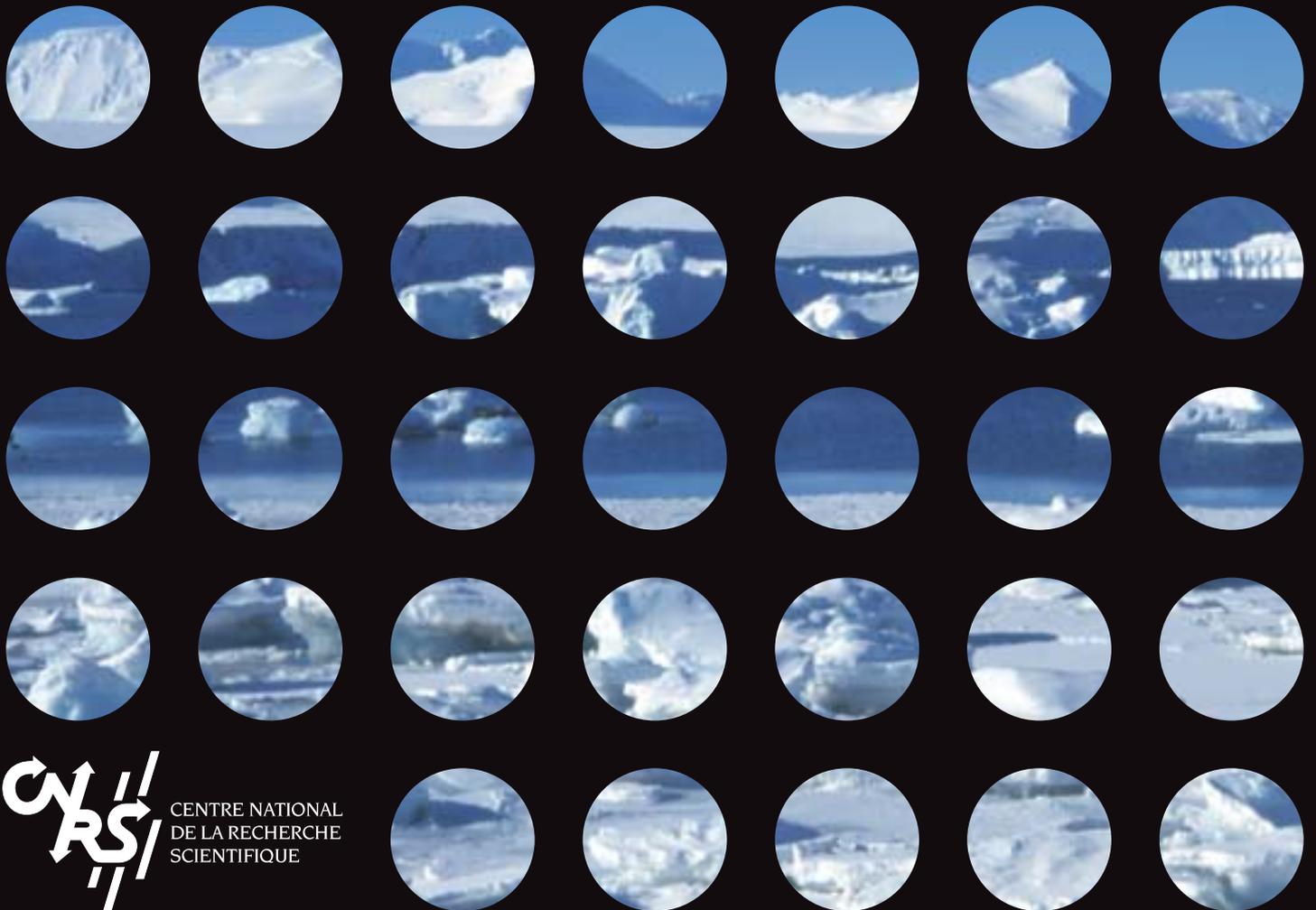


2007

A YEAR AT CNRS



CENTRE NATIONAL
DE LA RECHERCHE
SCIENTIFIQUE



“A Year at CNRS” presents the major scientific advances of 2007 that came out of CNRS’s intramural, joint and associated laboratories. The outstanding science described in this document not only highlights the energy and competitiveness of CNRS teams, but also the increase in projects at the interface between disciplines, one of the organization’s priorities.

