

2008 A Year at CNRS

Scientific report



www.cnrs.fr

This brochure is published by the CNRS Communications Office.

Publisher	Arnold Migus
Editorial director	Marie-Hélène Beauvais
Deputy editorial director	Fabrice Imperiali
Managing editor	Stéphanie Lecocq
Scientific advisor	Christophe Cartier dit Moulin
Staff writer	Julie Coquart
Graphic design, layout and graphics	Sarah Landel
Translator	Patrick de Mornay
Iconography	Sarah Landel and Marie Gandois

Printed by **TAAG Imprimerie** with plant-based inks on paper made from sustainable forests in factories with ISO 9001, ISO 14001 and Emas certification.

Legal deposit	June 2009
ISSN	1776-2154



A Year at CNRS sets out the main scientific findings and events that marked the year 2008. They underline the vitality and competitiveness of our teams, both in our own laboratories as well as in joint units and in partnership. The 25,500 publications, 10% of the European total, that saw the light last year are testimony to this remarkable progress, and I wish first of all to pay tribute to their authors, the women and men who work in research. Some of them saw their work honored by the highest international awards. We congratulate Luc Montagnier, honorary senior researcher at CNRS, and Françoise Barré-Sinoussi, researcher at INSERM, who were jointly awarded the 2008 Nobel Prize in Physiology or Medicine for their discovery of the AIDS virus twenty-five years ago. We also congratulate the geophysicist Claude Lorius, winner in 2002 of the CNRS Gold Medal and in 2008 the first French winner of Japan's Blue Planet Prize, as well as the eminent geneticist Jean Weissenbach, awarded the CNRS Gold Medal in 2008.

In 2008, an interdisciplinary approach yet again showed just how effective it is in getting results. There is no shortage of examples. Two that immediately come to mind are the development of molecules that can change color to order, opening the way to new methods of observing living organisms, and the joint work by historians and mathematicians in studying social networks among medieval peasants in southern France. We shouldn't forget other remarkable results, such as the identification of a protein that blocks the hepatitis C virus, the development of a self-healing rubber, and the discovery of evidence for extremely abrupt climate change at the end of the last ice age. CNRS has also continued to invest in research into clean energies, and especially into new designs for lithium batteries that will, for instance, be able to efficiently power a new generation of electric cars.

In keeping with its mission, CNRS has in 2008 also widely invested in scientific facilities of general interest, with the implementation of a supercomputer that totals 207 teraflops of computing power, and the launch of a large-scale digitalization initiative in the field of humanities and social sciences.

And, last but not least, 2008 saw the approval of CNRS's strategic plan, 'Horizon 2020', which lays down ambitious strategic goals for our organization. From an operational standpoint, this will lead to a new organization for CNRS, with discipline-based Institutes and interdisciplinary research clusters, which should be more flexible and reactive, as well as better adapted to partnerships with the newly autonomous Universities.

Thanks to its continual development and above all to its staff, who without exception work in unison to achieve excellence in research, CNRS will continue to strive to achieve groundbreaking scientific progress, pushing back the frontiers of knowledge ever further, while at the same time attempting to meet society's needs. I have no doubt that the next few years will see CNRS strengthen its position as a leader in European research and as a key international player.

A handwritten signature in black ink, reading 'A. Migus'. The signature is written in a cursive, flowing style.

Arnold Migus
CNRS Director General

CNRS key figures...

APPROXIMATELY **1,100 RESEARCH UNITS**, OVER **85 %** PARTNERSHIP
WITH **120 HIGHER EDUCATION AND RESEARCH INSTITUTIONS**, AND OTHER NATIONAL AND INTERNATIONAL ORGANIZATIONS.

AROUND **26,000 TENURED EMPLOYEES** (11,517 RESEARCHERS AND 14,169 ENGINEERS,
TECHNICIANS AND ADMINISTRATIVE STAFF ON 31/12/2008) AND **7,619 TEMPORARY EMPLOYEES**
(PH.D. STUDENTS, POST-DOCS, VISITING RESEARCHERS, SHORT-TERM CONTRACTS, FELLOWSHIPS, ETC) ON 31/12/2008.

5,941 RESEARCHERS FROM OTHER ORGANIZATIONS HOSTED IN 2008 IN CNRS LABORATORIES, INCLUDING **41,5 %** FROM ABROAD.

A BUDGET OF **€2.9 BILLION** IN 2008, OF WHICH **€570 MILLION** CAME FROM REVENUES GENERATED BY CNRS.

AN AVERAGE OF **25,500 SCIENTIFIC PUBLICATIONS PER YEAR** IN LEADING INTERNATIONAL JOURNALS
OF WHICH **OVER HALF WERE CO-AUTHORED WITH AT LEAST ONE LABORATORY ABROAD.**

FIRST PLACE IN EUROPE AND FOURTH IN THE WORLD IN THE WEBOMETRICS LIST OF THE MOST VISIBLE
RESEARCH INSTITUTIONS ON INTERNET.

RESEARCH WITHOUT BORDERS

- I **12** AWARD WINNERS IN THE 'CONFIRMED RESEARCHERS' CALL FOR PROJECTS BY THE EUROPEAN RESEARCH COUNCIL (ERC).
- I PARTICIPATION IN **880** EUROPEAN PROJECTS OF WHICH **234** NEW CONTRACTS SIGNED IN 2008
- I **85** AGREEMENTS FOR SCIENTIFIC COOPERATION WITH **60** COUNTRIES
- I **275** INTERNATIONAL SCIENTIFIC COOPERATION PROGRAMS
- I **88** JOINT RESEARCH PROJECTS
- I **89** ASSOCIATED INTERNATIONAL LABORATORIES
- I **90** INTERNATIONAL RESEARCH NETWORKS
- I **18** INTERNATIONAL JOINT UNITS
- I **8** OFFICES ABROAD (IN BRUSSELS, HANOI, JOHANNESBURG, MOSCOW, BEIJING, SANTIAGO, TOKYO, WASHINGTON)

INDUSTRIAL POLICY

- I AROUND **3,400** PRIMARY PATENTS OF WHICH **295** WERE PUBLISHED IN 2008
- I AROUND **1,700** NEW RESEARCH CONTRACTS SIGNED WITH BUSINESSES (2007 FIGURE)
- I **37** START-UPS IN 2008
- I PARTICIPATION IN **61** COMPETITIVENESS CLUSTERS THROUGH **400** RESEARCH UNITS

CNRS PUBLICATIONS

Research staff in CNRS-related laboratories contribute over 68% of French scientific publications in materials and life sciences, excluding medical research*. With an annual average of 25,500 publications**, CNRS is present in 4.2% of world publications and in 10.3% of those produced in laboratories in the European Research Area (ERA). The contribution of CNRS-related laboratories to French scientific publications is around 80% in the fields of physics, chemistry, Earth sciences and astronomy. It is 65% in engineering sciences, and accounts for over 47% of French production in fundamental biology and in ecology / applied biology. Over 53% of CNRS publications are produced jointly with laboratories abroad, especially with our European partners (33% with the European Research Area).

* Field not covered by CNRS

** Average calculated for publications produced between 2005 and 2007. Figures: SCl (Thomson Reuters)

> Filaments of the gills of a hydrothermal vent mussel: in yellow and mauve, labeling of bacteria that live in symbiosis with the mussel.

4	Public understanding of science	4
6	The biology of humans	
	The brain's machinery	6
	How the body deals with viruses and parasites	8
	Using imaging for diagnosis	10
	Weapons to fight diseases	12
14	Humans throughout history	
	Looking back at our origins	14
	Technology unlocks the secrets of ancient art	16
	Culture is an open book	18
20	The technological age	
	Developing computer tools	20
	Ingenious engineering	22
	Optics treads the light fantastic	24
26	Modeling matter	
	Exploring matter	26
	Understanding matter	28
	Taming matter	30
	The nano challenge	32
	The road to clean energy	34
36	Life at every tempo	
	Decoding the genome	36
	Dissecting the cell	38
	Life at the nanoscale	40
	Evidence of evolution	42
	Life's strategies	44
46	Our planet	
	The entrails of the Earth	46
	Research serving the environment	48
	The blue planet	50
	Deciphering the climate	52
	Biodiversity feels the heat	54
56	Infinitely near, infinitely far	
	Elementary particles	56
	Galactic events	58
	The mysteries of the Universe	60
	Star systems	62
64	Directory	64

Bringing science within everyone's reach

This year, a number of events were organized as part of the French presidency of the European Union. CNRS played a major part in these, as well as in regular events such as the European Research and Innovation Exhibition and the Paris Book Fair. It has also launched ambitious new initiatives, such as the Cinémascience Festival. We turn the spotlight on some of the year's big moments.

CINÉMASCIENCE FESTIVAL

2008 saw the first edition of the Cinémascience Festival. Created by CNRS in Bordeaux, the festival shows narrative feature films, some of which have never been seen in France, focusing on science, the cinema and the imagination. Each film is followed by a debate between one of the film makers, a researcher and the audience. Backed by institutional and private-sector partners, the festival offers CNRS the opportunity to showcase its laboratories and researchers. The video reports produced during the 2008 edition can be viewed on www.cnrs.fr/cinemascience. On the website you'll also find news about the second edition, which will take place from 1-6 December 2009 in Bordeaux.

THE INTERNATIONAL YEAR OF PLANET EARTH

CNRS's National Institute of Earth and Astronomical Sciences coordinated a number of activities, including the joint publication with the publishing house

Le Cherche Midi of a collective work, *Terre, planète mystérieuse*, that takes us on an extraordinary voyage of discovery from the center of the Earth to the deepest parts of the ocean. To extend the journey, there was also a dedicated website showing the 'Image of the Week', 'Hidden Face of the Planet' podcasts, and a virtual visit to the Laboratory for Internal Geophysics and Tectonophysics in Grenoble, produced by CNRS Images.

COLORS ON THE BODY

Last year, the Trocadéro Gardens in Paris were inundated with color as they hosted the exhibition 'Couleurs sur corps' ('Colors on the Body'). From 24 October to 9 November 2008, CNRS, together with the Observatoire Nivéa, the City of Paris, CASDEN and SILMO, took a fresh look at the social and cultural issues connected with the use of color on the body. Humans have always used color on their bodies as adornment, clothing, disguise, ostentation, or to stand out: colors placed or worn on

the body thus bear the mark of specific cultural or social systems. 'The Mysteries of the Universe', the next exhibition in the Trocadéro Gardens, will be held from 20 October to 1 November 2009.

CNRS RESEARCHERS AND YOUNG PEOPLE MEET UP AT THE SCIENCE AND CITIZENS CONFERENCE

On the occasion of the 'Young people and science in Europe' conference, which was held from 24 to 26 October 2008, three hundred young Europeans aged 17-25 from the twenty-seven countries of the European Union met up at the Futuroscope in Poitiers to debate the role of science in society and the building of a European knowledge-based society. At the end of the conference, the young Europeans drew up recommendations that were submitted to Valérie Pécresse, the French Minister for Higher Education and Research. The next conference will take place 6-8 November 2009.



> A jury made up of scientists, film directors and high school students, chaired by Régis Wagnier, named the award-winners of the Cinémascience Festival, set up by CNRS and sponsored by Jean-Jacques Beineix.

CELEBRATING SCIENCE

The science village, re-baptized European Science City, was hosted in the nave of the Grand Palais, in Paris, from 14 to 16 November 2008. For CNRS it was an opportunity to underline the European and international dimensions of its research through the presentation of around fifteen projects covering a wide range of disciplines. A highpoint this year, which is the International Year of Planet Earth, was the 'Objective Earth!' stand, where young and old alike were able to travel into the depths of the Earth, a fun way of discovering the importance of ocean drilling. The event heralded the opening of the 2008 Fête de la Science (Science Festival), from 17 to 23 November, which enabled the general public to visit CNRS labs throughout France and discover what goes on in science behind the scenes.

> The European Science City, at the Grand Palais, attracted thousands of visitors.

ONLINE DOCUMENTS FOR ALL

Got a scientific question or a presentation to prepare? You need search no further! You're bound to find the answer somewhere on the CNRS web site.

I Fascinated by archeology? Come on in and visit the Ausonius Institute and its Archéopôle, one of the showcases for archeological research in France, as if you were really there in person. This journey into the world of archeologists is the first virtual lab visit devised by CNRS, and is aimed at everyone from beginners to enthusiasts. Other virtual journeys will be available soon.

<http://www.cnrs.fr/cnrs-images/multimedia/ausonius/>

I Two new multimedia presentations joined the Sagascience collection in 2008: *Climat, une enquête aux pôles* (The climate, an investigation at the poles) is illustrated by over fifty films and three hundred photos and diagrams. This documentary, aimed at the general public, is a contribution to the International Year of Planet Earth.

Biodiversité ! (Biodiversity!) focuses on the interactions between humans and the species and environments which surround us.

<http://www.cnrs.fr/saga>

I You'll find the latest science news and research results from CNRS labs, as well as an in-depth report on a major research theme, monthly in the Journal du CNRS, and quarterly in CNRS International Magazine.

<http://www2.cnrs.fr/presse/journal/>

I Visit the online image bank, with over 18,000 photos, as well as the film catalog with 350 films that can be viewed on line.

<http://phototheque.cnrs.fr>

<http://videotheque.cnrs.fr>



The brain's machinery

The nature of the brain and how it works is a major puzzle for researchers, who are doing their best to pierce its secrets. Although there is still much that we don't yet understand, new discoveries follow thick and fast, whether about brain plasticity, the transmission of information or the brain's ability to repair itself.

Neurology

NEURONS ON TAP

Researchers have managed to transform in vitro murine embryonic stem cells into cerebral cortex neurons. Once grafted into a mouse brain, the neurons turn out to be completely functional. This discovery opens the way to an unlimited and reliable source of cortical neurons for the modeling of neurological diseases. It also leads to the longer-term prospect of replacing damaged neurons by means of intracerebral graft.

Published in Nature
Date 18 September 2008

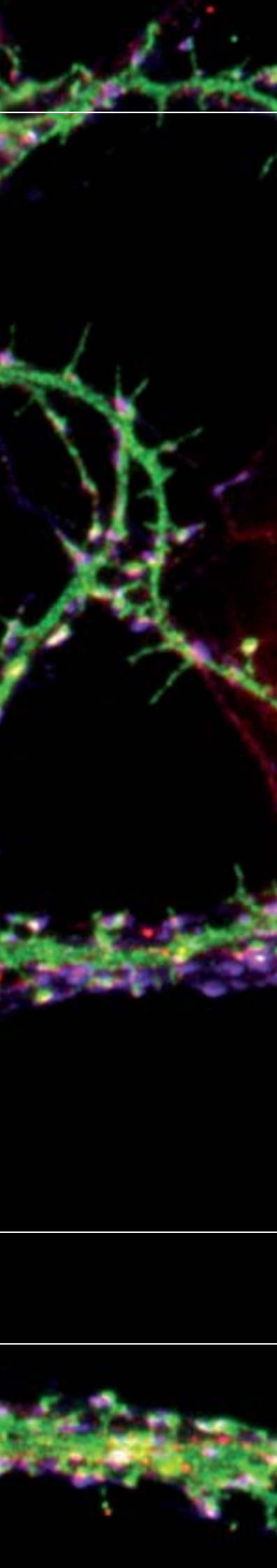
Neurotransmission

RECEPTORS GET MOVING IN ORDER TO COMMUNICATE

Biologists and physicists have shown that the mobility of receptors to neurotransmitters is involved in how reliably nerve signals are transmitted between two neurons. This enables desensitized receptors in the synapse (where two neurons meet) to be replaced by 'free' receptors. By doing this, neurons can transmit information at higher frequencies. Conversely, if neurons undergo a prolonged series of high frequency stimulation, the receptors come to a standstill, reducing the ability of the neurons to transmit high frequency activity. This is of crucial importance, since it is known that it is high frequencies, between 50 and 100 hertz, that are used in processes of memorization and learning, and also that neurological and psychiatric disorders are often caused by poor communication between neurons.

Published in Science
Date 11 April 2008

> A rat neuron observed by fluorescence.

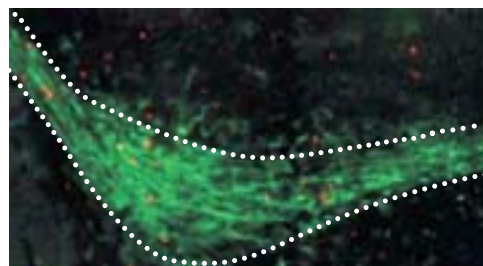


Perception

PROTEINS THAT HELP YOU TO SEE

Homeoproteins, which are proteins that were thought to be confined to the cell nucleus, are in fact able to move from one cell to another. This surprising property plays a role in regulating the plasticity of the visual cerebral cortex. The mechanism has been shown for homeoprotein Otx2 and could concern over 200 proteins. This work suggests that the transfer of Otx2, or the lack of it, could be one of the causes of amblyopia, a visual disorder.

Published in Cell
Date 8 August 2008



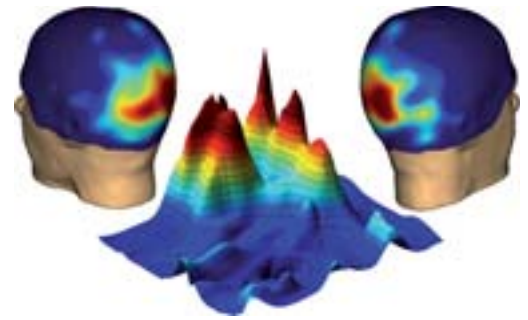
> A recently identified region of the adult brain in which new neurons are being created.

Stem cells

THE SELF-REPAIRING BRAIN

It was already known that certain glial cells in the adult brain could turn into neurons that are themselves able to migrate to the olfactory bulb and become incorporated into the existing neural network. The same team at the Institut Pasteur and at CNRS have just shown that glial stem cells spread out into many other regions of the brain. Moreover, a lesion that causes the loss of the olfactory senses leads to increased formation of new neurons. This study, which shows that the brain has intrinsic self-repair properties, paves the way for novel therapeutic strategies for the treatment of neurodegenerative pathologies such as Parkinson's disease and Huntington's chorea.

Published in Journal of Neuroscience
Date 22 October 2008



> In red, towards the rear of the cranium, the regions of the brain that control vision are responding to scarcely visible images shown to the subjects.

The two 3D images recorded by magnetoencephalography show that the mechanisms of consciousness can operate independently from those of attention.

Neuroscience

CONSCIOUSNESS IS NOT THE SAME THING AS ATTENTION

Attention and consciousness are based on independent brain mechanisms. Researchers have shown that, contrary to a commonly held idea, we can consciously see something to which we are not paying attention. This result, obtained by means of magnetoencephalography, could enable us to define these two concepts more precisely and make it easier to differentiate between pathological disorders of consciousness and attention.

Published in Journal of Neuroscience
Date 5 March 2008

How the **body** deals with **viruses** and **parasites**

Cancer research, resistance to dengue fever, the fight against AIDS: researchers are attempting to understand how the body reacts when attacked by disease.

Virology

DENGUE FEVER NOT THE SAME FOR ALL

Why do some people die after being infected by the dengue fever virus, while others only develop a mild version of the disease? It seems that the difference depends on the type of cell in the immune system that first comes into contact with the virus. If they are dendritic cells, they help the disease to spread, whereas in a dermal macrophage, the proliferation of the virus is inhibited.

Published in PLoS Neglected Tropical Diseases
Date 1 October 2008



MALARIA: THE FIGHT GOES ON

How does the parasite that causes malaria in pregnant women differ from the one that attacks children and adults? Finding the answer to this question won Benoît Gamain the 2008 CNRS Bronze Medal. Gamain

identified the gene which codes for the protein that causes this parasitic infection in pregnant women.

Awards
2008 Bronze Medal

Oncology

VIRAL PROTEIN TURNS INTO ANTICANCER AGENT

Researchers have recently shown that the mutation of a single amino acid can turn the E6 viral protein that causes cervical cancer into its opposite number, namely a tumor suppressor factor that specifically blocks the proliferation of cancer cells. This result shows how tenuous the frontier is between the molecular mechanisms that lead to the proliferation or death of cancer cells.

Published in Oncogene
Date 17 November 2008 online



> Computer graphic of the AIDS virus.



> Luc Montagnier and Françoise Barré-Sinoussi, joint discoverers of the AIDS virus, were awarded the 2008 Nobel Prize in Physiology or Medicine.



THE NOBEL PRIZE GOES TO THE DISCOVERERS OF AIDS

Françoise Barré-Sinoussi and Luc Montagnier have been awarded the Nobel Prize in Physiology or Medicine for their work which in 1983 led to the discovery of the retrovirus that causes AIDS. The journey that led to the isolation of the AIDS virus began in December 1982, when research got under way at the Institut Pasteur's Viral Oncology Unit directed by Montagnier. Most of the work on the new virus was carried out by Barré-Sinoussi. In January 1983, the scientists worked on the first lymphatic biopsy of a patient with 'generalized lymphadenopathy', in other words before the appearance of acute immune deficiency. In May 1983, the first description of the AIDS virus, which at that time the team called 'Lymphadenopathy Associated Virus' or LAV, was published in the journal *Science*.

Luc Montagnier is now Emeritus Professor at the Institut Pasteur, honorary senior researcher at CNRS, and a member of the French Academies of Sciences and Medicine. He is also President of the World Foundation for AIDS Research and Prevention, set up in 1993 with Federico Mayor, former Director General of UNESCO. Together with his research activity, Montagnier has taken part in setting up several biotechnology companies in the US and in France. In the course of his career, he has won many awards, including the CNRS Silver Medal and the Rosen Prize for Oncology. He is also a Commander of the Légion d'honneur and a Commander of the French National Order of Merit.

Françoise Barré-Sinoussi is a member of the French Academy of Sciences, a Professor at the Pasteur Institute, and a senior researcher at INSERM. She runs the Regulation of Retroviral Infections Unit at the Institut Pasteur. She is also President of the ANRS Scientific Board, and leads the Southeast Asia ANRS research site. Barré-Sinoussi has set up numerous partnerships with the countries that have been most severely affected by the HIV/AIDS epidemic, especially via the Institut Pasteur's International Network.

