TRANSITS



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TRANSITS

ANNUAL ADDRESS OF THE PRESIDENT OF
THE ROYAL NETHERLANDS ACADEMY OF
ARTS AND SCIENCES
AT THE ACADEMY AFTERNOON ON
5 JUNI 2012

ROBBERT DIJKGRAAF

TRANSITS

Today, we can observe an important transit in the world of science. There has been a lot about it in the papers. A little black dot will briefly pass in front of a large source of light and will cast its shadow on the Earth. At nine minutes past eleven tonight, Venus will start to pass in front of the Sun. Early tomorrow morning you will be able to see it with your own eyes...at least, if the weather is favourable. For just a short time, the Morning Star will become a sunspot.

The Transit of Venus is a rare phenomenon. It occurs in pairs, with eight years in between. The intervening period between the pairs is more than a century. If any of us is able to observe the next Transit, at 58 minutes past midnight on 11 December 2117, then science – in any case medical science – will have been more successful than we now think.

The actual physical effect of the Transit of Venus is very small. It will reduce the amount of light reaching us from the Sun by less than one hundredth of one percent. That's like a grain of sand in front of a low-energy light bulb. But all the same: this celestial phenomenon has captivated people for more than four centuries.

That was certainly the case with the French astronomer Guillaume Le Gentil. I'm looking forward to a Hollywood biopic being made about him, with Johnny Depp in the leading role. Perhaps you know the story. Le Gentil wanted to observe the Transit of Venus in 1761 from the French colony of Pondicherry, on the east coast of India. But when he arrived, Pondicherry had been captured by the British. To his great frustration, he had to observe the Transit from his ship, which was rolling about so much that

he was unable to take any measurements. Le Gentil decided to wait for the next Transit of Venus, eight years later in 1769. The great day arrived, after a month of fine cloudless weather, but just at the *moment suprême* clouds suddenly appeared and hid Venus and the Sun. Two hours later, the wind cleared away the clouds and the sky was cloudless again for another month.

It was all too much for Le Gentil. He lost his mind and fled into the jungle. Only years later did he make it back to France, after an epic journey. On the way, he lost all his books, all his scientific material, and almost his life. Not that that made much difference because he had already been officially declared dead, his wife had remarried, his estate was in the hands of his heirs, and his place in the *Académie* had been awarded to someone else.

What do we learn from this tragic succession of misfortunes? First of all, next time one of your measurements goes wrong, a colleague fails to cite your work correctly, or there isn't enough leg room in economy class on the way to a conference, don't forget what happened to Le Gentil. But you should also remember what caused him to lose almost everything in his search for a tiny black dot in front of the Sun. That urge to know, that struggle with the unknown, that unquenchable thirst for knowledge, that curiosity that sometimes literally leads to madness – that is what I want us to consider today. And because of that theme, today's annual address is somewhat more personal than you are used to.

SEARCHING FOR...WHAT, ACTUALLY?

Perhaps we can derive some valuable advice for every scientist or scholar from what a colleague was told when he had heard that he had been offered an excellent job at an institute where he would be free to work just as he wished: 'Now you will have to lead a life without excuses.' Those words are in any case appropriate to Le Gentil. There are indeed no excuses for a researcher not to explore the vast empty map of the unknown, and perhaps to battle with agoraphobia and uncertainty.

The shortest route from A to B is of course a straight line, but what do you do if you don't know where B is located or what it looks like? Experience shows that the most successful route often begins with a short step to the side. A frequent metaphor for research is that of a trek through a rugged mountain landscape. But that metaphor omits the dimension of time. The research landscape is not a static one. It is constantly changing, as if geological time had speeded up. Promising traverses become impassable, vistas appear, new biotopes are created.

In recent years I have been privileged to be able to talk to many young researchers about their dreams and frustrations. My advice to them was always to keep an open mind. Give chance a chance. Colour in outside the lines. Surprise yourself. Think big. But above all, don't take the advice of your seniors too seriously, and follow your heart. You are the only one who can discover your niche in the world of science or scholarship. The human spirit is a finely tuned musical instrument that only resonates to certain sounds. Go in search of your own vibration.

