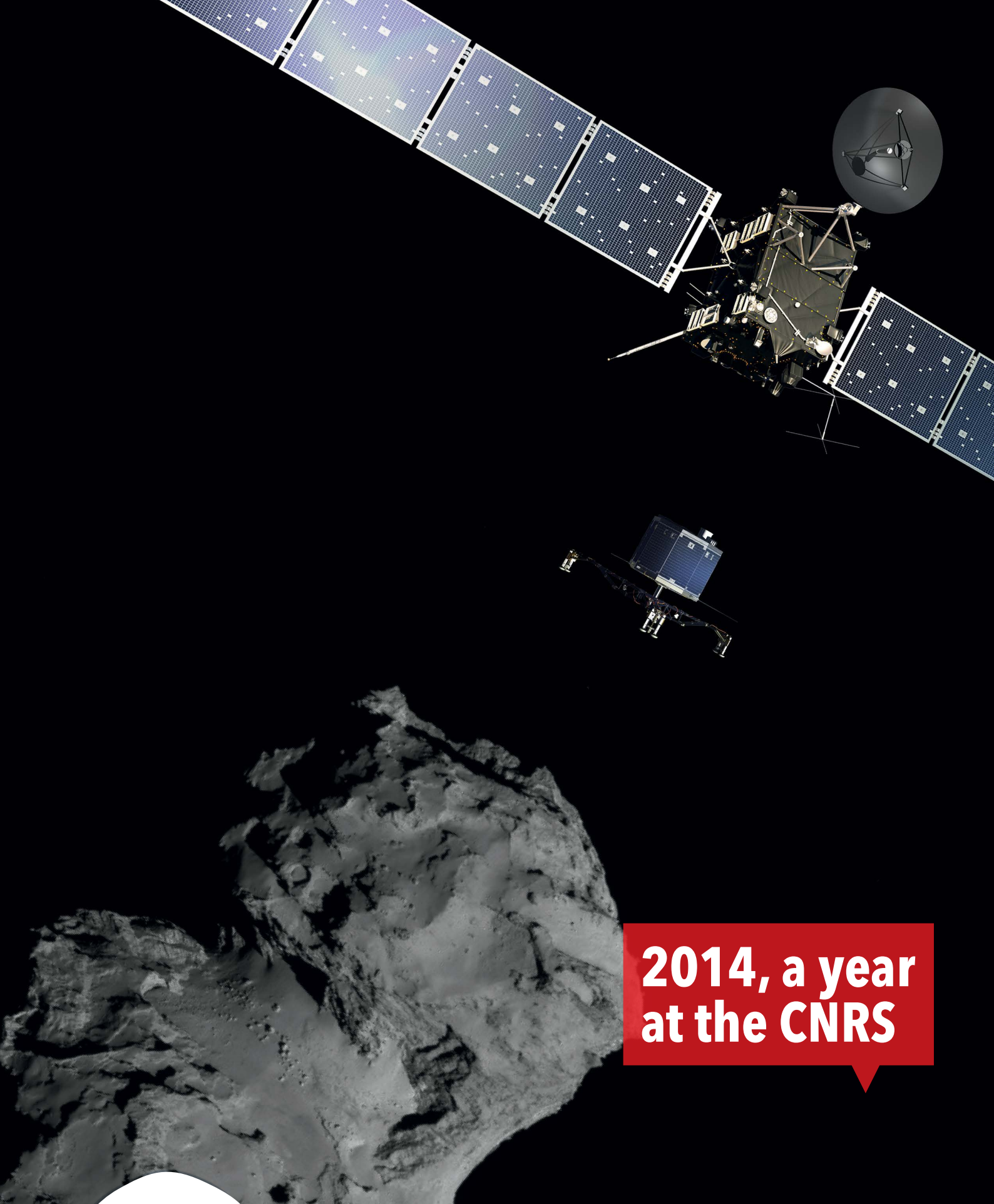




**2014, a year
at the CNRS**



www.cnrs.fr

**This brochure contains excerpts
from the CNRS 2014 Activity Report,
which can be viewed at: www.cnrs.fr**

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Cover page: Artist's impression of the separation of the Philae module from the Rosetta spacecraft, and its descent towards the surface of the comet Churi.
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A budget of **€3,290.43** million in 2014

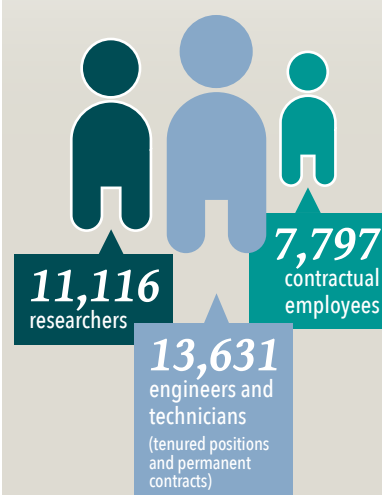
State funding
€2,568.04
million

CNRS-generated income
€722.39
million

Source: CNRS/DSFIM/BFC

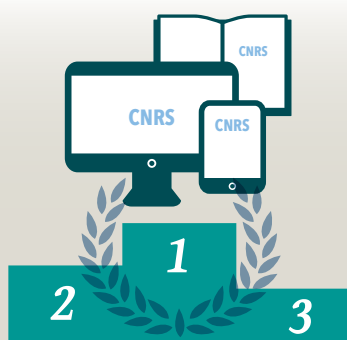
32,544
staff members

as at 31/12/2014



Source: Sirhus data as at 31/12/2014;
processed by CNRS/DRH/OMES

The CNRS tops



the Nature Index

a new ranking based
on the qualitative assessment
of 68 publications of excellence
over the past 12 months

Source: www.natureindex.com

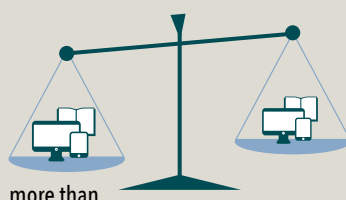
**and the university
and research
institutions ranking**

according to the
Scimago Institutions Rankings

Source: Scimago Lab/Scopus data
<http://www.scimagoir.com>

Out of an annual average of

35,500
publications



55%

are co-signed with at least one foreign
laboratory

Source: SCI expanded – CPCI-S
(Thomson Reuters) – processed
by CNRS/SAP2S and INIST

287

researchers
recruited in 2014

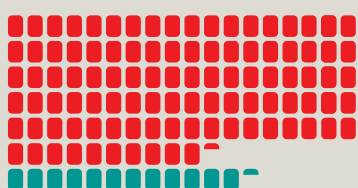


289

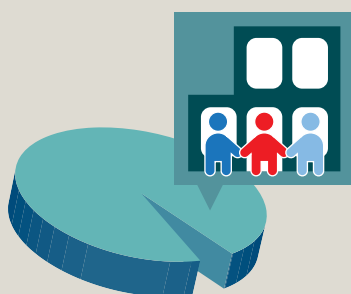
engineers
and technicians
recruited in 2014

Source: CNRS/DRH

1,025
research
units



and **123**
service units



95%

of the research and service units
operate in partnership with academic
and research institutions or other
types of organizations and businesses,
both in France and abroad

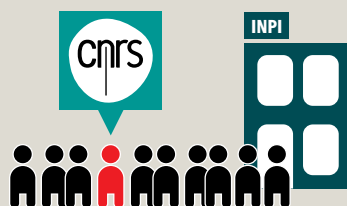
Source: Labintel data as at 31/12/2014 –
processed by CNRS/SAP2S

The CNRS features among the world's

100
leading
innovators

(Top 100 Global Innovators) since
this list was established by Thomson
Reuters in 2011

Source: 2014 Thomson Reuters
Top 100 Global Innovators



4,535 active
patent families
7th largest
patent filer
in France
in 2014

Source: CNRS/DIRE, INPI

25



ongoing
**framework
agreements**

with companies listed
on the stock exchange

100
active public/private
**research
structures**



including **23 joint
laboratories**
between the CNRS and industry

17 LabComs
(partnerships with an SME
or medium-sized company benefiting
from ANR funding)

Source: CNRS/DIRE

1,229
projects
submitted

by CNRS teams in the first year
of the EU Horizon 2020
programme



With **18.5%**

France achieves the highest success
rate in the first year of H2020

Source: CNRS/DERCI

62,000
missions
abroad



with an average duration of 11 days,
41,000 of which in the European
research area

35
**International
Joint Units**

in operation, including 5 created
in 2014

Source: CNRS/DERCI

In 2014, the CNRS strengthened its position as a leader in world science. This was reflected in prestigious rankings and awards, the creation of startups, international partnerships and, perhaps most importantly, the mobilization of its researchers on key societal issues.

The CNRS tops scientific rankings and 2014 again brought its share of breakthroughs and awards. Is it all systems go for the CNRS?

We must bear in mind that scientific excellence lies in peer evaluations rather than figures. Yet there are rankings, and they tell us something about the French higher education and research system in the global arena.

The *Nature Index*, based on a limited selection of only 68 journals, puts us in first place, an achievement we are naturally very proud of. Like the *Scimago Institutions Rankings*, this index classifies universities and RPOs¹ indiscriminately, which has the virtue of not setting them against each other as though they were in competition.

This ranking gives pride of place to journals of excellence. It shows that the CNRS's top position is due not only to its size, as suggested by some of our critics, but also to the scientific results obtained by its researchers. It highlights the world-class standing of French science. Indeed, the CNRS lends its name to many joint research undertakings with its academic partners, which should be a source of pride for everyone. Joint research units, which account for more than 95% of all CNRS laboratories, bring together 11,000 of our researchers and twice as many academics affiliated with universities. This diversity allows the "CNRS" name to feature highly in the rankings, and France to be a leader in science.

In December 2014, the CNRS published a survey on the launch of startups by research units. Did it reveal any surprises?

This study has several advantages. First of all, it shows the predominant role played by the CNRS in technology transfer in general, and business creation in particular. With its academic partners, especially the universities, the CNRS has helped launch more than 1,000 startups, generating over 7,000 jobs, since 1999. This is a very positive record in terms of technology transfer and research applications.

These startups are launched in a context of very close, extensive relations with industry, as reflected not only in the number of partnership agreements but also associated laboratories. These amount to about a hundred, are home to some 1,200 employees and represent a budget of €150 million. Lastly, the



© CNRS Photothèque / Francis Verhiet

CNRS shares more than 20 joint research units with companies, four of which are based outside of France. I think that these figures speak for themselves, and prove that criticisms of the French education and research system are actually unfounded.

Does France's participation in EU scientific programmes (ERC and H2020) meet expectations? How does the CNRS fare?