Awards

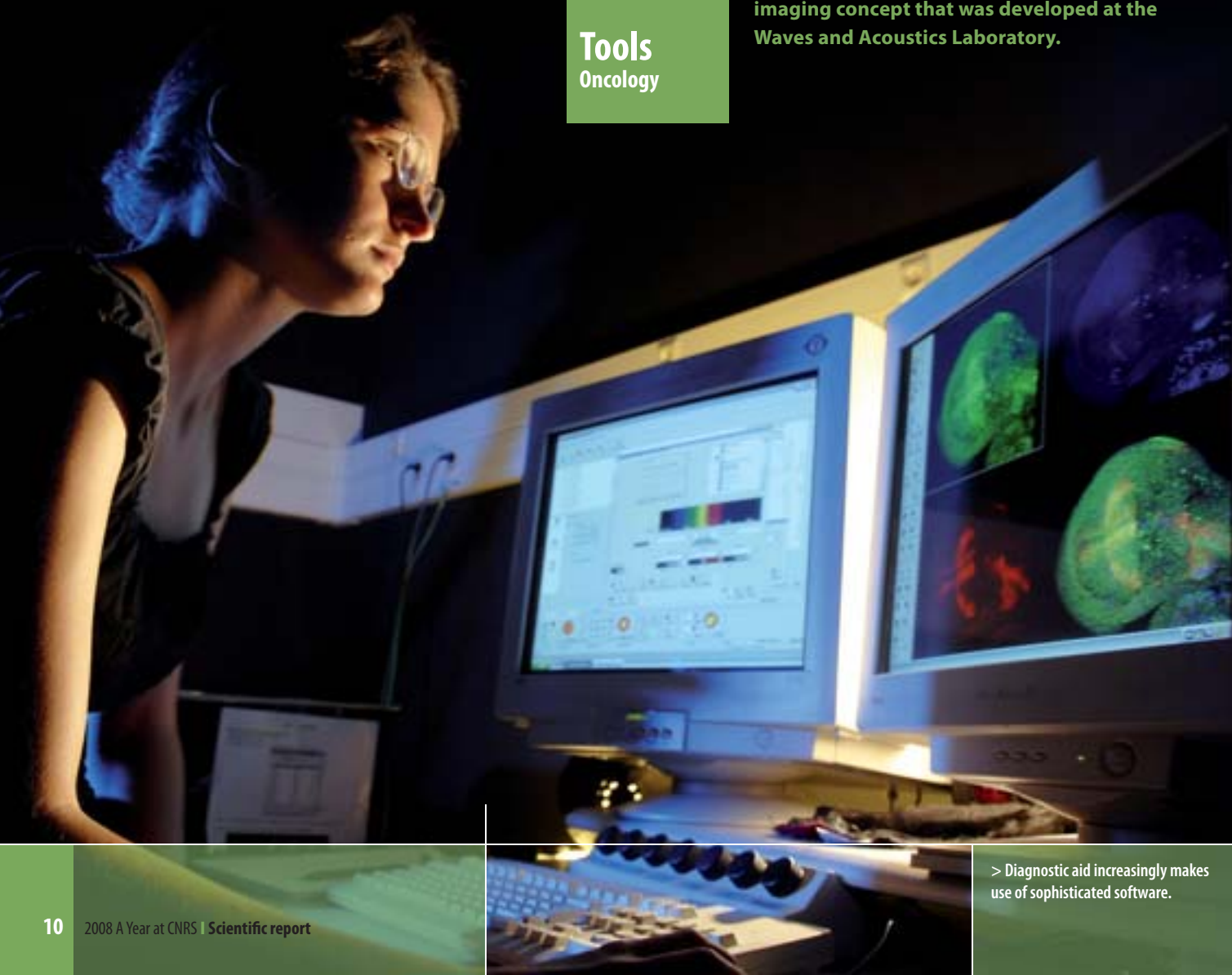
Using imaging for diagnosis

Locating an area affected by disease, detecting tumor cells, diagnosing a pathology earlier: these are some of the challenges that CNRS researchers are meeting successfully. Diagnosing disease early, rapidly and reliably is key to developing effective treatment.

ULTRASOUND USED TO SPOT TUMORS

Marketed by the firm Supersonic Imagine, the Aixplorer ultrasound system now makes it possible to precisely measure the elasticity of tissue inside the human body. It can therefore easily spot harder areas that may turn out to be tumors. More specifically aimed at detecting breast cancer, the ultrasound system uses a multiwave imaging concept that was developed at the Waves and Acoustics Laboratory.

Tools
Oncology



> Diagnostic aid increasingly makes use of sophisticated software.



> Images processed by Neurinfarct, software that makes it possible to predict the development of strokes.

Strokes

AN MRI SCAN FOR USE IN EMERGENCIES

In the first few hours that follow a stroke, an entire region of the brain is at risk of undergoing irreversible lesions. A new MRI technique enables the potential seriousness of a stroke to be predicted by showing the extent of the area affected. This approach could well become an essential tool in helping to decide on appropriate emergency treatment, since if the area affected is known, it can be treated and saved, thus avoiding disability.

Published in Radiology
Date 18 November 2008 online

Oncology

NANOPARTICLES TO IMPROVE DETECTION OF TUMORS

It will soon be easier to detect tumor cells thanks to newly synthesized porous nanoparticles. These particles are able to absorb energy from two photons in the near infrared and re-emit by fluorescence radiation which is then used for medical imaging. They should enable more precise detection of tumor cells, since they can explore tumors in greater depth and without damaging the tissue.

Published in Chemistry of Materials
Date 25 March 2008

Imaging

TARGETING DISEASE WITH MRI

How can MRI be used to identify a specific disease in a patient? The method developed by researchers in two CNRS teams at Orléans and Gif-sur-Yvette makes use of an enzyme whose reactions are the mark of a specific disease. They had the idea of developing a contrast molecule which, instead of increasing the contrast between healthy and diseased tissue on the basis of the difference in density of the tissue, bonds specifically to an enzyme that is present in unusually large amounts in the event of disease. In the presence of the enzyme, the contrast agent is activated. It thus reveals not only whether the patient is affected by the disease in question, but also makes it possible to locate the areas of the body concerned.

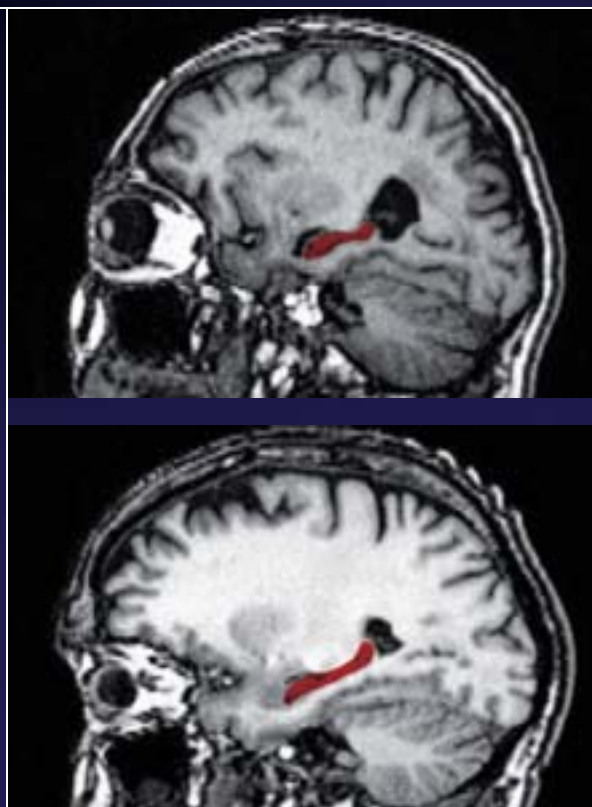
Published in Angewandte Chemie International Edition
Date 26 May 2008

Alzheimer's

SOFTWARE FOR EARLY DIAGNOSIS

New image processing software can be used to make a three dimensional reconstruction of the structures of the brain and calculate their volume on the basis of a simple MRI scan. In particular, it makes it possible to measure automatically the volume of the hippocampus, a brain structure that undergoes atrophy in the first stages of Alzheimer's disease. In collaboration with researchers at INSERM, the software was successfully used to distinguish between patients affected by Alzheimer's and healthy individuals of the same age. This process, which only requires a few minutes, will enable the disease to be detected earlier and thus improve treatment.

Published in Radiology
Date July 2008



> At top, the hippocampus of a patient suffering from Alzheimer's is atrophied. That of a healthy subject, at bottom, is normal.

Weapons to fight diseases

A double agent and metals to fight cancer, a protein that blocks the hepatitis C virus at the entrance to the cell, improved repair to neuronal connections: work carried out by CNRS researchers is leading to some highly ingenious medical applications.

Neurology

A PEPTIDE THAT PUTS NEW LIFE INTO THE BRAIN

Quality is better than quantity. That's an adage that also applies to brain repair following injury. With the BDNF peptide, it is possible to bring about the creation of new neuronal connections which, although small in number, hit the right targets. Researchers have shown that the endings of the new connections interact with the network of undamaged neuron cells and restore functions that are associated with them, such as synchronized motion and movement through space.

Published in Brain
Date 1 April 2008

> New neuron connections (in red) on a Purkinje cell in the brain of a rodent (in blue).

Oncology

METALS VERSUS TUMORS

Chemists and biologists have identified the activity of a new class of molecules, the polyoxometallates, which are composed of metals and oxygen. Such molecules specifically inhibit the protein kinase CK2, an enzyme that is hyperactivated in many cancers. These new 'metallic' molecules, which are effective at very low concentrations, could open the way to the design of new anticancer drugs.

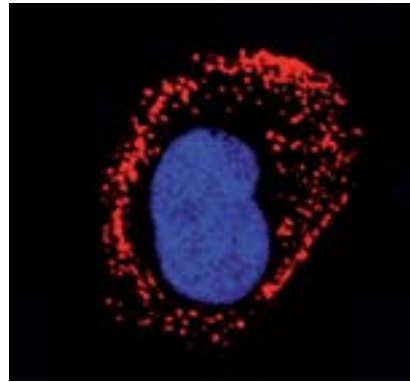
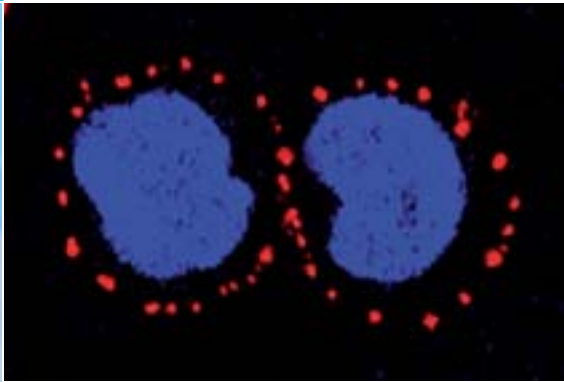
Published in Chemistry and Biology
Date 21 July 2008

Immunology

AN ANTI-LUPUS PROTEIN

A protein fragment, the P140 peptide, may be able to restore the normal state of the immune system in people suffering from systemic lupus erythematosus, a chronic, autoimmune inflammatory disease. Whereas current treatments are only palliative and often have severe side effects, the P140 peptide has produced encouraging results during initial clinical trials on humans.

Published in Arthritis & Rheumatism
Date December 2008



> Left: HB-19 (in red) binds to the nucleolin expressed at the surface of human breast carcinoma cells. Right: after one hour of incubation, HB-19 spreads into the cell, but without entering the nucleus (in blue).

Oncology

NEW MOLECULE HITS TUMORS TWICE

Researchers have studied a molecule called HB-19 which not only blocks the proliferation of cells from various human tumors, but also stops tumor angiogenesis, in other words the formation of networks of capillaries that feed cancer cells. Behind the design of this drug was the observation that surface nucleolin, a protein that acts as a growth factor receptor, is present in large amounts in tumor and endothelial cells. Inhibiting it therefore appears to be a promising avenue of research for anticancer therapy. When the researchers injected HB-19 into mice into which human tumor cells had been grafted, they observed significant slowing of tumor development, or even in some cases eradication of tumor cells. Another significant advantage of this anticancer drug is its lack of tissue toxicity.

Published in PLoS ONE
Date 18 June 2008

Virology

A PROTEIN THAT SHORT-CIRCUITS HEPATITIS C

In order to enter liver cells and infect them, the hepatitis C virus (HCV) uses at least three cell receptors. So why not keep the virus out by preventing it from recognizing one of the receptors, the CD81 receptor? This is just what happens when the CD81 protein is associated with the EWI-2wint protein: the virus no longer recognizes the receptor and is inhibited right at the beginning of its infection cycle.

Published in PLoS ONE
Date 2 April 2008

Stéphanie Pitre, a physicist and researcher at CNRS, has won the 2008 'Femme en Or' and 'Engineer

of the Year' awards for her work in medical imaging, and especially for the design of an

Awards

A physicist honored

innovative mini-camera dedicated to the surgical treatment of cancer.



Immunology

A NEW AVENUE OF RESEARCH IN THE FIGHT AGAINST AIDS

A new avenue of research is currently being explored in the fight against AIDS. The replication of the virus can be blocked by means of synthetic RNA molecules that bind strongly to a viral regulatory sequence, forming a complex structure called a 'kissing complex'. By using innovative nuclear magnetic resonance tools, researchers have worked out precisely how this binding takes place, and defined the parameters that are essential for its stabilization. This key information will make it possible to synthesize even more effective anti-HIV RNA.

Published in Proceedings of the National Academy of Sciences
Date 8 July 2008

Looking back. at our **Origins**

What role did North Africa play in the history of human populations? Why and how did the Neanderthals disappear? How old is Toumai? Are Pygmies and Bantus genetically far apart? Questions about our origins are still of great importance today. CNRS is helping to find the answers by actively taking part in excavations and wide-ranging multidisciplinary studies.

> An Aka pygmy woman preparing a caterpillar kebab.

Ecoanthropology

BANTUS AND PYGMIES SHARE THEIR GENES

The histories of the Pygmies and Bantu farmers in Central Africa are closely intertwined. A study based on the population and genetic history of both groups shows that they started to diverge from a common ancestral population no more than 70,000 years ago. After a period

of isolation from each other, the two groups have for the last 40,000 years been exchanging their genes again, via the marriage of pygmy women with male farmers. These results could serve as a basis for a study of the impact of sedentism on the evolution of the genome.

Published in Proceedings of the National Academy of Sciences
Date 5 February 2008



> Map of the hamlet of Saint-Privat, in the district of Flaugnac, in the eighteenth century.

Medieval history

CONNECTING PEOPLE

Is networking the key to success? There's nothing new about the idea. The medieval peasantry was already made up of 'small worlds' connected to each other by individuals who acted as go-betweens. These surprising results were obtained by sifting through thousands of agrarian contracts concluded between 1240 and 1520 in a parish in the French department of the Lot. This work was made possible by the use of mathematical and computing tools.

Published in Nature News
Date 19 May 2008



Awards
2008 Silver Medal

CHARCOAL UNLOCKS ARCHEOLOGICAL SECRETS

Right from the start of her career, Stéphanie Thiébault, winner of the 2008 CNRS Silver Medal, has been getting her hands dirty with charcoal. Thiébault is an archeo-paleobotanist, and makes use

of the remains from fires to study past environments. Our ancestors used wood that was immediately available in the vicinity to make their fires. So studying the resulting charcoal makes it possible to find out which plants were around at the time. From this, it is possible to infer information about the relationship between humans and their environment, and sometimes about the history of climates.



> The French-Moroccan team at the site of the Thomas I quarry in Casablanca.

Prehistory

AN EVEN OLDER *HOMO ERECTUS* FOUND IN MOROCCO

A complete jaw-bone of *Homo erectus* has been discovered in a quarry (Thomas I) in Casablanca, Morocco. The French-Moroccan team had already found four human teeth of *Homo erectus*—one of which was dated to 500,000 years before present—together with carved stone tools characteristic of the Acheulean. The jaw-bone was found in a stratum underlying that where the teeth were found, and is therefore the oldest human fossil found in scientific excavations in Morocco. The morphology of the jaw-bone is different from those discovered in Tighenif (Algeria), which enabled the North African variety of *Homo erectus* to be defined. This makes the Thomas I quarry one of the most important prehistoric sites for the understanding of Northwest Africa's first populations.



> Discovery of the oldest human fossil discovered in Morocco, a jaw-bone of *Homo erectus*.

Archeology

TOUMAI REALLY IS SEVEN MILLION YEARS OLD

How can Toumai, the oldest hominid ever discovered, be dated absolutely? The archeological sites are so old that conventional dating methods based on carbon-14 are of no use. So researchers have developed a new application of a method based on beryllium-10, whose half-life is much longer than that of carbon-14. This has confirmed that Toumai really is 7 million years old.

Published in Proceedings of the National Academy of Sciences
Date 27 February 2008 online

Paleoclimatology

NEANDERTHALS VICTIMS OF *HOMO SAPIENS*

It doesn't look as if the Neanderthals were killed off by the climate after all. Present in Europe 40,000 years ago when modern humans arrived, the Neanderthals disappeared after a period of cohabitation. A multidisciplinary team from France and the US used a novel method to eliminate worsening climate as a possible cause for their disappearance. The researchers reconstructed the climate of the period and identified the sites occupied by the last Neanderthals and the first modern humans with GARP, an algorithm more commonly used to predict the impact of climate change on biodiversity. This enabled the researchers to understand the role of the climate in the distribution of the areas occupied by Neanderthals and modern humans, which led them to conclude that it was actually competition with *Homo sapiens* that probably caused the extinction of the Neanderthals.

Published in PLoS ONE
Date 24 December 2008

Technology unlocks the secrets of ancient art

New technologies are helping us to understand the cultural treasures of the past, whether by revealing the existence of drawings on the back of one of Leonardo da Vinci's paintings, or by accurately dating the building of Mont Saint-Michel.



> Archeologists filling in the holes made by the removal of core samples from bricks at Mont Saint-Michel for dating.

Dating

NEW DATING TECHNIQUES PIN DOWN THE AGE OF MONT SAINT-MICHEL

The abbey of Mont Saint-Michel dates from the tenth century. Previous estimates of its age ranged all the way from the eighth to eleventh centuries. To obtain this result, archeologists used two powerful methods. Thermoluminescence dating is based on the fact that quartz grains in bricks record the moment at which these were baked, while archeomagnetism uses iron oxides present in clay to reconstruct the direction of the Earth's magnetic field at the time the oven cooled down. Since the Earth's magnetic field varies from year to year, this makes it possible to work out exactly when the material was heated. These techniques are a real improvement, since until they came along the only available technique for dating buildings was carbon-14, which is very reliable for dating charcoal in mortar, but could not be used for dating bricks, roof tiles and floor tiles.

> General view of Mont Saint-Michel.



> *The Virgin and Child with St. Anne*, by Leonardo da Vinci.

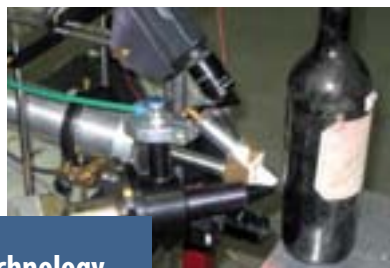


> On the other side of Leonardo's masterpiece, three sketches, seen in infrared reflectography, have the art world intrigued.

Mosaic

A ROMAN WORK OF ART IN GAULISH TERRITORY

With an area of 36 square meters and a wide range of colors, the mosaic brought to light on the Colline de l'Ermitage in the southern French town of Alès is an exceptional discovery. It dates from 50 BC, at a time when this Gaulish town was also a trading post on the frontier with the neighboring Roman province. Uncovered in a house that undoubtedly belonged to a rich Gaul, the mosaic is further evidence of Roman influence and exchange between the Roman and Gaulish worlds.



Technology transfer Dating

> Ions beamed onto the glass of a bottle of vintage wine make it possible to authenticate it.

DATING BOTTLES AUTHENTICATES VINTAGE WINES

Authenticating bottles to find out the age of the wine is the method proposed by Arcane, the technological transfer unit at the Centre d'études nucléaires in Bordeaux Gradignan. When the bottles are placed under an ion beam they emit X-rays which reveal their age. Authentication is possible because of the way in which the complexity of the glass manufacturing process has evolved over time.

Art

A NEW DA VINCI MYSTERY

Who made the drawings on the back of one of Leonardo da Vinci's paintings, *The Virgin and Child with St. Anne*? A curator who was taking down the heavy oil painting discovered two faint sketches on the back. The Centre for Research and Restoration of the Museums of France lost no time in analyzing the drawings with the help of an infrared reflectographic camera. A distinctive feature of infrared radiation is that it increases the degree of absorption by carbon-based pigments, which were usually used for preparatory drawings, thus revealing lines that are invisible to the naked eye. Eventually, three drawings appeared: a horse's head, half a skull, and the infant Jesus playing with a lamb. Although the style of the drawings is reminiscent of Leonardo, research is continuing in order to shed light on their origin.

Culture is an open book

The cultural wealth of a society can also be revealed through its books. In any case, books are one of the vehicles used by CNRS researchers to enable us to share their analyses of all our doings. Our language, bodies, food, even the TV: they're scrutinizing our every move!

Books

La plus belle histoire du langage (The Wonderful Story of Language)

In the light of recent discoveries, three leading researchers and storytellers retrace the history of language from the very first fossils to babies' brains. True to the style of the 'La plus belle histoire' collection, this is a fascinating account within the reach of the general public.

Authors Pascal Picq, Laurent Sagart, Ghislaine Dehaene and Cécile Lestienne
Published by Seuil, collection 'Essai'
Date January 2008

Éternelles coupables **Les femmes criminelles de l'Antiquité à nos jours** (Eternally guilty: Female criminals from antiquity to the present day)

Doubtless because violence removes women from their traditional role—as mothers and symbols of peace and gentleness—crimes committed by women are viewed and presented by society as doubly criminal. Historians, art specialists, and legal and political experts have joined forces to study how society's view of female criminals has changed, referring to over a hundred reproductions of works of art, newspapers and posters.

Author Myriam Tsikounas (ed.)
Published by Autrement
Date March 2008

Les lucarnes de l'Europe : Télévisions, cultures, identités, 1945-2005 (Europe's small screens: Television, culture, identity, 1945-2005)

Has television been a major player in Europe? Has a genuinely European radio and television emerged? And if so, is it helping to build a European culture and forge a new European identity? The authors offer no simple answers to these questions, but use a novel approach to analyze the various models of television and how they have changed, the difficulty of bringing together television, culture and Europe, television programs and crises, etc.

Authors Marie-Françoise Lévy and Marie-Noëlle Sicard (eds)
Published by Publications de la Sorbonne
Date September 2008





Awards

Two sociologists honored

The seventh Irène Joliot-Curie Prize was awarded in 2008 to two researchers in humanities and social sciences, Katell Berthelot and Catherine Marry. Berthelot was awarded the 'Young Female Scientist' prize for her work on the relationships that Jews and non-Jews maintain with the 'promised land'. And Marry was awarded the 'Prix du Mentorat' for her activity in promoting female scientists, working together with various organizations including the CNRS Mission for the Place of Women.

Le dictionnaire du corps (Dictionary of the Body)

In a society where the body is increasingly represented as an object, this book, a new updated edition of the Dictionnaire du corps en sciences humaines et sociales (Dictionary of the Body in the humanities and social sciences), offers the general public a fresh approach. The body can be seen as a 'political' body, resulting from the emotional impact of a competitive society that sidelines the real body, which is 'vulnerable, and still fragmented and exploited'. An essential guide for anyone who wants to recover a taste for harmony between matter and mind, and between nature and culture.

Authors Bernard Andrieu, Gilles Boëtsch (eds)
Published by CNRS Éditions
Date March 2008

Manger Français, Européens et Américains face à l'alimentation (Food: dietary habits in France, Europe and the US)

The fruit of a project proposed to the scientific board of the Observatoire des habitudes alimentaires (Observatory of French Dietary Habits), this book reports the results of a qualitative and quantitative international survey carried out from 2000 to 2002 about dietary attitudes in Europe (France, Italy, Switzerland, Germany and the UK), and in the US. It presents an up-to-the-minute overview of diet and its links to health and the body.

Authors Claude Fischler and Estelle Masson (eds)
Published by Odile Jacob
Date January 2008

Aux origines des théories raciales De la Bible à Darwin (The Origins of Racial Theories. From the Bible to Darwin)

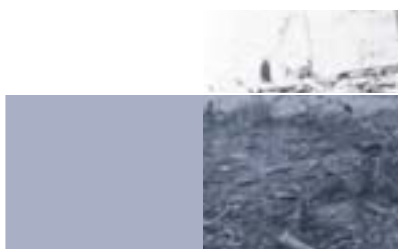
The epistemologist André Pichot proposes a historical and social perspective on Darwinian theories. The book takes an opposing view to a number of commonly held ideas, and in particular explains the basis for eugenic and racist ideologies by showing that «by 1900 all the ideological and racist underpinnings that the twentieth century was to make use of so tragically were already firmly in place».

