The mind
OF THE SCIENTIST

TOM FRANTZEN

With this sculpture I have tried to express the creative energy of scientists. The whole development emerges from a human head, half of which is represented anatomically. I allude to a strong contrast between the tight static form of the head and the open side of the mind where everything is in constant movement, symbolizing the constant evolution of science.

At the top, two people push a question mark out of the brain. One of them leans on the DNA ladder. A symbol triangle that represents mathematics appears from the top of the skull. The triangle is positioned in such a way that it can be interpreted as a small hat, giving a playful touch to an otherwise serious subject. From the centre of the brain a space telescope (Hubble) is focused on the infinite. Underneath a microscope makes the inverse movement, focused on the infinitesimal. Still lower, a computer and a book symbolize the various sciences, the arts and the humanities. Both the syringe (medicine) and the compass make an upward move like +x, thus making sure that the fetus (biology) floats. At the top edge of the dark hollow skull space, an atom (physics) moves just underneath a planet. The darkness in the background creates a sense of mystery. This reminds us of the dark infinity of the cosmos, where so much still remains to be discovered.
Dear reader,

Over the years, scientific prizes have become a significant source of funding for the Research Foundation Flanders. For the researchers involved, the prizes are a recognition of their efforts and the research they carry out. Every year, the Research Foundation Flanders awards a number of scientific prizes, often in collaboration with businesses. This is living proof of the symbiosis that exists between the research world and the business world. Over the years, a large number of scientific prizes have developed into a veritable quality label within their discipline, and guarantee widespread recognition and prestige.

The Excellence Prizes, which the Research Foundation Flanders awards every five years, are undoubtedly the most important of these. Each worth 100,000 euros, these prizes are given in recognition of the scientific career of eminent Flemish researchers.

The Research Foundation Flanders began this tradition in 1960, and during the past 55 years it has allowed us to honour an impressive selection of excellent researchers. This time around, the Research Foundation Flanders once again called on three independent juries made up of leading international scientists, responsible for evaluating the candidates. As one would expect, the selection procedure is invariably a very difficult task: Flanders has plenty of scientists who excel in their field, both nationally and internationally. But ultimately, only one candidate per discipline can win the prize.

So, as freshly appointed Secretary General of the Research Foundation Flanders, I am proud to present to you in this publication the laureates of the FWO Excellence Prizes 2015. All five are top scientists in their field with superb CVs. I would like to sincerely congratulate them on receiving this recognition, and hope that they will continue to contribute for many more years to ground-breaking research, which is the first link in the innovation chain and essential to all further research.

I am convinced that they will be a source of inspiration to many young scientists and will motivate them to persevere and keep progressing along the sometimes arduous path of scientific research.
The legacy of
DR. ALPHONSE DE LEEUW

Dr. Alphonse De Leeuw, curator of the clinical collections of the Faculty of Medicine and Pharmacy of the Université Libre de Bruxelles, died on August 24, 1953. On October 16 of that year, the Board of Directors of the NFWO accepted his legacy worth four million Belgian francs. His will determined that this legacy should be used to create a prize of 750,000 Belgian francs to be awarded once every five years. The prize, apart from his name, also bears the names of his wife Marie Damry and her former husband Leon Charles Bourlart, a cousin of Dr. De Leeuw.

The prize was awarded for the first time in 1960 and the winner was chosen from a list of winners of state-awarded five-year and ten-year scientific prizes (literature, mathematics, medical sciences, ...) and winners of the Francqui prize. Three juries, with ten prominent scientists drawn from the natural sciences and medicine, mathematics, physics and chemistry, and the humanities, were responsible for the selection of candidates.

Each jury nominated one candidate. From this shortlist the Board chose the final winner. For example, the first Dr. Damry-Bourlart Prize was awarded to Prof. Albert Dalcq, permanent secretary of the “Académie Royale de Médecine de Belgique”. The prize was presented on Friday, the 27th of May, 1960.
From one prize
TO THREE

For the presentation of the second Dr. Damry-Bourlart prize, a call for prominent researchers was launched. Unlike the first prize, fellow researchers nominated the candidates. The procedure has remained unchanged to the present day. For the 1965 edition no less than 13 applications were submitted in both the Humanities and in the Physical and Natural Sciences. Once again, it was up to the Board to choose a single winner, which proved to be a particularly difficult task. Therefore, they called upon the assistance of the Francqui Fund, which had successfully awarded the Francqui Prize every year since 1933, and had developed a lot of expertise on this matter. The Francqui Fund suggested the creation of two additional prizes. The following categories were therefore created:

- A prize for the Natural and Medical Sciences
- A prize for the Mathematical, Physical and Chemical Sciences
- A prize for the Humanities

To be able to award these three prizes, an additional sum of 1,500,000 Belgian francs was needed. At the request of the National Fund for Scientific Research (NFWO), the Board of Directors of the Francqui Fund decided on 22 January 1965 to invest this amount in the creation of two new scientific awards: the Baron Holvoet Scientific Prize and the Ernest-John Solvay Scientific Prize. With this donation, the Francqui Fund simultaneously paid tribute to two former Presidents of the NFWO, who also were leading figures in building the necessary funding channels for fundamental scientific research in Belgium.
On the 6th of June 1971, Joseph Maisin, professor at KU Leuven, died in a car accident. In memory of this great scholar, the Board of Directors of the NFWO on 19th November of that year decided to create the Joseph Maisin Scientific Prize. At the request of the family and friends of Professor Maisin, this prize will be awarded to scientists in the Natural and Medical Sciences. The Maisin family and the cancer institute of the KU Leuven jointly took the initiative to establish a steering committee to ensure the necessary fundraising. The Joseph Maisin Scientific Prize will be awarded, according to the wishes of the Maisin family, by the Fund for Scientific Medical Research (FGWO).