The initial trends for 2014, the first year of the H2020 programme, are very promising. French researchers responded massively to the EU calls for proposals and achieved the highest overall success rate with 18.5%, even though our country still lags behind Germany and the UK in terms of secured funding. Competition was fierce due to the tremendous amount of proposals, especially from Spanish and Italian research teams. With 1,229 submissions, the CNRS achieved roughly the same participation rate as in the first year of the previous programme, FP7, which had initially triggered a great deal of interest before plummeting. Our goal is that our researchers keep the pace, and continue to respond to future calls for proposals in years to come. They must not lose faith, even if their applications were unsuccessful the first year. I know how disheartening failure can be, especially in light of the effort required by these EU programmes. For this reason, the CNRS is striving to improve its administrative framework to provide better support for its teams.

Five new International Joint Units (UMIs) were created in 2014. For the CNRS, they are a means of promoting French research around the world.

Indeed, with these five new UMIs, the CNRS expands the presence of French science in other parts of the world — especially in Asia, which is poised to become the world's main research hub. More important still than the number of units, the diversity of research fields and the worldwide influence of these laboratories are worth noting. With UCLA² in California, we have created a multidisciplinary UMI at the interface of epigenetics and social sciences. In Japan, we have teamed up with Saint-Gobain and the Institute of Materials Science³ to conduct research on innovative materials. We have also launched two new UMIs in Singapore, in mechanobiology and quantum computing. Finally, to build on Chilean expertise in the field, the CNRS has funded a laboratory there to carry out research in coastal ecosystems.

Another Fields Medal for the CNRS: what is the secret of the vitality of French mathematics?

With the distinction awarded in August 2014 to Artur Avila, a French-Brazilian mathematician and CNRS senior researcher, France now boasts 12 Fields Medals, ranking just behind the US. In addition to this prestigious prize, the International Congress of Mathematicians (ICM), held in Seoul from 13 to 21 August 2014, singled out French researchers to deliver three of the 21 coveted plenary lectures. It was an excellent year for France at the ICM, a summit meeting that brings together thousands of mathematicians. Our country sent 38 speakers, the largest number after the US, illustrating the vitality of French research in this discipline. Furthermore, nearly one in five speakers of all nationalities was associated with the French school of mathematics, and the CNRS. Long recognized as one of the best in the world, this school is based on “filiation” with thesis supervisors. Illustrious names, but also new branches therefore make up the discipline's family tree — yet another sign of our school's vitality.

At the end of 2014, the CNRS took over the presidency of ATHENA, the French National Alliance for the Humanities and Social Sciences. How did the discipline react after the terrorist attacks that struck France in early 2015?

ATHENA, a think tank that gathers all French researchers in the humanities and social sciences, compiled an initial analysis of the research projects and publications of the past 15 years on social exclusion, education, the situation of young people in deprived suburbs, the practice of religion in all its diversity and its relationship with citizenship and the French Republic. This report also encompassed research on racism and anti-Semitism, the role of religion in building cultural identity and the integration of Muslim popu-

“With 18.5%, France achieved the highest overall success rate for proposals submitted to the H2020 programme in 2014.”

lations, along with the function of schools in integration and prisons in all types of radicalization.

As president of ATHENA, I am determined that this research be more widely shared with political decision-makers, and that steps be taken to remedy the shortcomings that we have identified. We have no doubt failed to use the critical approach and methods of the social sciences to carry out new research on risks to human safety and on all forms of terrorism and violence. Being a scientist also means pushing back the frontiers of ignorance. II

1. Research Performing Organisations.

2. University of California, Los Angeles (US).

3. Institut de Science des Matériaux de Mulhouse (CNRS / Université Haute Alsace).

Ebola: the CNRS to the rescue of populations

Scientists have been working to address the unprecedented Ebola epidemic that has affected West Africa since the end of 2013. In France, a team led by Viktor Volchkov at the International Center for Infectiology Research¹ is attempting to identify the molecular mechanisms underlying the virulence of Ebola. Focusing on one of the seven proteins produced by the virus, they have shown that it is involved in the acute inflammatory reaction that follows infection in humans. Part of this protein binds to certain immune cells, triggering the release of large quantities of inflammatory molecules. The researchers also discovered that the same viral protein weakens the walls of blood vessels, which explains the onset of massive bleeding in infected patients. They successfully restrained this phenomenon *in vitro* by using antibodies that target one type of receptor in human immune cells.

GIVING POPULATIONS A VOICE

Meanwhile, anthropologists on the ground are striving to elucidate how both the population and aid workers react to the disease. In the face of rumors that make the work of medical staff even more difficult, Alain Epelboin from the Ecological Anthropology and Ethnobiology Laboratory² is helping to design appropriate methods of communication while trying to get the local authorities and medical staff to listen to the population's demands.

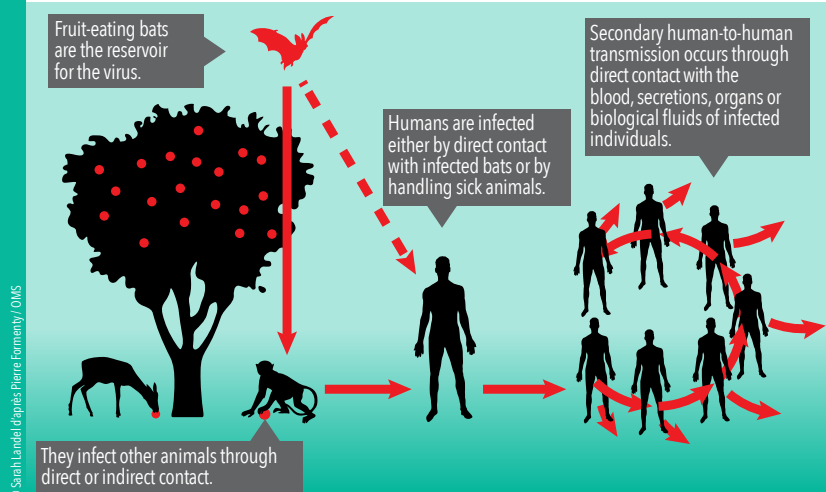
For their part, the researchers at the International Center for Medical Research in Franceville, Gabon, headed by Éric Leroy, were the first to diagnose a new outbreak of the disease in the Democratic Republic of the Congo (RDC) during the summer, before successfully sequencing the genome of the virus that caused it. They discovered that the strain is not the same as in West Africa, but is very similar to those that spread across the region during the epidemics of 1995 to 1997. For François Renaud, director of the Infectious Diseases and Vectors: Ecology, Genetics, Evolution and Control laboratory (MIVEGEC)³, "this means that the virus was in the environment all these years". How does it circulate in its animal reservoir? Under what conditions is it transmitted to humans? Why are such transmissions on the increase? CNRS researchers and their partners are sparing no effort to answer these questions. II

1. CNRS/Inserm/ENS Lyon/Université Lyon 1.

2. CNRS/MNHN/Université Paris Diderot.

3. CNRS/IRD/Université Montpellier 2.

EBOLA VIRUS LIFE CYCLE



© Sarah Landel d'après Pierre Formenty / OMS

USING LIGHT TO ACTIVATE THE BRAIN

The development of new investigative tools plays a key role for studying the brain on several scales simultaneously – an ongoing revolution in the neurosciences. Researchers at the Neurophotonic Laboratory¹ have developed a fiberscope that can, in the conscious and freely behaving mouse, manipulate the activity of every neuron in a brain region so as to correlate neuronal activity with behavior. Concretely, a microscope forms light patterns at the micrometer scale that match the shape and position of the cells to be activated. An extremely compact optical fiber bundle then transmits the pattern to the brain of a mutant mouse whose neurons contain a protein that can be photoactivated.

1. CNRS/Université Paris Descartes.

Neuron, November 2014

A NEW GENERATION OF IMAGING AGENTS

Metals known as luminescent lanthanides, which belong to the rare earth elements, exhibit properties that make them very attractive for optical biological imaging, such as fine fluorescence/ luminescence emission bands whose wavelengths do not vary whatever the environment. However, they require indirect excitation known as antenna effect. A team at the Center for Molecular Biophysics¹ has developed an efficient antenna for a promising lanthanide, samarium, which has two emission bands in the visible and near infrared regions. This paves the way for a new generation of imaging agents that will be able to obtain two different types of information from a single probe.

1. CNRS.

Angewandte Chemie International Edition, February 2014

AN INNOVATIVE SOLUTION FOR ORGAN REPAIR

Convincing results obtained using rats confirm the huge clinical potential of a method that uses adsorption to suture organs.

Because they are soft and fragile, organs such as the liver, lungs or spleen are impossible to suture. Tissues tear when a needle passes through them, leaving surgeons powerless when it comes to repairing a lesion or stopping bleeding. Moreover, available adhesives perform poorly or are toxic to the body. However, work carried out by Ludwik Leibler and his team at the Soft Matter and Chemistry Laboratory¹, in collaboration with a team from INSERM, could well be a game-changer. Their novel concept for gluing gels and biological tissues using adsorption of silica and iron oxide nanoparticles has been successfully tested on rats *in vivo*. An aqueous solution of nanoparticles applied with a brush to a deep gash in the rat's skin closes the wound in a few seconds, leading to complete healing with no complications. Still using rats, the researchers repeated the experiment on the liver, and successfully stopped the bleeding, simply by spreading the solution on the edges of the wound and pressing them together. The next step will be to confirm these results in large animals such as pigs. II

1. CNRS/ESPCI ParisTech.

Angewandte Chemie, April 2014.



APPLICATION OF THE SOLUTION



USING PRESSURE TO HOLD THE EDGES TOGETHER



SKIN CLOSURE

© Laboratoire Matière molle et chimie, CNRS/ESPCI ParisTech

Thirty seconds is all it takes to close a deep wound after applying the aqueous solution of nanoparticles proposed by the researchers.

IMMORTAL FLATWORMS: A WEAPON AGAINST BACTERIA

The immune response of a primitive organism has revealed that a gene involved in resistance to bacterial infections is present in a latent state in humans.

Do humans make full use of their ability to resist bacteria? To find out, Éric Ghigo and his team at the Emerging Infectious and Tropical Diseases Research Unit (URMITE)¹ in Marseille decided to get off the beaten track in immunology and delve into the immune response of the planarian *Dugesia japonica*, an aquatic flatworm that is potentially immortal due to its extraordinary regeneration capacities.