Author André Pichot
Published by Flammarion
Date September 2008

Birthday

CLAUDE LÉVI-STRAUSS CELEBRATES HIS HUNDREDTH BIRTHDAY

On 28 November 2008, Claude Lévi-Strauss, holder of the CNRS Gold Medal, celebrated his hundredth birthday. An ethnologist and a tireless theoretician of human societies, Lévi-Strauss is the father of structuralism, a method borrowed from linguistics which has influenced contemporary thinking.



> Claude Lévi-Strauss on an expedition to Brazil. Lucinda, the little monkey that became his pet, got into the habit of clinging onto one of his legs.

Developing computer tools

Computing is everywhere in our day-to-day lives. Researchers are hard at work helping to make our computers and software more effective and creative.

Large facilities

FRANCE, A MAJOR COMPUTING POWER

207 teraflops, in other words hundreds of thousands of billions of calculations per second. This is the staggering number of operations that CNRS's new computing platform is able to carry out. Since 2000, CNRS, via its national computing center IDRIS (Institute for Development and Resources in Intensive and Scientific Computing), has been working in partnership with IBM to provide researchers with ever more powerful intensive computing capability. The processing power

provided by the new platform will make it possible to tackle extremely complex scientific problems that require simulations or calculation of probabilities, such as global warming, complex living systems or the combustion of hydrocarbons. These 207 teraflops put France into first place in Europe and among the international frontrunners in scientific computing power.

HIGH-PERFORMANCE COMPUTING

CNRS's Institute for Development and Resources in Intensive and Scientific Computing (IDRIS) and the 'Research and Technology' Computing Center at the French Atomic Energy Agency (CEA), now connected by an ultra-high speed link, have come together to form the 'Jacques-Louis Lions National Center for High-Performance Computing in Essonne'. Joining forces in this way puts France in the running to host one of Europe's first petaflop supercomputers.

> The processing power of computers is becoming ever greater. Here, it is being used to display the movements of a person's eye as they watch video images.

SOFTWARE HELPS STUDENTS WITH EXAM REVISION

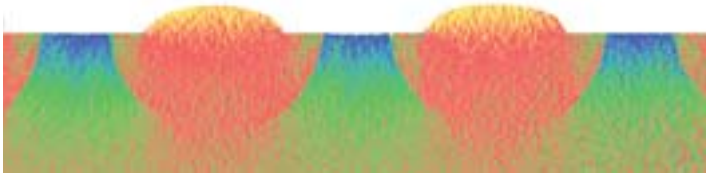
To study for their Baccalauréat exam, French secondary-school students now have a helping hand in the form of LyText.

Software

This software package aimed at preparing the Baccalauréat exam in French language enables students to manipulate literary texts interactively: the interface

provides information about the selected text, and helps the student to unravel its meaning. Designed as a revision tool for students, the method also aims to be an aid to teachers in preparing their lessons.





> Observation of deformations in a crystal using electron holography: in blue, regions of compression; in red, regions of tension.

Engineering

SILICON UNDER CONTROL

Microprocessors are faster when the silicon of which they're made is strained, since local deformation in the crystal lattice increases electron mobility. Physicists have recently developed a new technique based on electron holography which enables crystal deformation in numerous materials to be measured with a precision exceeding 0.1% and with spatial resolution on the nanometer scale. This is a major innovation, as until now manufacturers were unable to measure the deformation and had to rely mainly on simulations when designing chips, without ever truly knowing the strain state. As well as being extremely precise, the technique, patented by CNRS, makes it possible to directly analyze areas that are ten times larger than before (a micrometer as opposed to ten nanometers) with a level of precision never before attained.

Published in Nature
Date 19 June 2008

SUCCESS STORY FOR GENETICS SOFTWARE

With over a thousand citations in 2008, the article dedicated to the PhyML algorithm for phylogenetic reconstruction has joined a very select club, since fewer than 25 articles published since 2003 in any discipline have reached this total. The article describes a rapid and precise algorithm in a user-friendly software package that can be used to reconstruct the evolutionary history of sequences of DNA or proteins.

Publications

Computing

CONCENTRATED MEMORY

How can DRAM memories be miniaturized even further? By doing away with the capacitor and using the body of the transistor for storage. On the basis of this idea, researchers have developed a new memory concept, 'MSDRAM', which uses an SOI (silicon-on-insulator) transistor. The coupling between the two gates of the transistor is used to differentiate between the 0 and 1 states. The main advantages of this memory, which has been patented by CNRS, are its low consumption and extreme miniaturization.

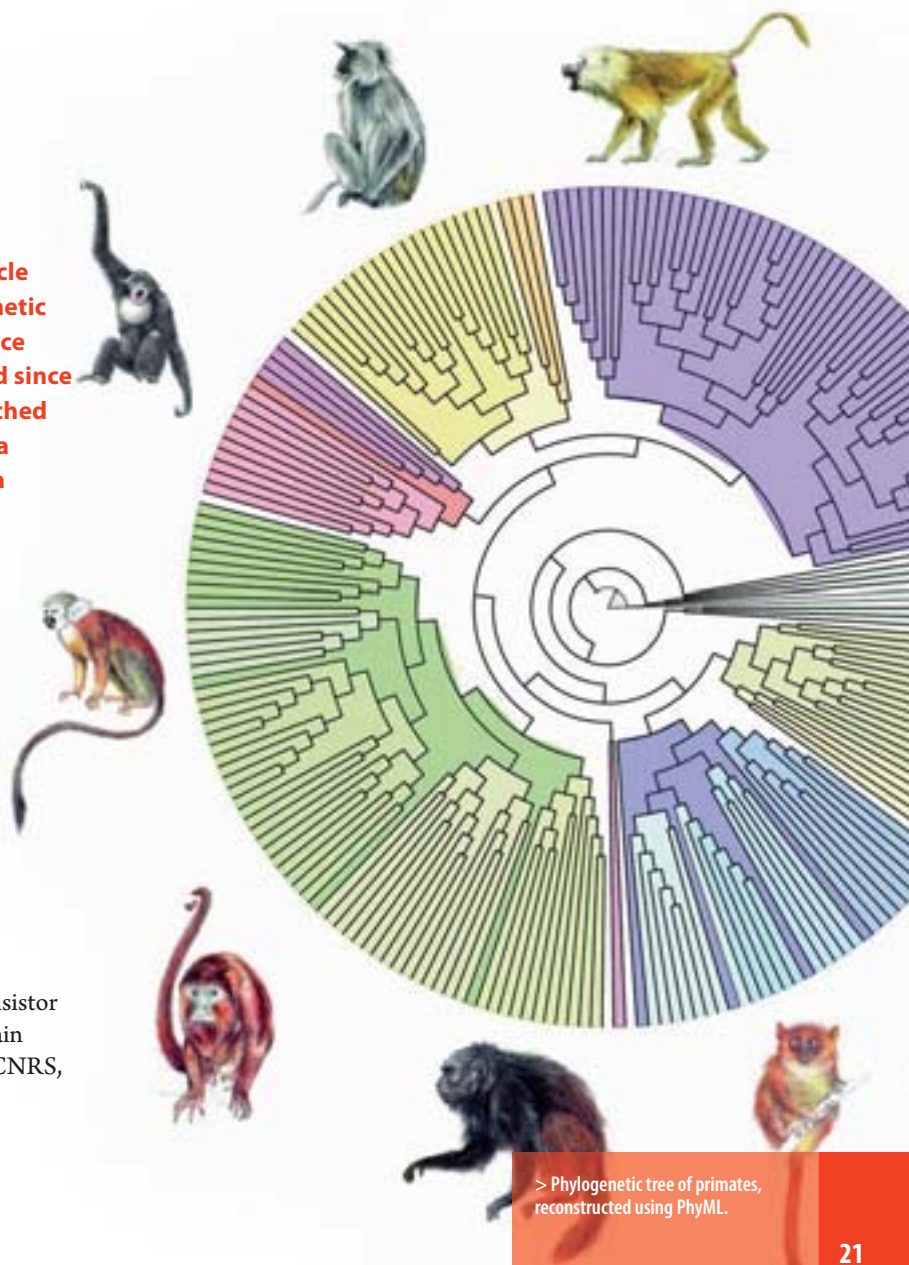
Published in IEEE Electron Device Letters
Date July 2008

Awards

Two mathematicians honored

CNRS MATHEMATICIANS WIN INTERNATIONAL AWARDS

Aged just 29, Artur Avila, a senior researcher at CNRS, has been awarded the European Mathematical Society prize for his work on the theory of dynamical systems. And the Clay Prize has gone to Claire Voisin, senior researcher at CNRS, for her work on complex algebraic geometry.



> Phylogenetic tree of primates, reconstructed using PhyML.

Ingenious engineering

Manipulating and characterizing molecules, using the iris for identification, fighting fires, imitating the way eels swim: there seems to be no limit to the ingenuity of the techniques developed by CNRS.

FIREFIGHTING RESEARCHERS

Code names: Fire Code and Hydroleme.

Mission: fighting forest fires. Fire Code is a software program that integrates ground topography, vegetation and wind to predict the spread of a forest fire. Hydroleme is based on the measurement of the moisture content

of plants in order to assess the risk of fire. Hopefully, this software will lend a helping hand to firefighters in the South of France.

Software



> View of a section of the robot eel and its skin.

Biomechanics

ROBOT EEL TAKES TO THE WATER

Champagne corks were popping after the success of the robot eel's first test in the water on 26 November 2008. Taking its inspiration from the morphology of the eel, the robot is made up of platforms assembled in parallel, stacked rather like a fish's vertebrae. It was an important stage in a project that aims to make a submarine robot capable of swimming in three dimensions in extremely restricted environments such as piping in nuclear power plants.

| **Conference** 7th IFAC World Congress

| **Date** 6-11 June 2008

| 32nd Annual Mechanisms and Robotics Conference

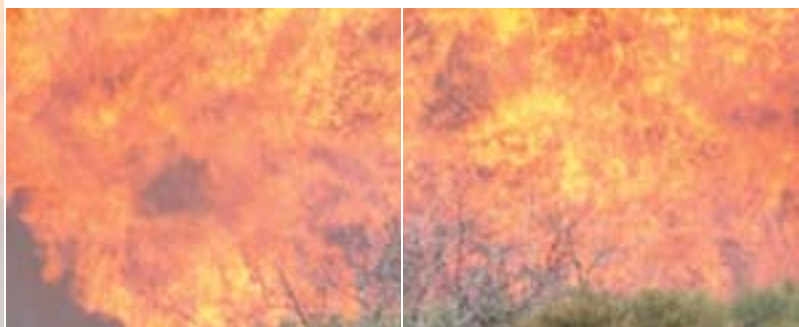
| 3-6 August 2008

Thermochemistry

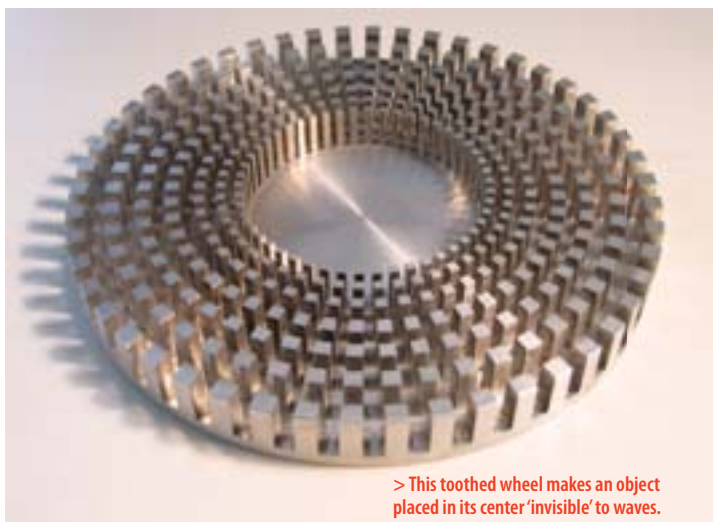
IMPROVED SIMULATION OF FUEL OXIDATION

There has been a major step forward in the understanding of emissions of nitrogen oxides, air pollutants that impact health and the environment. The burning of hydrocarbons involves hundreds of chemical species in thousands of successive reactions. In these conditions, how is it possible to predict the amounts of nitrogen oxides produced in the oxidation reactions of such fuels? Until now, it was hard to find the answer to this question with conventional numerical simulations, since nitrogen oxides are produced in two stages: very rapidly during the oxidation of hydrocarbons, and then at high temperatures in the burning gases. Now, researchers in Rouen have managed to integrate both production pathways in a new numerical simulation model of turbulent combustion.

| **Symposium Date** 32th International Symposium on Combustion 2008
4-8 August 2008



> Controlled burning in the Gard department in southern France, being used to test the Fire Code system for fighting forest fires.



> This toothed wheel makes an object placed in its center 'invisible' to waves.

Waves

PROTECTION AGAINST WAVES

How can waves be diverted from an object? Or put another way, how can that object be made invisible to their wrath?

One answer is to place the object in the middle of a structure that looks rather like a large toothed wheel, which deflects waves around its center, where the water is totally calm. Because of the material used, a metamaterial, the waves are guided and their tangential velocity accelerated as they approach the center. They thus behave rather like water in a river, which flows around a rock and recovers its normal flow downstream as if the rock had never existed. Invisibility to waves had already been demonstrated for electromagnetic waves; it has now been shown to be possible for waves of a completely different nature. The structure, which is made up of rigid pillars, could open up new approaches for the protection of maritime facilities and port infrastructures.

Published in Physical Review Letters
Date 25 September 2008

Applied optics

A LASER THAT TRIGGERS LIGHTNING

Being able to trigger lightning might sound like the dream of a mad inventor, but the day's not far off when we'll be able to do it. Thanks to the Teramobile laser, the most powerful mobile laser in the world, researchers have succeeded in creating microdischarges in a storm cloud. The next step will be to increase the power of the laser tenfold, which will at last make it possible to spark off lightning. The ultimate goal is to protect vulnerable facilities by deflecting lightning towards other points of impact.

Published in Optics Express
Date 14 April 2008

> Lightning observed from the Langmuir laboratory in the United States.

Biometrics

SMILE, YOUR IRIS IS BEING FILMED

It's possible to identify someone from their iris. But first you have to get a picture of it. So researchers have suggested replacing the camera that is normally used—which often requires several shots to be taken—by a movie camera, associated with a 'real time' algorithm, and selecting the best pictures of the iris from the video images as they come in. The system should hopefully prove much less inconvenient for users.

Published in Machine Vision and Applications Journal
Date October 2008

Bioengineering

A BIOSENSOR THAT DETECTS BIOMOLECULES

Researchers have created a new generation of biosensors that can detect a tiny amount of biomolecules and indicate their presence by means of an electrical signal. This gives them a key advantage when it comes to incorporating them into miniaturized electronic systems. Such biosensors have a promising future as in vitro diagnostic tests.

Published in Nature Nanotechnology
Date 1 October 2008

Microelectronics

MANIPULATING MOLECULES WITH TWEEZERS

Can molecules be directly manipulated? Well yes, they can, thanks to some recently created nanotweezers made of silicon. Made up of two arms that end in fine points facing each other ten micrometers apart, this microsystem can be used for the biomechanical characterization of molecules, thanks to the application of an intense electrical field. This technological innovation could well prove to be useful in numerous biological tests.

Published in Journal of Microelectromechanical Systems
Date June 2008

Optics treads the light fantastic

Photons, vision, and imaging are some of the many facets of light that optics research is enabling us to understand and control.

Optics

A LIQUID OPTICAL FIBER

Physicists have used a theoretical model they developed to create a liquid fiber whose one millimeter length is a hundred times greater than its diameter. This is quite an achievement, since a cylinder made up of fluid normally breaks up as soon as its length exceeds its diameter. The geometry of the liquid fiber is stabilized by shining an intense beam of light through it.

Published in Physical Review Letters
Date 30 June 2008

Imaging

MOLECULE, SHOW THYSELF!

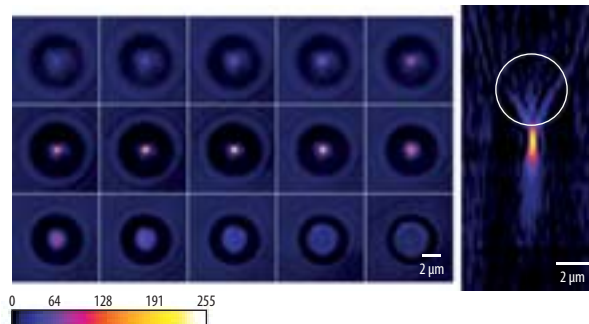
It's more compact, and it's cheaper: those are two of the advantages of a new multi-shot imaging technique. It makes use of miniature nanosecond laser sources combined with microstructured optical fibers. The system, which is based on the response of a biological sample to optical excitation, makes it possible to simultaneously identify several chemical compounds with a high degree of sensitivity.

Published in Optics Letters
Date 1 May 2008

> Compact laser system developed for a new multi-shot imaging technique.

> Detail of an integrated optical component for interferometry in astronomy.

> Photonic nanojets produced by a ball five micrometers in diameter.



OPTICAL SANDWICH EXPERT

The thing that interests Guillaume Rogez, a winner of the 2008 CNRS Bronze Medal, is making multifunctional hybrid materials with magnetic and optical properties. That's quite a

challenge, since it means grafting organic molecules that have optical

properties such as fluorescence between inorganic layers of magnetic materials. Or put another way, he makes optical sandwiches.

Awards
2008 Bronze Medal



Photonics

PHOTONIC NANOJET STEALS THE SHOW

We now have the first ever images of photonic nanojets. These beams, which are obtained when a ball with a micrometer-scale diameter is illuminated, have unusual optical properties, exceeding those predicted by conventional optics. By using a novel confocal microscopy system, the researchers were for the first time able to view the nanojets, what's more in 3D, and show that they could significantly improve the sensitivity of optical microscopes.

Published in Optics Express
Date 12 May and 15 September 2008

Physics

PHOTONS CAUGHT OUT TANDING STILL

Can light be frozen just by observing it? Yes, say researchers who have made use of the 'quantum Zeno effect', named after a paradox first set forth by the Greek philosopher Zeno. If a measurement is carried out on a physical system at the quantum scale, the system momentarily 'freezes' into a given state. And if several measurements are made at extremely short intervals, the system remains trapped in the state in question. The light well to which the physicists transposed this principle is a microwave cavity, which is a box with reflective walls that fills up with photons when it is placed in a microwave field. Everything is perfectly normal until the researchers reduce the time interval between their measurements of the number of photons. When the interval is down to 0.2 seconds, the number of photons stops increasing. In other words, by observing the cavity frequently, the researchers have frozen its state. 'Freeze tag' quantum physics style!

Published in Physical Review Letters
Date October 2008

DIAMOND SENSITIVE TO UV

To meet the increasing need for electronic detectors that are sensitive to ultraviolet

but not to visible light, researchers have explored a promising technological avenue that relies on the use of diamond. Diamond is the only substance made up of just

one chemical element that, in addition to the remarkable physical and chemical properties for which it is famous, naturally has this property. A patent has been taken out jointly with Japan.

Patents

VISION ON ALL SCALES

On 7 March 2008, IN2P3/CNRS, Sagem Défense Sécurité (Safran Group), the Université Claude-Bernard in Lyon and the Université Louis-Pasteur in Strasbourg signed an agreement to set up an optics and extreme vision technology scientific consortium. The consortium aims to strengthen partnerships between its members with a view to carrying out

research in the fields of optics, optronics, microelectronics and associated instrumentation.

Scientific consortium

Exploring matter

Taking photographs of electrons with a laser, combining tomography and diffraction to better observe materials, developing a national microscopy network: nothing's left to chance at CNRS, and scientists use every technique available in order to scrutinize matter, dissect it and probe its innermost depths.

Heterogeneous materials

OBSERVING MATERIALS WITHOUT DESTROYING THEM

Physicians at CNRS and at the European Synchrotron Radiation Facility in Grenoble have developed a non-destructive diffraction tomography technique, which can be used to determine locally the composition of heterogeneous materials such as cements, minerals and bones. The researchers had the brilliant idea of combining the excellent spatial resolution of tomography with the ability to carry out quantitative analyses provided by X-ray diffraction, and they also had the know-how to pull off this technical feat.

Published in Nature Materials
Date 1 June 2008

Chemical reactions

A CATALYST OBSERVED IN ACTION

How can a catalyst's performance be improved? The first step is to understand how it works. This is no easy matter, since the intermediate products are numerous and extremely short-lived. However, by using nuclear magnetic resonance, chemists have succeeded in observing a tungsten-based catalyst at work during the synthesis of propene, a raw material of huge importance to the chemical industry. They were thus able to identify the intermediate products and show that they were an integral part of the catalytic cycle.

Published in Proceedings of the National Academy of Sciences
Date 26 August 2008

A TOOL TO MAP MATTER

The inauguration of an innovative microscope and the launch of a national platform: two events which mark the beginning of a new era for transmission electron microscopy (TEM) and atom probes in France. UltraSTEM, acquired by CNRS with the backing of the Council

of the Essonne department and the Université Paris-Sud, is one of today's most powerful transmission electron microscopes. It is in particular able to map the position of atoms within matter and determine the nature of their chemical bonds. It will be part of the METSA network, which was jointly set up by CNRS, the French Atomic Energy Agency (CEA) and the French Ministry of Higher Education and Research. This national network of platforms equipped with specific high-tech devices is both a means of stimulating French microscopy research and a structure for training and hosting teams from abroad. It builds on work in this field of physics that has already led to striking results in numerous disciplines.

Large
facilities



Matter and radiation

A LASER THAT PHOTOGRAPHS ELECTRONS

To photograph the electron clouds surrounding atoms you need to be able to generate and above all control incredibly short flashes of light. By using two laser beams—with the first one lining up the gas molecules that are to be photographed, and the second one exciting them—researchers have created an ‘adjustable flash’ on the scale of a billionth of a billionth of a second that will undoubtedly prove to be an invaluable tool for chemists.

Published in Nature Physics
Date 1 July 2008

Quantum physics

QUANTUM OSCILLATIONS UNDER OBSERVATION

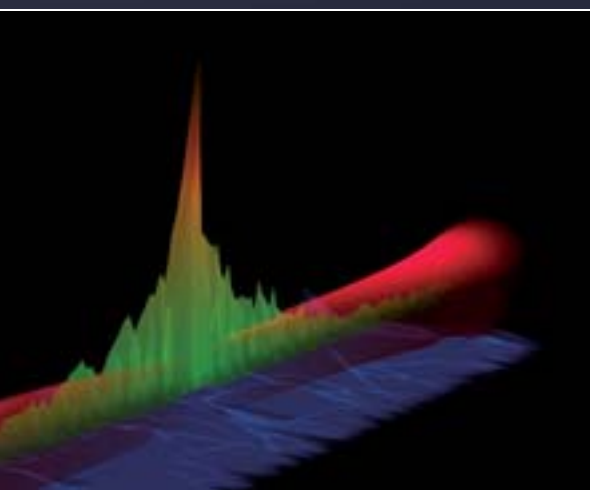
By creating a complex quantum system made up of large magnetic molecules, researchers in Grenoble have succeeded in observing it for a few microseconds. That’s no mean feat, since such systems usually lose their quantum character (their ability to be in two different states at the same time) as soon as they’re observed. This is a result that could eventually lead to the creation of a quantum molecular computer.