Further support from the Francqui Fund was no longer necessary thanks to this patronage and thus the Baron Holvoet Scientific Prize ceased to exist. The Ernest-John Solvay Scientific Prize was continued due to a donation from the Solvay family. This led in 1975 to the following arrangement:

- Joseph Maisin Scientific Prize for Natural and Medical Sciences
- Dr. Damry-Bourlart Scientific Prize for Mathematical, Physical and Chemical Sciences
- Ernest-John Solvay Scientific Prize for the Humanities
For the period 1971-1975, the prizes were awarded in duplicate. Each prize had a Dutch and a French winner. This duplication was motivated by the great scientific potential in Belgium and it avoided some difficult community problems that threatened to overshadow the Prizes.

On June 23, 1975, the then Belgian Parliament passed the amendment by which prizes and grants awarded to scholars would be exempted from income tax. As a result, the five-yearly prizes of the NFWO acquired their final structure in 1975.

This system of six academic prizes, for three Dutch- and three French-speaking researchers, continued to be implemented until the end of the century. The sums involved were the only item to be changed. In 1980, each prize was increased to 1,250,000 Belgian francs and in 1985 to 2,000,000 Belgian francs. By 1995 this figure had already risen to 3 million Belgian francs. In 1995, Christine Van Broeckhoven (Antwerp University) was the first woman to win a five-yearly NFWO prize.
Fame of the five-yearly NFWO prizes increased and more candidates were being nominated each year. For the period 1996-2000, there were no less than 33 nominees. Due to the large number of candidates, the decision to split the Dr. Damry-Bourlart Scientific Prize and Joseph Maisin Scientific Prize was made during the meeting of the Federal Agency and the Federal Council of December 5th, 1999. This gave rise to two sets of five prizes (one set for each language group), each worth 3,000,000 Belgian francs:

- The Dr. Damry-Bourlart Scientific Prize Physical Sciences
- The Dr. Damry-Bourlart Scientific Prize Applied Sciences
- The Joseph Maisin Scientific Prize Biomedical Sciences
- The Joseph Maisin Scientific Prize Clinical Biomedical Sciences, and
- The Ernest-John Solvay Scientific Prize Language, Cultural, Social and Behavioural Sciences

The new Research Foundation - Flanders continued this tradition and for the period 2001-2005, the fund decided to increase the amount of each prize to € 100,000.
In 2010, the prizes were renamed Excellence Prizes. Previously, the prizes went by the unofficial and somewhat restrictive name of ‘Five-yearly Prizes’. By choosing this new name, the Research Foundation - Flanders focuses more on the researcher’s scientific excellence.
Laureates Excellence Prizes 1960-2010