Intrigued by the flatworm's resistance and assuming that this is due to its highly efficient immune defense, the researchers studied the genes expressed by the flatworm when it is infected by the causative agent of tuberculosis (*Mycobacterium tuberculosis*) and Legionnaires' disease (*Legionella pneumophila*), or by *Staphylococcus aureus*. Among all the genes identified, they only retained those that are also present in the human genome, where they are poorly expressed or not expressed at all. This is the case for the gene MORN2, on which the researchers focused all their efforts. Their work showed that this gene plays a key role in eliminating the three types of bacteria. For example, in the presence of *M. tuberculosis*, it favors the sequestration of the bacterium in an intracellular cavity. However, in the fruit fly and the roundworm *Caenorhabditis elegans*, two classic immunological models, this gene has been lost over the course of evolution. This is why it had never been identified until now. By activating the MORN2 gene in human immune cells, the researchers successfully gave these cells the ability to eliminate the three bacteria tested. These results reveal a hitherto unknown immune mechanism in a latent state in humans, and open up a new approach in the fight against bacteria. "MORN2 may not be the only resistance gene in a latent state in humans," Ghigo points out. The researchers are set to screen all the other genes involved in the immune response of bacterially-infected planarians that are homologous with sequences in the human genome. This could enable them to identify other resistance genes whose expression could be stimulated by pharmacological means. II

1. CNRS/IRD/Inserm/Aix-Marseille Université.

Cell Host and Microbe, September 2014.



The immune response of the *Dugesia japonica* flatworm opens up new approaches to fight infections.

© CNRS/Photothèque/URMITE/Éric Ghigo

EPIGENETICS INVOLVED IN THE HERITABILITY OF COMPLEX TRAITS

A team of biologists has debunked the myth that genetic differences between individuals are solely caused by the sequence of their genomes. To do this, the scientists created a population of lines called 'epiRILs' in the model plant *Arabidopsis*: although all the lines have the same genome, there are numerous epigenetic variations along the genomes of each line. Specifically, chromatin is not compacted in the same way from one line to another. It turns out that these variations cause 90% of the measured heritable differences between lines in terms of flowering time and primary root size. "Although there were a few examples of this, our study shows for the first time the role of epigenetics in the transmission of complex traits," says Vincent Colot, at the Institute of Biology of the École Normale Supérieure¹. The study may partially solve the problem known as "missing heritability", i.e. the fact that, in humans, variations in DNA sequences between individuals only account for a fraction of the genetic differences between them.

1. ENS/CNRS/Inserm.

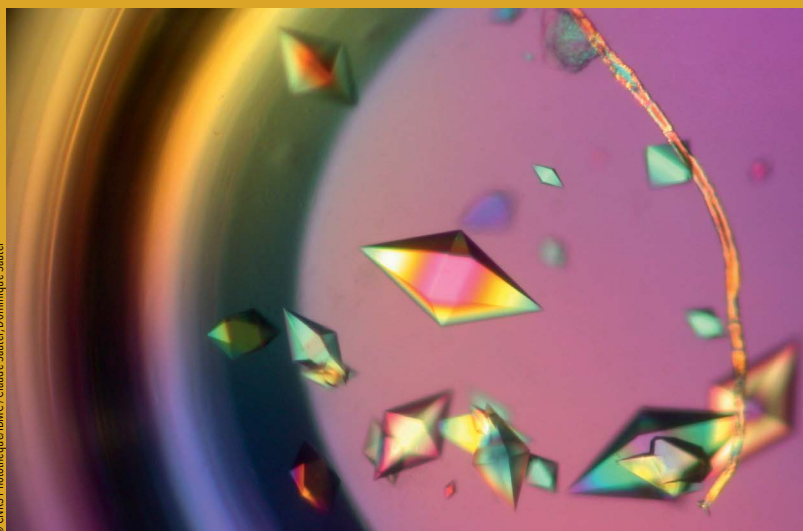
Science, March 2014.



Epigenetic variations alone are enough to explain the heritable differences in flowering time between these two epiRILs plants.

© Photos: Vincent Colot

Crystallography in the limelight



X-ray diffraction analysis of these protein crystals made it possible to reconstruct a 3D image of this biological macromolecule.

UNESCO declared 2014 the International Year of Crystallography, turning the spotlight on this essential discipline.

If you feel crystallography is passé, think again! “Because it makes it possible to study the microscopic structure of matter, it is vital for everything from physics to archaeology and from chemistry to biology, not to mention energy or the Earth sciences,” says Sébastien Pillet, from the Laboratory of Crystallography, Nuclear Magnetic Resonance and Modelling¹. Moreover, it is a science that aims to answer intractable fundamental questions involving physicists, mathematicians and computer scientists. It is also a source of innovations in a wide range of fields, and a science so vibrant that UNESCO declared 2014 as the International Year of Crystallography. “It gave CNRS laboratories the opportunity to introduce this discipline to the general public through a host of events,” says Pillet, who represented the CNRS on the steering committee for the International Year of Crystallography in France. It also made it possible to showcase some of the most recent advances in the field.

CRYSTALS OF CRYSTALS

Among other achievements, researchers at the Chemistry of Complex Matter research unit² have for the first time successfully controlled the three-dimensional growth of crystal layers which form “Russian dolls” around a seed crystal, ending up with what is known as an embedded crystal, or crystal of crystals. Better still, by exploiting the nature of the metallic compounds used, the chemists managed to color the transparent regions of the

mineral, giving them different refractive indices. This property could be put to use in optical systems such as waveguides or multiplexers.

MODELING IMPURITIES

Meanwhile, physicists and mathematicians are continuing to explore the laws that govern the formation and structure of crystals. They are developing numerical simulations to calculate their electronic structure, which is the key to their electrical and magnetic properties and therefore to the development of a wide range of everyday objects, such as memory cards, batteries and photovoltaic cells. In addition, the scientists are not only interested in perfect crystals, but are now also seeking to model the role of impurities, which, depending on the temperature, can have an impact on the transport of electrons. “This information is essential for example to describe the operation of a telephone battery in a non-temperate climate,” explains Hakim Boumaza, at the Laboratory for Analysis, Geometry and Applications³. “This is further proof that crystallography will indeed be at the heart of tomorrow’s innovations, as testified by the International Year,” Pillet concludes. II

1. CNRS/Université de Lorraine.

2. CNRS/Université de Strasbourg.

3. CNRS/Université Paris 13 Nord/Université Vincennes-Saint-Denis.

DISCOVERY

LIGHT SHAKES A FIBER

Propagation of a light wave shakes optical microfibers.

Optical microfibers, obtained by stretching glass fibers like those used in telecommunications, are 50 times thinner than a strand of hair. This makes their diameter smaller than the wavelength of infrared light, an unusual feature that led to a surprising discovery. Researchers at the Institut Femto-ST¹, working in collaboration with colleagues at the Laboratoire Charles Fabry², observed that an infrared laser beam sent through such a microwire makes it shake, since the light is tightly confined inside it. “The resulting displacement, which has an amplitude of a few millionths of a millimeter, is caused by the propagation of an acoustic wave travelling at over 3,000 meters per second along the surface of the microfiber,” explains Thibaut Sylvestre from the Institut Femto-ST. This phenomenon, which is particularly sensitive to the surrounding environment (pressure, temperature, gas composition, etc.), could offer interesting prospects for the design of optical sensors that are both highly sensitive and very compact. II

1. CNRS/Université de Franche-Comté/ENSMM.

2. CNRS/Institut d’optique Graduate School.

Nature Communications, October 2014.

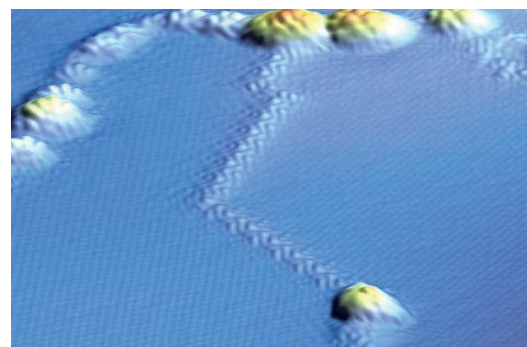
PROSPECTS

GRAPHENE'S WEAKNESSES ARE AN ASSET

Physicists show how to make the most of crystallographic defects in graphene, which were previously thought to limit its applications.

Perfection is not of this world. Notwithstanding its exceptional physical and chemical properties, graphene is no exception. While it is often described as a thin sheet of carbon atoms arranged in a perfect honeycomb lattice, reality is somewhat different. In fact, graphene looks more like a mosaic, where the perfect structure of each piece, typically about a micrometer in size, is interrupted by irregular boundaries separating it from neighboring domains. Such defects are seen as an obstacle to the large-scale production of this material. "We decided to turn things around by showing that these imperfections could in fact be useful," says Jérôme Lagoute from the Materials and Quantum Phenomena Laboratory¹.

Using a low-temperature scanning tunneling microscope, the scientists first analyzed a large number of these grain boundaries at the atomic scale. They observed that when the angle between the orientation of the crystal lattice in two neighboring domains is less than 20°, the graphene buckles at the boundary, forming a blister of a few angströms in height, with irregular relief. However, if the angle is greater, the domains are separated by a fine wrinkle made up of a succession of carbon atoms forming pentagons and heptagons.



© Equipe STM du laboratoire Matériaux et phénomènes quantiques

This scanning tunneling microscope image shows the boundaries between individual grains in a sheet of graphene.

The physicists then successfully characterized the electronic properties of the two types of boundary. Although the blisters have a disastrous effect on electrical conductivity, the fine wrinkles on the other hand act as filters that can select electrons according to their direction and speed.

"Making such grain boundaries in a controlled way is still out of reach," Lagoute explains. "Nonetheless, their use opens up new avenues for the design of graphene electronic devices, for example to control the transport of electrons in the material." Which all goes to show that weaknesses can sometimes turn into strengths. II

1. CNRS/Université Paris Diderot.

Nano Letters, October 2014.

Neutrinos: tiny particles with great prospects

Lying at the heart of several puzzling phenomena, neutrinos are drawing increasing attention from scientists.

Almost undetectable, the neutrino is the most discreet of fundamental particles. In the last few years, however, physicists have stepped up experiments in a bid to determine its properties, which are linked with some of matter's best kept secrets. Among these, one question is central: how do fundamental particles acquire their mass? "In fact, the mass of the neutrino may have a totally different origin from that of other particles," explains Reynald Pain, deputy scientific director for astroparticles and neutrinos at the IN2P3.

To find out, the specialists are focusing on neutrino oscillations from one type to another, which, according to the theory, are related to the fact that they have a mass. In 2014, for instance, the OPERA experiment, which involved researchers from the IN2P3, revealed how a muon neutrino changes into a tau neutrino. Similarly, the NEMO detector at the Modane Underground Laboratory is investigating the very nature of neutrinos by attempting to identify a new, extremely rare type of radioactive decay.

360° VIEW ON...



© CNRS Photographie/APC / Jean-Luc Robert

This new detector, now operational at the Double Chooz experiment, should shed light on the strange ability of neutrinos to change identity.