The excellence of CNRS was honored several times in 2007 through its researchers and laboratories. Albert Fert, emeritus professor at the Université Paris-Sud, member of the CNRS/Thales Joint Unit and the CNRS Scientific Board, was awarded the Nobel Prize in physics for his discovery of giant magnetoresistance. The Nobel Peace Prize was jointly awarded to the Intergovernmental Panel on Climate Change (IPCC), which includes several CNRS researchers among its members. In addition, Joseph Sifakis, CNRS senior researcher, was awarded the 2007 Turing Prize, considered equivalent to a Nobel Prize for computer science. Economist Jean Tirole was awarded the CNRS Gold Medal, the highest scientific honor in France, for his work on information and game theory applied to economics.

2007 was also a year of changes to our research system. It marks the start of Thematic Advanced Research Networks, with various scientific communities launching ambitious scientific programs within this new framework. For universities, our main partners, 2007 was the year of the University Freedom and Responsibility (LRU) law, which aims at full autonomy for universities. CNRS has clarified its position with regards to this law in its strategic plan, “CNRS Horizon 2020.”

CNRS continues to optimize its resources by being highly selective in financing its research units and in acquiring equipment. It emphasizes interdisciplinary work, investment in equipment and network platforms, and national coordination of these endeavors. It is also worth highlighting the prominent role that the life sciences and information and communication technologies and sciences play in interfacing with all other disciplines. The Institut d’Alem- bert, inaugurated in 2007 on the campus of the École normale supérieure de Cachan, is an excellent example of this growing focus, illustrating the nano-bio-IT convergence.

In 2007, CNRS continued to rank among the ten organizations filing the most patents in France. Our organization uses its attractiveness and presence abroad to enhance its position among its European and international competition. Every year CNRS recruits nearly 25% of its researchers from outside of France, and more than 50% of publications by CNRS research teams are co-published with foreign teams. Young CNRS researchers were exceptionally successful in 2007, receiving more than 9% of the European Research Council (ERC)’s “Young Researcher” grants.

As it did in 2007, CNRS will continue to adapt in the coming years. Its operations and intervention procedures will evolve according to changes in the national research and innovation system and to developments shaped by Europe and the world, all in the best interest of its research.

A handwritten signature in black ink that reads "A. Migus". The signature is written in a cursive, slightly slanted style.

ARNOLD MIGUS /
CNRS DIRECTOR GENERAL

p. 03 **Key figures**

KEY ACTIVITIES IN 2007

Life on Earth

- p. 04 — Decoding the genome
- p. 06 — Unraveling the mysteries of the cell
- p. 08 — Ingenuity in the animal world
- p. 10 — Strategies in the plant world

Human health

- p. 12 — Understanding diseases
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Humans and society

- p. 16 — How does the brain work?
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Intelligent systems

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OUTLOOK 2007

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KEY FIGURES...

CNRS PUBLICATIONS

CNRS produces, on average, 25,000 publications per year*. In materials science and life science —exclusive of medical research— researchers at CNRS-affiliated labs produce two thirds of French publications. CNRS publications in these fields correspond to 4.2% of world scientific production and 10.4% of production in the European Research Area. CNRS laboratories are particularly strong in physics, chemistry and earth sciences and astronomy, fields in which CNRS produces 80% of French publications. More than half the publications coming from CNRS-affiliated research laboratories are a result of collaboration with foreign labs, and nearly one third of CNRS publications are co-written with European partners (~32%).

* This average is based on publications produced from 2004 to 2006. Data from SCl (Thomson-Scientific)

MORE THAN 1100 LABORATORIES LOCATED THROUGHOUT FRANCE,

OF WHICH **MORE THAN 90%** ARE PARTNERSHIPS WITH INSTITUTIONS OF HIGHER EDUCATION OR RESEARCH, FRENCH, EUROPEAN OR INTERNATIONAL ORGANIZATIONS, OR WITH PRIVATE INDUSTRY.

NEARLY 26,000 TENURED STAFF MEMBERS

(**11,595** RESEARCHERS AND **14,316** ENGINEERS, TECHNICIANS AND ADMINISTRATIVE STAFF) AND **8400 TEMPORARY STAFF** (PH.D. STUDENTS, POST-DOCS, SHORT-TERM CONTRACTEES, GRANTEES...).

2.83 BILLION EURO

BUDGET FOR 2007,
OF WHICH CNRS GENERATED 519 MILLION.

25,000 PUBLICATIONS

PER YEAR IN TOP INTERNATIONAL JOURNALS,
MORE THAN HALF OF WHICH ARE CO-PUBLISHED WITH AT LEAST ONE FOREIGN LABORATORY.

CNRS RANKS AMONG **THE TOP-TEN PATENT FILERS** IN FRANCE.