The Nobel Prize-winner Frank Wilczek was a 21-year-old student when he discovered how quarks are held together in a nuclear particle. When he was recently asked to sum up his philosophy of life in three words, his apt reply was 'Think, Play, Repeat.' It is indeed an endless cycle of imagination and concentration, of divergence and convergence, of playing and thinking, that determines the rhythm of science and scholarship.

VALUES OF SCIENCE AND SCHOLARSHIP

It is not exaggerated to say that we would like to see the fundamental values of science and scholarship reflected more broadly within society. The symbolic and inspiring role of science and scholarship could then perhaps become as important as their physical, applied role. Or rather, the two go hand-in-hand. Everyone would benefit from having a critical spirit and the application of organised scepticism that allows the facts to speak rather than just opinions. An open, universal culture within which everyone – regardless of age or origin – can contribute and in which ideas and results are shared openly encourages more than merely high-quality research. That also applies to the ability to adopt different points of view. Beauty is in the eye of the beholder, including in science and scholarship. There are so many different questions in which you can immerse and lose yourself. The many facets of science and scholarship reflect the richness of the surrounding world.

Because science and scholarship can mean so much to so many people, they are in their essence a public matter. But how do we make that public character visible? Like artists, researchers largely live a hidden life. Like whales, they dive down to the depths for lengthy periods to feed on the gloomy bed of the ocean, only now and again coming up for air. And when they do come up and they're unlucky, they risk getting shot at by critical journalists or politicians.

THE PUBLIC GOOD

How can we researchers get in touch with the society that makes possible our dedication to research, both financially and in other ways? I am truly convinced that the most significant contact takes place when we dare to reveal the vulnerable interior of science and scholarship, the interior where one can find the doubts, the big questions, the adventure, the excitement, and the disappointment. Researchers are just like people!

It was my pleasure recently to give a television lecture on the Big Bang. And the greatest pleasure was to watch the film clip that a viewer sent me of his two four-year-old boys, whose jaws dropped when they heard how many stars there are in the Milky Way, and who exclaimed together 'A hundred billion?!' But as a matter of fact, it's bizarre – after centuries of research, after the greatest possible intellectual and physical efforts from Galileo to Le Gentil, from Einstein to ESO, from burnings at the stake to the Big Bang, after we have reconstructed the history and size of our cosmos – that that 13.7 billion-year narrative may then – very exceptionally – take up forty-five minutes of our valuable time.

There is a wonderful cartoon by Sidney Harris in which one of the two scenes shows a caveman gazing up at the stars and wondering "Where did it all come from?" The other scene shows an astronomer with a big telescope and piles of calculations, who is also sighing 'Where did it all come from?' Are we living in a period of progress or stasis? Or even reversal? Because that cartoon also shows how we have farmed out our natural wonderment to a handful of experts. Our ancestors must often have looked up at the starry sky and asked themselves profound questions about existence. When does mod-

ern man still do that? If he can even see the stars at all. Remember the stories about the big power cut in 2003, when children in New York were able to see the stars for the first and perhaps only time in their life? Can the planet Venus still seduce us and make us crazy as it did Le Gentil?

I am convinced that a love for research can be shared with people outside that small circle of experts. Interest among the wider public is desperately necessary if future generations are to be inspired and motivated. Science and scholarship have always benefited from emancipation and democratisation. It is hard to imagine nowadays that only one hundred years ago secondary education was the preserve of fewer than five percent of the Dutch population. Only 1 in 300 young people went to university. I am very much aware that if I had been born a century earlier – which is just the blink of an eye in cosmic terms – I would probably not be addressing you today. The same applies to many of my colleagues here in the hall.