The Dr. A. De Leeuw-Damry-Bourlart EXCELLENCE PRIZE

LAUREATES

1960
Prof. Albert Dalcq († 29/10/1973)
Académie Royale de Médecine de Belgique

1965
Prof. Jean Dabin († 13/08/1972)
Université Catholique de Louvain

1970
Prof. Pieter De Somer († 17/06/1985)
KU Leuven

1975
Prof. Walter Fiers
UGent

1980
Prof. Severin Amelinckx († 22/02/2007)
UAntwerpen

1985
Prof. Jean Bourgain
VUB

1990
Prof. Marc Van Montagu
UGent

1995
Prof. Romain Coussement († 09/07/2012)
KU Leuven

LAUREATES FOR EXACT SCIENCES

2000
Prof. Arnold De Loof
KU Leuven

2005
Prof. Victor Moshchalkov
KU Leuven

2010
Prof. Dirk Inzé
UGent

LAUREATES FOR APPLIED SCIENCES

2000
Prof. Paul Van Houtte
KU Leuven

2005
Prof. Willy Verstraete
UGent

2010
Prof. Bart De Moor
KU Leuven
The Ernest-John Solvay EXCELLENCE PRIZE

1965
Prof. Ilya Prigogine († 28/05/2003)
Université Libre de Bruxelles

1970
Prof. Pol Swings († 28/10/1983)
Université de Liège

1975
Prof. Joseph Nuttin († 23/12/1988)
KU Leuven

1980
Prof. Herman Van der Wee
KU Leuven

1985
Prof. Leo Apostel († 10/08/1995)
VUB

1990
Prof. Raoul Van Caenegem
UGent

1995
Prof. Adrian Verhulst († 17/11/2002)
UGent

2000
Prof. Marc Waelkens
KU Leuven

2005
Prof. Ronny Lesthaeghe
VUB

2010
Prof. Sonja Snacken
VUB

The Dr. Joseph Maisin EXCELLENCE PRIZE

1975
Prof. Georges Peeters († 10/07/2014)
UGent

1980
Prof. Marc Verstraete
KU Leuven

1985
Prof. Herman van den Berghe
KU Leuven

1990
Prof. Alfons Billiau
KU Leuven

1995
Prof. Christine Van Broeckhoven
UAntwerpen

LAUREATES FOR FUNDAMENTAL BIOMEDICAL SCIENCES

2000
Prof. Erik De Clercq
KU Leuven

2005
Prof. Bart De Strooper
KU Leuven

2010
Prof. Peter Carmeliet
KU Leuven

LAUREATES FOR CLINICAL BIOMEDICAL SCIENCES

2000
Prof. Daniel Pipeleers
VUB

2005
Prof. Frans Van de Werf
KU Leuven

2010
Prof. Paul Rutgeerts
KU Leuven

Prior to 1975, the Baron Holvoet Scientific Prize for research in the Medical Sciences was also awarded twice, in 1965 to Prof. Albert Claude († 22 May 1983, Free University of Brussels), and in 1970 to Prof. Maurits Gysseling († 24 November 1997, Ghent University).
The Dr. De Leeuw-Damry-Bourlart EXCELLENCY PRIZE

This prestigious prize has been awarded since 1960 to outstanding researchers active in Flanders. The prize is named after an important sponsor of the FWO, dr. Adolphe De Leeuw (1880-1953), MD, University of Brussels, who donated 4 million BEF to set up a five-yearly prize (at that time equaling 750,000 BEF). The prize is also named after his wife, Marie Damry, and her first husband, Leon Charles Bourlart.
LAUREATE OF THE
DR DE LEEUW-DAMRY-BOURLART EXCELLENCE PRIZE 2015
IN EXACT SCIENCES

Prof.
GUSTAAF VAN TENDELOO
*17 MARCH 1950

CURRENT POSITION
Full Professor at the University of Antwerp

EXPERTISE/INTERESTS
Gustaaf Van Tendeloo researches the smallest of things—atoms—but never loses sight of the bigger picture: a sustainable economy. In his world-renowned EMAT lab at the University of Antwerp, he and his researchers use the world’s most powerful electron microscope to study how atoms interact, how they behave in various situations, and how to create new substances. This knowledge leads to better and more sustainable materials.

The fact that your car does not rust is because its body is protected by a thin layer of zinc. This came about after scientists studied the whole process of rusting at an atomic level. Many of these devices work on the basis of gold particles, because material scientists found that gold atoms are more loosely bound on the outside than on the inside and are therefore more easily able to bond with other substances, such as glucose. “We are the behavioural scientists of matter,” says Staf Van Tendeloo. “In the same way that you can come to conclusions about a community or a nation by studying individuals and their interactions, you can understand matter by looking at atomic bonds”.

Van Tendeloo’s lab—a productive team of mathematicians, physicists, chemists, engineers and biologists—has improved a long list of existing materials. This has led to better superconductors, materials that conduct electricity without any loss of energy. The researchers recently discovered why batteries discharge faster over time. The positions of the lithium atoms—which can charge and discharge—become increasingly occupied by metal atoms. Preventing that would enable batteries to last much longer. Van Tendeloo’s team is also working on carbon nanotubes—rolled up layers of graphene which look like chicken wire—. These would allow you to target the administration of medicines. “Chemotherapy destroys all rapidly dividing cells, but with carbon nanotubes you would be able to deliver the chemo specifically to the tumour”. You can encourage the nanotubes to release their medicine by focusing a laser beam on them or by locally adjusting the degree of acidity with an injection, for example. “We are testing that out in one of our European projects”.

Buying TIME

In spite of his lab’s success, Van Tendeloo is concerned about the future of basic research. “When we develop applications today, within no time at all they are making them cheaper in countries such as China. We must therefore continue to conduct innovative basic research. But there isn’t enough funding. Divide and conquer seems to be the rule: give everyone a little bit of money. This means, however, that a lot of genuinely innovative research will have little or no chance”.

Van Tendeloo uses the income from industrial contracts to help fund the basic research in his lab. “I want to give my researchers time to work on projects that might not produce results straightaway”, just as in his own early career, when he carried out research into symmetry and defects in materials.

Question: you are filling a cubic millimetre by stacking atoms at a rate of one million atoms a second. How long does it take you to fill your tiny cube? “A few million years,” beams Van Tendeloo. “That’s how small atoms are”. To be able to see these tiny building blocks of all matter, you need an electron microscope. Van Tendeloo’s group has the world’s most powerful model in-house. The Qu-Ant-Em microscope (there is now also a second type) is the size of a large shower cabinet and is located in a bunker to prevent vibrations. The microscope can zoom in on an atom, down to half an angstrom, a twentieth of a nanometre. Moreover, as Van Tendeloo’s team has demonstrated, you can see a group of atoms—a nanoparticle—in three dimensions.

“Our microscope zooms in to the atom and shows a nanoparticle in 3D.”

This makes EMAT (Electron Microscopy of Materials Sciences) the world’s leading centre of electron microscopy and materials science. “Research into improving materials is a hot topic. But thanks to the Qu-Ant-Em microscope and our expertise, foreign research groups are very keen to work with us”. The research centre was established in 1965, and in 1980 produced a former winner of the De Leeuw-Damry-Bourlart prize: Severin Amelinckx, who was a huge inspiration to Van Tendeloo. And the succession is already in place: talented young researchers are now taking up the torch.