RESEARCH WITHOUT BORDERS

- > **85** AGREEMENTS FOR SCIENTIFIC COOPERATION WITH **60** COUNTRIES
- > **306** INTERNATIONAL PROGRAMS FOR SCIENTIFIC COOPERATION
- > **22** EUROPEAN ASSOCIATED LABORATORIES
- > **39** INTERNATIONAL ASSOCIATED LABORATORIES
- > **38** EUROPEAN RESEARCH NETWORKS
- > **31** INTERNATIONAL RESEARCH NETWORKS
- > **13** INTERNATIONAL JOINT UNITS
- > **8** OFFICES ABROAD (BRUSSELS, MOSCOW, WASHINGTON, JOHANNESBURG, TOKYO, BEIJING, SANTIAGO, HANOI)

INDUSTRIAL POLICY

- > **3058** PORTFOLIO PATENTS, OF WHICH **210** WERE FILED IN 2007
- > MORE THAN **1600** CURRENT RESEARCH CONTRACTS WITH COMPANIES AND **46** COMPANIES CREATED IN 2007 BASED ON RESULTS FROM CNRS LABORATORIES

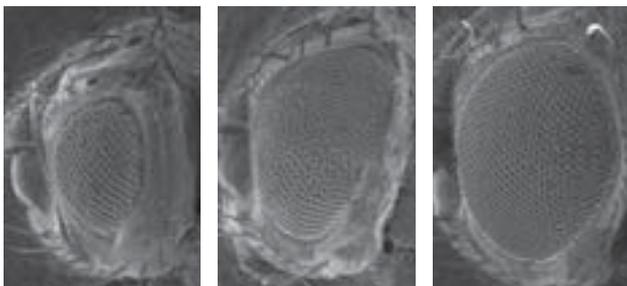
WEB VISIBILITY OF RESEARCH AND DEVELOPMENT CENTERS: CNRS 6TH IN WORLD.

THE WEBOMETRICS WORLD RANKING PLACED CNRS IN **6TH POSITION** FOR WEB VISIBILITY AMONG RESEARCH AND DEVELOPMENT INSTITUTES. IT IS RANKED RIGHT AFTER 5 AMERICAN R&D INSTITUTES, AND IS THE LEADER FOR EUROPE.

DECODING THE GENOME

EVERYTHING, OR NEARLY, IS “INSCRIBED” IN OUR GENES. BUT KNOWING EXACTLY WHAT INFORMATION THEY CONTAIN REMAINS A QUESTION THAT BIOLOGISTS, PHYSICISTS, AND CHEMISTS ARE WORKING TO RESOLVE.

Fluorescence microscopy image of chromosomes prior to cell division.



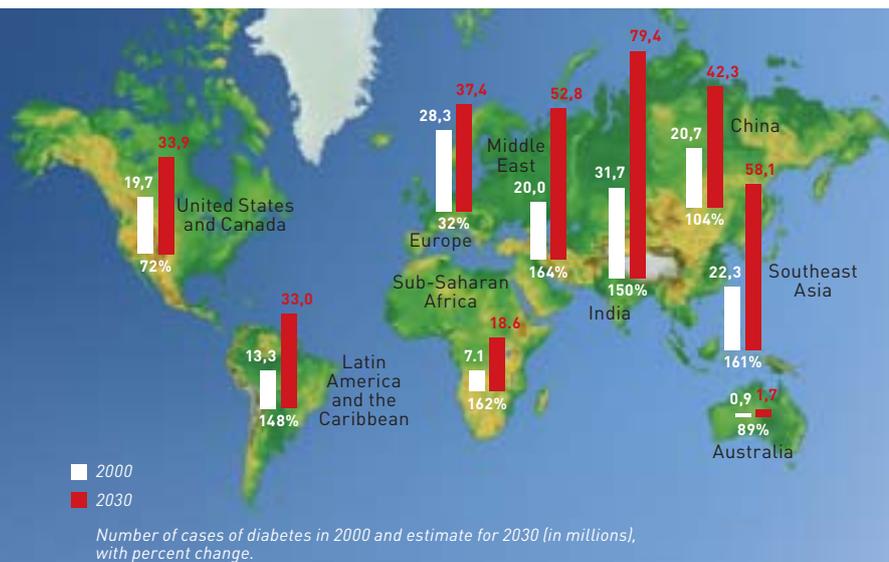
Electron microscopy images of an eye. Normal case, expression of form 1 of the protein Eyeless, and overexpression of form 2.

> ORCHESTRA CONDUCTOR FOR THE EYE

What controls eye development? It turns out there is a splicing factor* that controls the subtle balance between two forms of the protein Eyeless. One form stimulates the growth of the eye, and the other causes it to atrophy. This promising discovery may help in treating the absence of the iris, a pathological condition in humans.