The number of people who have completed higher education is now approaching fifty percent. That figure sometimes causes a frown. Aren't we all being too highly educated? That seems to me to be a misconception. It is quite conceivable that in the future, according to current definitions, one hundred percent of the population will be made up of people with higher education. From the perspective of the Cananefates, our ancestors here in the Roman era, every inhabitant of the Netherlands in 2012 is certainly a genius.

New technology offers excellent opportunities for reaching even more people. I once attempted to introduce 'Dijkgraaf's Law' in the field of scientific communication. The formula states: effective knowledge transfer K is the product of the quantity of information I that is put across and the size of the public P who take in that information. A one-minute spot in the main evening news on TV is thus comparable with a complete lecture for a small, specialised audience.

'Dijkgraaf's Law' never made it, which is particularly disappointing when you consider some of the laws that have indeed done so. To take one example: in a new edition of the cookbook compiled by the Household School in Amsterdam that was published to mark that institution's hundredth anniversary, I discovered the principle – attributed to me – that preparing a meal should take no longer than eating it. A sympathetic reader could take that as a plea for lengthy and enjoyable dining, but a narrower interpretation of that 'law' would basically appear to exclude casseroles and Indonesian banquets. Is 'fast food' all we want? Where science and scholarship are concerned, that is pretty much the very last thing we want! The dishes that are prepared in our laboratories and studies in fact demand extremely lengthy preparation. And you can taste that too when they are served up!

THE USEFULNESS OF USELESS RESEARCH

My two favourite definitions of technology are 'anything invented after you were born' and 'anything that doesn't work'. But a better description of technology is 'the greatest natural and cultural power shaping society'. It operates stealthily, but no less drastically. And it is extremely difficult to predict.

In 1939, 44 million people visited the New York World's Fair. The theme was 'The World of Tomorrow'. At the time, there were two discoveries that would affect the near future more than any other but they could not be seen at the World's Fair. They were nuclear energy and the computer, and the basis for both those revolutions was laid about the same time, close to the World's Fair site. Let me tell you something about that.

The year 1921 saw the appearance of the essay *The Usefulness of Useless Knowledge* by the influential American education expert Abraham Flexner. The essay was a passionate defence of the value of the freely ranging, creative spirit and a sharp denunciation of American universities at the time, which Flexner considered to have become large-scale education factories that placed too much emphasis on the practical side of knowledge. Columbia University, for example, had a course on how to open a shoe shop. Flexner was convinced that the less researchers needed to concern themselves with direct applications, the more they could ultimately contribute to the good of society.

A few years later, he was given the opportunity to put his ideas into practice. He was approached by two philanthropists who had sold their department store only a few weeks before the Wall Street crash. They asked him to set up a research institute based on his ideas. In 1930, Flexner became the first director of the Institute for Advanced Study in Princeton.

The unforeseen applications came faster than expected. One of the first people who Flexner appointed was Albert Einstein, who in 1939 sent a crucial letter to President Roosevelt urging him to promote the atomic bomb project. The second appointment was that of the Hungarian mathematician John von Neumann, perhaps an even greater genius than Einstein, of almost extra-terrestrial brilliance. Von Neumann was one of the 'Martians', an influential group of Hungarian mathematicians and physicists that also included Edward Teller and Eugene Wigner. The story went that hyper-intelligent extra-terrestrial beings had infiltrated Earth and that their English accent was so bad that they had to pretend to be Hungarians.

Although Von Neumann's reputation was established through his work on the logic and mathematical foundations of quantum theory, he also focused on everything to which it was possible to apply mathematics. For example, he developed economic game theory and took the first steps in research on artificial life. Von Neumann was also fascinated by Alan Turing's abstract idea about the universal electronic calculating machine. The American atomic programme required large-scale numeric modelling. At the end of the 1940s, under Von Neumann's supervision, the first fully programmable computer was constructed in the basement of the Institute for Advanced Study. Without really meaning to do so, by setting up his academic paradise Flexner had given the starting signal for both the nuclear and digital revolutions.