A NEUTRINO WAITING TO BE DISCOVERED?

In addition, several experiments, such as STEREO, now under construction at the reactor at the Institut Laue-Langevin in Grenoble, will be tracking hypothetical neutrinos called sterile neutrinos. "Their existence could help solve the problem of the missing mass of the Universe," says Pain.

In the longer term, the CNRS is also involved in several international projects that aim to study the role of neutrinos in the almost complete absence of antimatter in the Universe. "There is a surge of interest in neutrinos," Pain confirms. No matter how discrete they are, it looks like these elementary particles will have to get used to being in the spotlight. II

CHARACTERIZING FINE PARTICULATE POLLUTION IN REAL TIME

The SIRT Atmospheric Research Observatory reveals widespread air pollution in the Paris region.

During episodes of fine particulate air pollution, an alternate driving scheme can be imposed by the Paris local authorities. During the air pollution incident that affected the Ile-de-France region on March 7-15, 2014, researchers at the Climate and Environmental Sciences Laboratory¹, in collaboration with teams at the INERIS² National Competence Centre for Industrial Safety and Environmental Protection, successfully quantified and characterized this fine particulate pollution in real time. Their achievement was made possible by the latest-generation measuring instruments of the SIRT Atmospheric Research Observatory near Saclay, in the suburbs

of Paris. The researchers found that the pollution was exacerbated by the weather conditions and consisted of fine particles mainly originating from emissions linked to human activities, formed from precursor gases such as nitrogen oxides from transportation and ammonia from farming. In addition, the concentrations observed were comparable with those recorded by the Airparif air quality monitoring network for the Paris conurbation alone, showing a widespread pollution episode. II

> <http://sirta.ipsl.fr/>

1. LSCE/IPSL, CNRS/CEA/Université de Versailles Saint-Quentin.

2. Institut National de l'Environnement Industriel et des Risques.

IN BRIEF

NANOPARTICLES FOR GREEN CHEMISTRY

Synthesizing chemical products requires compounds such as solvents and surfactants, which need to be produced, transported, heated – and which nonetheless end up as waste. Scientists have therefore been trying to find a way of eliminating them so as to make chemistry more environmentally friendly. Now, researchers at the Eco-Efficient Products and Processes Laboratory¹ (E2P2L) in Shanghai (China) have taken a first step in this direction. Without solvents or surfactants, they successfully used a model

reaction in organic chemistry to react water-like ethylene glycol with an oil-like fatty aldehyde, and obtained an excellent yield. The trick was to use recyclable silica nanoparticles, which are able to interact with both ethylene glycol and the fatty aldehyde. They also act as a catalyst, lowering the temperature of the chemical reaction and thus saving energy – a fine example of how nanomaterials may help to make chemistry greener.

1. CNRS/Solvay/ENS de Lyon/East China Normal University/Fudan University/Université de Lille 1.

Journal of the American Chemical Society, March 2014.

HIGHLIGHT

Getting to the bottom of deep-sea mining

**The ocean floor contains important mineral resources.
A joint survey reviews the impact of potential mining operations.**

As raw materials get scarcer on land, mineral resources on the ocean floor are attracting increasing interest, with the development of numerous exploration projects eventually opening the way to mining operations. In this context, the French Environment and Research Ministries commissioned a collective scientific expertise (ESCo) from the CNRS and IFREMER on the potential environmental impact of seabed mining. Presented on June 19 2014, the final report is the most comprehensive ever completed on the issue. It is based on 14,000 references from scientific literature, synthesized by around fifty researchers,

including geologists, geochemists, biochemists, geneticists, economists, ecology and legal experts. Specifically, this extensive interdisciplinary survey looks at the potential scope of seabed resources, and investigates possible extraction methods and impacts on vulnerable marine ecosystems. This provisional review highlights the uncertainties associated with these issues: the environmental impact of deep-sea mining will not remain confined to the seafloor, but could also affect the functioning of the oceans and working of the planet, including human populations. This conclusion points to the need for more research into the impact of seabed mining on ecosystems and on their ability to recover. II

DISCOVERIES

IQUIQUE EARTHQUAKE: GEOLOGISTS IN THE FRONT LINE

The CNRS and its partners are contributing to seismic risk prevention in Chile through a large monitoring network.

On April 1 2014, a powerful 8.2 magnitude earthquake struck the region of Iquique, in northern Chile. Located above a subduction zone where the Nazca plate descends beneath the South American plate, Chile is affected by intense seismic activity and is frequently struck by highly destructive earthquakes. It thus acts as a real-life laboratory for the study of major quakes. Geophysicists from around the world, including scientists from the CNRS, have deployed extensive monitoring facilities in the country with the aim of quantifying seismic hazards and contributing to risk prevention. In collaboration with scientists from Germany, researchers at the International Associated Laboratory Montessus de Ballore, set up in 2006 by the CNRS, CONICYT¹ – its counterpart in Chile – and the University of Chile in Santiago have notably set up a vast installation in central and northern Chile comprising GPS receivers, inclinometers and seismometers. “We can record ground deformation over time scales ranging from a few minutes to several decades, as well as violent ground motion of just a few seconds during massive earthquakes,” explains Jean-Pierre Vilotte, director of the International Associated Laboratory CNRS-GFZ.



Regular measurements have been made over the years, before and after 2014, at point C06 in Punta Chipana, some 100 Km south of Iquique.

The scientists were thus in the front line during the last two major earthquakes to strike Chile: the 2010 Maule quake in the center of the country, and the April 2014 Iquique seism in the north. During the latter, they were able to record the event itself with great precision, but also the seismic activity before and after it. Analysis of the data led to an unexpected result. “Despite its high magnitude, the earthquake didn’t release all the accumulated energy. As a result, northern Chile continues to be a high seismic risk zone,” Vilotte reckons. The researchers have therefore carried out several post-earthquake monitoring missions to get a better grasp of how the region is readjusting and to accurately identify the areas most likely to rupture in a future earthquake. II

1. Comisión Nacional de Investigación Científica y Tecnológica, the Chilean body that coordinates and funds scientific research.

HIGHLIGHT

No environment is spared

Published in 2014, volume 2 of the IPCC report, to which CNRS researchers made a significant contribution, reviews the impact of climate change.



The IPCC’s conclusions are indisputable: “The effects of global warming are now being felt on every continent and ocean on the planet,” says Wolfgang Cramer, deputy scientific director of the Mediterranean Institute of Marine and Terrestrial Biodiversity and Ecology (IMBE)¹ and a member of the editorial board for the IPCC summary report. In particular, several chapters of volume 2 focus on the impact of climate change on marine and aquatic environments. “For several years now, researchers at the Villefranche Oceanographic Laboratory have been studying increasing ocean acidification caused by oceanic uptake of atmospheric carbon dioxide,” Cramer explains. As a result, IPCC experts are in no doubt that this process is a definite threat to certain marine species, especially corals. To assess the effects of global warming on terrestrial ecosystems — such as the migration of species, changes in crop yield and quality, the emergence of new pests, and forest decline — “scientists at the IMBE have focused on Mediterranean crops, while their colleagues at the Laboratory of Alpine Ecology (LECA)² have looked at the impact of climate change on alpine meadows,” says Cramer. Accordingly, the third volume of the report, which deals with mitigation measures, advocates a 40-70% reduction of greenhouse gas emissions by 2050. Studies by economists including CNRS researchers show that, if this goal is to be met, the ongoing transition to an economy that is less dependent on fossil fuels will have to be stepped up in all areas. II

1. CNRS/IRD/Aix-Marseille Université/Université d’Avignon.

2. CNRS/Université Joseph Fourier - Grenoble/Université Savoie Mont Blanc.

IN BRIEF

COMPOSITES FOR AIRCRAFT ENGINES

In an effort to reduce consumption of aviation fuel, aircraft manufacturers are turning towards composite materials, which are both light and strong. At the Contact and Structure Mechanics Laboratory¹ (LaMCoS) in Villeurbanne (France), researchers are taking a close look at carbon fiber-based composite structures known as 3D interlock composites. Strong, rigid and light, these structures are used to reinforce the blades of the new aircraft engines being developed by SNECMA. In 2014, researchers at the LaMCoS and SNECMA jointly developed software that could simulate the shaping of these reinforcements, a key step in ensuring good dynamic properties and resistance to impacts. Thanks to a weaving technique that locks each layer to those above and below it in the through-thickness dimension, these interlock 3D composite reinforcements prevent the delamination that can occur in stratified composite structures.

1. CNRS/Insa/Université de Lyon.



© ESA/MTG medialab - Comat image n.º ESA/Pocottal/Navram

HIGHLIGHT

Rosetta: a comet up close

Placed in orbit around comet Churi in the summer of 2014, the European spacecraft reveals an unexpected world and sheds light on the origin of the Solar System.

No doubt 2014 will be remembered as the year of Rosetta. On August 6, after a journey of more than ten years around the Solar System, the European spacecraft became the first man-made instrument to orbit a comet, namely comet 67P/Churyumov-Gerasimenko — aka Churi. On November 12, the craft again made space exploration history by successfully landing a module dubbed Philae on the surface of this chunk of ice and dust, a world first that made the headlines and was followed massively on the social networks.

French scientists, in particular from the CNRS and CNES, play a leading role in this spectacular undertaking — Europe's most ambitious yet — whose goal is to shed light on the origin of our Solar System, no less. Comets are remnants of the formation of the Solar System, more than 4.5 billion years ago. Their small size and the fact that they spend most of their time in frozen regions have allowed these icy objects to preserve an almost intact record of the primitive matter that gave birth to the Sun and its planets.

Moreover, these tiny bodies are believed to have provided Earth with its water, and possibly even with the molecules necessary for the emergence of life.

UNEXPECTED LANDSCAPES

To uncover the secrets of our origins, Rosetta and Philae were equipped with an array of no fewer than twenty-one instruments between them, including visible and infrared cameras to observe Churi's surface in fine detail, spectrometers to analyze the gases it releases, a radar to examine its internal structure, tools to collect and study ejected grains of dust, and a drill to take samples from beneath the surface. "The CNRS is a key player in this intensive collection of data," says Denis Mourard, deputy scientific director for astronomy and astrophysics at the National Institute for Earth Sciences and Astronomy (INSU). "Our laboratories are involved in virtually every instrument on the spacecraft and in half of those on the lander, and we are responsible for three of them." Since its mission began, Rosetta has piled up discoveries. For instance, the images taken by the spacecraft, sometimes during flybys skimming the surface at a height of less than ten kilometers, have revealed a variety of totally unexpected landscapes¹. "The comet's surface is far more rugged than we had imagined," Mourard explains. "You can see fallen

rocks, very high cliffs and even deep pits. The origin of all these landforms remains difficult to explain." According to the scientists, these structures may have been sculpted by outgassing from Churi. Due to the heat from the Sun, the ice making up the comet gradually sublimates, giving rise to powerful jets of gas, which rip matter off the star, generating a huge halo that completely surrounds it. By analyzing the water vapor emitted in these jets, Rosetta has made an important discovery: Churi's water is very different from that of Earth's oceans. The spacecraft's instruments revealed that the ratio between hydrogen and its isotope deuterium in the water outgassed by Churi is three times greater than that measured on our planet². This is a surprising finding, since it suggests that comets are not the main source of water on Earth.