SOURCE PLOS ONE

DATE FEBRUARY 28, 2007



> TYPE 2 DIABETES REVEALS ITS SECRETS

The genome of patients with type 2 diabetes (DT2) has been mapped for the first time, thanks to DNA chips* which can analyze 400,000 mutations at a time. French, English, and Canadian researchers have identified at least four genes* conferring predisposition to the illness, all of which are implicated in the development of the pancreas and insulin-producing cells. These discoveries, which can account for approximately 70% of the hereditary risk for this rapidly spreading disease, are useful for prediction as well as prevention and treatment. Indeed, the products of some of the identified genes are possible targets for treatments.

SOURCE NATURE

DATE FEBRUARY 11, 2007

> INDICTMENT OF BIN 1 GENE

One of the causes of a recessive congenital myopathy has been identified. Researchers have been able to reveal mutations in the gene* BIN 1, which codes for a protein involved in the internal structure of the cell. A precise genetic diagnosis for patients and a prenatal diagnosis for couples carrying the mutation are in sight.

SOURCE NATURE GENETICS

DATE SEPTEMBER 1, 2007

> A HALF-ANIMAL, HALF-PLANT ALGA?

The true identity of *Chlamydomonas reinhardtii*, a unicellular alga showing specific characteristics of both plants and animals, has been revealed. Thanks to the complete sequencing of its genome, researchers hope to improve their understanding of the basic eukaryotic cell*. There are potential applications in agronomy, biotechnology, and medicine.

SOURCE SCIENCE

DATE OCTOBER 12, 2007



Film of bacteria on a puddle of water.

> ARSENIC-LOVING BACTERIA

Detoxification of arsenic-rich areas can be carried out thanks to a bacterium by the name of *H. arsenicoxydans*. Besides analyzing its genome, researchers have shown that this bacteria lives up to its name: It is attracted to areas rich in arsenic, which it transforms into a less harmful and less mobile product. The bacteria can even sequester arsenic in a matrix of sugars. This has valuable potential for preserving groundwater and tap water from arsenic contamination, and even for rehabilitating sites polluted by the poison.

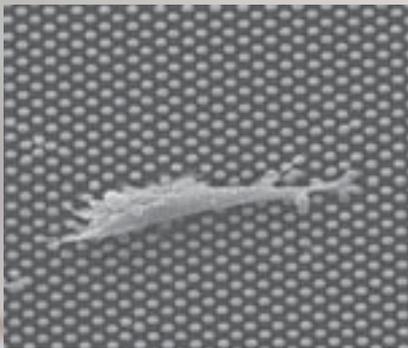
SOURCE PLOS GENETICS

DATE APRIL 13, 2007

UNRAVELING THE MYSTERIES OF THE CELL

SCIENTISTS ARE TRYING TO UNDERSTAND THE MECHANISMS THAT CONTROL THE INNER WORKINGS OF THE SMALLEST UNIT OF LIFE. TAKE STOCK OF THEIR MOST SPECTACULAR RESULTS.

Preparation of a medium allowing living neurons to be studied.



Cell adhering to a micro-pillar substrate.

> CELLS ON A BED OF NAILS

Researchers have dreamed up an elastic and deformable substrate for cells, and shown that tissue growth and cell migration are guided by the structure of this cellular scaffolding. This discovery will make it possible to better understand tumor proliferation.

SOURCE PROCEEDING OF THE NATIONAL

ACADEMY OF SCIENCES

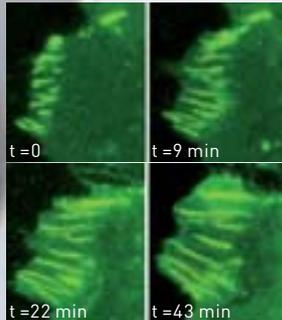
DATE MAY 15, 2007

> WATER DOES NOT ALWAYS LEAD THE BAND

What governs protein movements, and hence their function? For a long time, it was thought that the answer was water, and for every type of protein. For membrane proteins, this idea has been overturned by a discovery by an international team. The research demonstrates that a change in water dynamics had no effect on membrane protein dynamics, contrary to what is observed with soluble proteins. The researchers think that it is the lipid environment of the cell membrane that primarily controls the dynamics of membrane proteins. This is a fundamental discovery because more than 50% of medications target membrane proteins.

SOURCE PROCEEDING OF THE NATIONAL ACADEMY OF SCIENCES

DATE OCTOBER 29, 2007



Images representing the growth of contacts (green lines) between cells.

> THE GLUEY SIDE OF CELLS

Cell to cell contacts behave like springs. Physicists have discovered that these contacts can either be extended or contracted by local forces of neighboring cells. Understanding the physical properties of adhesion between cells should, in the long term, improve our understanding of the healing process.