And the society that Flexner had wanted to exclude found its way in through the basement window anyway. The entire ideological spectrum was represented in three rooms on a single corridor. Einstein became the figurehead of the peace movement and of disarmament. Oppenheimer was the father of the atomic bomb but his opposition to the hydrogen bomb meant that he became terribly stuck in the machinery of the Cold War. In the meantime, Von Neumann continued to make successful calculations for that same hydrogen bomb, convinced that an offensive war was the sole option.

The period when nuclear weapons and computers became entangled cast its shadow far ahead, as appears from recent newspaper reports on how the United States and Israel have been attempting to thwart the possible nuclear ambitions of Iran by means of advanced computer viruses.

Von Neumann's ideas extended even further, by the way. In the evening, when the engineers had gone home, he used the computer to produce the first weather fore-

casts. How clearly he saw things is shown by his visionary statement – way back in 1950 – that the climate problem would ultimately be more of a threat to countries’ interests than nuclear weapons. Today – with Iran, North Korea and Fukushima, and with flooding, drought, and melting ice caps – the social responsibility of scientists and scholars – in the words of the United Nations, ‘to manage the unavoidable and avoid the unmanageable’ – continues to be crucial.

The history of modern humanity is to a significant extent coloured by science. Many scientists therefore fail to understand why the importance of their work is only recognised to such a limited extent if at all. Nostalgia for better times is understandable. Who would not want to be that philosophy professor in nineteenth-century Heidelberg who had just received a fine offer from Berlin. Roadmenders were digging up the street outside his house and he was unable to concentrate, so he opened the window and told them ‘If you don’t stop, I’ll move to Berlin.’ The foreman talked to the mayor, who contacted the city architect, and the work was postponed until the university vacation.

But scientists and scholars shouldn’t complain about their crumbling status. The time-honoured Dutch adage that authority needs to be earned fits in perfectly with the dynamic image of science and scholarship that develop and renew themselves continuously, and within which new generations are given every opportunity.

THE STATE OF SCIENCE AND SCHOLARSHIP

In this address, I cannot ignore the question that has been put to me most frequently in the past two years, a question that might be put by a doctor paying a house call: ‘How is the patient doing?’ – with the patient being Dutch science and scholarship. Let me recount one of my favourite anecdotes.

When Leonid Brezhnev was asked to sum up the situation of the Soviet Union in just a single word, his answer was ‘Good’. When he was then asked what he would say if he could use two words, the answer was “Not good”.

In just a single word, the situation of Dutch science and scholarship is ‘Good’. There is a great deal of quality, and great achievements in recent years. In that connection, I would like to congratulate the four most recent Spinoza Prize-winners. The Netherlands is a leader in science and scholarship, one respected throughout the world. We score high in many rankings.

But in two words, the situation is also ‘Not good’. We have not yet succeeded in converting that excellent performance into sufficient public and political support and thus into actual, financial support. If we fail to reverse that trend, we will have only a bleak future to offer coming generations. It is precisely among young researchers that there is existential angst; they wonder ‘Is there in fact a place for me?’

I will not attempt to hide the fact that it is with mixed feelings that I position the balance of my presidency in the long series of reports by my predecessors, all of them

showing zero growth in the science budget. I sincerely hope that my successor will succeed in reversing this stubborn trend. I am very well aware, of course, that the period from 2008 to 2012 was not the most favourable from the economic point of view. It is a sign of globalisation that mortgages in Florida and tax evasion in Athens have been of greater significance for Dutch science policy than all the academic discussion here at home.

Looking back is always easier than looking ahead. It is painful to note that the nearby countries that we have so often held up as examples because of their inspiring scientific and innovation policy in recent years – countries like Sweden, Denmark, Finland, and in particular Germany – have not only, as expected, come through the 2008 financial crisis stronger but have also been able to distinguish themselves positively in the current euro crisis. I would like to say to the ladies and gentlemen in the world of politics: just how much proof do you still need?