POSSIBLE ORGANIC MOLECULES

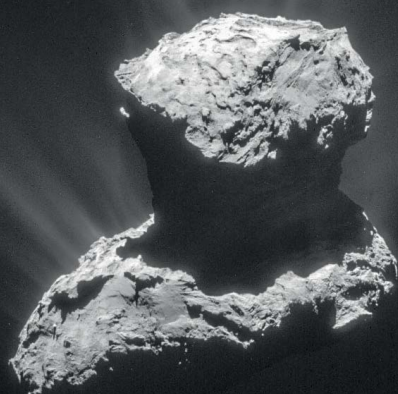
Philae, too, has made a host of discoveries. Despite a series of unexpected bounces upon landing, the little robot successfully collected information and transmitted it to Earth. As well as close-up images of the comet's surface, the data revealed the possible presence of complex organic molecules. Laboratory analyses are still being carried out to determine the exact nature of these compounds, which could help elucidate the origins of life on our planet.

And it looks like the mission will be just as exciting in 2015. As Churi gets closer to the Sun, it will become increasingly active. Rosetta, which will accompany the comet until December 2015, will have a grandstand view of the unfolding spectacle — and the possibility to analyze the basic composition of the comet. II

1. *Science*, January 2015.

2. *Science Express*, December 2014.

Comet Churi photographed by the Rosetta spacecraft on March 25 at a distance of 86.6 kilometers.

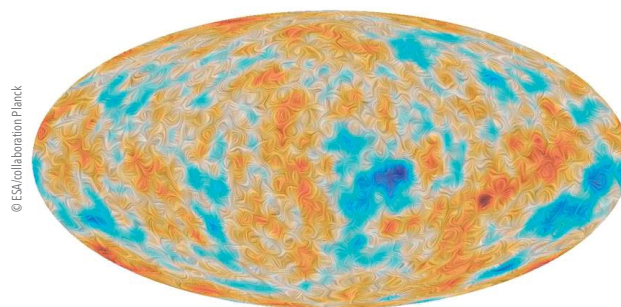


PLANCK REVEALS FURTHER SECRETS ABOUT THE UNIVERSE

Scientists have released data from the whole mission, disclosing new secrets about the Universe.

For four years, between 2009 and 2013, the European Planck satellite surveyed the sky with the aim of mapping the cosmic microwave background, the oldest light in the Universe. In 2013, the scientists unveiled the first results from the mission, derived from partial observations. At the end of 2014, they released the full data collected by the spacecraft, with the stated goal of elucidating the origin of the Universe.

For astrophysicists, the cosmic microwave background is an invaluable source of information. "Emitted 380,000 years after the Big Bang, this first light has not only retained the imprint of what happened before that time, but also the signature of what it has travelled through to date," explains Cécile Renault, from the Laboratoire de Physique Subatomique et de Cosmologie¹, and a member of the Planck collaboration. "Observing it makes it possible to achieve an accurate reconstruction of the history of the Universe."



Whole-sky reconstruction of the Cosmic Microwave Background, based on data from the Planck spacecraft. The color indicates the intensity of the emission, while the texture reflects the direction of oscillation of the associated electric and magnetic fields.

The new data sheds fresh light on the cosmic microwave background radiation: for the first time, astrophysicists have performed a detailed, whole-sky study of its polarization properties, which reflect the orientation of the electric field associated with the light.

This characteristic allowed the scientists to detect the first evidence of the existence of neutrinos (particles that hardly interact with matter) just after the Big Bang, as well as traces of primordial dark matter². Closer to home, polarization also enabled them to reveal the magnetic field of our Galaxy, the Milky Way³.

Finally, their findings confirm, even more convincingly than in 2013, the Standard Model of cosmology, according to which the Universe was initially extremely hot and dense, and occupied a tiny volume of space. It then started to expand and cool, giving birth to the first stars and galaxies. And the scientists will not stop there. "A final analysis of the data should get under way in 2015," Renault says, "and this could help us solve yet more mysteries of the history of the Universe." II

1. CNRS/Université Joseph Fourier/INP Grenoble.

2. *Astronomy & Astrophysics*, February 2015.

3. *Astronomy & Astrophysics*, May 2014.

HIGHLIGHT

WWI: looking beyond the statistics

A century after the start of the "Great War", CNRS researchers are turning their attention to daily life in wartime.



© CNRS Photothèque/UEC / Matthieu Le Bailly

These hairworm (nematode) eggs found on a German soldier are similar to those of a rat parasite.

"Beyond the toll of the First World War, now well known, historians are focusing on the problems encountered by societies faced with an unprecedented conflict — both by its duration and intensity," notes INSHS project leader Fabrice Boudjaaba.

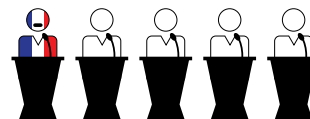
A new book by Stéphane Audoin-Rouzeau of the CESPRA¹ illustrates this trend. In *Quelle Histoire, un Récit de Filiation (1914-1940)*², the researcher examines how accounts of the war were transmitted within his own family. From another perspective, *Tous Unis dans la Tranchée? 1914-1918, les Intellectuels Rencontrent le Peuple*³, a book by Nicolas Mariot of the CESSP⁴, reflects the involvement of other disciplines in research on World War I. These disciplines include

the anthropology of violence and paleo-parasitology, which has enabled CNRS biologist Matthieu Le Bailly to prove that French infantrymen suffered from intestinal parasites, and thus add to the understanding of their living conditions. According to Boudjaaba, "the centennial was the opportunity to reflect on commemoration and the ways in which history becomes heritage." A clear sign that the memory of this unprecedented conflict is still very much alive. II

1. Centre d'Etudes Sociologiques et Politiques Raymond Aron (CNRS/EHESS).
2. (EHESS/Gallimard/Seuil, 2013).
3. Seuil, 2013.
4. Centre Européen de Sociologie et de Science Politique (CNRS/EHESS/Université Panthéon-Sorbonne).

CLOSE-UP

WOMEN AT THE ICM IN SEOUL, SOUTH KOREA



Nearly **1** out of **5** speakers was French.

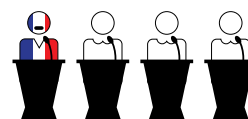
Only

12%

of the speakers in Seoul were women.



Among them



More than **1** out of **4** of the women who took the floor was French.

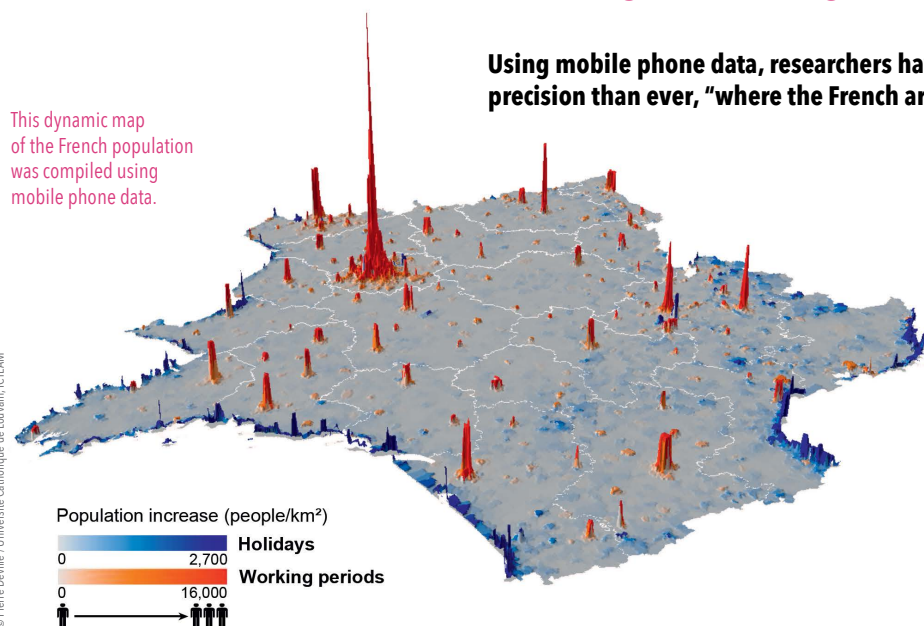
At the ICM in Seoul, 3 of the 21 plenary speakers and 19.3% of all speakers were French, showing the vitality of mathematics in France.

© CNRS / Sarah Landel

DISCOVERY

THE FIRST DYNAMIC MAP OF THE FRENCH POPULATION

This dynamic map of the French population was compiled using mobile phone data.



© Pierre Deville / Université Catholique de Louvain, CTEAM

Using mobile phone data, researchers have been able to determine, with greater precision than ever, "where the French are".

Natural catastrophes, wars, epidemics: in certain circumstances, precise maps of population distribution can be of vital importance. This information cannot be obtained from census studies, which are limited by their frequency and low spatial resolution. To overcome the problem, a group of researchers thought of developing these indispensable decision-making tools, based on mobile phone data aggregated by transmitter. Using statistical processing, they were able to estimate with unrivalled precision the number of people present in every location throughout the country. Better still, unlike the "snapshot" provided by a census, this new method makes it possible

PROSPECTS

DIGITAL COMMUNICATION SPARKS SCIENTIFIC INTEREST

Text messages, e-mails and tweets are reshaping language use – and fascinating linguists.

The mass of texts produced directly on digital devices constitutes a new type of linguistic objects. SMS language, for example, which enables quasi-synchronous long-distance private written communication, has no equivalent in the history of writing. "It is particularly interesting for identifying the different registers that exist in written expression, just as in spoken language: academic, familiar, technical, etc.," explains Josie Bernicot of the CeRCA.¹

One thing is certain: her research has shown that SMS-style writing has no negative effect on teenagers' spelling skills and there is therefore no reason to disparage this linguistic evolution. At the CNRS, the study of digital languages is notably supported through the HuMain PEPS² call for proposals, supervised by the Mission for Interdisciplinarity. Three programs dedicated to SMS language and tweets have received funding in this way. II

1. Centre de Recherches sur la Cognition et l'Apprentissage (CNRS/Université de Poitiers).
2. Projets Exploratoires Premier Soutien.

to observe the population's mobility on the scale of a day, month or year. "For example, we can see the migration from the big cities to the coasts in summer, or the daily flow of commuters between urban centers and the suburbs," reports Samuel Martin of the CRAN¹. Reliable and easy to generate, these dynamic population maps could prove invaluable in national emergencies, "especially in countries with no adequate census data", Martin adds. II

1. Centre de Recherche en Automatique de Nancy (CNRS/Université de Lorraine).

Proceedings of the National Academy of Sciences, October 2014.