SOURCE *PHYSICAL REVIEW LETTERS*

DATE JUNE 29, 2007

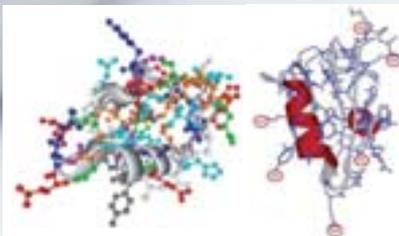


Diagram of insulin (left) and a charge map of the molecule (right).

> PROTEINS IN A VACUUM

Locating electric charges on a protein in its natural environment is no easy feat, but the task can be performed by isolating the protein in a vacuum and studying it with mass spectrometry* and laser spectroscopy*. The resulting knowledge should help improve our understanding of certain reactions *in vivo* and our ability to control them.

SOURCE *AMERICAN CHEMICAL SOCIETY*

DATE JULY 11, 2007



Changes in the structure of chromatin* fiber as a function of DNA* length by nucleosome, from 177 to 207 base pairs.

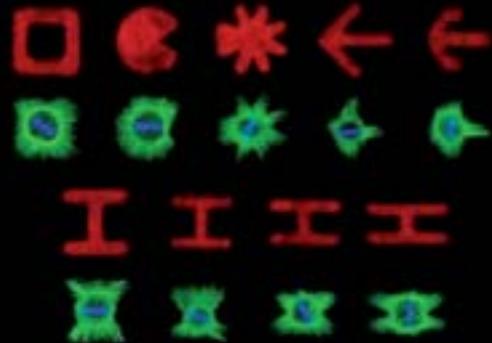
> WHEN DNA GETS ALL WOUND UP

Chromatin*, the basic fiber of our chromosomes made up of DNA* and protein, can fold itself in multiple ways, unlike what was previously thought. This result, which was established based on techniques from robotics, could explain gene* regulation and expression.

SOURCE *PLOS ONE*

DATE SEPTEMBER 12, 2007

In red: different forms of micro-patterning. In green: retraction fibers maintaining contact between the cell and the micro-pattern. In blue: the chromosomes.



> THE "TOP MODEL" OF CELL DIVISION

Cellular "micro-patterning" is an approach developed by biologists at the Institut Curie, in collaboration with physicists at the Max Planck Society. It allows a cell's environment to be modulated by reproducing the spatial information that the cell receives from a tissue—the cell's response can then be studied. Researchers have used this microtechnology to develop a predictive model for the orientation of cell division. This model may be applied to tissues to describe division deregulations in diseased cells, for example.

SOURCE *NATURE*

DATE MAY 24, 2007

INGENUITY IN THE ANIMAL WORLD

ALL ANIMALS HAVE SECRETS FOR SURVIVING AND REPRODUCING IN THEIR ENVIRONMENT. DISCOVER THE VARIETY OF STRATEGIES THEY HAVE COME UP WITH.

Hornet being suffocated.



> BEES THAT KILL HORNETS

It is a bad idea for a hornet to come too close to the hive of certain bees. French and Greek researchers have discovered a collective tactic that Cyprus bees use to defend themselves against these predators: they asphyxiate them. When a hornet tries to attack a bee at the entrance of the hive, a large number of bees surround it tightly and stop its breathing by blocking its abdominal movements and covering its orifices. This asphyxiation strategy, previously unknown, is probably very rare in the animal kingdom.

SOURCE CURRENT BIOLOGY

DATE SEPTEMBER 18, 2007

> EXTRA CREDIT OR DUNCE'S CAP FOR BEES

Bees can distinguish between reward and punishment. Researchers have taught them to associate a specific odor with either an electric shock or sugar. They learn their lesson well, for when the bees are exposed to an odor they have been taught, they either stretch out their stinger in defense or their proboscis to receive the sugar reward.

SOURCE PLOS ONE

DATE MARCH 14, 2007



Theropod dinosaur footprint in Phu Lang, Thailand.



TRACKING THAI DINOSAURS

A French-Thai team is excavating a site with a large variety of dinosaur remains. Recently discovered in northeastern Thailand, this 115 million year old site will make it possible to trace the evolution and migration of fauna in this part of the world.

> BACTERIA HOOKED ON NICOTINE?

Bacteria have nicotine receptors, which were previously thought to exist only in the brains of highly evolved species. A simplified version of the receptor also appears in primitive bacteria. Understanding the structure of these receptors is important for developing new treatments for nicotine addiction.