**Qu-Ant-Em**

Question: you are filling a cubic millimetre by stacking atoms at a rate of one million atoms a second.
Artists
AS SPOKESPEOPLE

When you talk to Van Tendeloo, the conversation soon turns to art. In 2006 he published a book called The Beauty and the Beast about the common denominators between scientists and artists, such as a sense of wonder, keen observation, originality and the role of coincidence. Van Tendeloo sees media figures in general, and artists in particular, as ideal spokespeople for the sustainable economy that scientists and engineers are building. "Scientists are still much too isolated. They need to convince artists, filmmakers, authors and musicians about their ideas for a sustainable world. Public figures can change the consciousness of the general public. Look at what Bob Geldof’s Live Aid campaign achieved in 1985."

"Scientists are still much too isolated."

Conversely, materials scientists also serve art. "We are looking into how we can restore paintings while remaining true to the original work. Give us a tenth of a millimetre of Van Gogh’s yellow paint, and we can tell you what it is made of”. Science and art go hand in hand, even at the nanoscale.
LAUREATE OF THE DR DE LEEUW-DAM-RY-BOURLART EXCELLENCE PRIZE 2015 IN APPLIED SCIENCES

Prof.
LUC VAN GOOL
*18 APRIL 1959

CURRENT POSITIONS
Adjunct Professor at KU Leuven
- Full Professor at ETH Zurich

EXPERTISE/INTERESTS
Texture analysis, object recognition, 3D modelling, robot control and navigation, motion and emotion interpretation.
Two young researchers are writing codes for Toyota’s ‘Highway Teammate’, the Japanese car manufacturer’s driverless car. This will not work in the same way as Google’s better-known version. The roof of a Google Driverless Car features a rather obvious LIDAR, a kind of radar based on laser pulses. However, a self-driving Toyota mainly operates on the basis of small integrated cameras. No wonder, then, that this massive car manufacturer is knocking on Luc Van Gool’s door. The automatic interpretation of video images forms the core business of his research.

‘Car manufacturers such as Toyota are far more cautious than Google’, says Van Gool. ‘In the case of accidents involving driverless cars, the manufacturer will almost always be held responsible. And that means lots of claims for compensation. For this reason, I can’t really envisage driverless cars on the streets in the years ahead. Instead, driving will become increasingly computer-assisted. However, driverless cars are ultimately inevitable, I think.’

‘People aren’t quite ready for driverless cars.’

Self-driving and computer-assisted cars are safer than normal cars. ‘You can drive faster without things getting less safe’, says Van Gool. And because they communicate with the other cars, they can stay closer to the car in front. In turn, this will make roads less congested. They also drive more evenly and are therefore more efficient. ‘However, the general public will need to accept the technology. In an American survey about driverless cars, at least a third of the respondents were concerned about safety. And the main point is that only 6% would put their children into a self-driving car alone.’ Good communication will therefore be crucial in order to gain their confidence. ‘The press will hugely inflate any accident involving a driverless car. A robot which kills a person is especially hard to stomach.’

Computer VISION

The self-driving car brings together the three pillars of Van Gool’s research into computer vision: the automatic recognition of objects in photos or videos (object class detection), the automatic extraction of 3D information from video images (3D acquisition and modelling) and the tracking of objects through videos and the interpretation of gestures (tracking). Van Gool heads two computer vision research groups: 15 scientists at the University of Leuven and 25 at the ETH Zürich.

‘We have made 3D user-friendly’, says Van Gool when we ask what he considers his main contribution. ‘We have put 3D technology into lots of people’s hands. Take the very first 3D camera which we developed at the end of the 1990s, 15 years before Microsoft came up with the Kinect. It was a portable camera which captured the pattern of a projected grid and then distorted it to build a 3D model, just like the Kinect-1 did later. The technology has been used extensively in numerous Hollywood films, including James Bond and Lara Croft. It’s a shame that we didn’t get the funding at the time to further develop this early version of the Kinect. Although admittedly, the price tag would also have been huge. Microsoft ultimately jumped on the bandwagon by buying Kinect from the Israelis.’ The Kinect technology, with its powerful GPU processors, now has millions of users.

In order to move 3D out of the lab, among other things Van Gool has also developed a free web service (ARC3D) which automatically converts video images (also from smartphones) into 3D.

Hulp for archaeologists AND CONSERVATORS

Another striking device in the demonstration area of Van Gool’s lab is a small igloo known as the mini dome. If you place an object beneath it, a camera will capture 260 images from above, with the object constantly being illuminated from a different angle. Small LED lights each create a different shadow pattern on the object. These shadow patterns are then used to build a 3D representation of the object in extremely high resolution. ‘Conservators use this device to digitise their museum collections.’ Van Gool, who originally wanted to study archaeology himself, often works with archaeologists. ‘We make their field work easier. Take catacombs, for example, which they cannot easily access: we can reconstruct the entire site for them on the basis of camera images or a series of photos, captured using a mobile robot.’ Van Gool has already created several possible.
3D reconstructions of the city of Pompeii, based on the archaeological findings. ‘This also means I can play at being an archaeologist,’ he laughs.