AWARDS

GÉRARD BERRY: THE GOLD STANDARD IN COMPUTER SCIENCE

The 2014 CNRS Gold Medal was awarded to the computer scientist Gérard Berry for his significant contributions to the formal processing of programming languages, the design and verification of integrated circuits and parallel real-time programming. Berry has developed Esterel, a programming language that has found many industrial applications, notably in electronics and aviation, where it is used to operate embedded systems on aircraft like the Airbus A380 and the Rafale fighter jet. Also a skillful communicator, the scientist enjoys interacting with the public to explain the key concepts of information science and related ethical issues. In the course of his career, Gérard Berry has been a researcher at Mines Paris Tech, the scientific director of Esterel Technologies and a senior researcher at INRIA. He now holds the computer science chair at the Collège de France.



© CNRS Photothèque / Cynil Fésillon

ARTUR AVILA RECEIVES THE FIELDS MEDAL

On August 13, 2014, Artur Avila, a researcher at the Institut de Mathématiques de Jussieu-Paris Rive Gauche¹, was presented with the Fields Medal, the world's most prestigious distinction in mathematics. The award came in recognition of the significant advances made possible by his work, primarily concerning dynamical systems and analysis. Aged 36, Avila has already enjoyed an impressive career. He began his dissertation at 19, before entering the Collège de France for postdoctoral studies with Jean-Christophe Yoccoz in 2001. Recruited by the CNRS in 2003, he became the organization's youngest senior researcher in 2008. Today he divides his time between his Paris laboratory and the Brazilian Institute of Pure and Applied Mathematics in Rio de Janeiro.



© CNRS Photothèque / Sébastien Ruel

1. CNRS/UPMC/Université Paris Diderot.

THE NOBEL PRIZE IN ECONOMICS GOES TO JEAN TIROLE

On October 13, 2014, Jean Tirole became the third French recipient of the Nobel Prize in Economic Sciences, after Gérard Debreu and Maurice Allais. The prize rewards his analysis of market imperfections and regulation. Laureate of the 2007 CNRS Gold Medal, the 61-year-old economist is internationally acclaimed for his work on the "new industrial economy". CNRS president Alain Fuchs congratulated this "exceptional theoretician who has succeeded in modeling key economic issues and broadening the international scope of his research".



© CNRS Photothèque / Christophe Lebedinsky

In step with world science

Keeping pace with scientific evolution, the CNRS is bolstering its presence worldwide through the creation of new International Joint Units.

“From Singapore to Japan, the US and Chile, 2014 was a vintage year for international joint units,” reports Patrick Nédellec, director of the European Research and International Cooperation Department (DERCI) at the CNRS. This bumper year brings the number of UMIs (International Joint Units) to 35, underlining the key role that these partnerships play in the organization’s international strategy. “We are the only worldwide research group that offers such structured, long-term cooperations,” Nédellec emphasizes. “It’s a strong differentiating factor and a real draw for our partners.”

THE ASIAN POWERHOUSE

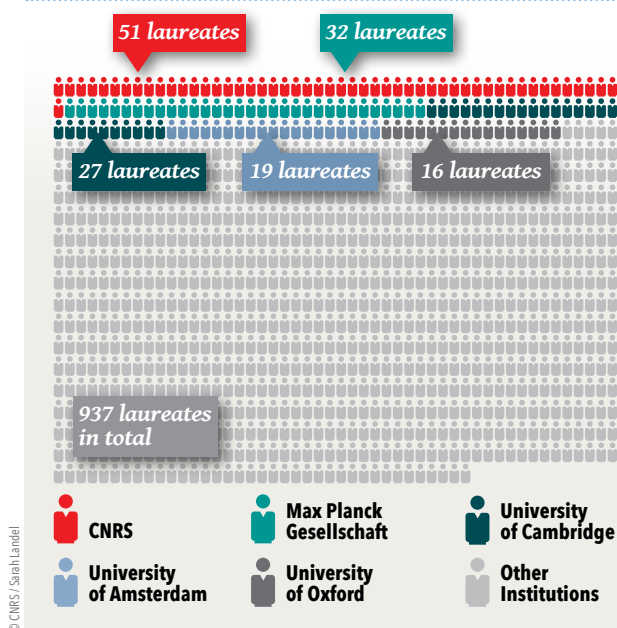
The fact that three of these new UMIs are in Asia provides further proof of the scientific and technological vitality of that region. With the opening in Lille of a mirror site¹ of the French-Japanese UMI LIMMS² (the SMMIL-E project), the CNRS has strengthened its ties with Japan, its main institutional partner. “For the Japanese, who are often reluctant to leave their country, this host structure makes everything much easier.” In Singapore, the ongoing scientific boom has led to the creation of two new UMIs. On a more administrative level, it has prompted the transfer of the CNRS representative office for Asia, previously located in Vietnam. “Our international structure remains flexible,” Nédellec adds, “adapting to researchers’ needs and the evolution of the global scientific scene.” And that is only

the beginning. Contacts are now being made in Singapore to develop new partnerships focusing on energy. In the Americas, the CNRS’s extensive collaborations with the US were extended in 2014 with a new interdisciplinary UMI, called EpiDaPo, in the humanities and social sciences. In South America, another region enjoying rapid scientific development, the CNRS now operates six UMIs.

MOBILIZATION FOR HORIZON 2020

In Europe, the initial results of the European Commission’s Horizon 2020 program are being scrutinized. This scheme resulted in a surge of participation involving most EU countries. France submitted many more projects in 2014 than at the end of the Seventh Framework Programme the previous year, when participation dropped sharply. Our country remains in first place in terms of accepted proposals (18.5%), but lags behind Germany and the UK for secured funding. As far as the CNRS is concerned, 231 projects (12 of which are collaborative) were accepted out of the 1,229 submitted in 2014. “Our researchers did especially well in the ‘Excellent Science’ pillar, with very good results in the ERC Starting, Consolidator and Advanced Grants,” reports Nédellec. Their performance is also encouraging in FET Open³ grants: of the 24 proposals accepted in 2014, six are coordinated by France, including three by the CNRS. No matter the even stricter selection criteria, researchers who embark on the

ERC: THE CNRS COMES TOP!



As part of the Horizon 2020 excellence program, the ERC (European Research Council) is funding projects by young, more experienced and established researchers through Starting, Consolidator, and Advanced Grants, respectively, in all areas of science and technology.

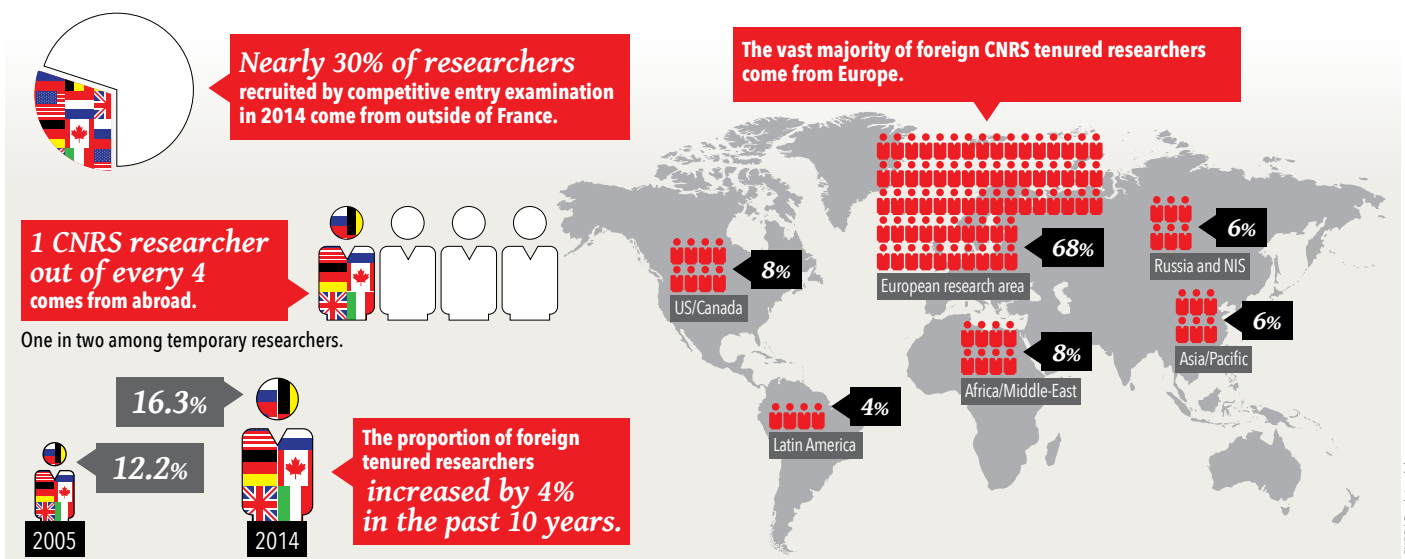


of French laureates chose the CNRS as host institution

The French success rate with the ERC reaches

16.1%

compared with 11.8% for the whole of Europe



adventure of collaborative projects — with the invaluable help of the IPE (European Project Engineers) — do not regret it, the director of the DERCi points out. “Whether in terms of scientific progress, building up a wide network, or rapid career advancement, these projects have many positive repercussions,” he says.

CLOSER SUPPORT FOR EUROPEAN PROJECT LEADERS

To strengthen its presence with EU decision-makers, the CNRS representative office in Brussels has been transferred to the premises of CLORA, the Club of Associated French Research Organizations. Moreover, it was decided that the head of the Brussels office would report to the director of the DERCi as of April 1, 2015. “This means that the CNRS’s European operations will now be managed from Brussels,” Nédellec explains. “This will enhance our presence and efficiency, both internally and in relation to our partners.” In parallel, the IPE pool has been expanded. Working hand in hand with the regional offices, the 10 IPEs contribute their expertise to help researchers set up winning projects for EU calls for proposals.