SOURCE *NATURE*

DATE JANUARY 4, 2007

> MOSQUITOES LIKE IT WARM

Bloodsucking insects know where to bite to find blood. Using artificial skin, researchers have been able to identify that the insects' antennae detect the temperature difference between skin and blood vessels. If they do not find blood at the warmest point on the skin, they bite around that point, at increasing distances, until they find a vessel.

SOURCE *PLOS ONE*

DATE SEPTEMBER 26, 2007

Head of a fly.



> DO INSECTS HAVE A PILOT ON BOARD?

To ensure a turbulence-free flight, insects go into auto-pilot. They have an "optic flow regulator," which enables them to maintain a constant in-flight speed/altitude ratio. The discovery, made by researchers in bio-robotics and supported by experiments with a flying robot, relies on the existence of neurons that detect movement. The optic flow regulator explains how an insect can fly without measuring its altitude or its speed, and it could have applications in the aerospace sector.

SOURCE *CURRENT BIOLOGY*

DATE FEBRUARY 20, 2007



Fly outfitted with a microelectrode leash.

STRATEGIES IN THE PLANT WORLD

THEY MAY BE ROOTED IN PLACE, BUT PLANTS STILL HAVE THE MEANS TO OVERCOME INSECT AND PARASITE ATTACKS. RESEARCHERS EXPLAIN THE MYSTERIES OF THE PLANT KINGDOM.

> GRAPEVINE GENOME DECODED

The grapevine now has the first completely sequenced genome of a plant cultivated for its fruit. Researchers have a detailed analysis of its gene* sequence and have identified the genes involved in wine aroma. The possibility of using the data to create disease-resistant varieties means this result has great potential.

SOURCE **NATURE**

DATE **SEPTEMBER 27, 2007**

> BACTERIAL RUSE FOR INFECTING PLANTS

A bacterium's stratagem – worthy of the Trojan horse – that causes tumors in plants has been explained by the Genopole d'Évry. It is a fatal error for a plant to use its defense program against the pathogenic *Agrobacterium tumefaciens*. The bacteria will take advantage of this mechanism to inject several genes* into the plant's genome that will stimulate cell division and hence the development of tumors. This discovery raises the possibility of designing protection strategies for the plants or of improving plant transformation* techniques.

SOURCE **SCIENCE**

DATE **OCTOBER 19, 2007**

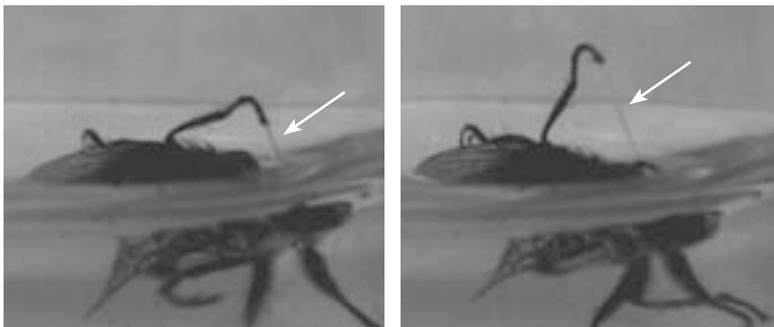


> INSECTS CAUGHT IN THE TRAP

What makes the trap of the *Nepenthes* carnivorous plants so effective? Contrary to common belief, it is not just their funnel-shaped leaves. Two researchers have discovered that their effectiveness is largely due to sticky saliva, which has viscoelastic characteristics ideal for preventing their prey's escape.

SOURCE PLOS ONE

DATE NOVEMBER 21, 2007



Pitcher of the carnivorous plant and a sequence of a fly trapped in the sticky saliva with a strand attached to its leg.

Violet fungus spores on the anthers of the plant *Saponaria ocymoides*.



> PARASITES HAVE A SENSE OF FAMILY

Is infecting a plant a family affair for fungi? It appears so: in 70 percent of cases, a plant with anther smut disease is infected by several strains of related parasites, suggesting that as long as the fungi belong to the same family, they will share the resources of the same plant. This result is of prime importance in understanding the virulence of diseases.

SOURCE PLOS PATHOGENS

DATE NOVEMBER 16, 2007

> RECIPE FOR GROWING CASSAVA

Why are Amerindians among the best cassava farmers in the world? Because they know how to preserve the genetic diversity of the plants on their land. Recent work has revealed their secrets: Amerindian farmers regularly incorporate plants into their crops from seeds that were dormant underground and germinate when conditions are right. Besides allowing abandoned varieties to reappear, this ancestral practice provides farmers with a seed bank of dormant cassava below the soil surface.