Published in Nature
Date 8 May 2008

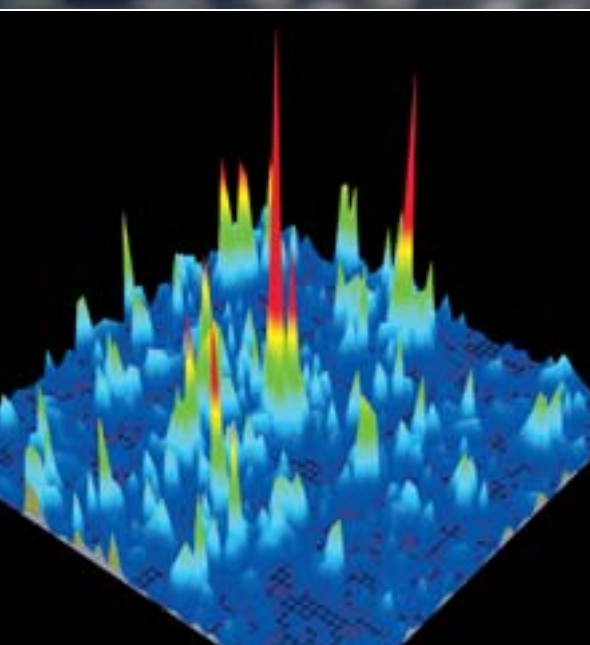
> X-ray spectrometer for surface characterization.

Understanding **matter**

Why do alloys age prematurely? How do amorphous materials flow? Under what conditions does a metal suddenly become an insulator? The properties of matter are studied from every angle, right down to the very heart of the atom.



> Observation of Anderson localization in one dimension for atomic waves. In green, the localization of atomic waves, brought to a halt by a slight optical disorder (shown in blue). In red, the light axis along which the atoms moved.



> Spatial distribution of sound intensity transmitted through a sample of aluminium beads. Very sharp peaks are characteristic of the Anderson localization regime.

Quantum physics

ELECTRONS HATE DISORDER

Three results have confirmed experimentally what Philip Anderson had predicted in 1958, and which won him the 1977 Physics Nobel Prize. When impurities are introduced into certain conducting metals they suddenly become insulating. Anderson considered that it was the disorder introduced by the impurities that stopped the movement of electrons. On a macroscopic scale, that's a bit like saying that a few blades of grass scattered haphazardly over a golf course could stop a full-speed golf ball in its tracks. It seems hard to believe. But that's what happens on microscopic scales, where matter can also behave like a wave. In a perfectly ordered solid, an electron moves freely without being disturbed by the underlying regular crystal structure. In disordered solids, however, any flaw will diffuse the matter wave in multiple directions. Combining all these disorder-generated waves can lead to a wave that does not propagate and remains frozen within the crystal. The electrons (or the atoms) stop moving which, in the case of electrons, turns the material into an insulator. The first experiment made it possible to directly observe the phenomenon in one dimension, and showed that sufficient disorder led to the complete immobilization of waves of ultra-cold atoms. Then, by using acoustic waves, the researchers observed this phenomenon, known as Anderson localization, in three dimensions. Finally, a third team was able to show how an increase in disorder leads to a gradual increase in resistivity. It has taken fifty years for the Anderson localization to be observed directly, making France one of the world leaders in this field.

Published in Nature Physics
Date 19 October 2008

Published in Nature
Date 12 June 2008

Published in Physical Review Letters
Date 15 December 2008



> Sample made up of aluminium beads 4.11 mm in diameter, used to study Anderson localization in three dimensions with acoustic waves.



Awards
2008 Silver Medal

NANOTUBE THEORETICIAN

Simulating all sorts of systems described by quantum physics is the main theme of Xavier Blasé's research. The physicist, who was awarded the 2008 CNRS Silver Medal, was one of the first theoreticians to study the properties of carbon nanotubes, just a year after they were first synthesized.

There's a promising future for such materials, especially as the miniaturization of electronics is rapidly approaching the molecular scale.

Structure of materials

WHY SOME MICROPROCESSORS AGE PREMATURELY

Why do certain electronic components undergo spontaneous, irreversible breakdown? It's a bit like a mayonnaise that separates, researchers explain. Most alloys have defects, called dislocations, responsible for the mechanical properties of the material, but now also suspected of being the cause of their premature ageing. By using transmission electron microscopy to observe a film of aluminium containing inclusions of silicon nanoparticles, the researchers noticed that the atoms in a small drop of silicon move away from it to swell the ranks of a larger drop. Whereas they were initially intimately mixed, the silicon and aluminium separate, just like the oil and water in a mayonnaise that curdles. The presence of a crystalline dislocation in the aluminium accelerates the phenomenon by a factor of over a thousand. The alloy is thus destroyed far more quickly than if there were no defects.

Published in Science
Date 21 March 2008

Chemistry in extreme conditions

HIGH TEMPERATURE LIQUID SPLITS INTO DIFFERENT STATES

In order to better understand phase transitions, researchers studied samples of a type of synthetic rock heated to a very high temperature. The experimental setup made it possible to subject the sample, formed of drops of liquid floating on a jet of gas, to synchrotron radiation without any contact. The chemists were able to show that the material, once liquid, separated into two different states. This work should help us to get a better understanding of liquids at high temperatures, such as those in the Earth's crust.

Published in Science
Date 24 October 2008

Physical chemistry

HOW TO CHOOSE A SOLVENT

Understanding how molecules of a solvent interact with the solute is essential when it comes to predicting the chemical reactivity of the solvated molecules. So what determines the rate at which a compound dissolves in a liquid solvent? Contrary to all expectations, to obtain the fastest solvation it isn't the viscosity that counts the most, but rather the molecular structure of the solvent, through its ability to provide cavities that can host the solute.

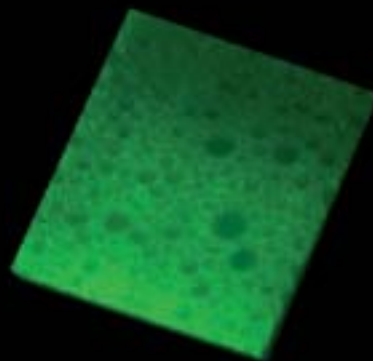
Published in Radiation Physics and Chemistry
Date October-December 2008

Physics

CRITICAL TEMPERATURE LEADS TO ELECTRON PAIRING AT HIGH TEMPERATURES TOO

It was already known that for conventional superconducting materials, the temperature at which electrons associate in pairs (a stage that always precedes superconductivity) is the critical temperature. An experiment has now shown that this is also true for high critical temperature superconductors, even though until now theory predicted a higher temperature.

Published in Nature Physics
Date 1 August 2008



Physics and chemistry of matter

HOW CHOCOLATE MOUSSE FLOWS

Holding their shapes like solids, but lacking crystalline structure like liquids, amorphous materials such as chocolate mousse or beauty creams are poorly understood. We now know that they deform and flow due to a collective movement of the particles that make them up. This discovery should make it possible to better control the spreading of thin layers of fragile materials such as those used in the cosmetics and food processing industries.

Published in Nature
Date 3 July 2008

> A dense emulsion made up of many oil droplets of various sizes.

Taming **matter**

Manipulating atoms and molecules is the challenge being taken up by many CNRS researchers, thanks to increasingly sophisticated devices. This is opening the way to new materials with surprising properties.

Physics of nanostructures

ELECTRONS MOVE ALONG JUNCTIONS

Physicists have studied the electrical conductivity of materials made up of crystal grains. The conductivity is affected by the presence of junctions between the grains. To understand this phenomenon, physicists used electron lithography to engrave artificial networks on the surface of a semi-conductor substrate. They showed that electrons tend to move along the junctions between grains rather than across them.

Published in Physical Review B
Date 13 June 2008

> Zeolite crystals growing on alumina ceramic.



> This self-healing rubber can glue itself back together without being previously heated. Below, the rubber being tested by being pulled apart after self-healing.

Chemistry

SELF-HEALING RUBBER

Everyone is familiar with rubber, a soft material that can be stretched to 500% of its length and then return to its initial shape. However, a self-healing rubber would be rather more unexpected. Nevertheless, a material of this type has been developed by researchers at the Soft Matter and Chemistry Laboratory. They managed to create a network of molecules linked together by hydrogen bonding that is neither vitreous nor semi-crystalline. To do this, they used a mixture of small fatty acid molecules carrying two or three groups made up of several different atoms, all capable of linking together via hydrogen bonding. And it works: at room temperature, the material behaves like rubber, whereas at higher temperatures, around 130-150°C, it flows and can be shaped or re-shaped. And surprisingly, after being cut, the surfaces glue themselves back together when put into contact, without any need for heating! The researchers point out that, apart from its many potential applications, the material is simple to produce, and made from non-toxic products. The research was carried out in collaboration with the chemical company Arkema with a view to industrial production.

Published in Nature
Date 21 February 2008

Physics of nanostructures

MOLECULES CHILL OUT

How can molecules be cooled down by laser? By stopping their vibrations, in other words the jiggling motion of atoms within the molecule. However, this isn't as easy as it sounds. Nonetheless, physicists have managed to do this by adapting a technique, called optical pumping, which consists in exciting atoms so that they fall back to a lower energy level, and therefore to a lower vibration level. The physicists used an ultrashort-pulse (femtosecond) laser, whose broad spectral distribution can be used to excite all the vibration levels of a molecule.

Published in Science
Date 11 July 2008

Colloids

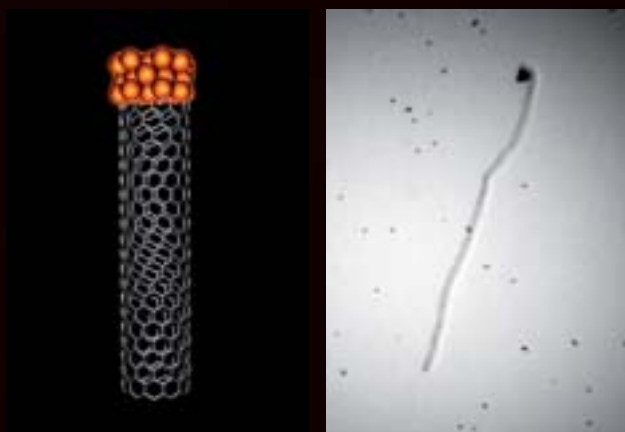
THE STRUCTURE OF DNA REPRODUCED IN THE LAB

Nature is packed full of amazing molecules, called chiral molecules, which coexist in two forms that are mirror images but not superimposable on each other. Such molecules intrigue chemists, because, although they have the same chemical composition, they have a different spatial organization. So, what is the origin of these differences? To try and answer this question, researchers turned to colloids, which are liquids or gels containing a suspension of particles that are small enough for the mixture to be homogeneous. What makes the particles in colloids interesting is that they perfectly mimic the behavior of atoms and molecules. Under the effect of a magnetic field, the colloidal particles designed by the team self-assemble in the form of a double helix, just like the chiral structure of DNA. This makes it possible to describe the properties of colloidal objects which turn into double helices.

Published in Nature
Date 18 September 2008

The nano challenge

From spintronics to nanoelectronics, not forgetting nano-objects, researchers are learning to manipulate, control and direct ever smaller particles, for an ever wider range of applications.



> Illustration of the principle of bipolar electrochemistry, used to deposit gold on one end of a carbon nanotube. At left, the model; at right, the experimental result.

Chemistry

NANO DISSYMMETRY GOAL ACHIEVED

Present everywhere, symmetry makes life difficult for researchers who attempt to create dissymmetric objects. Now however, chemists have succeeded in depositing gold selectively on one of the two ends of a carbon nanotube, without the need to protect the other end. To do this, they placed the nanotubes in solution in a powerful electric field, which caused them to line up and become polarized. The difference in charge was enough for different chemical reactions to take place at either end of the nanotubes. The method, dubbed 'bipolar electrochemistry', may make it possible to synthesize large quantities of dissymmetric objects with novel properties.


Published in Nano Letters
Date 12 January 2008 *online*

Spintronics

MOLECULAR MAGNET ELECTRICALLY CONTROLLED

For the first time, researchers have managed to change a fullerene C60 molecule from a magnetic state to a non-magnetic state by applying an electric voltage. The physicists created a transistor by inserting a fullerene molecule one nanometer in diameter between two nanometer-scale electrodes. They then supplied the molecule with two electrons. Depending on the electric field applied, the directions of magnetization (the spins) of the two molecules either point in opposite directions (non-magnetic molecule), or in the same direction (magnetic molecule). This work opens the way to a new field of research: molecular spintronics. It could lead to the production of a quantum information memory, and thus vastly increase the storage capacity of hard disks.

Published in Nature
Date 29 May 2008

A high-magnification scanning tunneling microscope (STM) image showing a carbon nanotube transistor. The nanotube is a thin, dark line with several bright, circular spots along its length, representing the self-assembled and electrically connected rings. The background is a textured, reddish-brown surface.


Molecular chemistry

NANO SWISS KNIVES

Chemists have produced some promising new objects: magnetic nanoparticles made up of a core and several magnetic networks stacked in successive rings each with a different chemical makeup. By combining their physical properties, the researchers hope to create nano-objects that are able to carry out various tasks within miniaturized mechanisms, such as information storage or signal processing.

Published in Angewandte Chemie
Date 22 December 2008

> Transistor based on a carbon nanotube, self-assembled and connected electrically while being synthesized.

A close-up photograph of a scanning tunneling microscope (STM) tip. The tip is a small, dark, metallic structure with a sharp, pointed end. It is positioned over a surface, and a small, bright, circular spot of light is visible at the point of contact. The background is blurred, showing other parts of the microscope and the sample surface.

Electronics

COMPRESSED LIGHT FOR MICROPROCESSORS

Plasmons, which are signals resulting from the compression of light, are at the center of research into the miniaturization of electronic circuits. For the first time, researchers at CNRS and the French Atomic Energy Agency (CEA) have observed them through a microscope on the surface of conductors measuring 30 nanometers. They were thus able to confirm that at this dimension, the plasmon develops a so-called 'slow' mode: it oscillates at the frequency of a light wave even though it has a wavelength well below that of light. Although the phenomenon was already known, it had never before been observed at such high resolution.

Published in Nano Letters
Date 12 March 2008

> Scanning tunneling microscope.

The road to clean energy

Developing clean energy is a challenge that CNRS labs are meeting every day. The avenues being explored include producing hydrogen more cheaply by mimicking nature, improving the performance of batteries in electric cars, and oxidizing methane to methanol at room temperature.



> Lamps powered by solar energy.

Catalysis

PHOTOSYNTHESIS SHOWS THE WAY

Plants use photosynthesis to convert sunlight and water, which come free, into hydrogen, a gas that can be used as a fuel. So the solution to producing this clean source of energy might simply be to copy them. However, there's a snag. Until now the catalysts used in the systems developed to convert water into hydrogen were based on precious metals, which are too rare and too expensive to be used on an industrial scale. But now, a new family of catalysts that are far cheaper and which can be produced in a single stage have stepped into the spotlight. Although the exact mechanism underlying the catalytic action of these cobalt-based complexes is as yet unknown, they are already being tested on an industrial scale.

Published in Angewandte Chemie International Edition
Date 8 December 2008



Awards 2008 Bronze Medal

BRONZE MEDAL FOR GOLD CATALYST EXPERT

Valérie Caps adores gold, but not for the usual reasons. This 2008 CNRS bronze medal winner's specialty is gold catalysis, which can be used to activate atmospheric oxygen at room temperature in order to transform molecules through oxidation. One of the applications of this process could

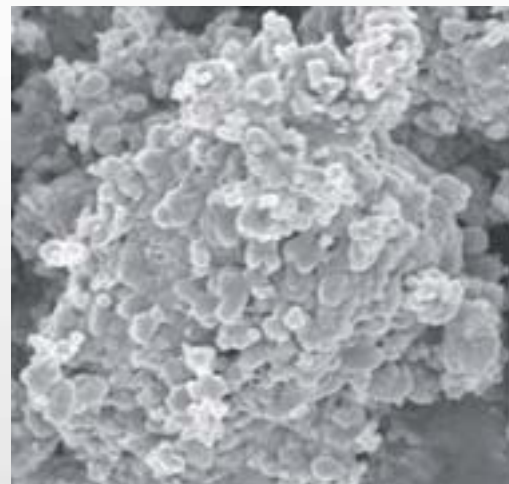
be the purification of hydrogen, a key step for its use in fuel cells.

Chemical reactions

A CATALYST THAT PRODUCES METHANOL

At the moment, methods for producing methanol, an energy source, are expensive and environmentally unfriendly (solvents, high temperature, high pressure). Now, chemists have succeeded in making a catalyst that oxidizes methane in water and at room temperature, drawing their inspiration from the only natural enzymes that are able to do this. For the moment, the oxidizing action of this new iron phthalocyanine-based complex goes a bit too far, because as soon as the methanol forms it is oxidized to formic acid. But this is at least a major first step toward this goal.

Published in Chemical Communications
Date May 2008



> Nanoparticles of lithium iron phosphate (100 nanometers) in a cluster are altered one by one by the 'domino-cascade' effect while the battery is charged.

Materials chemistry

WHY AN INSULATING MATERIAL CONDUCTS ELECTRICITY

Although it's an insulator, it conducts electricity. The name of this paradoxical material is lithium iron phosphate, and light has now been shed on this odd behavior through an experimentally verified 'domino-cascade' effect: local stresses within the material allow electric and ionic conduction to spread from one area to the next. This should guarantee the material a great career in future lithium batteries for electric cars.

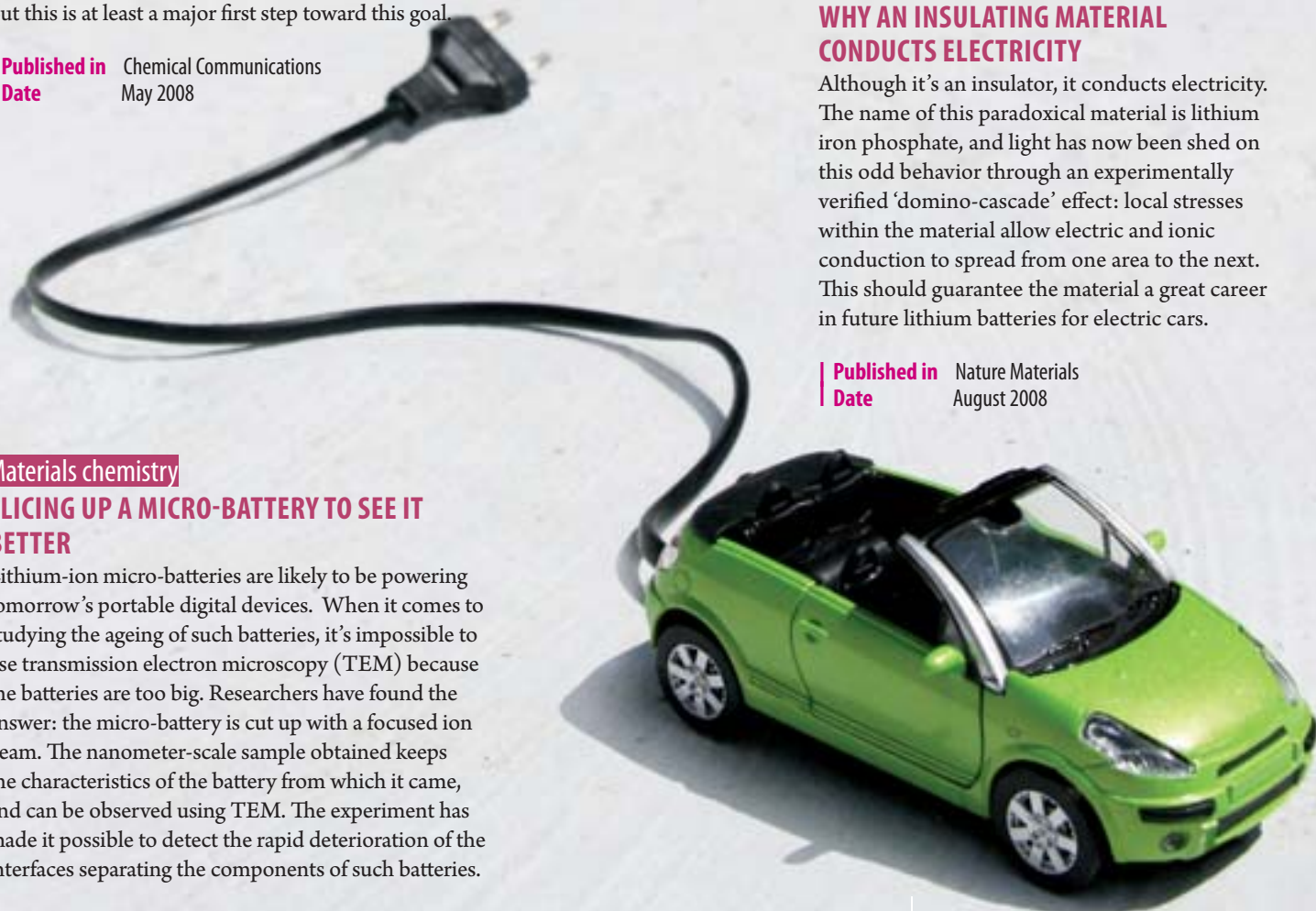
Published in Nature Materials
Date August 2008

Materials chemistry

SLICING UP A MICRO-BATTERY TO SEE IT BETTER

Lithium-ion micro-batteries are likely to be powering tomorrow's portable digital devices. When it comes to studying the ageing of such batteries, it's impossible to use transmission electron microscopy (TEM) because the batteries are too big. Researchers have found the answer: the micro-battery is cut up with a focused ion beam. The nanometer-scale sample obtained keeps the characteristics of the battery from which it came, and can be observed using TEM. The experiment has made it possible to detect the rapid deterioration of the interfaces separating the components of such batteries.

Published in Chemistry of Materials
Date March 2008



> Lithium ion batteries hold out great promise for powering tomorrow's electric cars.

Decoding the genome

Uncovering all the secrets of the genome may well be a long way off, but researchers are devoting all their energy to this elusive goal, whether by trying to understand the mechanisms of the transmission of cell memory or those of the evolution of our gene pool. CNRS has even awarded its 2008 Gold Medal to a genome pioneer.

Genetics

DIABETES AND BIOLOGICAL RHYTHMS

Thanks to a study carried out on 23,000 people of French, Danish and Finnish origin, researchers have discovered the genetic connection between the regulation of biological rhythms by the hormone melatonin and type 2 diabetes. They showed that mutations in the gene that produces melatonin receptor 2 lead to higher blood-sugar levels, and increase the risk of diabetes.

Published in Nature Genetics
Date 7 December 2008

2008 CNRS Gold Medal

JEAN WEISSENBACH STRIKES GOLD

The distinguished French doctor, the late Jean Bernard, called him the 'Vasco da Gama' of science. Bernard was talking about Jean Weissenbach, winner of the 2008 CNRS Gold Medal, the highest French scientific distinction. Weissenbach's field of research, his unexplored world, consists of the 3.5 billion 'letters' of the human genetic code that he helped to discover.