The past few years have been characterised by a difficult discussion of innovation policy and the key economic sectors, a discussion muddled by a kind of magical thinking whereby the gap opened up by the loss of the proceeds from natural gas can supposedly be filled in by cannibalising on fundamental scientific research. One might here consider the warning to be found in the Russian fable of the wild boar and the oak tree. The boar dug away deeper and deeper under the roots of the ancient tree in search of acorns, not realising that he was literally undermining the long-term source of those delicacies.

How appropriate it is that Europe – specifically Europe! – gave us such a clear signal only last week. Let me quote a not very literary but definitely clear passage from the recommendations by the European Commission: “Finally, neglecting basic research in favour of applied research may well harm the long-term growth prospects of the economy. In this respect, the channelling of a substantial share of the funding of fundamental research by the Netherlands Organisation for Scientific Research (NWO) to applied uses under the top sector approach is a cause for concern.” – end of quote!

As far as I am concerned, that critical European comment is both welcome and justified. The Netherlands cannot be seen as anything other than first of all an important knowledge hub within Europe. Science is highlighted far too little as an area in which Europe does in fact work. Over the past twenty years, our continent’s competitiveness has increased enormously. The world is jealous of the fairs organised by the European Research Council. The Brussels fragmentation and inertia that we like to complain about also has a positive side. Complex partnerships can tone down the political fluctuations of individual Member States, thus promoting stability. It was only in that way that it was possible to find the 25 years and many billions of euros needed to design and construct the Large Hadron Collider at CERN – a particle accelerator that needs to keep going for another 25 years. Compare that success with the fate of the

American Superconducting Super Collider that was planned in the early 1990s. Many factors contributed to the demise of that project, but it is clear that the location in Waxahachie, Texas, was more attractive for the initiator – President Bush senior – than for President Clinton, who pulled the plug on the project. One newspaper headline referred to the three-kilometre tunnel that had already been excavated as ‘the world’s largest wine cooler’. Let’s not forget that after the Second World War it was in fact the Americans who more or less forced Europe to collaborate on its own particle accelerator.

Europe also collaborates extremely well in other research fields, including outside the natural sciences. Our own Netherlands Institute for War Documentation (NIOD) is engaged in a large-scale project that attempts to reconstruct the individual histories of the holocaust by linking together the various European archives. That is a bitter reminder of the period when Europe was cruelly united and of the fact that we also share the darker chapters in our past.

Besides a pragmatic reason, there is also a somewhat more fundamental reason why Europe needs to embrace science to a greater extent. The birth of modern science in the early seventeenth century was essentially a European matter, following on directly from the humanist tradition of a century previously. Books, ideas, discoveries, and experiments had been freely exchanged for centuries, long before the European research area was formalised by bureaucrats in Brussels. As the country of Erasmus, Huygens and De Groot, the Netherlands in particular should embrace the view of Europe as an ancient ‘knowledge continent’.

THE ACADEMY

What is the role of the Royal Netherlands Academy of Arts and Sciences in all this? The first thing that needs to be said is that the Academy has a lot of nerve. It refers to itself as the forum, conscience, and voice of the arts and sciences. That means a theatre, a court of law, and a church combined! In a period when the performing arts, the law, and religious belief are not doing very well, that would seem at best ambitious and at worst asking for trouble. Can we therefore expect a triple punitive cut for the Academy? Isn't the Academy – which, in the best Dutch tradition, has always been against any official uniform for its members – getting too big for its pants?

My experience over the past four years, however, is that that central role for the Academy is an appropriate and desirable one, and is also valued as long as the Academy – and with it science and scholarship – remains true to itself. Disseminating the fascination for education and research, advising on science policy, demanding integrity – all of these can be approached in the same spirit of study, with the same attitude of experimentation, reflection, criticism, and openness that we consider to be the core values of science. Clausewitz said that war was the continuation of *Politik* by other means; similarly, for the Academy policy and communication must be the continuation of *research* by other means.