Lack of VENTURE CAPITAL

Van Gool is proof that science produces jobs. He is the co-founder of no less than ten spin-offs, including Eyetronics (3D for the film industry), eSaturnus (digital imaging for the medical sector) and Parquery (mobile parking assistance). ‘Of the ten spin-offs, only one went under’, says Van Gool. ‘That actually means that we aren’t taking enough risks. In the States, most spin-offs have ceased operation after five years. However, it’s the craziest ideas which are often the biggest success and which bring about the biggest changes. In Europe, there’s a shortage of venture capital. European investors are too cautious: they only want to come on board once success is almost guaranteed. We don’t dare to fail. But look at Google: Andy Bechtolsheim, a renowned computer manufacturer, invested 100,000 dollars in Larry Page and Sergey Brin when they were still hammering out their search engine in a garage. When we set up kooaba we had a technological advantage over Snaptel, which was founded in the US a little later. However, they had ten times as much start-up capital as we did. This allows you to concentrate on the product and the sales, instead of the next venture capital round. One year later, Amazon bought Snaptel. The investors made a good deal.’

“’Pressure to publish? Researchers must be judged on their merits and their publications remain important indicators’”

No EMOTIONS

Objectivity and measurability are of paramount importance to Van Gool. ‘In the scientific sector, emotions often have negative consequences. In the discussion about the pressure to publish, I hope that the pendulum does not swing back towards greater subjectivity. If this happens, we will undoubtedly start seeing cronyism again in the evaluation of researchers. Researchers must be evaluated by independent colleagues and on their merits: which valuable publications can they present and have they been published in high-quality journals? If this is no longer allowed, it will open the floodgates.’ Fast publication is not always bad, he thinks. ‘Fast publication also helps to disseminate ideas. I see it with archaeologists: many die with full notebooks in their desks.’

Despite the frequent travel between Leuven and Zürich, coordinating all that research and supervising the spin-offs, Van Gool still feels more like a researcher than anything else. When did he know that he wanted to become a scientist? ‘When I was a teenager and I saw a robot on TV that took photos of objects on a table and then captured them. I found it really intriguing. The technology was brand new at that time. Looking back on it now, I can see that I’ve got pretty close,’ he laughs.
Composition
OF THE JURY

PROF. CLIVIA SOTOMAYOR TORRÉS
Catalan Institute of Nanoscience and Nanotechnology
Spain

PROF. FREDE BLAABJERG
Aalborg University
Denmark

PROF. FRANÇOIS FLEURET
Idiap Research Institute
France

PROF. SINE LARSEN
University of Copenhagen
Denmark

PROF. HELMUT LEEB
Vienna University of Technology
Austria

PROF. BENGT NORDÉN
Chalmers University of Technology
Sweden

PROF. KARL SIGMUND
University of Vienna
Austria
The Ernest-John Solvay EXCELLENCE PRIZE

This prestigious prize has been awarded since 1965 to outstanding researchers working in Flanders. The prize is named after Ernest-John Solvay (1895-1972), entrepreneur and President of the National Fund for Scientific Research (NFWO) from November 1955 to 1965. Ernest-John Solvay was a grandson of the famous Belgian industrialist and chemist Ernest Solvay (1838-1922), who founded the Solvay company in 1863 and became one of Belgium’s leading industrial entrepreneurs.

Solvay used some of his considerable wealth for philanthropic purposes, such as establishing the “Institut des Sciences Sociales” and the “Solvay Business School”. In 1911 he launched the world-famous Solvay conferences, a series of important physics conferences which brought together all the eminent physicists of the day, such as Albert Einstein, Max Planck, Marie Curie etc.

The Solvay family has continued to act as a patron for Belgian science, and made a significant contribution to the start-up capital for the NFWO (25 million Belgian Francs). Their contribution was the trigger for a national fundraising campaign that eventually led to the creation of the NFWO in 1928. In 1975 the Solvay family made a donation to enable the Ernest-John Solvay prize, which had previously been awarded every five years, to continue.
LAUREATE OF THE ERNEST-JOHN SOLVAY EXCELLENCE PRIZE 2015 IN HUMANITIES AND SOCIAL SCIENCES

Prof. MARC LEMAN

*30 NOVEMBER 1958

CURRENT POSITION
Full Professor at Ghent University

EXPERTISE/INTERESTS
Perception-based analysis of music, musical audio-mining, research on emotions and movements in response to music, neurosciences and music, forensic musicology.
One of Marc Leman’s graduate students comes running up with a bracelet that vibrates at the tempo entered by the researcher in a smartphone app. “A good start”, says Leman. “We just need to be able to transmit the tempo even more precisely”. He had received a call from a deaf woman who wanted to learn to tango and who had asked whether the IPEM—the Institute for Psychoacoustics and Electronic Music—could come up with something. The deaf woman’s request contained three central elements in the Institute’s research: music, the body and the brain.

Leman has developed a new conceptual framework in musicology: embodied music cognition. Questions that the scientists ask themselves include: how do people interact with music, both individually and as a group? When is this interaction meaningful and motivational? And what role do expression, physicality and patterns of expectations play in this? “Music entrances people and provokes an expressive response”, says Leman. “We study the physical and biological feedback to music and what effect it has on motivation and experience. We look, for example, at how a musical tempo influences your experience of walking or running”. He takes us to see his D-Jogger, an interactive treadmill which continuously measures your walking/running pace and then plays an equally fast song from a digital music library. The pace of the runner determines the tempo of the music, and not the other way around. Running to the beat has a motivating effect, which means you can jog for longer. The D-Jogger helps with rehabilitation, and tests have shown that patients with Parkinson’s disease shake less whilst walking on the treadmill.