Weissenbach, one of the world's top geneticists, is the man behind the first high resolution map of the human genome. Thanks to this reference tool, it has been possible to discover hundreds of genes associated with genetic diseases, making it possible to diagnose them early. Prior to this, he had already localized on the Y chromosome the region that contains the gene that determines gender. In 1997, Weissenbach was appointed head of the

Genoscope-Centre national de séquençage (CEA), which he had set up. Since then, he has also been leading the Metabolic Genomics Joint Research Unit (Université d'Évry/CNRS/CEA). It was at this time that Weissenbach took part in the great project to sequence the human genome: he and his team entirely sequenced chromosome 14. This was a titanic task and also a genuine battle for science and freedom, for the American scientist Craig Venter was at the same time working on an identical privately funded project, with the aim of selling access to the data. Meanwhile, Weissenbach was also developing innovative techniques for the exploration of the genomes of biology's model organisms, such as the anopheles mosquito (which carries malaria), rice and the paramecium. He has now turned the page of human genetics, and has redirected his research towards micro-organisms, especially those that break down waste in nature. Understanding them better could lead to all sorts of applications, especially with regard to the environment, such as making chemistry cleaner or even destroying pollutants. For the sum of all his work on the genome, Weissenbach has won many awards, including the CNRS Silver Medal in 1994, and the Grand Prix de la Fondation pour la Recherche Médicale in 2007.

Other prizes are awarded each year by CNRS. The Silver Medal is awarded to nationally and internationally recognized experienced researchers, while the Bronze Medal rewards the work of promising young researchers. Finally, the 'Cristal du CNRS' Award honors engineers and technicians for their contribution to progress in knowledge and scientific discovery. You can find all the award winners in 2008 on the CNRS web site, in the 'La recherche' section > Talents - Prix, distinctions.

> Jean Weissenbach, winner of the CNRS 2008 Gold Medal.

Epigenetics

FROM MOTHER CELL TO DAUGHTER CELL

How does a dividing cell hand down its functions and characters to the two daughter cells produced by its division? One of the first steps in the transmission of the memory of a cell to its descendants has just been clarified: thanks to a protein called UHRF1, small chemical alterations to DNA known as methylations are faithfully handed down. And it is precisely such methylations that, by taking part in the regulation of gene expression, affect the characters and functions of cells.

Published in Nature
Date 3 September 2008

Population genetics

WOMEN ENCOURAGE GENETIC DIVERSITY

Women from different populations have genomes that are more similar to each other than do men also from different populations. The reason usually put forward is that women migrate in order to settle in their husband's village, thus supplying new genes. The joint study of various genetic markers shows that an additional factor is the influence of social organization, particularly patrilinearity, which encourages the grouping together of genetically related men.

Published in PLoS Genetics
Date 26 September 2008



> Colocalization of the MatP protein (red) with the macrodomain (green and blue) on the chromosome of a colibacillus.

Molecular genetics

TAKING APART THE BACTERIAL CHROMOSOME

How is the chromosome of the bacterium *Escherichia coli* organized spatially? It was already known that it is organized into macrodomains. We now know that one of these macrodomains contains around twenty repetitions of a short DNA sequence, called MatS, with which a recently characterized protein, MatP, interacts. This condenses this region of DNA and restricts its mobility.

Published in Cell
Date 31 October 2008



> Depositing human DNA on an agarose gel in order to separate certain fragments of interest by electrophoresis.

Population genetics

NEW EVIDENCE OF NATURAL SELECTION

Natural selection really does model our gene pool. This is what has been found by a human population genetics study undertaken at the level of the genome. Carried out on 210 individuals representative of the different human populations, the study examined the case of over 2.8 million polymorphic markers in the human genome. It was able to identify 582 genes which have been subjected to strong positive selection pressure and thus vary between human populations. Some are involved in physical differences (skin pigmentation), while others are connected to diseases whose prevalence varies between populations (diabetes, high blood pressure, etc) or which play a role in immune response to pathogens. The researchers now intend to continue their work by examining the role of natural selection in human-pathogen interactions.

Published in Nature Genetics
Date 3 February 2008

Dissecting^{the} cell

The cell still hides many secrets. What gives it its shape? How does it react to stress? How are genes organized inside its nucleus? Researchers are hard at work trying to find out.



SECRETS OF CELL DIVISION

It was his identification of new genes involved in cell division that opened the doors of CNRS to Régis Giet in 2002. The pursuit of his research in this field has now won him the 2008 CNRS Bronze Medal.

Awards
2008 Bronze Medal

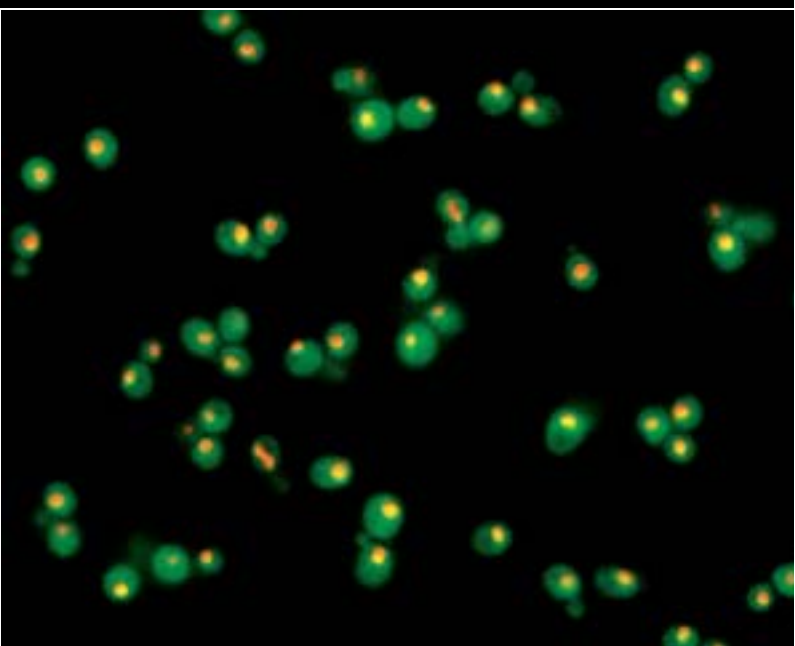
Developmental biology

HOW CELLS SCULPT TISSUE

What physical forces do cells generate to shape tissue during embryonic development? Now, physicists and chemists have found an answer to this question by showing that 'force generators', coming from the cells themselves, act locally at the interfaces between cells. It's as though the cell, which is encircled by a kind of elastic covering made up of filaments of a molecule called actin, sets in motion a tiny engine—myosin II—that is able, locally, to pull the elastic covering in question. As a result, stresses appear on the surface of the cell, which ends up breaking off contact with one or more of its neighbors. Now that it is free to join on to other cells, it stretches out and changes its position. This process of rearrangement, synchronized among several cells, results in the elongation of all the tissue.

Published in Nature Cell Biology
Date 1 December 2008

> Mouse embryo at the eight cell stage. In blue, the cell membrane; in red and green, the nucleus.



Bioengineering

STRESSED OUT CELLS

A cell needs to react at the right rate in order to ensure its survival. For the first time, researchers have succeeded in measuring, and even altering, the rate of reaction of a yeast cell to environmental stress. They also discovered that if yeast is subjected to too much stress, due to its environment being altered too frequently, the cell no longer reacts.

Published in Proceedings of the National Academy of Sciences

Date 14 May 2008

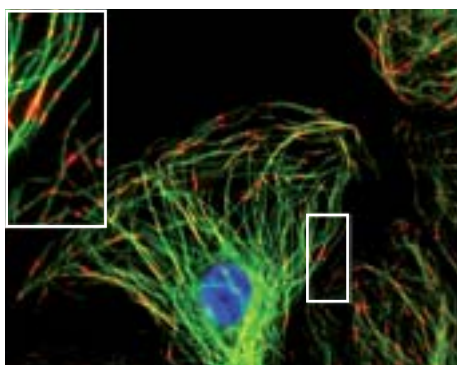
Molecular biology

THE NUCLEUS MORE ORGANIZED THAN THOUGHT

It's a bit like finding a needle in a haystack. This is what two teams of researchers have done using a novel technique that combines confocal microscopy and mathematical processing to map the regions occupied by a gene in the nucleus of live yeast cells. Their results describe the spatial organization of the nucleus far more precisely than before.

Published in Nature Methods
Date 1 December 2008

> Yeast cells after osmotic shock (stress): the hog1 protein (in green) localizes to the nucleus (in red).



> Detection of microtubules (in green) and islands of GTP (in red) by immunofluorescence in mammal cells.

Cell biology

CELL ARCHITECTURE MOLECULES OBSERVED MORE CLEARLY

Microtubules are protein polymers that play a key role in the life of the cell, inside which they assemble and disassemble in dynamic fashion. Biologists have for the first time revealed in vivo the presence of the energy donor GTP (guanosine triphosphate) not only at the ends of growing microtubules but also, contrary to what was thought, inside these polymers. This discovery opens up a new field of research into the dynamics of these cell architecture molecules.

Published in Science
Date 16 October 2008

Biophysics

BELLY-DANCING CELLS

Cells that are moving and about to enter into contact with a new surface appear to belly dance. Using a novel method of optical microscopy, researchers managed to observe undulations in the cell membrane, with an amplitude of a few nanometers and a period of around one second. This is an important discovery for the understanding of the interactions of cells with biomaterials.

Published in Biophysical Journal
Date 15 May 2008

Life at the nanoscale

Observing life at nanometer scales means it can be explored in greater depth than ever.

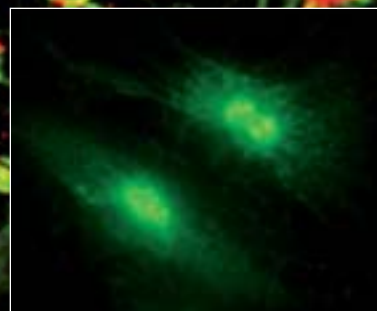
Welcome to the world of nanoscopy, where researchers vie with each other in ingenuity to develop these new techniques of high-resolution microscopy.

Experimental biology

TRACKING CELLS WITH THE HELP OF NANOPARTICLES

It is now possible to follow a cell's every move as it travels through the body of a live animal. This is done by inserting magnetic nanoparticles (of iron for instance) into the cells that are to be monitored, and then observing them by magnetic resonance imaging. Researchers have shown that the nanoparticles do indeed enter the cells, bringing their magnetic properties with them: the local magnetic field produced by the tagged cell leads to signal loss, which can be detected with an ultrasensitive antenna. The detection of individual cells has been demonstrated in vivo in small animals with doses of iron as low as 0.2 picograms per cell, using a clinical MRI scanner. The technique has been successfully used to monitor lymphocytes involved in antitumor immune response, in a model of cell therapy on animals.

Published in Magnetic Resonance in Medicine
Date December 2008



> Live cells with incorporated nanoparticles of silicon carbide observed by fluorescence microscopy under UV/violet excitation.

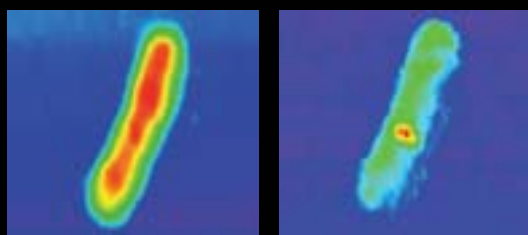
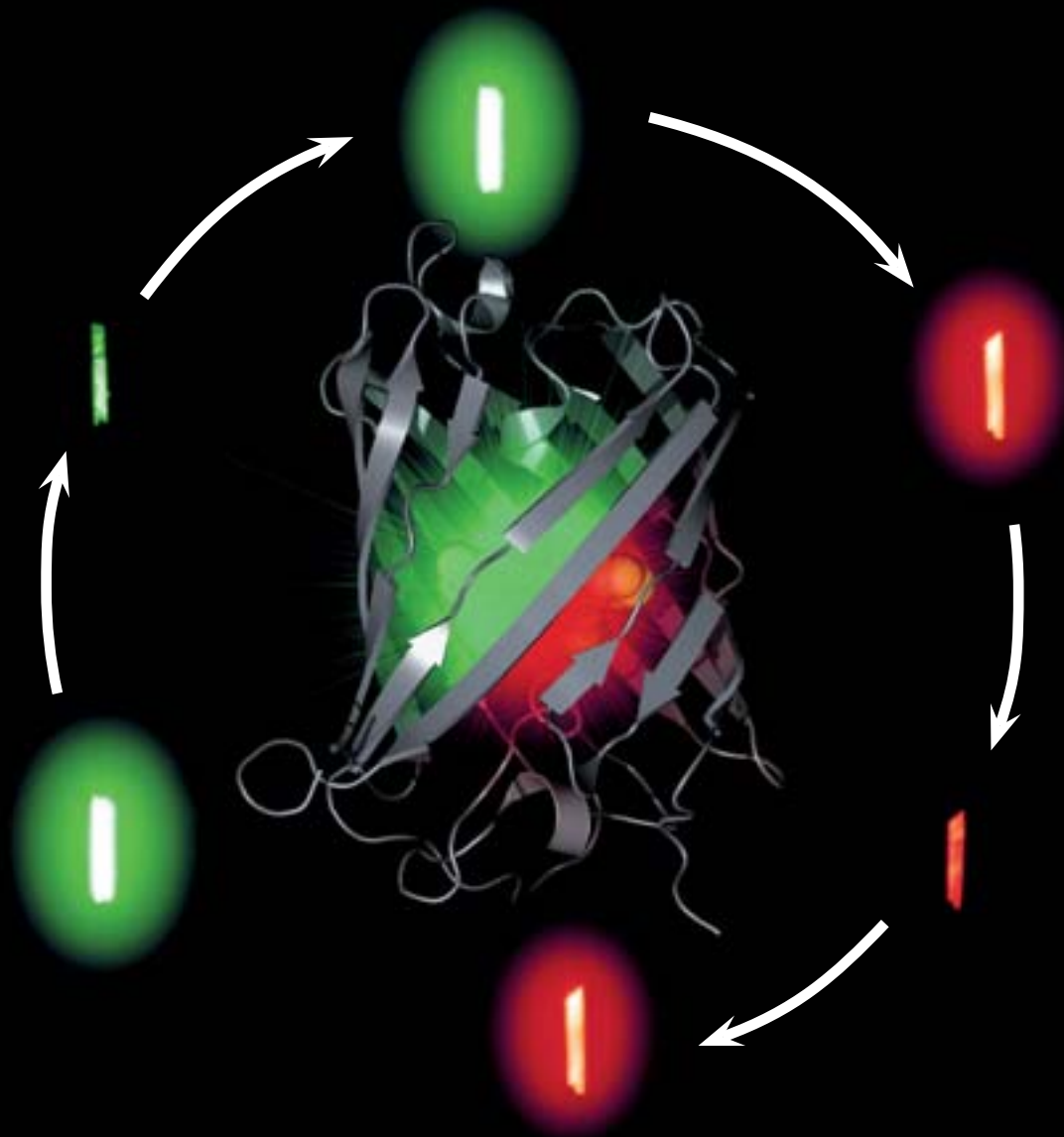
Spectrometry

FLUORESCENT NANOPARTICLES AS MARKERS

By using the remarkable properties of fluorescence of silicon carbide nanoparticles, researchers have succeeded in using them to 'label' living cells. There are many technological applications, since these nanoparticles can be functionalized, which means that many different compounds can be attached to their surface. Some of their other advantages are their biocompatibility, stability, and low production cost.

Published in Applied Physics Letters
Date 2 May 2008

> Liposomes, which could carry drugs, are guided magnetically towards target regions in the brain (in red).



> Topographic image of an *E. Coli* bacterium (left) and map of the chemical signature of the virus (right).

Infrared microscopy

A VIRUS OBSERVED IN A BACTERIUM

Locating a virus inside a bacterium: that's the remarkable technical feat pulled off by a team of physical chemists who set up an experiment that is unique in the field of infrared spectromicroscopy. The experiment is based on the detection of photothermoelastic deformations generated by the absorption of infrared radiation. This makes it possible to attain a resolution of the order of a nanometer, which is the size of many biological objects.

Published in Ultramicroscopy
Date June 2008

Biology

A LUMINOUS PROTEIN FOR NANOSCOPY

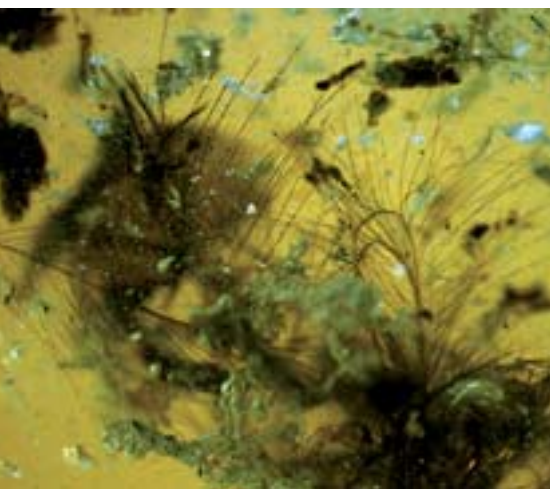
A fluorescent protein that not only switches on and off to order but can also change color! Meet Iris-FP, a highly flexible biological marker that will soon be playing a role in nanoscopy. This novel molecule, whose structure was revealed and whose luminous forms were characterized using X-rays from the synchrotron radiation facility in Grenoble, should make it possible to monitor the spatio-temporal dynamics of proteins in the cell.

Published in Proceedings of the National Academy of Sciences
Date 18 November 2008

> In the center, the structure of the Iris-FP protein. Around it, all the switched on/switched off, and red/green forms of the protein.

Evidence of evolution

Bacteria that diversify, insects trapped in amber: evidence of evolution that researchers scrutinize closely, looking for the origins of life.



> Primitive feathers of archaic birds or of avian dinosaurs, one millimeter long, found in amber.

Paleontology

BIRDS REALLY DO DESCEND FROM DINOSAURS

Coming after mites, ants, spiders and other plant and animal fossils discovered in extremely well preserved 100 million-year-old amber, a feather has created a sensation. And it's not just any old feather: its morphology shows that it's the missing link between feathers found on certain dinosaurs and modern bird feathers. The discovery confirms that birds are indeed the modern version of a group of dinosaurs.

| **Published in** Proceedings of the Royal Society
| **Date** 22 May 2008

Geosciences

SHEDDING LIGHT ON FOSSILS IN OPAQUE AMBER

It's now possible to see right into the heart of opaque amber, thanks to the X-rays produced by the synchrotron radiation facility in Grenoble. This means that paleontologists will be able to access the contents of opaque amber, which until now were invisible. Researchers have already been able to observe 356 fossil animals inside 640 pieces of amber, only half of which have been identified. Enough to keep them busy for some time to come!

| **Published in** Microscopy and Microanalysis
| **Date** 3 June 2008

Genetic diversity

WHEN INVASIVE SPECIES DIVERSIFY

It was generally thought that invasive species had little adaptive potential and limited genetic diversity. But it may not turn out to be so. A study carried out on a freshwater snail that has recently invaded Martinique reveals spectacular genetic variation. The diversity is due to a succession of repeated introductions, leading to the overlapping of strains of different origins. Could invasions turn out to be a source of biodiversity?

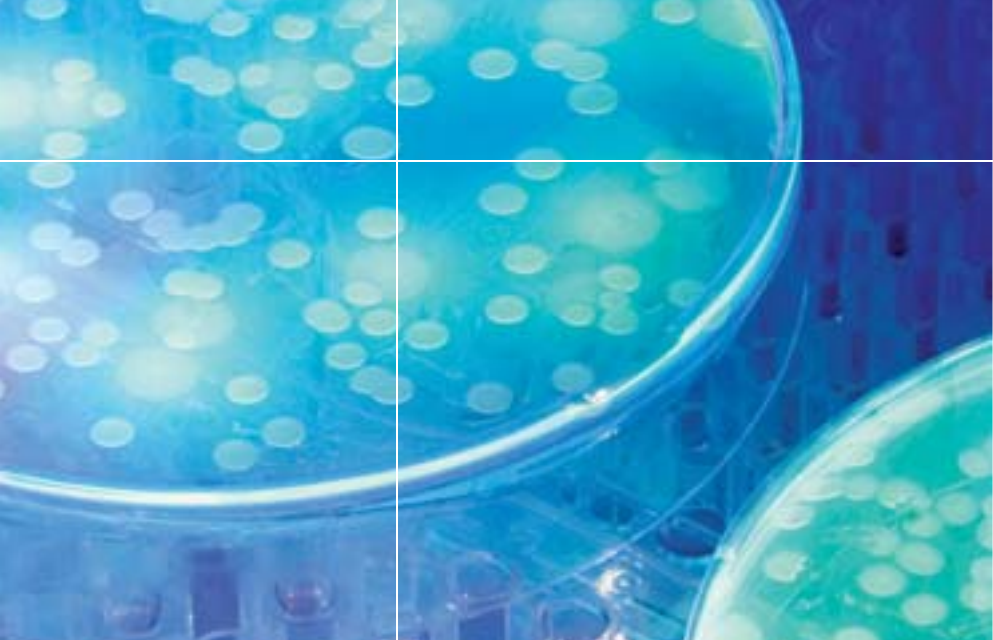
| **Published in** Current Biology
| **Date** 11 March 2008

Physics

A LONG BEAK, ALL THE BETTER TO DRINK WITH

"What a strange long beak you have, Master phalarope," said the researcher. "All the better to overcome gravity and suck up the precious water that gives me life," the bird replied. The shape of a phalarope's beak, which is more closed up near the mouth, allows it to exert a capillary force on the drops of water that it picks up with the end of its beak. The bird brings the water up its beak by means of a mandibular movement that moves the drops along at a speed of as much as an astonishing one meter per second.

| **Published in** Science
| **Date** 16 May 2008



Molecular chemistry

THE FIRST TRACES OF LIFE ON EARTH

Molecular chemistry has revealed that life has existed on Earth for the last 3.5 billion years. By using pyrolysis to analyze traces of organic matter in a rock, researchers have shown that it contains hydrocarbons that mostly have an odd number of carbon atoms, which is evidence for the existence of a biological mechanism. Just how much further will the origin of life be pushed back?