MANAGEMENT AND TOOLS CONTINUE TO EVOLVE

Since international projects are a priority, a dedicated steering committee has been formed, under the supervision of the CNRS president and its chief research officer. Bringing together the ten CNRS institutes and the DERCi, it will examine new cooperative projects and potential improvements to international cooperation tools. For example, the committee has already decided to discontinue the “exchange agreements” between the CNRS and various countries. “There were too many of these so-called prospecting tools, which led to funds being too thinly spread, with little return in terms of concrete research projects,” Nédellec reports. In addition, these agreements overlapped with the CNRS International Programs for Scientific Cooperation (PICS) and with initiatives of the French Ministry of Foreign Affairs. Only a few exchange agreements have been maintained in the form of joint research projects (PRCs) with partner countries. Similarly, the director of the DERCi is set to update the International Associated Laborato-

Our international policy fosters scientific excellence, not only with the leading research countries, but also with top-level laboratories anywhere in the world.

ries (LIAs) and International Research Networks (GDRIs). The DERCi has also drafted an international chart aimed at the CNRS Management Board. The chart incorporates a number of key indicators on joint publications, funding levels per country, etc., to facilitate the strategic coordination of the CNRS’s institutional partnerships.

INVOLVING UNIVERSITIES IN INTERNATIONAL COOPERATION

The CNRS remains committed to involving French universities in international partnerships. “We make our resources available to the university communities in order to allow them, for example, to create UMIs under their own names.” To this end, everyone must take concrete action to pool resources. “At the CNRS, we want universities to be more involved in the project appraisal phase, so as to encourage them to use these resources. We want to show them all the advantages that come from working together at the international level,” Nédellec concludes. ¹

1. Mirror site: a research laboratory associated with a UMI, in France or in the partner country.
2. Laboratory for Integrated Micro-Mechanical Systems.
3. FET Open is an open program (with no pre-defined themes) to support exploratory collaborative research in the field of new technologies.

Partnerships with industry: a clearly stated ambition

As an extension of its research operations, the CNRS seeks to place greater emphasis on technology transfer. An insight into the new action plan defined in 2014.

In 2014, three companies derived from the CNRS's research activities and technology transfer strategy were listed on the stock market. All three are now in operation, based on CNRS patents and licenses in strategic societal fields: toxic waste treatment for Inno-veox, a revolutionary medical imaging technique for SuperSonic Imagine, and hydrogen production for McPhy. The CNRS continues to support these companies and invests in their progress, notably by taking a stake in two of them through its subsidiary FIST SA (France Innovation Scientifique et Transfert). These success stories are only the tip of the iceberg, the result of a sustained technology transfer strategy carried out in partnership with both academic and industrial institutions, whether at the regional or international level.

Moreover, the CNRS intends to further improve the effectiveness of its technology transfer processes and consolidate its position in a sector that has undergone radical changes in recent years. For this purpose, the Innovation and Business Relations Department (DIRE) joined forces with the CNRS Institutes, FIST SA and the MPR (Mission for the Monitoring of and Relations with CNRS Regional Offices and Institutes) in 2014 to

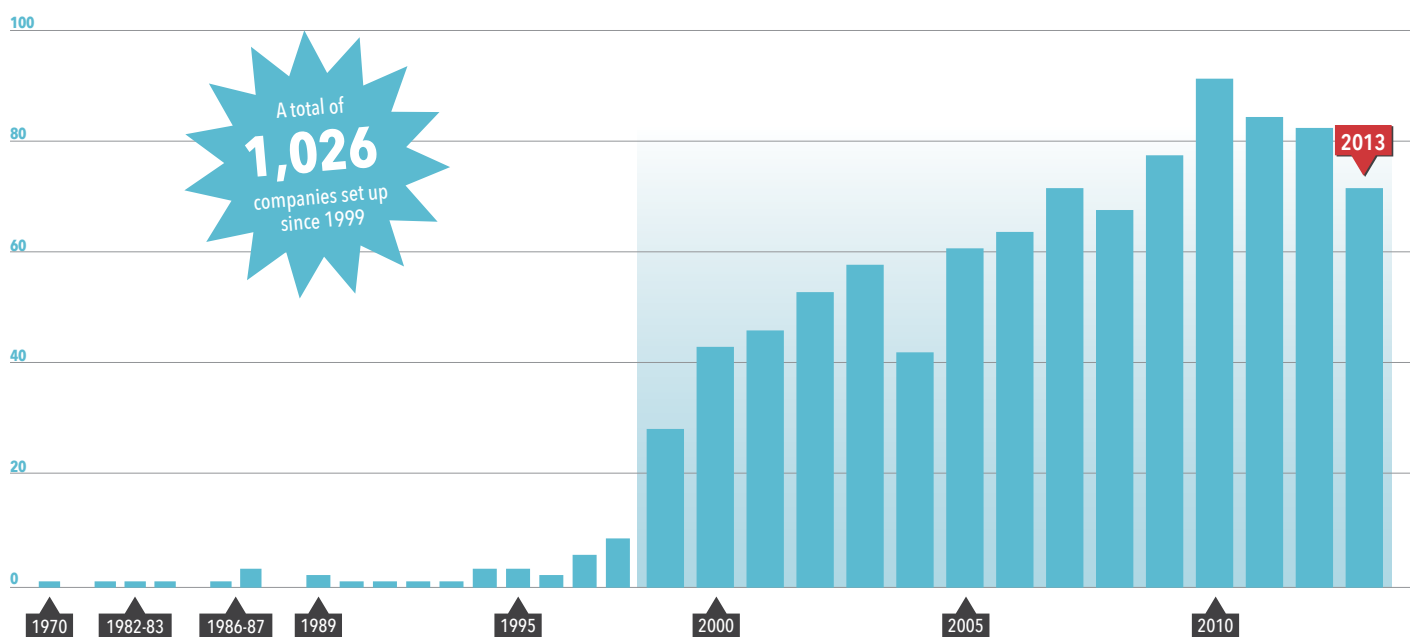
rethink the organization's strategy in this field. Their action plan, which was approved by the Management Board at the end of the year, focuses on openness in relation to partners, fine-tuning technology transfer areas and improving the organization's ability to react.

A DEVELOPMENT-ORIENTED PARTNER FOR SMEs

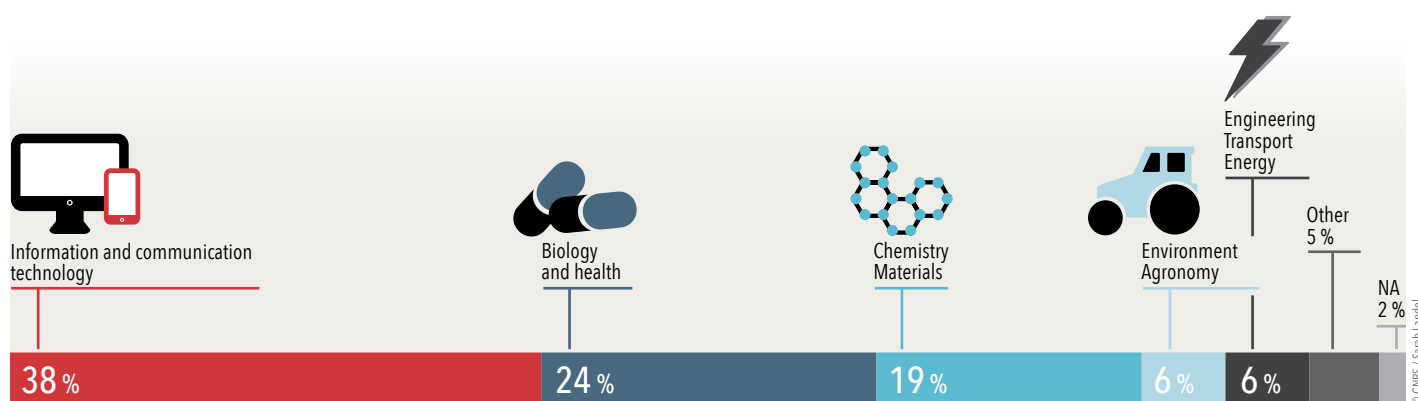
"More than ever, industrial partnership is the cornerstone of our technology transfer policy," says Marie-Pierre Comets, director of the DIRE. The 25 framework agreements with large corporations and 2,000 research contracts signed annually testify to this strategy. While continuing to collaborate with companies listed on the French stock exchange, the CNRS seeks to expand its partnerships with SMEs. "Small and medium-sized enterprises have significant needs in terms of technological development," Comets emphasizes. "Our laboratories have the skills and desire to provide concrete solutions." In order to facilitate progress, the CNRS will develop new resources to complement its skills directory, which already offers an initial entry point for those who want to work with its laboratories. "Knowing each other better and maximizing contacts through innova-

Startups initiated by CNRS laboratories since 1970

With the implementation of more favorable regulations, the creation of research-based startups rocketed in the early 2000s.



Startups derived from CNRS-affiliated laboratories, by sector



tion forums, for example, are essential for promoting collaborations,” the director adds. The CNRS is also striving to improve its responsiveness and step up the implementation of collaboration agreements. An innovation portal for businesses is also underway.

SUPPORTING BREAKTHROUGH INNOVATION

In terms of innovation, the CNRS operates far upstream, making full use of its scientific excellence and interdisciplinarity. “Today we are the only research organization capable of detecting, in our laboratories, the basic projects that could lead to breakthrough innovation,” Comets points out. One example is the “pre-maturation” scheme introduced in 2014 on a trial basis at the Institute of Physics. With a dedicated budget, the research teams were able to pursue their work until proof of concept — in other words, up to the point where technology transfer or the launch of a company are the most timely, generating substantial added value. Considered as highly effective, this initiative will be extended throughout the organization in 2015.

Another key step forward in the new action plan is the fine-tuning of the CNRS’s fields of national expertise in technology transfer. In the wake of the organization’s Strategic Pillars of Innovation (ASI), 14 “CNRS Transfer Focus” areas were defined, based on current scientific strengths and weaknesses, socioeconomic needs and issues, and related patents. “These are the sectors with the greatest potential for technology transfer at the national scale today,” Comets asserts. “In these fields, the CNRS’s nationwide expertise and its strong negotiating position with its industrial partners complement the SATTs (Technology Transfer Companies), active in the other fields at the local level.”

1,026 STARTUPS FROM CNRS LABORATORIES

The year 2014 also shed light on a lesser-known aspect of the CNRS’s technology transfer activity: the creation of companies and the support provided on the winding road to success. An internal study has shown that some 80 startups are launched every year, based on technologies from CNRS laboratories. “Of the 1,026 businesses set up over the past 15 years, more than 80% are still in operation — a rather exceptional survival rate,” Comets enthuses. “With at least 7,000 jobs created and an annual

turnover of €700 million, these companies make a sizeable contribution to the economy.” In addition, “startups are probably the best vehicle for innovation,” says Jean-René Bailly, head of contracts and investments at FIST. For certain technologies, they act as the interface between the laboratory and the economy. They have become the prime breeding ground for international industry.” In the short term, the CNRS plans to further facilitate the creation of startups by adapting financial conditions (licensing, intellectual property fees, etc.) and increasing its support for new entrepreneurs.