“APPLICATIONS CONTINUALLY TEST OUR BASIC RESEARCH.”

The streaming music service Spotify and a dozen other musical databases have marketed a similar jogging function, but Leman will soon be releasing his own app, which he says works more precisely. “We are interested above all in the data that the app will give us, which will further underpin our theoretical research. That is the goal of the many applications we develop here: to test our basic research. This theoretical work gives us a stable core for all our applications”.

Moving away from SHEET MUSIC

In a room on the ground floor, researchers are now busy working on a bicycle apparatus based on the D-Jogger technology, and in a large test room we can see, among other things, the Music Paint Machine, with which you can create a digital painting on a screen by playing the trumpet. The intensity of the sound determines the thickness of the lines, while the drawing line moves up or down with the pitch. The application is ideal for music education. ‘Music education is still often too elitist’, says Leman. "With the Music Paint Machine you can learn to play an instrument more intuitively, more creatively and more physically, even if you can’t yet read music”.

In the 1990s, Leman’s research group—which today is a diverse and young team of musicologists, engineers, computer scientists and art historians—made the switch from musicology as an analysis of scores to the computer analysis of audio files, and later also to empirical research. “It was the time of Lernout and Hauspie. In fact, we almost worked with them”. Computer analyses of music are still used to interpret the brain activity of a listener. Today, the focus is entirely on the role of the body in experiencing and playing music. Leman has just finished a new monograph on this subject. ‘Many international groups are now working on this embodiment’, especially in the UK. I’ve put together a large foreign network, often by inviting researchers to my home for something to eat (laughs). In this way, you can forge bonds”.

Interdisciplinary

Collaborating across the boundaries of specialist fields with brain scientists, sports scientists and experts in rehabilitation, among others, comes quite naturally to Leman’s researchers. Together they have improved the software for cochlear implants, so that the hard of hearing can perceive music better and can fine-tune their implant themselves via a synthesiser. Or they help patients who have a slightly crooked gait after a stroke by playing musical samples that sound increasingly better the straighter the patients walk on a training area.

“THE FUTURE OF THE HUMANITIES IS INTERDISCIPLINARY.”

‘This interdisciplinary approach aroused prejudices for a long time, especially among my colleagues in the humanities’, said Leman. “But collaborating with researchers in the physical and social sciences is precisely the future model for the humanities. I hope this Excellence Prize can be an incentive for researchers and for the providers of funding”. Leman also wants to give a helping hand himself. “I’m going to use some of the prize money to support a number of crowdfunding projects that are an extension of our research”.

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Composition
OF THE JURY

Prof. MICHEL DENIS
CNRS-LIMSI
France

Prof. KIRSTEN DROTNER
Syddansk Universitet
Denmark

Prof. NICOLAI J. FOSS
Copenhagen Business School
Denmark

Prof. THOMAS Y. LEVIN
Princeton University
USA

Prof. KERSTIN LIDÉN
Stockholm University
Sweden

Prof. BRIGITTE RÖDER
University of Hamburg
Germany

Prof. SHEARER WEST
Oxford University
UK
The Joseph Maisin EXCELLENCE PRIZE

This prestigious prize has been awarded since 1975 to outstanding researchers active in Flanders. The prize is named after a great scientist and physician, Prof. Joseph Maisin (1893-1971), on demand of the Maisin family. Prof. Maisin was a renowned oncologist who made significant contributions to cancer research. He was professor at the KU Leuven (from 1924) and founded a Cancer Institute at that university in 1925.
LAUREATE OF THE JOSEPH MAISIN EXCELLENCE PRIZE 2015 IN FUNDAMENTAL BIOMEDICAL SCIENCES

Prof. PETER VANDENABEELE

*3 April 1961

CURRENT POSITION
Full Professor at Ghent University

EXPERTISE/INTERESTS
Inflammation and immunity, cancer, proteomics.
For a book to mark the twentieth anniversary of the Flanders Institute for Biotechnology, Peter Vandenabeele found himself in a photo studio. He was required to burst white balloons. The white balloons symbolised cells, while the balloon-bursting Vandenabeele represented the discovery of the mechanism in our body that causes cells to explode.

At the cellular level, the body is an ebb and flow of life and death. Every second, around one million cells die, and in the next second approximately the same number comes into being. In a healthy organism the two processes are in balance. In many diseases cell death is either excessive—as is the case with inflammatory and degenerative diseases—or insufficient—as is the case with tumour growth and resistance. The process of unravelling cell death at a molecular level is important in order to be able to attack these diseases.

“The process of cell death ensures the constant replacement of all the components making up the human body, making it look as if we are walking about in exactly the same body for the entire duration of our lives.”

“This research field only really got going in the last twenty years, because biologists, as the word itself suggests, study life, and for centuries they have considered death to be a failed experiment, an accident that forms no part of life itself”, says Peter Vandenabeele. “But at a cellular level, life and death are completely intertwined. The correct balance between cell death and cell growth is required for our organs to form, our limbs to grow to the right length and the networks in our brains to come into being. And when cells die, they don’t just go away; the substances they release stimulate repair activities, and the dead cells become the building blocks for the new ones”.

Suicide COMMANDS

When a cell is infected, damaged or old, in normal situations ‘suicide programs’ come into effect. In the early seventies, scientists discovered the cell death mechanism ‘apoptosis’: the cell transmits find-me and eat-me signals, forms bubbles and boils over like milk. Its nucleus and DNA then disintegrate, after which the alerted white blood cells (phagocytes) clean up the debris.