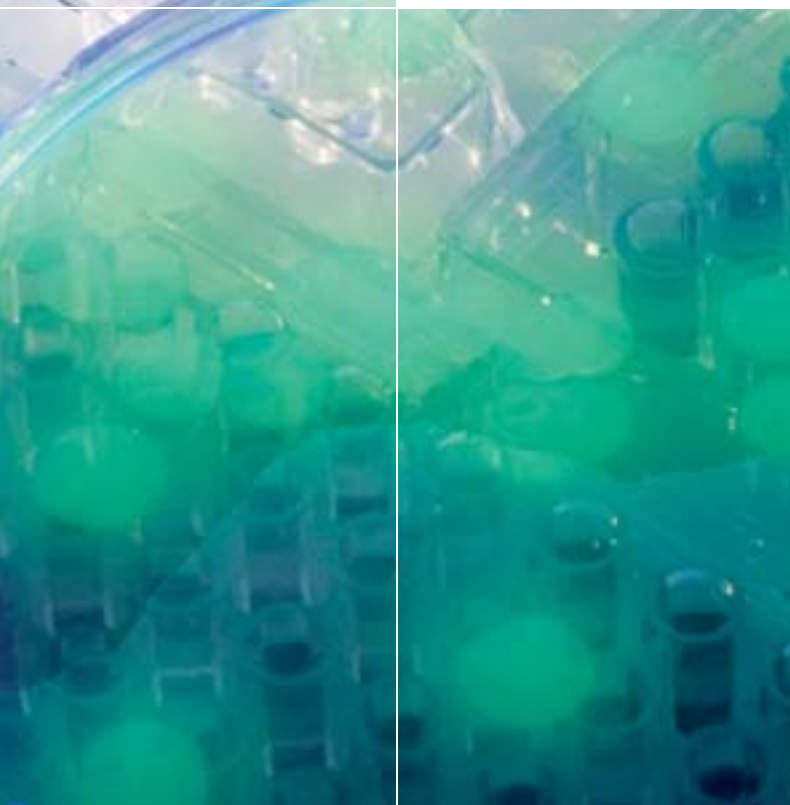
Published in Earth and Planetary Science Letters
Date 30 July 2008

Biology

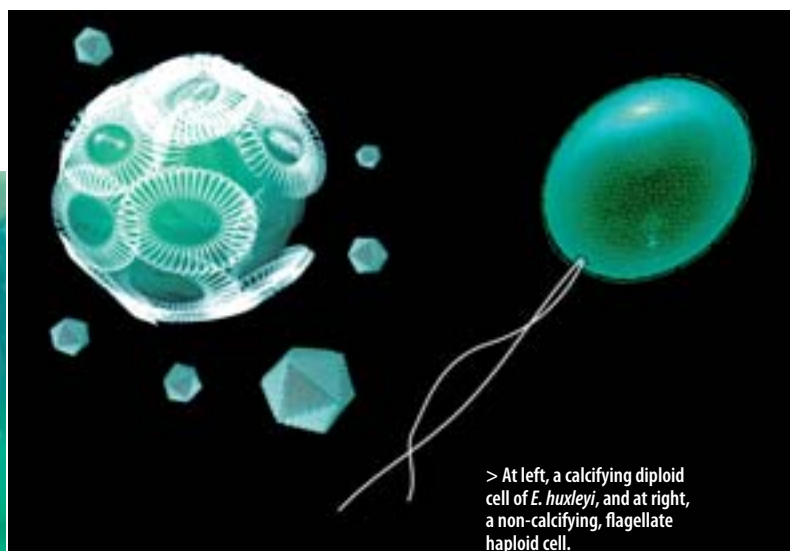
BACTERIA THAT DIVERSIFY

Evolution can lead to more diversity and in particular to improved functioning of ecosystems. Those are the conclusions that biologists have drawn from a laboratory experiment. They left clones of a bacterium to evolve for five hundred generations in artificial microcosms each one of which was made up of a microplate in which each well contained a different source of carbon. They then moved the bacteria between the different wells at precise concentrations. The experiment shows that the effect of spatial heterogeneity of resources and dispersion is to accelerate the diversification of the bacteria and increase their ecological productivity, in other words boost their ability to create biomass. It also indirectly shows that increasingly uniform terrestrial ecosystems caused by the pressure of human activity could eventually reduce life's ability to diversify.

Published in Nature
Date 13 March 2008



> Microplates in which each well contains a different source of carbon. The violet color depends on the bacteria's ability to make use of the sources of carbon.



> At left, a calcifying diploid cell of *E. huxleyi*, and at right, a non-calcifying, flagellate haploid cell.

Marine biology

A MICRO-ORGANISM DIVIDES TO SURVIVE

To defend themselves against the attack of marine viruses, a unicellular organism uses the strategy of the Cheshire Cat in Alice in Wonderland: it becomes invisible. In their diploid form, i.e. with two sets of chromosomes, the cells of *Emiliana huxleyi* are sensitive to the viruses. But when attacked by the viruses, they become haploid, with half the number of chromosomes, and become completely invisible to them.

Published in Proceedings of the National Academy of Sciences
Date 14 October 2008

Life's strategies

Male baboons who look after their young, bumblebees that take the easy way out, viruses that infect viruses: there's no shortage of oddities in the living world for researchers to discover.

Marine biology

PARASITE COULD BE USED TO FIGHT TOXIC ALGA

To put an end to blooms of dinoflagellates—a planktonic microalga that causes toxic red tides—a parasite could soon be used. Researchers at the Roscoff biological station have shown that the disappearance of toxic blooms is the result of the action of a parasite that is able to adapt specifically to the dinoflagellate in question, infecting and destroying it.

Published in Science
Date 21 November 2008

Evolutionary biology

'DOUBLE MUTANT' MOSQUITOES ON TOP FORM

Contrary to what was thought, mosquitoes that are resistant to two types of insecticide survive better than others when there are no insecticides around. For mosquitoes, resistance to insecticides usually goes hand-in-hand with a genetic burden that puts them at a disadvantage for everything else (fertility, etc). However in this case, these 'double mutants' are unfortunately not doubly handicapped, in fact quite the opposite. A factor that needs to be taken into account in strategies for fighting disease-carrying mosquitoes.

Published in BioMed Central Evolutionary Biology
Date 8 April 2008

Experimental biology

FEMALE BUNTING SETS HIGH STANDARDS FOR HER PARTNER

She also chooses her mate on the basis of the ecological context of the moment, for her goal is clear: to get the greatest number of eggs possible to hatch. So for instance, if there's a lack of grasshoppers, it is the males with large beaks, who can easily catch the insects, that are preferred. This process of short-term sexual selection undoubtedly has an influence on the evolutionary mechanism. But since the criteria for selection change every year, researchers think that in the long term this type of selection has fewer effects on the buntings' plumage: it is the males who have a wide range of characters that are the most likely to be picked.

Published in Science
Date 25 January 2008

When the female bunting chooses the partner who will accompany her throughout the brooding season and after the eggs hatch, she's not only interested in the male's bright plumage.



> The female bunting chooses her male partner (inset) according to the ecological context.



Ecology

BUMBLEBEES TAKE IT EASY

Why make life complicated if there's an easier way? That appears to be the bumblebee's philosophy when it comes to looking for food. In the absence of competition with their fellows, bumblebees are quite happy to forage the flowers whose nectar is easiest to get at. The result is that the flowers that the bumblebees neglect don't get pollinated. This phenomenon, caused by the increasing rarity of foraging insects, could accelerate the impoverishment of ecosystems that is partly responsible for the collapse of insect biodiversity.

Published in Journal of Ecology
Date September 2008



> A bumblebee, identified by means of a label on its thorax, foraging a flower in an experimental setup.

Behavioral biology

BABOONS ARE DOTING DADS

Baboons are among the 10% of male mammals that look after their young. And according to an analysis of data collected over thirty years in a national park, having a doting dad helps the little ones get to sexual maturity sooner. But how does their presence encourage such early development? How do these model fathers recognize their young? Many questions still remain unanswered.

Published in Proceedings of the National Academy of Sciences
Date 12 February 2008

> Young baboons being watched over by their father.

Environment

FISH MIGRATE IN THE WAKE OF HUMANS

What determines the number of species of freshwater fish introduced by humans into a region where they aren't present naturally? The answer is economic activity, according to researchers from Toulouse, who have studied the worldwide geographical distribution of non-native fish. The more intense the activity, the greater the number of invasive species. Since such activity is expected to increase in developing countries, this scenario is likely to be harmful to the preservation of aquatic biodiversity.

Published in PLoS Biology
Date 5 February 2008

Biology

DISCOVERY OF A VIRUS THAT INFECTS VIRUSES

We already knew about viruses, bacterial viruses, and giant viruses. Now meet the virus-infecting virus. This new biological entity, dubbed a virophage, is able to infect giant viruses such as Mimivirus and Mamavirus, and transfer genes from one giant virus to another. Unable to multiply in the cell on its own, the virophage multiplies by hijacking the replication machinery of the mamavirus. As a result, the virophage, which behaves like a genuine parasite, makes the host virus ill, as a result of which it multiplies less and accumulates defects. The virophage's genome is a surprise. Analysis shows that it has exchanged certain genes with the giant viruses, and has captured genes from parasitic viruses in other domains of life, such as archaea and bacteria.

Published in Nature
Date 7 August 2008



The entrails of the Earth

We walk around on its surface, but what do we really know about the Earth's structure? How much do we know what goes on in its depths? At CNRS, scientists are especially interested in the Earth's mantle, as well as in its mysterious core.

Geodynamics

MONITORING BUBBLES TO PREDICT EARTHQUAKES

During an oceanographic campaign in the Sea of Marmara, researchers used gas-bubble detecting acoustic sonars (normally used for fishing) to observe emissions of gas lined up along active submarine faults. The long-term goal is to test the hypothesis that the properties of fluids in submarine fault zones change over time, and determine whether there exist any detectable signals that could warn of seismic activity.

Published in Earth and Planetary Science Letters
Date 30 September 2008

Geophysics

NEW METHOD FOR PREDICTING VOLCANIC ERUPTIONS

A new method for monitoring volcanoes in real time makes it possible to predict eruptions with greater precision. The technique, which is based on listening to seismic background noise, may also be able to better predict the intensity of an eruption, a key factor in volcanic hazard mitigation. The method could also be applied to seismic risk.

Published in Nature Geoscience
Date 20 January 2008

Geophysics

VESUVIUS: THE WORST MAY BE BEHIND US

By recreating the conditions of the last four explosive eruptions of Vesuvius, researchers have concluded that coming eruptions may not be as serious. The reason for this is that the magma reservoir has risen over 4000 meters towards the surface, lowering its pressure and increasing its temperature. As a result, the magma is less viscous, which should mean less violent eruptions.

Published in Nature
Date 11 September 2008

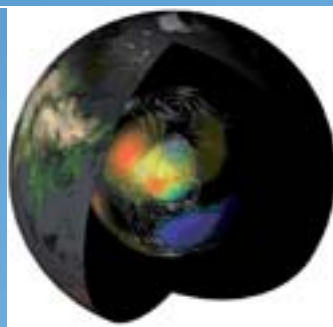
> Rivers of lava flowing out of the Kilauea volcano carry fragments of the Earth's mantle. Their analysis reveals much about the mantle's structure and composition.

Earth sciences

ONLY ONE CONVECTION LAYER IN THE MANTLE?

Volcanism is caused by convection currents flowing through the mantle, transferring the Earth's internal heat outwards. But is the convection in one layer or two? Opinions differ. The presence of primitive gases in certain basaltic lavas was until now considered to be evidence that very large volumes of rock remain confined in the depths of our planet, suggesting that convection takes place in two layers. According to a researcher, primitive gases, just like petroleum, migrated very early on in the Earth's history into reservoir rocks that are so hard that they are not stretched by convective motion. There is thus a permanent influx of primitive gases from the reservoir rocks into the flowing magma. This approach could unify geophysical and geochemical views of mantle processes.

Published in Science
Date 15 February 2008



> Cutaway view of the Earth's interior. In red, the eastern hemisphere where the inner core is growing more rapidly due to temperature differences.

Geosciences/Geophysics

REPRODUCING THE EARTH'S CORE IN THE LAB

The Earth's inner core, which is a solid ball of iron in the center of the liquid iron outer core, has different seismic properties in the west (Atlantic hemisphere) and the east. Since the core is more or less uniform, the reason for these differences is a mystery. Researchers have assumed that what happens inside the core is caused by events at the core-mantle boundary: when a tectonic plate sinks right down to the base of the mantle, it cools the core beneath it, affecting the crystallization of the inner core, and therefore its properties. To verify this hypothesis, researchers set up a digital simulation of core dynamics under the influence of a thermally heterogeneous mantle. This showed a cyclone appearing on the surface of the liquid outer core, directly beneath Asia. The match between the simulation and the observed facts confirms the validity of the proposed scenario.

Published in Nature
Date 7 August 2008



> The lava lake at the summit of the volcano is made up of very fluid lava with remarkable electrical properties.



> The Masai volcano with, in white, a recent flow of liquid carbonates.

Geochemistry

WHY THE EARTH'S MANTLE IS A CONDUCTOR

How can the Earth's mantle be a conductor when its main constituent, olivine, is an insulator? The answer appears to be the presence between the grains of solid rock of small amounts of liquid carbonates, the most stable and conducting form of carbon present within the mantle. The quantity of such carbonates in the upper mantle could also explain the amount of carbon dioxide emitted into the atmosphere from volcanoes.

Published in Science
Date 28 November 2008

Research serving the environment

Measuring pollution, improving air quality forecasts, inventing new ways of producing biofuels: the environment is a major concern for CNRS researchers.

Climate

THE HIMALAYAS ALSO HIT BY POLLUTION

Southwest Asia, consisting mainly of soot particles, are carried for thousands of kilometers, right up to the slopes of Everest at over 5000 meters altitude. In addition, the masses of polluted air mix with clean air flowing down from the Tibetan high plateau, causing the formation of new nanometer-scale particles. The effects of these phenomena are hard to assess, even though it is known that the presence of soot particles is bound to increase the rate of melting of glaciers. As for the nanoparticles, they are transported by the wind into the upper layers of the troposphere, where their lifetime is very long, giving them a potentially major impact on the world's climate.

Published in Proceedings of the National Academy of Sciences
Date 14 October 2008

> The highest atmospheric monitoring station in the world, in Nepal, at an altitude of 5079 meters.



Genomics

A FUNGUS THAT TURNS PLANTS INTO FUELS

Could a fungus produce second-generation biofuels from plant waste? *Trichoderma reesei* is highly efficient at breaking down plants into simple sugars, which are the basic components of ethanol. When researchers sequenced its genome, they found that only a small number of genes were involved in its enzyme activity. This is a real stroke of luck, since it will make it all the easier to improve the genotype of the fungus and increase its efficiency.

Published in Nature Biotechnology
Date May 2008

Atmospheric chemistry and physics

NEW METHOD FOR MEASURING OZONE

Thanks to a new generation of satellite-borne instruments that use infrared wavelengths to sound the atmosphere and to the development of a method of analyzing the data obtained, it is now possible to precisely measure concentrations of tropospheric ozone, a powerful greenhouse gas that is also harmful to health. This should make it possible to improve air quality forecasting models as well as climate models.

Published in Geophysical Research Letters
Date 23 September 2008



> The Mata Atlântica, Brazil's primitive Atlantic forest, is a hotspot of world biodiversity that it is essential to preserve.

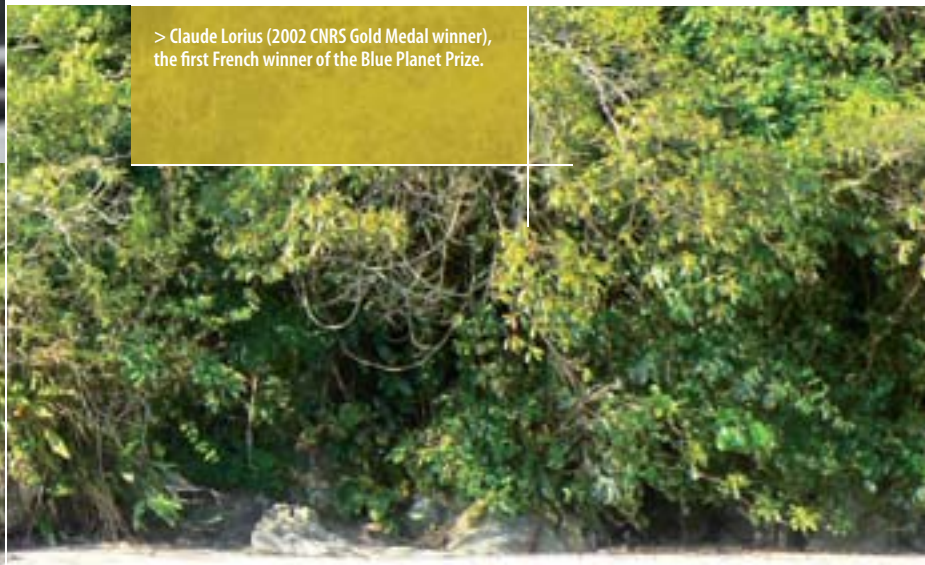
CLAUDE LORIUS, FIRST FRENCH WINNER OF THE BLUE PLANET PRIZE

Awards Environment

Claude Lorius, together with José Goldemberg, has won the 2008 Blue Planet Prize, one of the most prestigious international awards in the field of the environment. Lorius, a respected glaciologist and emeritus senior researcher at CNRS, is the first French winner of the award. He is honored for having helped, through his research, to raise awareness of the influence of human activity on the environment.



> Claude Lorius (2002 CNRS Gold Medal winner), the first French winner of the Blue Planet Prize.



3D modeling

DUST IMPACTS ATMOSPHERE

What is the impact on the atmosphere of 'Saharan episodes', when up to a million tons of mineral dust can be blown to Europe or America? Now, researchers have shown that, under the effect of sunlight and in the presence of dust containing titanium dioxide (a frequent occurrence), atmospheric nitrogen dioxide is converted into nitrates and nitrous acid. By using 3D modeling, they have also shown that this reaction leads to a drop in concentrations of tropospheric ozone, a greenhouse gas of which nitrogen dioxide is the precursor.

Published in Geophysical Research Letters
Date 12 March 2008

Evolutionary biology

MICRO-ORGANISMS REVEAL PAST ENVIRONMENTS

3.5 billion years ago, organisms lived at moderate temperatures (around 20°C), before adapting to much warmer environments (70°C), after which temperatures then gradually decreased until today. These results were obtained by using 'molecular thermometers', which are based on the fact that certain molecular characteristics of unicellular prokaryotic organisms are correlated with the temperature at which they lived.

Published in Nature
Date 26 November 2008

The blue planet

Understanding the Earth system and the upheavals currently affecting it, such as climate change and ocean acidification, is the ambitious challenge that CNRS researchers are attempting to meet.

> Pillow lavas, formed when lava comes into contact with seawater. Samples collected from their surface are used to study $^{37}\text{Cl}/^{35}\text{Cl}$ ratios.

Global warming

SEA LEVEL RISE MAINLY CAUSED BY MELTING ICE

Mean global sea level has been continuously rising for a century. According to the latest report by the IPCC (International Panel on Climate Change), between 1993 and 2003 fifty percent of the rise, which was then three millimeters per year, was due to the thermal expansion of sea water caused by warming, while the rest was mainly caused by the melting of ice on land (polar ice sheets and glaciers). However, since 2003, the situation has turned around. Ocean warming appears to have temporarily halted, according to a calculation of thermal expansion carried out independently on the basis of satellite data and data provided by the system of Argo buoys. As a result, 80% of the current global sea level rise of 2.5 millimeters per year is likely to be due to the increasingly fast melting of ice on land. So trouble could be in store if the rate of ocean warming rises once again to its 1990 values.

Published in Global and Planetary Change
Date November 2008

Physical chemistry

OCEAN WATER CAME FROM SPACE

That's the only possible conclusion to be drawn from recent analyses of chlorine isotopes in the oceans and in the Earth's mantle. The ratios of the isotopes chlorine-37 and chlorine-35 (the more abundant of the two isotopes) in the mantle and in seawater are not similar enough for the chlorine in the oceans to have had a terrestrial origin. The water in our oceans may therefore well have come from comets that collided with the Earth several billion years ago.

Published in Science
Date 14 March 2008

> A scientist diving in the Mediterranean.

A MODEL FOR FORECASTING AND OPERATIONAL OCEANOGRAPHY

With the signature in January 2008 of a European consortium agreement based around the ocean modeling platform NEMO (Nucleus for European Modeling of the Ocean), the partners (CNRS, GIP Mercator-Océan, the Met Office and NERC/NOCS*) made official the widespread use of this model in fundamental research, operational

European consortium agreement

oceanography, climate and seasonal forecasting, etc. The agreement, which crowns

twenty-eight years of research coordinated by France, is also a guarantee that funding and human resources to improve the model in the future will be available.

*Natural Environment Research Council
/ National Oceanography Centre of
Southampton, UK

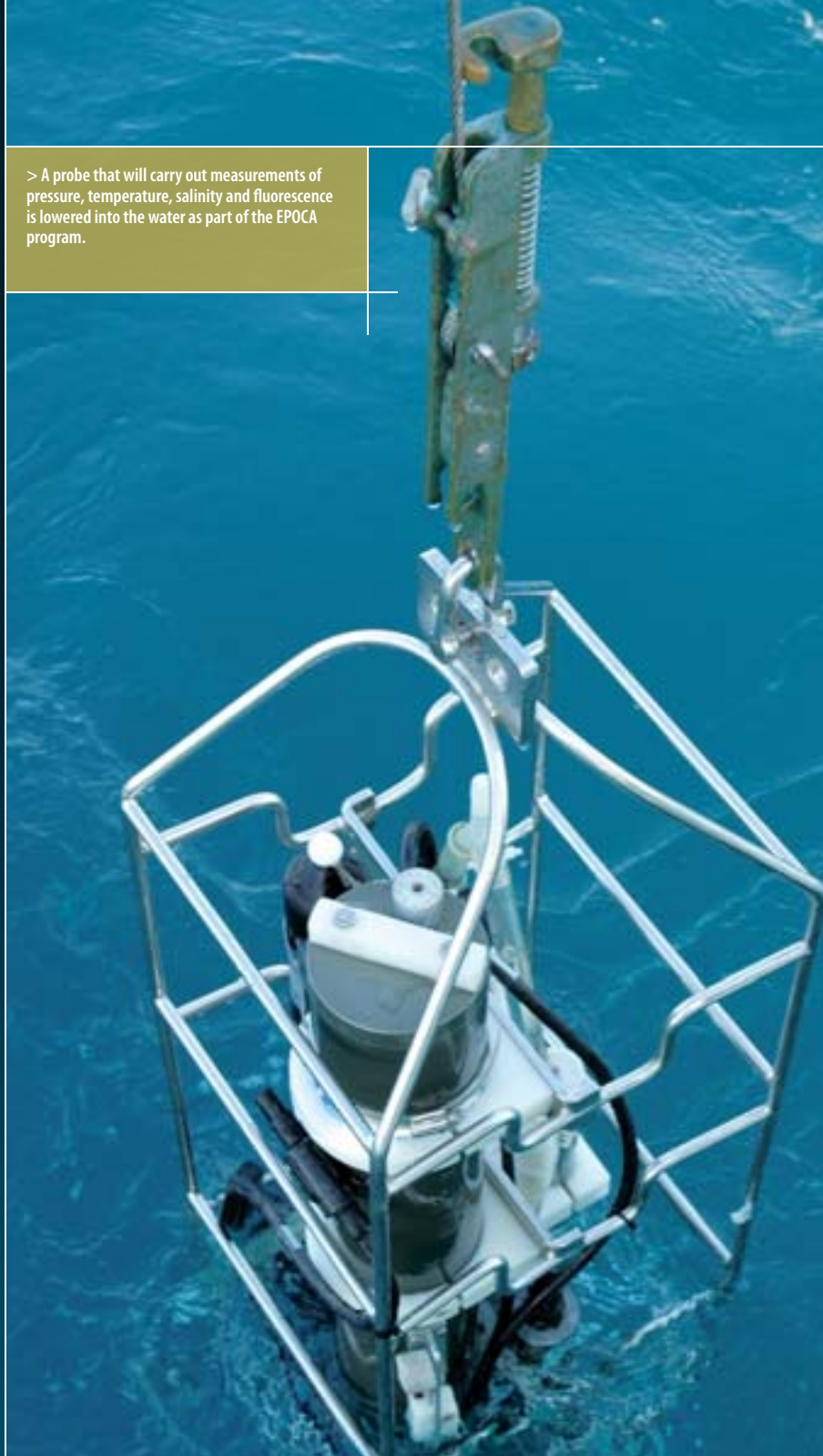
Physical oceanography

KEEPING AN EYE ON EL NIÑO

To better understand changes in the characteristics of the El Niño climate phenomenon, physicists are carrying out an oceanographic campaign in the Southwest Pacific. Data collected by a submarine glider was used to estimate the absolute transport of water mass caused by the South Equatorial Current in the top 600 meters of the ocean. The long-term goal is to sample the mass flux entering the Coral Sea and the variable fraction of this flux which flows back towards the Western Equatorial region where the El Niño events originate.