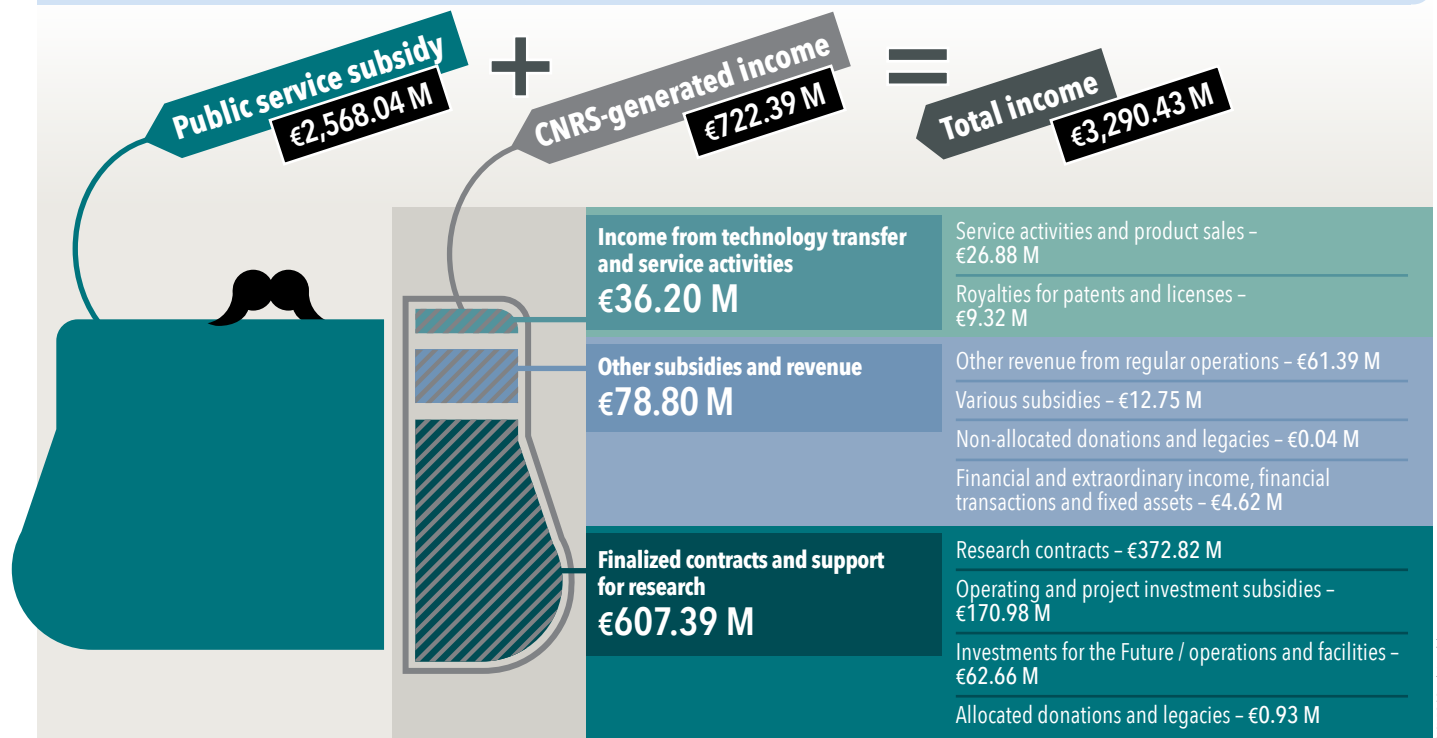
We identify breakthrough innovation and technology, and transfer them to the industrial world.

FACILITATING TECHNOLOGY TRANSFER PROCESSES

“In order to progress in these areas — all of them strategic for our organization — the CNRS needs to adapt,” Comets warns, “especially since the scope of technology transfer activities has become broader, more diversified and more complex in recent years.” Concretely, this means giving greater responsibility to the people in the field, at the sites, and adopting a controlled risk strategy, more conducive to technology transfer than the “hyper-protective” approach that has prevailed in the past. Similarly, the CNRS will maintain synergies with its partners, in particular the SATTs, through closer cooperation and new contractual resources. “Given the number of parties involved, our goal is to simplify procedures as much as possible and establish relationships of trust and confidence with all of our partners,” Comets concludes. “The success of technology transfer depends on it!” II

Budgetary and financial information

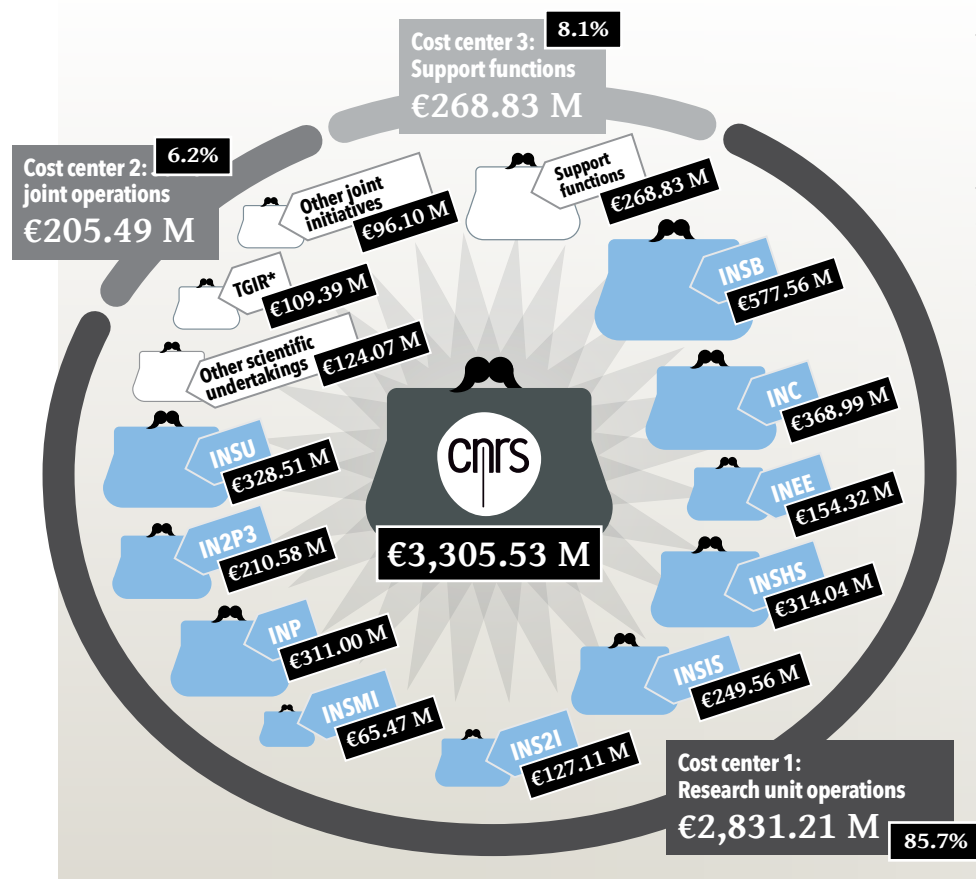
CNRS financial resources in 2014



Source : BFC / DSFIM

In 2014, the organization's funding came primarily from public service subsidies (€2,568.04 M), which represent 78.05% of the total. Research contracts (€372.82 M, excluding the "Investments for the Future" program) are the primary source (11.33% of the total) of CNRS-generated income (€722.39 M).

Expenditure by cost center and line item



The 2014 figures for cost center 1 reflect the priority given to the funding of laboratories as more than 85% of the organization's financial resources are devoted directly to them.

The breakdown of expenditure by line item reveals that chemistry and the Earth sciences and astronomy, with 11.16% and 9.94% of the total, respectively, are the two main areas of expenditure, behind biological sciences (17.47%).

*Very large research facilities and infrastructure.

Source : BFC / DSFIM

ORGANIZATIONAL CHART

as at 31/05/2015



Alain Fuchs, President



Philippe Baptiste,
Chief Research Officer

Joël Bertrand Director up until
June 1, 2015



Christophe Coudroy,
Chief Resources Officer

Xavier Inglebert Director up until
February 22, 2015



Marie-Hélène Beauvais,
Head of Cabinet Office



Institute of biological sciences
(INSB)

Catherine Jessus, Director



National Institute for Earth
Sciences and Astronomy (INSU)

Pascale Delecluse, Director



Financial Strategy, Real Estate and
Modernization Department (DSFIM)

Ophélie Robin, interim Director
Chantal Chambellan-Le Levier Director up until
March 31, 2015



Institute of Chemistry (INC)

Dominique Massiot, Director



Mission for Interdisciplinarity (MI)

Anne Renault, Director



Department of Human Resources (DRH)

Pierre Coural, Director
Christophe Coudroy Director up until
February 22, 2015*



Institute of Ecology
and Environment (INEE)

Stéphanie Thiébault, Director



Department for the Territorial
Organization of Research (DASTR)

Jean-Noël Verpeaux, Director



Legal Affairs Department (DAJ)

Nicolas Castoldi, Director



Institute for Humanities
and Social Sciences (INSHS)

Patrice Bourdelais, Director



European Research and International
Cooperation Department (DERCI)

Patrick Nédellec, Director



Information Systems Department (DSI)

Jean-Marc Voltini, Director



Institute for Information Sciences
and Technologies (INS2I)

Michel Bidoit, Director



Innovation and Business
Relations Department (DIRE)

Marie-Pierre Comets, Director



Security Department (DIRSU)

Philippe Gasnot, Director



Institute for Engineering
and Systems Sciences (INSIS)

Jean-Yves Marzin, Director



Scientific and Technical
Information Department (DIST)

Renaud Fabre, Director



National Prevention and Safety
Coordination (CNPS)

Yves Fenech, National Coordinator



National Institute for Mathematical
Sciences (INSMI)

Christoph Sorger, Director



Communications Department
(DirCom)

Brigitte Perucca, Director



National Coordination of Preventive
Medicine

Arnaud Vasseur, National
Coordinator



Institute of Physics (INP)

Alain Schuhl, Director

Jean-François Pinton Director up until
January 31, 2015



Mission for the Monitoring
of and Relations with Regional
Offices and Institutes (MPR)

Joëlle Raguideau, Director



National Institute of Nuclear
and Particle Physics (IN2P3)

Jacques Martino, Director



Accounts and Financial Information
Department (DCIF)

Marie-Laure Inisan-Ehret, Director
Bernard Adans Director up until March 23, 2015

* *Isabelle Longin* was interim Director from
February 23, 2015 until April 30, 2015.

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