SOURCE BIOLOGICAL CONSERVATION

DATE MAY 2007



Cassava field in New Caledonia.



Mice infected with leukemia.

UNDERSTANDING DISEASES

RESEARCHERS ARE TAKING A STAND AGAINST THE “DISEASES OF THE CENTURY” SUCH AS AIDS, CANCER, AND ALZHEIMER’S. THEY ARE CLOSELY EXAMINING THE MECHANISMS OF ACTION OF THESE DISEASES IN HOPES OF FINDING A CURE OR, AT THE VERY LEAST, REDUCING THEIR EFFECTS.

> ALZHEIMER’S STILLBORN NEURONS

In the hippocampus* – the structure in the brain involved in short-term memory – there are “progenitor” cells that produce new nerve cells. In test mice with Alzheimer’s*, the proliferation of these cells is not affected, but their production of new neurons diminishes. The reason is that the cells die before they are mature.

SOURCE JOURNAL OF NEUROSCIENCE

DATE JUNE 20, 2007

> FINDING AN ANTIDOTE TO LEAD POISONING

Lead is found in paints, gasoline, and even in the lining of ancient aqueducts, and can cause lead poisoning*. A new study describes how, on the molecular scale, this poison affects two proteins essential for calcium transport and hemoglobin synthesis. The ultimate objective is to find an antidote that binds lead but not trace elements indispensable to the human body.

SOURCE ANGEWANDTE CHEMIE

INTERNATIONAL EDITION

DATE JANUARY 15, 2007

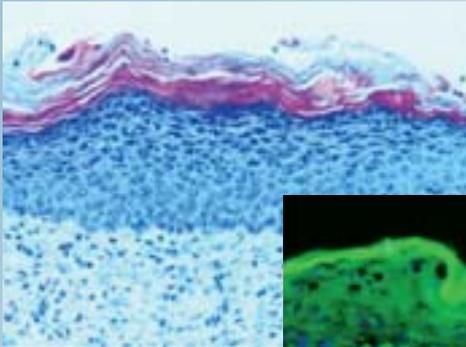
> WITHOUT OB-RGRP, OBESITY GOES ON A DIET

The protein OB-RGRP looks promising for obesity treatment. In mice, the protein is a negative regulator of the leptin receptor, the hormone that controls body weight. In other words, without OB-RGRP, neurons are more sensitive to leptin, the satiation hormone. Inhibiting OB-RGRP could therefore contribute to weight loss.

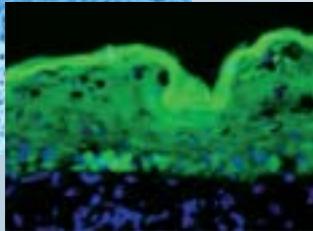
SOURCE PROCEEDINGS OF THE NATIONAL

ACADEMY OF SCIENCES

DATE DECEMBER 4, 2007



Skin regenerated by a graft of genetically corrected stem cells.



In green: cells containing the therapeutic gene*.

> GENE THERAPY FOR SKIN CANCER

How can epidermal stem cells which have been genetically corrected for cancer be sorted from those which have not been modified? Until now, an antibiotic-resistant gene* was used, but the cells could then no longer be used for skin grafts. The new solution is to tag the stem cells' surface with a protein, which enables them to be isolated later on. This method has great potential for patients with a predisposition to skin cancer.

SOURCE MOLECULAR THERAPY

DATE OCTOBER 1, 2007

> FLUSHING HIV OUT OF HIDING

Despite the progress of triple therapies, the human immunodeficiency virus is never completely eliminated because it hides in certain immune cells and becomes latent. But researchers have a plan to dislodge HIV: They reactivate the virus by disabling cellular factors causing its latency, so that antivirals can then destroy it. The next step for this research is animal testing.

SOURCES SCIENCE, EMBO JOURNAL, MOLECULAR CELL

DATES MARCH 16, 2007, JANUARY 24, 2007, FEBRUARY 9, 2007



HIV particles.

> IDC16 STOPS AIDS VIRUS FROM MULTIPLYING

CNRS researchers at the Université de Montpellier have developed a new approach to fighting the AIDS virus: attack the cellular mechanisms that the virus uses to replicate itself. They tested a chemical molecule, IDC16, and showed that it stops infection by preventing the RNA of the virus from maturing inside the infected cell, thus inhibiting replication. This molecule had already demonstrated its efficacy against different viral strains in the laboratory and also on viruses isolated from patients – even ones resistant to triple therapy.