The Academy is extremely suited to propagating the essence of science and scholarship, and able to do so. That is emphasised by the many new initiatives that it has undertaken in the past decade. I would like to commend my two immediate predecessors, Pim Levelt and Frits van Oostrom, for the vision they showed in opening wide the doors and windows of the Academy – it was a privilege to continue along the same

lines . We have welcomed the winners of the Education Prize and rightly celebrated them; teachers inspired by an evening about neutrinos; a group of eight-year-olds who came to do experiments; the presidents of foreign academies who visited to discuss the problem of climate change – the Trippenhuis Building has repeatedly been able to appeal to a different public.

The same applies to the Academy's various institutes. The Academy is proud of their achievements, which place them at the top in the Netherlands and in some cases among the leaders internationally also. A splendid challenge also awaits the Academy in the years ahead to promote and strengthen the humanities, and to equip them with a digital backbone using modern technology.

A PERSONAL WORD OF THANKS

It has been an exceptional honour for me in the past four years to have been able to help put a face to science and scholarship in the Netherlands from this unique position where so much comes one's way. I sometimes compare it with being an air traffic controller in the control tower at Schiphol Airport, but without any radio communication with the planes. I found that a lot is going on in the world of science and scholarship in this country. I was also surprised by the cordiality and encouragement that greeted my move to Princeton and the pleasure you have in seeing me leave. Fortunately, nobody drew a parallel with that Italian cruise ship captain by shouting 'Dijkgraaf, get back on board!' But then the ship of the Academy has definitely not capsized.

I am aware of my own experimental nature. Perhaps some of you feel that I have coloured in outside the lines a bit too much. Please understand that my intentions were always good and that I was acting in the spirit of science and scholarship. I feel part of a highly privileged community and, where the past few years are concerned, a comment is highly appropriate that was made 25 years ago by a rather grumpy elderly professor and directed at our rebellious group of young string theorists: 'I haven't the faintest idea what you're up to, and I don't think it will lead anywhere, but I must admit that you seem to be having a lot of fun with it.'

Finally, I would like to say a heartfelt thank-you to a number of individuals. First of all, to the other members of the Academy Board during the first and second terms for their warm friendship and commitment. What a privilege to be able to share one's enthusiasm and concerns with such talented researchers! Then there are my fellow scientists in and around the Academy, who I would like to thank for the confidence they

had in me, for their advice – invited and uninvited – and for their unceasing efforts to promote the good cause. I would like to thank the directors of the various Academy institutes for the way they and their staff are advancing the banner of science and scholarship. My thanks go also to the Board of Management and the Staff Department for all their hard work and for their enormous, loyal support. I would like to thank Godelieve and Corina for the miraculous way they have managed to keep the Dijkgraaf travelling circus on the road. I feel privileged to have my beloved family here today, with whom I have been able to share so much and with whom I hope to continue to share things. My thanks go out to all of you for the way in which you serve science and scholarship or the way in which you endorse and support their interests.

It was a great privilege to be just a little dot briefly moving across the enormous Sun of the Academy and of Dutch science and scholarship. And if that silhouette has been visible, then it makes me think of a well-known academic saying: 'If dwarves cast long shadows, then it must be late in the day.'

THE NEW PRESIDENT

There is one other person whom I would like to address. It's high time to cast the spotlight on my successor, Hans Clevers.

Hans, we have had a lot of opportunities in recent months to say nice things about one other in the media. It's now high time to be more direct in the presence of all these people here today. Dutch science and scholarship in general, and the Academy in particular, can be extremely pleased to have managed to get you to put your shoulder to its wheel. You are a true world star – an impressive researcher and an exceptionally clear communicator. You're also a great colleague who always remains true to himself.

In all the various interviews, you have made clear what you will attempt to do over the course of the next four years: ensure scope for 'basic scientific research', as you call it, a solid position for science in political circles in The Hague, and a more prominent presence for scientific knowledge in the policy that those circles produce. Allow me to wish you every possible success in achieving those objectives, not forgetting that the maelstrom that political events will drag you into will create both opportunities and threats.

I am proud to be able to hand over the chairman's hammer to you.