The pioneers of molecular biology saw this process at work in the transparent roundworm C. elegans. As it grows to maturity, the worm loses exactly 131 of its 1090 cells. Each of those cells dies at a particular place and at a perfectly predictable time in the life cycle. They believed that there must be a genetic mechanism behind this. The discovery of all the genes in the roundworm that trigger apoptosis and that recognise and clean up the dying cell led to Sydney Brenner, Bob Horvitz and John Sulston being awarded the Nobel Prize for Medicine in 2002.

Over the past twenty years, Peter Vandenabeele and his team have used cell cultures and genetically modified mice to unravel another form of programmed suicide in cells: necroptosis. In this form, the cell explodes and its contents are immediately released into the area around the cell, triggering an inflammatory response. Apoptosis is at work every second of every day, but we do not feel it, whereas we often experience necroptosis at first hand in the form of viral infections, problems of rejection after organ transplants, multiple sclerosis, heart attacks, severe liver damage or loss of auditory neurons.

Vandenabeele and colleagues in China, the USA, Europe and Australia have uncovered the entire molecular cascade caused by such an exploding cell, a complicated interplay of TNF (Tumour Necrosis Factor), RIP kinases (RIPK1 and RIPK3), caspases and MLKL proteins. The latter drill holes in the cell membrane, after which the cell fills up and bursts, like a water balloon that is too heavy. Recently, Vandenabeele’s lab started researching into yet another type of necrotic cell death, ferroptosis: cell death under the influence of iron. Ferroptosis occurs above all in stressed neurons.

Better CANCER THERAPY

Preventing cell death can limit damage, reduce inflammation or cure diseases. If you block necrotic cell death in a patient with blood poisoning (sepsis), their chances of survival will increase. Research in mice has shown that blocking necrotic cell death after heart attacks and strokes can lead to significant improvements. And the same tactic can also be used to extend the shelf life of organs
for transplant or to suppress rejection phenomena in kidney and heart transplants.

Stimulating or increasing the sensitivity of cell death may also have interesting applications. We know that cancer cells have developed a strategy for bypassing apoptosis, allowing them to proliferate. Counteracting that strategy would be a major step in the fight against cancer. But there are sometimes practical obstacles on the journey from basic research to clinical practice. “In animal studies, a combination of different anti-cancer drugs and substances that increase the sensitivity of cell death yielded promising results. This would mean that there would be less need for irradiation and that lower doses of chemotherapeutic agents would suffice. But many pharmaceutical companies don’t want to get involved at the moment, because they would have to share patents or licences with their competitors, and because the legislation is based primarily on the development of monotherapies. I consider that to be an ethical problem. Fortunately, the thinking in this area is slowly beginning to change. Compare it to the treatment of HIV: here too, only a cocktail of different active substances can overcome the virus”.

Vandenabeele and his team are looking for yet more ways of tackling tumours. For instance, they are studying how to use the necrotic cell death of cancer cells to stimulate the immune system itself to attack the cancer.

Basic lack of RECOGNITION

The transition from bench to bedside is not always easy, because cell death often occurs at the end, when the damage has already been done. But less than six years after Vandenabeele’s discovery of the role of the RIPK3 protein, which partly triggers necrotic cell death during acute inflammatory responses, clinical trials are now beginning. “If blocking necroptosis is going to save lives, I will be proud that my research group contributed to that. But I’m not a doctor: I will continue to be a researcher into basic mechanisms”.

Applications are important in Vandenabeele’s view, but he believes that there is still a lack of recognition, especially in the media, for the basic research process that precedes medical or other applications. Scientists today are not always given the time and financial resources to work on very basic science. Vandenabeele: “John Sulston himself said in his Nobel Prize speech that today he would not receive funding for the description of those dead cells in a tiny, insignificant roundworm”.

“In these utilitarian and transatlantic times, could we still get funding to study cell death in an insignificant little worm? The Research Foundation Flanders resolutely continues to support fundamental research.”

But this laboratory study of cell death has grown into an important branch of the life sciences. In the early nineties, a few hundred papers on cell death were published each year, while today the figure is no less than 25,000. Peter Vandenabeele has paved the way for a large number of these, and we are still only at the beginning. “Is that not the characteristic feature of any solid basic research: to open new doors, and in turn to be a new starting point?”
LAUREATE OF THE JOSEPH MAISIN EXCELLENCE PRIZE 2015 IN CLINICAL BIOMEDICAL SCIENCES

Prof.
GREET VAN DEN BERGHE
*14 FEBRUARY 1960

CURRENT POSITIONS
Adjunct Professor at KU Leuven

EXPERTISE/INTERESTS
Anaesthesiology, intensive care medicine, biostatistics, endocrinology.
The intensive care unit at Gasthuisberg University Hospital in Leuven receives more than three thousand patients every year, making it one of the largest in Europe. The difference between life and death is often a matter of minutes and as a doctor or member of nursing staff you need to be able to cope with this. ‘The frequent confrontation with death is stressful,’ says Greet Van den Berghe, who manages the intensive care unit and its staff of around 180 nurses and 30 doctors. Van den Berghe is also head of the intensive medicine research lab, with around 30 researchers. As tiring as it is, she believes this combination is necessary. ‘Patient care is the stimulus for my research. Interesting ideas are only generated when you take both practice and theory into account.’