Published in Journal of Physical Oceanography
Date March 2008

> A probe that will carry out measurements of pressure, temperature, salinity and fluorescence is lowered into the water as part of the EPOCA program.



STUDYING OCEAN ACIDIFICATION WITH EPOCA

In the last two hundred years, the oceans have absorbed a third of the carbon dioxide produced by human activity, resulting in the inevitable acidification of surface water. What effects is this having on living organisms and ecosystems? EPOCA (European Project on Ocean Acidification) was launched on 10 June 2008 in order to study and predict the effects of this acidification on marine biology, and submit recommendations to political decision-makers. It brings together twenty-seven partners from nine countries, including CNRS and the French Atomic Energy Agency (CEA).

Study program

Deciphering^{the} climate

CNRS studies the Earth's climate from every angle, past, present and future. And digital simulations are enabling researchers to reconstruct the climate of the past so as to better predict the future.



> Vortex in a soap bubble subjected to a temperature gradient between the equator and the pole.

Physics

STORM IN A SOAP BUBBLE

Researchers are busy blowing bubbles, but not for fun. By creating vortices in soap bubbles, they are trying to reproduce the dynamics of real tropical cyclones, or hurricanes, in the atmosphere. This experiment enabled them to characterize the random factor that governs the movement and paths of vortices. The information will be key to predicting the likelihood of impact on a specific site.

Published in Physical Review Letters
Date 7 April 2008

Chemistry

TROPICAL PARIS

Did Paris once swelter under a tropical sun? Well, yes, if analyses of the structure of a compound present in 55 million-year-old amber are anything to go by. Discovered in a quarry in the Oise department just north of Paris, the amber contained a molecule which could be derived from isoozoic acid. It turns out that the only trees that produce a resin containing this acid currently grow in Amazonia. This evidence that the region that is now Paris was once located at tropical latitudes is in agreement with data about the past movement of the Earth's tectonic plates.

Published in Journal of Organic Chemistry
Date 18 January 2008

Carbon footprint

NEW DATA FROM OLD FORESTS

Old forests will henceforth have to be taken into account when it comes to drawing up the planet's carbon footprint. Until now, it was thought that forests more than 150 years old attained a balance between absorption (by photosynthesis) and emission (by plant and soil respiration) of carbon dioxide. But a recent study has shown that this isn't true: old forests may be contributing to carbon storage, to the tune of between 0.8 and 1.8 billion tons per year. So they'll now need to be included in future carbon footprint calculations.

Published in Nature
Date 11 September 2008

Meteorology

FORECASTING MORE THAN A WEEK AHEAD

What will the weather be like in ten days' time? We may soon be able to answer this question, even though current weather forecasts are unable to see more than a week ahead. A researcher has shown that fluctuations in winter temperatures and precipitation in Europe are affected, via the atmosphere, by the variability of the tropical climate on a seasonal level. This could be another step toward an approach that combines weather forecasting (over days and weeks) with climate trends (over decades and centuries).

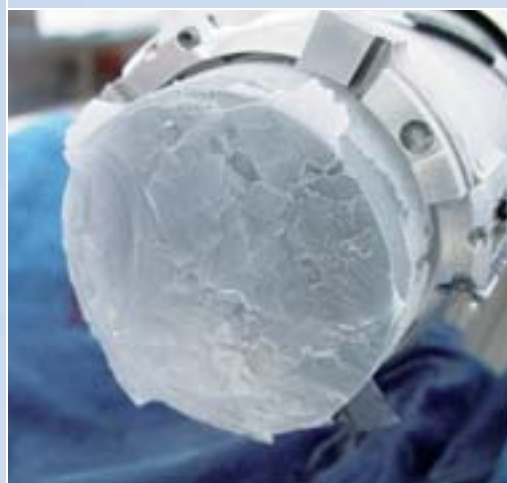
Published in Nature
Date 25 September 2008

Paleoclimatology

CLIMATE EPISODE REVEALED

Formed year after year by the accumulation of snow, layers of ice record information about the climate conditions that prevailed at the time they were laid down. By analyzing them, it is therefore possible to reconstruct the history of the climate. Thanks to new ultra-high resolution analyses of ice cores from Greenland, from the three-kilometer-deep NorthGRIP drill site, an international team has revealed that the climate changed extremely abruptly, over just a few years, at the end of the last ice age around 10,000 years ago. This sudden shift is thought to be connected to drastic changes in atmospheric circulation. These new data should help to improve the models used to predict future climate change.

Published in Science
Date 1 August 2008



> Ice core.

Chemistry

A DOUBLY EFFICIENT CO₂ TRAP

Chemists at the Institut Lavoisier, working in collaboration with other French teams, have managed to trap carbon dioxide (CO₂), the principle greenhouse gas, in impressive quantities. Their work is part of the fight against global warming, in which CO₂ storage could play an important role. The researchers have developed a material, dubbed MIL-101, a cubic meter of which is able to store an astonishing 400 m³ of carbon dioxide at 25°C. This is double the amount that can be managed by materials currently on the market. At the moment, the researchers are alone in being able to synthesize this material, whose pore size (3.5 nanometers) is what enables it to capture so much CO₂. MIL-101 should have no trouble in finding industrial applications soon. Unless of course it's replaced by a new generation of materials which the chemists are already working on.

Published in Langmuir
Date 21 March 2008



> Prototype ice-corer being tried out during the 2008 season at Concordia, Antarctica.

Biodiversity feels^{the} heat

What effect will global warming have on biodiversity? Researchers are doing all they can to better measure, understand and also fight the impact of climate change. They're observing species as diverse as penguins, great tit birds and trees, and finding that some species are adapting, while others are not.

Ecology

PENGUINS UNDER THREAT

Will penguins survive global warming? Unfortunately, there's no guarantee that they will. For nine years, 450 penguins were individually monitored thanks to electronic tags implanted under their skin. Worryingly, the researchers discovered that in summer, an increase in sea surface temperature near the Crozet Islands,

> A group of king penguins returning from the sea, on the Crozet Islands.

where king penguins breed, leads to an immediate fall in the reproductive success of these birds. A second observation is that in winter an increase of a mere 0.26°C in the sea surface temperature at the edge of the sea ice leads two years later to a 9% drop in the probability of the penguins' survival. This is due to an increasing scarcity of marine resources, probably krill, at the base of Antarctic food chains.

Published in Proceedings of the National Academy of Sciences
Date 11 February 2008

> Adelie penguins on the edge of the pack ice at the Dumont d'Urville base in Antarctica.

Environment

TREES COME INTO LEAF EARLIER

Every spring, the first leaves and buds appear on trees. However, according to detailed analysis of satellite data, since the late 1980s they seem to have been appearing five days earlier than usual in large parts of the Eurasian boreal forest. It's all due to global warming, which is leading to higher spring temperatures.

| Published in Global Change Biology
| Date March 2008

> Great tit chick aged two weeks.

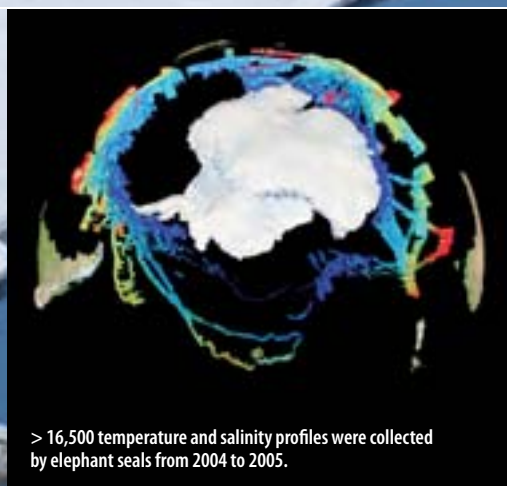


Ecology

SOME BIRDS ADAPT TO WARMER CONDITIONS

Whereas other birds appear to be suffering from global warming, great tits appear to be having no trouble adapting. This is revealed by a survey carried out in the UK over the past forty years. The entire breeding period has shifted by 14 days in order to make up for the rise in spring temperatures of 2°C. And the fledglings hatch at the precise moment when caterpillars, which are their favorite food, are abundant. The high temperatures are thought to be the reason for this surprising physiological adaptation. They probably trigger a hormone peak in females that stimulates reproduction in the couple, thus ensuring that the fledglings hatch when caterpillars are in plenty. Great tits will undoubtedly be a useful model in helping us understand how evolutionary processes cope with global climate change.

| Published in Science
| Date 9 May 2008



> 16,500 temperature and salinity profiles were collected by elephant seals from 2004 to 2005.

Oceanography

SEA ELEPHANTS HELPING US TO UNDERSTAND THE CLIMATE

Elephant seals are helping us to better understand the climate. Fifty-eight of these diving marine mammals were fitted with a new generation of Argos beacons, which recorded the temperature and salinity of ocean water at various depths over the course of the southern autumn and winter. The data collected will help to refine our understanding of the formation of Antarctic deep water, which plays a major role in regulating the world's climate.

| Published in Proceedings of the National Academy of Sciences
| Date 11 August 2008 *online*

Elementary particles

Protons, bosons and other particles are relentlessly hunted down by CNRS researchers. And now, to lend them a helping hand, there's the Large Hadron Collider (LHC), the most powerful particle accelerator in the world.

LHC: READY TO ROLL

It's been twenty years in the making, involving seven thousand scientists, including four hundred from France (CEA and CNRS/ IN2P3), and has a circumference of 27 kilometers and a temperature of -271°C : the European Organization for Nuclear Research (CERN) inaugurated its famous Large Hadron Collider (LHC) on 10 September 2008, with an initial beam of protons circulating at an injection energy of 450 gigaelectronvolts (GeV).

Despite a technical incident which means that the accelerator will only start up again in September 2009, researchers are confident. When the stable beams are collided with each other at the different detectors located at four points around the ring, LHC's acceleration system will boost the energy to 5 teraelectron volts, making the accelerator the most powerful in the world, and ushering particle physics research into as yet uncharted waters: hunting down the elusive Higgs boson, attempting to pierce the secret of the Universe's dark matter, and explaining why matter predominates over antimatter.

On 26 March 2008, CNRS (IN2P3), the Université Paris-Sud 11, the Université Joseph-Fourier in Grenoble, the Institut Polytechnique in Grenoble and the Thalès group came together to form the 'Sources and Accelerators' scientific consortium. The agreement will in particular enable the partners to share strategic choices concerning large instruments (XFEL, FAIR, LHC, Spira2, etc), and provide many young engineers with doctoral or post-doctoral training, supervised by leading world specialists in their disciplines.

Large facilities



> Artist's impression of tracking chambers in the ALICE experiment's muon spectrometer at the Large Hadron Collider.

Nuclear physics

SUPER-HEAVY ATOMS CREATED IN THE LAB

How can a super-heavy atom be identified even though its creation, via fusion of two lighter nuclei, causes it to become excited and split into two lighter nuclei? The answer is by measuring the amount of time it takes to undergo fission. Using a technique developed at GANIL*, researchers produced and identified atomic nuclei with as many as 120 and 124 protons. Amazing when you think that uranium, the most massive element to occur naturally on Earth, has a mere 92 protons!

Published in Physical Review Letters
Date 15 August 2008



> Modeling nuclear fusion and fission reactions.

Exotic nuclei

NUCLEUS COMPRESSED AS IN THE STARS

Physicists at GANIL* have for the first time succeeded in compressing an unstable nucleus (i.e. one that has an anomalous ratio of neutrons to protons). The nucleus in question, nickel-56, isn't found on Earth but is present when a star explodes at the end of its life. This breakthrough opens up the possibility of compressing several hundred exotic nuclei, and should help us to understand how some stars become compressed before exploding.

Published in Physical Review Letters
Date 1 February 2008

*The French large heavy-ion accelerator

Standard Model

CLOSING IN ON THE MASS OF THE HIGGS BOSON

Particle physicists are on the hunt for the famous Higgs boson, the missing link in the Standard Model which describes the interactions between fundamental particles. Using experimental data obtained at the Tevatron (the most powerful accelerator in the world before LHC started up), the possible mass of the boson, already constrained in the range 115-185 GeV/c², has now been refined further by researchers, including researchers from CNRS and the French Atomic Energy Agency CEA: it has now been ruled out that its mass is in the region of 170 GeV/c².

Conference International conference on high energy physics, Philadelphia
Date 3 August 2008

Particle physics

PROTON'S MASS IS MOSTLY ENERGY

The protons and neutrons that make up the nucleus of an atom are themselves made up of particles called quarks and gluons. However, the total mass of the particles that make up a proton only accounts for 5% of its mass. So where does the remaining 95% come from? The answer is provided by Einstein's famous equation relating mass and energy, $E=mc^2$: the missing mass comes from the energy due to the motion of the quarks and gluons and their interactions. So by determining this energy, it should in principle be possible to calculate the mass of the proton on the basis of the Standard Model, which describes the interactions between fundamental particles. This has now been done by an international collaboration including physicists at the Center for Theoretical Physics in Marseille. The calculations were carried out using some of the most powerful super-computers in the world, and for the first time attained a level of precision high enough to enable theoretical and experimental values to be compared.

Published in Science
Date 21 November 2008

Galactic events

Astronomers and astrophysicists tell us about the formation of the atmospheres of Earth and Mars, the origins of the fragmentation of binary asteroids, and a whole host of other events in our Galaxy's past and present.



> Aurora borealis on the island of Svalbard, Norway.

Physics

NORTHERN LIGHTS ARE POLARIZED

Until now, it was thought that light emitted in the Earth's upper atmosphere—the well-known northern lights, or aurora borealis—couldn't be polarized, because of the numerous collisions between molecules and atoms of gas which depolarize light. However, an international team has shown the opposite to be true. Observing such polarization could enable us to get a clearer understanding of the characteristics of the solar wind and of the terrestrial environment.

Published in Geophysical Research Letters
Date 19 April 2008



> Digital simulation of the process leading to the formation of binary asteroids.

Digital simulation

ASTEROIDS CUT IN TWO BY THE YORP EFFECT

What caused the formation of binary asteroids, celestial objects made up of a nearly spherical central body and a smaller satellite in an almost circular orbit around it? A digital simulation suggests that it could be due to the 'YORP effect'. The result of this thermal effect could be to accelerate the rotation of an asteroid made up of rubble and thus cause it to break up into two porous pieces. A finding that could help us to set up a strategy to defend our planet if it was faced with the risk of collision with an asteroid.

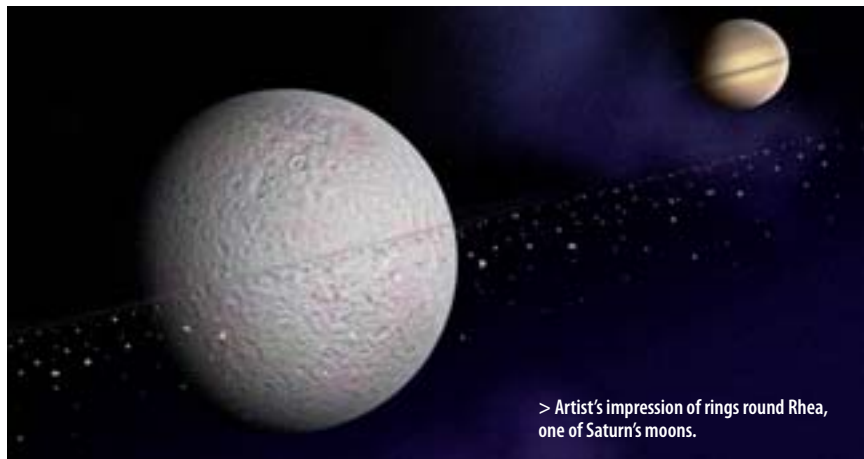
Published in Nature
Date 10 June 2008

Physical chemistry

SIMULATING THE MARTIAN ATMOSPHERE

Just as on Earth, Mars' ozone layer is controlled by clouds. This is what emerges from a study carried out by introducing into an atmospheric circulation model a process that has been demonstrated in the laboratory: the capture of HOx radicals, which normally destroy Martian ozone, on the surface of ice crystals in clouds. The results show unprecedented agreement between the ozone layer simulated by the model and that actually observed by ESA (European Space Agency)'s Mars Express SPICAM spectrometer.

Published in Nature
Date 21 August 2008



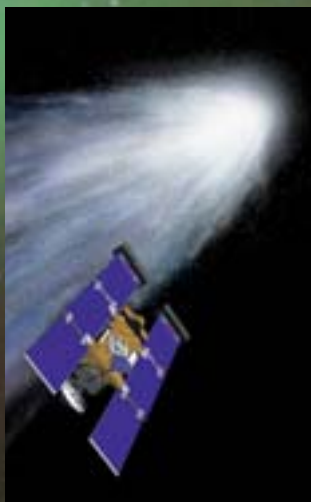
> Artist's impression of rings round Rhea, one of Saturn's moons.

Astrophysics

RINGS INSIDE SATURN'S RINGS

Everyone knows that some giant planets, such as Saturn, have rings. But a moon with rings is a bit more unusual. Nevertheless, this is the case for Rhea, Saturn's second-largest moon. Detected by the Cassini spacecraft, Rhea's rings are made up of solid particles up to one meter across, consisting mainly of water ice contaminated with dust. They were detected thanks to the absorption signatures they induce in populations of energetic electrons in Saturn's magnetosphere. A more detailed analysis revealed the presence of three nearly circular rings, the outermost of which has a diameter of around 4040 kilometers, and the innermost a diameter of about 3220 kilometers.

Published in Science
Date 7 March 2008



> Artist's impression of the Stardust spacecraft approaching the comet Wild2/p.

Mission

COMETS HAVE ENRICHED ATMOSPHERES

Did comets make a significant contribution to the atmospheres of some planets in the solar system? This hypothesis has in any case become much more credible thanks to the analysis of samples brought back by NASA's Stardust mission. The aim of the Stardust mission was to send a spacecraft through the tail of the Wild2/p comet, the idea being to trap cometary grains in a silica aerogel. Returned to Earth on 15 January 2006, the samples have now yielded their first results. The noble gases in the cometary grains show similarities with gases trapped inside the organic matter in primitive meteorites, in concentrations that are up to a million times greater. Such concentrations lend weight to the possibility that comets may have added significant amounts of volatile elements to the surface of some planets such as Mars, or even Earth.

Published in Science
Date 4 January 2008

The mysteries of the Universe

Why is the Universe the way it is?

Why is its expansion accelerating?

What is the nature of the enigmatic

dark energy? Astronomers are peering into the depths of the Universe with increasingly powerful instruments to try to answer these questions.



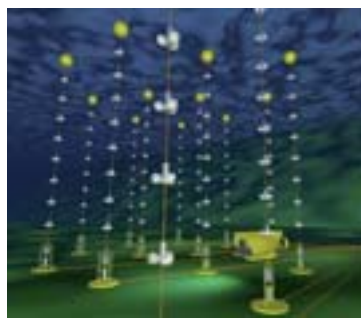
> Images taken by the Hubble space telescope in which gravitational effects can clearly be seen.

Cosmology

LENSES HELP TO MEASURE DARK MATTER

How is dark matter, which is in principle undetectable, distributed throughout the Universe? One way of trying to answer this question is to count the number of strong gravitational lenses in the sky. But these aren't ordinary lenses. Strong lenses are phenomena that appear when the light from a distant galaxy is amplified and deformed by a massive object located between the observer and the galaxy. An international team has identified sixty-seven such strong lenses by meticulously analyzing a series of images obtained by the Hubble space telescope (NASA-ESA). Extrapolating this result to the whole sky gives an estimated total of nearly half a million strong lenses. When enough strong lenses have been discovered, astronomers should be able to make a precise inventory of all the matter present in the Universe.

Published in Astrophysical Journal Supplement Series
Date May 2008



> Detection line of the submarine neutrino telescope Antares (at left, picture of the telescope using virtual images).

WATER CAPTURES ELUSIVE PARTICLES

How do you capture a neutrino that's come all the way from the ends of the Universe, given that it has no electric charge and hardly interacts with matter? The answer is to use water. This is just what the submarine telescope Antares is doing. Located on the sea bed off the southern French town of Toulon, the instrument was completed in

June 2008. Antares makes use of the fact that when a neutrino collides with a water molecule it produces a muon, which is easier to detect. It should therefore provide invaluable information about the violent cosmic phenomena to which neutrinos bear witness.

Large facilities

A TELESCOPE CALLED EINSTEIN

The design project for the Einstein Telescope, a future third generation gravitational wave detector, was

launched at the end of 2008. The telescope will provide a hundred-fold increase in sensitivity compared to the current instruments, Virgo and

LIGO, making it possible to observe a region of the Universe with a volume a million times greater. This will enable it to explore gravity, and thus general relativity, in extreme conditions.

Large facilities

Cosmology

SHEDDING NEW LIGHT ON DARK ENERGY

So just what is causing the acceleration of the expansion of the Universe? Is it due to a mysterious dark energy that fills the Universe and counteracts the gravitational braking produced by matter? Or should we add extra dimensions to our description of space to correct the theory of gravitation? An observation campaign carried out with the VIMOS spectrograph on the Very Large Telescope at the European Southern Observatory (ESO) measured the position and speed of 10,000 galaxies in the distant Universe. The survey concluded that dark energy makes up 70% of the Universe. The same method, applied to surveys that explore volumes ten times greater than the one covered by the VIMOS survey, should make it possible to decide between the two current hypotheses about the causes of cosmic acceleration.

Published in Nature
Date 31 January 2008



Awards
2008 Bronze Medal

DARK MATTER LIGHTER THAN BELIEVED?

Céline Boehm thinks that the particles that make up dark matter might be a thousand times lighter than protons. For daring to buck the trend—which suggests quite the opposite—Boehm was awarded the 2008 CNRS Bronze Medal.

Cosmology

COLOSSAL STRUCTURES OF DARK MATTER

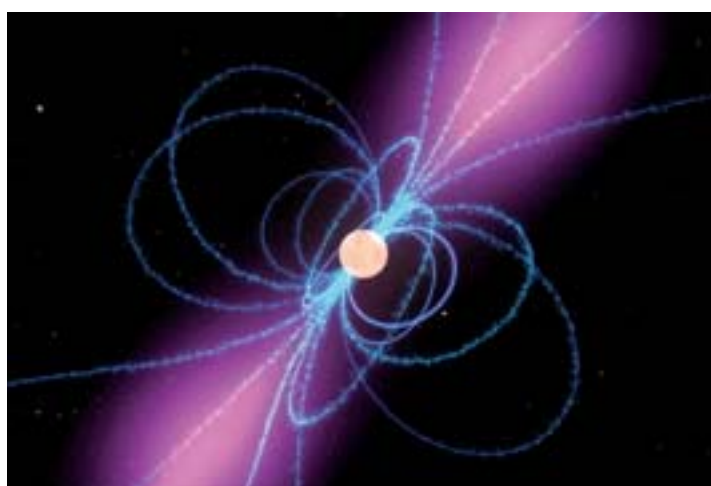
Huge structures of dark matter over 2000 times the size of our Galaxy have been discovered, making them the largest ever observed. They were discovered by a team of astronomers who analyzed the gravitational distortion effects produced by these cosmic structures. The finding offers unprecedented insights into this mysterious dark matter, which is five times more abundant in the Universe than 'ordinary' matter.