“Managing intensive care and the lab produces some valuable ideas for research.”

Most patients in the intensive care ward only spend a short time there. In her research, Van den Berghe focuses on the critically ill patients who stay longer, around a third. They simply don’t get better, even when the factors causing the critical illness, such as trauma or serious infection, are under control. ‘All these patients’ bodies exhibit the same kind of chronic stress. The metabolism and endocrine system change in response to this stress.’ Van den Berghe is studying exactly what metabolic and hormonal changes these patients experience as well as which ‘stress reactions’ are useful and which are harmful.

Lowering blood-sugar level

Van den Berghe also often turns standard practice on its head. She disproved the long-standing theory that an elevated blood-sugar level is a useful reaction of the body during critical illness. Van den Berghe and her team showed through lab tests and with clinical studies that an excessively high blood-sugar level during critical illness in fact increases the risk of death. Keeping blood sugar at a normal level, using insulin, reduces organ failure, shortens the duration of the illness and reduces the number of deaths. ‘We must dare to question practice habits in care that are actually based on opinions rather than on the results of interventional studies,’ according to Van den Berghe.

“We have to dare to question ingrained customs in care.”

The study had a huge impact. ‘You could even say the response was too fast,’ she reflects. ‘All intensive care units around the world started to lower patients’ blood-sugar level. But applying the protocol that had been perfected here at Gasthuisberg - administering the right amount of insulin at the right time - proved more difficult than expected. A blood-sugar level that is too low also has negative effects. So some hospitals began to turn against the concept.’ But repeat research confirmed the original findings. Although there is still discussion on the most optimal and achievable blood-sugar level for centres with less experience, intensive care units around the world are avoiding excessively high blood sugar, with adjusted protocols.

To facilitate safer and more effective implementation of the concept, Van den Berghe worked with the research group of engineer Bart De Moor (University of Leuven and FWO Excellence prize laureate in 2010). Together they developed a system that automatically calculates the correct doses of insulin, completely customised to the patient. This kind of device worked well during the test phase according to nursing staff.

Fasting

Blood sugar is not the only dogma that Van den Berghe and her researchers put an end to. They saw that in the case of critical illness, the clean-up system for cell damage functioned poorly and that there was a connection between the quantity of nutrition the patient received. It was always believed that receiving nutrition early would promote recovery. So doctors and the industry strongly preferred to provide intravenous nutrition at an early stage. But according to Van den Berghe’s findings, the opposite seemed to be true. She showed that fasting - not administering intravenous nutrition during the first week of critical illness and accepting the shortage of food in the normal way - activated a mechanism in the body that protects the organs, prevents infections and encourages recovery. ‘In the US, the intensive care units immediately agreed, whilst here in Europe it took a little longer, partly due to pressure from producers of intravenous nutrition. But the use of intravenous nutrition has now also been significantly reduced here.’
So does she specifically look for controversial studies? ‘No, I just stumble across them. Intensive care is still a very recent discipline that only exists since the 1950s, with the emergence of ventilation equipment. There are still a lot of gaps in our knowledge on critical illness. Through scientific research we are trying to fill these gaps little by little, in order to improve the recovery of many patients.’

In a sense, patients are more complex than atoms or cells: there are many more parameters and variables at play in a body. How do you approach this complexity? ‘You have to see patterns in the chaos, remove the noise, introduce order and simplify things. Then it becomes manageable. Looking for patterns over a long period is even harder - the consequences of critical illness twenty years or so later.’

Today, Van den Berghe is working hard on these long-term studies. ‘Not always easy from a practical perspective,’ she says. ‘My researchers often have to visit former patients at home. It take a long time before you obtain exciting results.’

More INDEPENDENT

Most clinical studies, especially long-term studies, are very expensive and resources are scarce. Many researchers therefore choose financial support from the pharmaceutical and other industries. ‘Cooperation with the industry is good,’ says Van den Berghe. ‘A small part of some of my studies were also financed by the industry, but a contract always states that the sponsors will have no say on the design of the study, the analysis and the publication of the results.’ Van den Berghe does regret the fact that little research is carried out independently, however. She investigated this herself for the leading journal, the New England Journal of Medicine: this was the case for less than 10 percent of the submitted papers. ‘That’s too little.’

Van den Berghe also thinks that repeat research is important, particularly for clinical studies. ‘Before doctors roll out new findings in their practice - such as that study about nutrition - the proof of concept must be established and repeated. Other labs often enthusiastically attempt to undermine our findings. And that’s a good thing. I see no “replication crisis” in the clinical world.’

“I GIVE YOUNG RESEARCHERS THE FREEDOM TO PURSUE THEIR OWN IDEAS.”

Offer FREEDOM

Van den Berghe decided to study medicine when her younger brother underwent surgery for a heart defect as a child. ‘I am a “doer” and a “thinker”, so I first ended up in intensive medicine and then endocrinology. My trainers gave me the freedom to formulate and test my own hypotheses, even when they were high-risk. I was very fortunate to be offered this freedom. So I don’t want to control every aspect of my lab either. I encourage young researchers to pursue their own ideas too. But you have to be prepared to also tell them in good time that this will come to nothing. Then I guide them back to more familiar ground.’
Composition of the Jury

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