Published in Astronomy and Astrophysics
Date February 2008

> Image taken from a numerical simulation of large structures in the Universe, showing a sample 100 million light years across.

Star systems

Planets, stars and other stellar objects are constantly scrutinized and studied with instruments like the Fermi telescope. They reveal magnetic fields that flip back and forth, stellar winds whose particles recombine, and other marvels. Makes it hard to tear your eyes away from the sky!



> Illustration showing the beam of gamma rays (in violet) produced by clouds of charged particles flowing along the magnetic field lines of a pulsar (in blue).

Astroparticles

FERMI, THE UNIVERSE'S OFFICIAL PHOTOGRAPHER

The GLAST space mission, launched on 11 June 2008, has just provided its first findings. Its aim is to detect gamma rays—the highest energy electromagnetic radiation there is—produced by the most extreme phenomena in the Universe. The result of an international collaboration bringing together seven countries, including France, GLAST was rapidly renamed Fermi, in honor of the particle physics pioneer. This space telescope continuously observes the entire sky every three hours, which allows scientists to monitor the activity of highly variable sources. Fermi wasn't long in providing an image of the sky that shows bright gas in the Milky Way, pulsars, and a galaxy billions of light years away. After that, it managed to spot a hitherto invisible pulsar situated about 4600 light years away that only emits gamma rays. And this is just the beginning!

Published in Science Express
Date 16 October 2008

Science
21 November 2008

Astrophysics

A MISSING LINK BETWEEN STARS AND PLANETS

Astrophysicists have discovered a very cold brown dwarf with an atmosphere containing ammonia. It appears to form a new category of objects half-way between brown dwarfs and the giant planets. The distinctive features of CFBDS0059 make it the archetype of a new class of brown dwarfs (Y dwarfs). The discovery of this missing link means that we now have a continuum of objects ranging from the hottest stars all the way down to the giant planets.

Published in Astronomy and Astrophysics
Date May 2008

Astrophysics

SUSPECTED EXOPLANET CONFIRMED

A French team led by a CNRS researcher may have detected what could be the closest exoplanet to a star ever seen. The existence of the planet had long been suspected, but it was only when the researchers re-analyzed observations of the star beta Pictoris made by the European Southern Observatory (ESO)'s Very Large Telescope with the NACO adaptive optics instrument that they finally obtained the image.

Published in Astronomy and Astrophysics Letters
Date November 2008

Astrophysics

STAR'S MAGNETIC FIELD SWITCHES BACK AND FORTH

Tau Bootis A's magnetic field has just flipped. Like all stars, tau Bootis A generates its own magnetic field, rather as if it had a bar magnet stretching from pole to pole. Regularly, the magnetic field reverses. Although this reversal is clearly observed in the Sun, where it takes place every eleven years, it's harder to study on other stars. However, an international team of astrophysicists led by CNRS researchers has managed to catch tau Bootis A in the act of switching over, by measuring its magnetic field directly. The high frequency of these reversals may be due to the close proximity of a giant planet in very close orbit. Studying the magnetic reversals on tau Bootis A should certainly help us to better understand solar cycles on Sun-like stars.

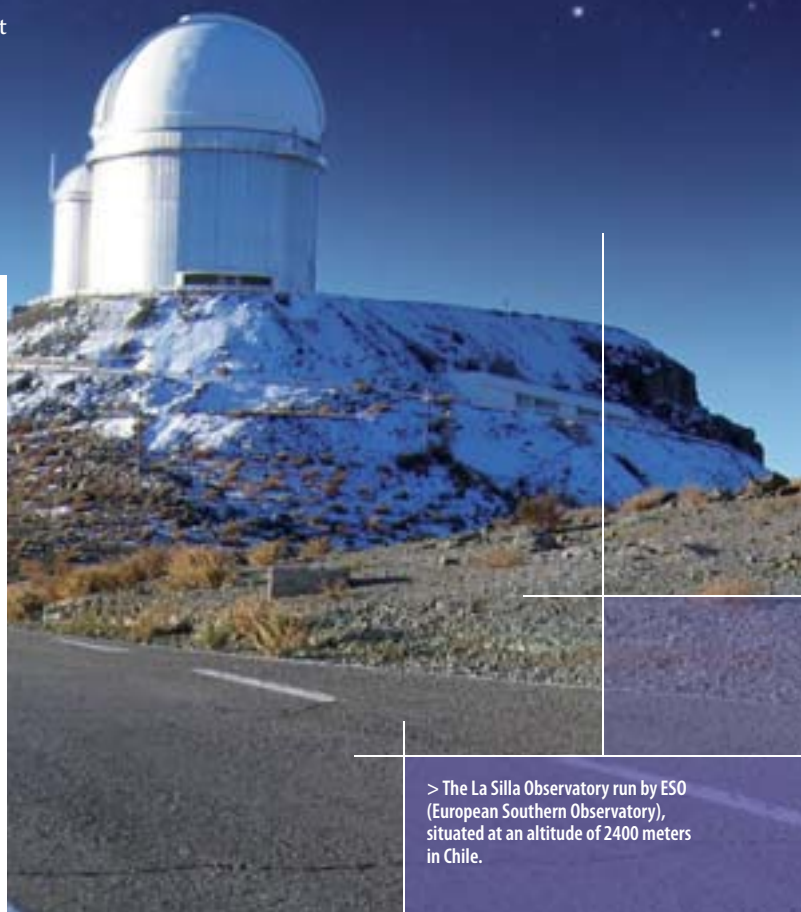
Published in Monthly Notices of the Royal Astronomical Society
Date April 2008

Astrophysics

BLOWING IN THE STELLAR WIND

HD209458b, a gas exoplanet provisionally named Osiris, is surrounded by an extremely extensive envelope of hydrogen, which probably originates in the stellar wind made up of protons and electrons ejected by its nearby star. When the protons and electrons collide with Osiris's atmosphere, they apparently recombine, forming a cloud of atomic hydrogen that preserves the kinetic properties of the stellar wind. However, this doesn't call into question the possibility that its atmosphere may be evaporating.

Published in Nature
Date 21 February 2008



> The La Silla Observatory run by ESO (European Southern Observatory), situated at an altitude of 2400 meters in Chile.



> Sunset on Osiris.

Physics

GREEN SKY AT NIGHT, SHEPHERD'S DELIGHT

A bluish green sunset in a crimson sky, is what you'd see if you were on Osiris (HD209458b). Thanks to observations from the Hubble space telescope's (NASA-ESA) data archive, researchers have obtained the first optical spectrum of this exoplanet (or extrasolar planet) when it passes in front of its star. The spectrum reveals the presence in Osiris's atmosphere of several layers of sodium, oxygen, and what could be vanadium oxide and titanium oxide.

Published in Astrophysical Journal
Date 10 October 2008

Directory

French National Center for Scientific Research (CNRS)

HEADQUARTERS

3, rue Michel Ange
75794 Paris Cedex 16 – France
Tel. +33 1 44 96 40 00
Fax +33 1 44 96 53 90
www.cnrs.fr

— Catherine Bréchnagnac
President
— Arnold Migus
Director General
— Alain Resplandy-Bernard
Secretary General
— Gilberte Chambaud
Institute of Chemistry (INC)
— Françoise Gaill
Institute of Ecology and Environment (INEE)
— Bertrand Girard
Institute of Physics (INP)
— Michel Spiro
National Institute of Nuclear and Particle Physics (IN2P3)
— Patrick Netter
Institute of Biological Sciences (INSB)
— Bruno Laurieux
Institute for Humanities and Social Sciences (INSHS)
— Guy Métivier
Institute for Mathematical Sciences (INSMI)
— Pierre Guillon
Institute of Information and Engineering Sciences and Technologies (INST2I)
— Dominique Le Quéau
National Institute for Earth Sciences and Astronomy (INSU)
— Alain Laquière
Director of Partnerships
— Marc Ledoux
Director of Industrial Policy
— Izo Abram
Director of European Affairs
— Frédéric Benoliel
Director of International Relations
— Marie-Hélène Beauvais
Director of Communications

CNRS around France

ALPS

Departments of the Drôme, Isère, Savoie and Haute-Savoie
Regional Representative
— Younis Hermès
25, rue des Martyrs
BP 166
38042 Grenoble Cedex 9
Tel. +33 4 76 88 10 00
Fax +33 4 76 88 11 61
www.alpes.cnrs.fr

ALSACE

Departments in the Alsace region
Regional Representative
— Philippe Piétri
23, rue du Loess
BP 20 CR
67037 Strasbourg Cedex 02
Tel. +33 3 88 10 63 01
Fax +33 3 88 10 60 95
www.alsace.cnrs.fr

AQUITAINE LIMOUSIN

Departments in the Aquitaine and Limousin regions
Regional Representative
— Philippe Leconte
Esplanade des arts-et-métiers
BP 105
33402 Talence Cedex
Tel. +33 5 57 35 58 00
Fax +33 5 57 35 58 01
www.cnrs.fr/aquitaine-limousin

BRITTANY AND THE LOIRE REGION

Departments in the Brittany and Loire regions
Regional Representative
— Patrick Saubost
Centre d'affaires Oberthur
74E, rue de Paris
35069 Rennes Cedex
Tel. +33 2 99 28 68 68
Fax +33 2 99 28 68 01
www.dr17.cnrs.fr

CENTRAL AND EAST

Departments in the Lorraine, Champagne-Ardenne, Franche-Comté and Burgundy regions
Regional representative
— Michel Retourna
17, rue Notre-Dame des Pauvres – BP 10075
54519 Vandœuvre Cedex
Tel. +33 3 83 85 60 00
Fax +33 3 83 17 46 21
www.cnrs.fr/centre-est

CENTRE POITOU-CHARENTES

Departments in the Centre and Poitou-Charentes regions
Regional Representative
— Patrice Soullie
3E, avenue de la recherche scientifique
45071 Orléans Cedex 2
Tel. +33 2 38 25 52 00
Fax +33 2 38 69 70 31
www.centre-poitou-charentes.cnrs.fr

CÔTE D'AZUR

Departments of the Alpes-Maritimes and Var
Regional Representative
— Marie Florence Grenier-Loustalot
250, rue Albert Einstein
06560 Valbonne
Tel. +33 4 93 95 42 22
Fax +33 4 92 96 03 39
www.cote-azur.cnrs.fr

LANGUEDOC-ROUSSILLON

Departments in the Languedoc-Roussillon region
Regional Representative
— Ghislaine Gibello
1919, route de Mende
34293 Montpellier Cedex 5
Tel. +33 4 67 61 34 34
Fax +33 4 67 04 32 36
www.cnrs.fr/languedoc-roussillon

MIDI-PYRÉNÉES

Departments in the Midi-Pyrénées region
Regional Representative
— Armelle Barelli
16, avenue Édouard-Belin
BP 24367
31055 Toulouse Cedex 4
Tel. +33 5 61 33 60 00
Fax +33 5 62 17 29 01
www.cnrs.fr/midi-pyrenees

NORD, PAS-DE-CALAIS AND PICARDY

Departments in the Nord-Pas-de-Calais and Picardy regions
Regional Representative
— Jean-Benoist Duburcq
2, rue des Canoniers
59046 Lille Cedex
Tel. +33 3 20 12 58 00
Fax +33 3 20 63 00 43
www.dr18.cnrs.fr

NORMANDY

Departments in the Basse-Normandie and Haute-Normandie regions
Regional Representative
— Frédéric Faure
Unicité
14, rue Alfred-Kastler
14052 Caen Cedex 4
Tel. +33 2 31 43 45 00
Fax +33 2 31 44 86 56
www.dr19.cnrs.fr

PROVENCE AND CORSICA

Departments of the Alpes de Haute-Provence, Hautes-Alpes, Bouches du Rhône, Vaucluse, Haute-Corse and Corse du Sud
Regional Representative
— Pierre Doucelance
31, chemin Joseph Aiguier
13402 Marseille Cedex 20
Tel. +33 4 91 16 40 00
Fax +33 4 91 77 93 04
www.provence-corse.cnrs.fr

RHÔNE AUVERGNE

Departments of the Ain, Ardèche, Loire, Rhône and in the Auvergne region
Regional Representative
— Bruno Andral
2, avenue Albert Einstein
BP 61335
69609 Villeurbanne Cedex
Tel. +33 4 72 44 56 00
Fax +33 4 78 89 56 73
www.dr7.cnrs.fr

EASTERN ÎLE-DE-FRANCE

Departments of the Val-de-Marne and Seine-et-Marne
Regional Representative
— Brice Kerber
Tour Europa 126
Centre Belle Épine
94532 Thiais Cedex
Tel. +33 1 56 70 76 00
Fax +33 1 45 60 78 81
www.iledefrance-est.cnrs.fr

WESTERN AND NORTHERN ÎLE-DE-FRANCE

Departments of the Hauts-de-Seine, Seine-Saint-Denis, Val d'Oise and Yvelines
Regional Representative
— Gilles Traimond
1, place Aristide Briand
92195 Meudon Cedex
Tel. +33 1 45 07 50 50
Fax +33 1 45 07 58 99
www.dr5.cnrs.fr

SOUTHERN ÎLE-DE-FRANCE

Department of the Essonne
Regional Representative
— Michèle Saumon
1, avenue de la Terrasse
91198 Gif-sur-Yvette Cedex
Tel. +33 1 69 82 30 30
Fax +33 1 69 82 33 33
www.dr4.cnrs.fr

PARIS A

Paris, except for the 5th arrondissement and CNRS headquarters
Regional Representative
— Alain Mangeol
27, rue Paul-Bert
94204 Ivry-sur-Seine Cedex
Tel. +33 1 49 60 40 40
Fax +33 1 45 15 01 66
www.dr1.cnrs.fr

PARIS B

Paris 5th arrondissement
Regional Representative
— Liliane Flabbée
16, rue Pierre et Marie Curie
75005 Paris
Tel. +33 1 42 34 94 00
Fax +33 1 43 26 87 23
www.dr2.cnrs.fr

PARIS MICHEL-ANGE

including the headquarters
Regional Representative
— Gilles Sentise
3, rue Michel-Ange
75794 Paris Cedex 16
Tel. +33 1 44 96 40 00
Fax +33 1 44 96 53 90
www.cnrs.fr/paris-michel-ange

CNRS Representation abroad

EUROPEAN UNION

Office head
— Monica Dietl
98 rue du Trône
B-1050 Brussels
Belgium
Tel. +32 2 548 10 40
Fax +32 2 548 10 46
CNRS@clora.net

RUSSIA AND COMMONWEALTH OF INDEPENDENT STATES

Office head
— Vladimir Mayer
APP 98
14, rue Goubkina
117312 Moscow
Russia
Tel. +74 95 129 03 13
Fax +74 95 938 22 29
mayer@orc.ru

USA - CANADA

Office head
— Jean Favero
Ambassade de France
Mission scientifique et technologique
4101 Reservoir Road RD
N.W. Washington DC 20007-2176
USA
Tel. +1 202 944 62 40
Fax +1 202 944 62 43
CNRS@CNRS-usa.org

SOUTH AMERICA

Office head
— Jean-François Marini
Román Díaz 264
Provincia
Santiago
Chile
Tel. +56 2 236 34 64
Fax +56 2 236 34 63
CNRS-amlatine@123.cl

NORTH ASIA

Office head
— Natacha Aveline
Maison franco-japonaise 6F
3-9 Ebisu
Shibuya-ku Tokyo
150-0013 Japan
Tel. +813 3443 8551
Fax +813 3443 8552
aveline@jp.cnrs.fr

CHINA

Office head
— Jean-Claude Thivolle
Golden Lake Appartment
Baijiazhuang Dong Li # Block 18B
100600 Beijing
China
Tel. +86 10 6590 1132
Fax +86 10 6590 1127
CNRS@ambafrance-cn.org

SOUTH-EAST ASIA

Office head
— Luc Le Calvez
Maison des sciences et des technologies
35 rue Dien Bien Phu
Hanoi
Vietnam
Tel. +84 4 734 51 23
Fax +84 4 734 51 22

AFRICA

Office head
— Anne Corval
IFAS
66 Wolhuter Street
PO Box 542
Newton 2113 Johannesburg
South Africa
Tel. +27 11 836 0561
Fax +27 11 836 5850
CNRS@ifas.org.za

Cover	© CNRS Photothèque / Bernard Clantin	Page 36	© CNRS Photothèque / Christophe Lebedinsky
Editorial	© CNRS Photothèque / Christophe Lebedinsky	Page 37	© CNRS Photothèque / Hubert Raguét
Pages 2-3	© CNRS Photothèque/@mex / Sébastien Halary		All rights reserved
Pages 4-5	© CNRS / Benoit Lafosse	Pages 38-39	© CNRS Photothèque / Institut Jacques Monod / Vasily Gurchenkov
Page 5	© CNRS Images, N. Lambert.	Page 38	© CNRS Photothèque / Jean-François Dars
Page 6	© CNRS Photothèque / Magali Mondin, Daniel Choquet	Page 39	© CNRS Photothèque / Pascal Hersen
Page 7	© CNRS Photothèque / Valentin Wyart		© Perez and al.
	© <i>Journal of Neuroscience</i>	Page 40	© Gazeau, Wilhelm, Lesieur
Page 8-9	© CNRS Photothèque / www.gregcirade.com		© V. Lysenko
Page 8	© CNRS Photothèque / Jean-François Dars	Page 41	© V. Adam
Page 9	© Fondation Mondiale Recherche et Prévention Sida		© Alexandre Dazzi
	© Institut Pasteur/Christophe Soubert	Pages 42-43	© CNRS Photothèque / Patrick Venail
Pages 10-11	© CNRS Photothèque / Hubert Raguét	Page 42	© CNRS Photothèque / Vincent Perrichot, Didier Neraudeau
Page 11	© C. Rosso, S. Baillet	Page 43	© CNRS Photothèque / Miguel Frada
	Laboratoire de Neurosciences Cognitives & Imagerie Cérébrale / UPR640-LENA et Service des Urgences Cérébrovasculaires, hôpital de la Salpêtrière	Page 44	© Alexis Chaine
	© CNRS Photothèque / O. Colliot	Page 45	© Alexis Chaine
Page 12	© CNRS Photothèque / François Jannin		© S.C. Alberts
	© CNRS Photothèque / Rachel Sherrard	Page 46	© Colin Fontaine, BIOEMCO
Page 13	© A. Hovanessian	Page 47	© CNRS Photothèque / Benoit Ildefonse
	© CNRS Photothèque / Hubert Raguét		© Hannes Mattsson, ETH Zurich
Page 14	© CNRS Photothèque / MNHN / Serge Bahuchet		© Hannes Mattsson, ETH Zurich
	© Florent Hautefeuille	Pages 48-49	© IPGP-CNRS / Julien Aubert
	© CNRS Photothèque / Jean-François Dars	Page 48	© CNRS Photothèque / Jérôme Fournier
Page 15	© CNRS Photothèque / Rosalia Gallotti	Page 49	© Ev-K2-CNR
	© CNRS Photothèque / Jean-Paul Raynal, Fatima-Zohra Alaoui	Page 50	All rights reserved
Page 16	© CNRS Photothèque		© CNRS Photothèque / Frédéric Zuberer
	© CNRS Photothèque / Philippe Dufresne		© Submarine Ring of Fire 2002 Exploration, NOAA-OE (Christine Patrick)
	© CNRS Photothèque / Christophe Lebedinsky	Page 51	© CNRS Photothèque / John Puseddu
Page 17	© C2RMF / J.-L. Bellec	Page 52	© CNRS Photothèque / Franck Roux
	© C2RMF / E. Lambert		© CNRS Photothèque / APS / Hamid Kellay, Fanny Seychelles
	© ARCANÉ / CENBG	Page 53	© CNRS Photothèque / Claude Delhaye
Page 18	© Friday/Fotolia.com		© CNRS Photothèque / Laurent Augustin
Page 19	© CNRS Photothèque / Jean-François Dars	Pages 54-55	© CNRS Photothèque / Erwan Amice
	© CNRS Photothèque / Sébastien Godefroy	Page 54	© CNRS Photothèque / Yves Handrich
	© Musée du quai Branly / C. Lévi-Strauss	Page 55	© Teddy Wilkin / Edward Grey Institute, Univ. Oxford
	© Éditions PLON / C. Lévi-Strauss		© MAMVIS-SMRU
Page 20	© CNRS Photothèque / Christophe Lebedinsky	Page 56	© Cern Geneva
Page 21	© CNRS Photothèque / Martin Hytch	Page 57	© CNRS Photothèque / Laurence Medard
	© CNRS Photothèque / Christophe Lebedinsky	Page 58	© CNRS Photothèque / INSU / LPG / Guillaume Gronoff
	All rights reserved		© OCA / INSU
	© E. Douzery, P.-H. Fabre / ISEM-CNRS and F. Chevenet / IRD	Page 59	© NASA
Page 22	© CNRS Photothèque / IUSTI		© NASA
	All rights reserved	Page 60	© NASA / ESA Hubble space telescope / C. Faure (<i>Zentrum Für Astronomie Heidelberg</i>), J. P. Kneib (Laboratoire d'astrophysique de Marseille)
Page 23	© CNRS Photothèque / Claude Delhaye		© CNRS Photothèque / IN2P3 / François Montanet
	© CNRS Photothèque / Stefan Enoch		© CNRS Photothèque / CPPM / Marie Chevais
Page 24	© CNRS Photothèque / INSU / LAOG / Emmanuel Perrin		© CNRS Photothèque / ESO / INSU / VVDS / Klaus Dolag
	All rights reserved	Page 61	© CNRS Photothèque / Jean-François Dars
Page 25	© CNRS Photothèque / Jean-François Dars		© CNRS Photothèque / ESO / Xavier Delfosse
	© From Ferrand and al., Optics Express, 2008	Pages 62-63	© CNRS Photothèque / ESO / Xavier Delfosse
Pages 26-27	© CNRS Photothèque / Jérôme Chatin	Page 62	© NASA
Page 28	© John H. Page and Hefei Hu, <i>Department of Physics and Astronomy, University of Manitoba</i> , Winnipeg, Manitoba, R3T 2N2, Canada	Page 63	© IAP
	© CNRS / Philippe Bouyer		
Page 29	© CNRS Photothèque / Jean-François Dars		
	© Julie Goyon, LOF, Bordeaux		
Page 30	© CNRS Photothèque / Didier Cot		
Page 31	© CNRS Photothèque / François Tournilhac, Ludwik Leibler		
Pages 32-33	© CNRS Photothèque / Vincent Bouchiat		
	© CNRS Photothèque / Hubert Raguét		
Page 32	© A. Kuhn		
Page 34	© GETTYIMAGES / Jill van Nes		
Page 35	© CNRS / Sarah Landel, Stéphanie Lecocq		
	© CNRS Photothèque / Jean-François Dars		
	© ICMCB		



CNRS

3 rue Michel-Ange
75794 Paris cedex 16

T +33 1 44 96 40 00

F +33 1 44 96 53 90

> Protein crystals in polarized light.