SOURCE PLOS PATHOGENS

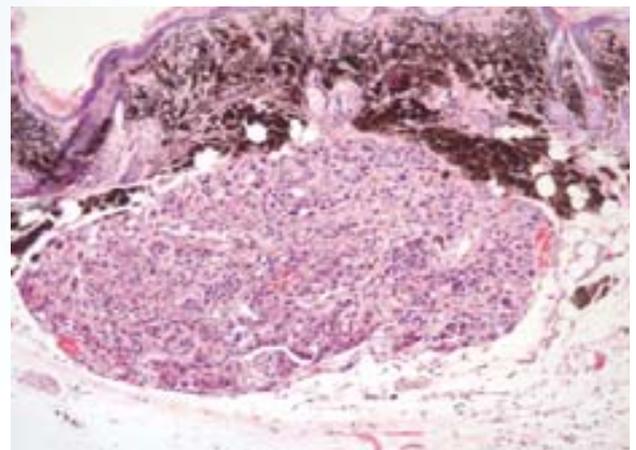
DATE OCTOBER 26, 2007

> FROM MOLE TO MELANOMA

How does a simple mole become a melanoma? Melanocytes undergo active proliferation due to a mutation in their genome, before entering into senescence*. In this state, cells no longer divide, but they do not die either... Sometimes, they become immortal, proliferating indefinitely and giving rise to a melanoma. The secret to this immortality is the protein β -catenine. It had already been known to play a role in proliferation, but it can also induce immortalization by suppressing a key gene* in the cellular cycle.

SOURCE GENES AND DEVELOPMENT

DATE NOVEMBER 15, 2007

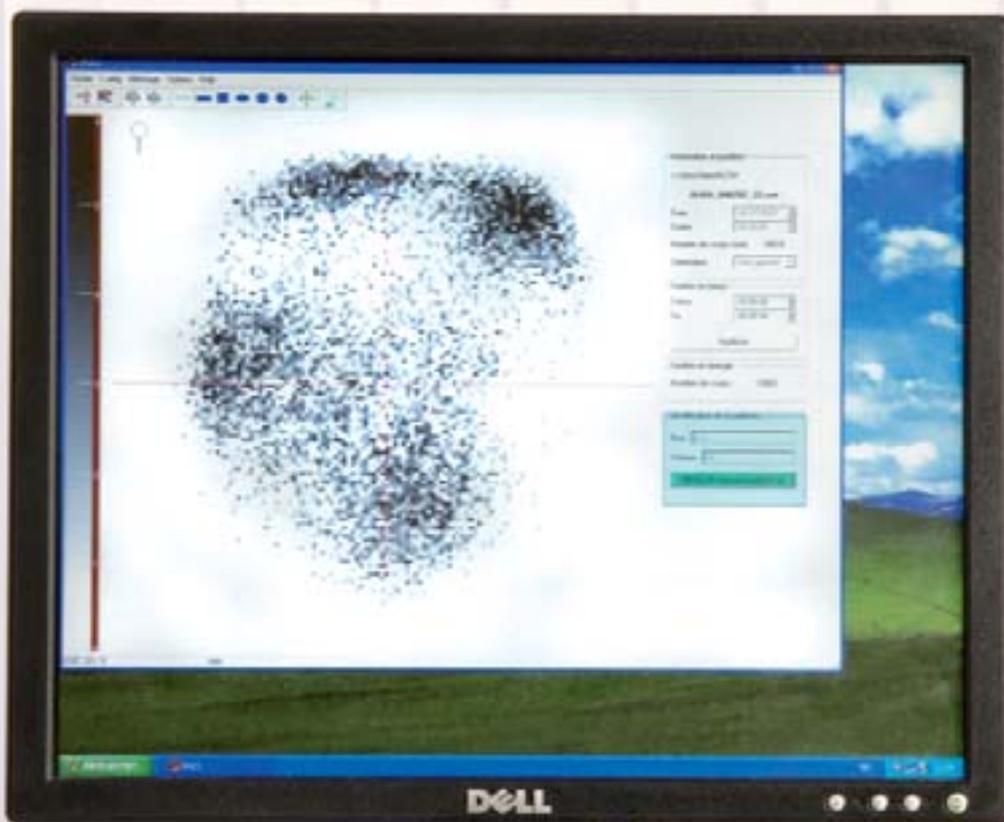


Tumor cells invading the dermis.

DIAGNOSIS, TREATMENT

INNOVATIVE TREATMENTS, PROMISING DIAGNOSTIC TOOLS, NEW DRUG FORMULATIONS. CHEMISTS, BIOLOGISTS, AND ENGINEERS, WORKING TOGETHER WITH HEALTH CARE PRACTITIONERS, ARE SPARING NO EFFORT TO OVERCOME DISEASE.

Medical imaging device attached to POCI camera.

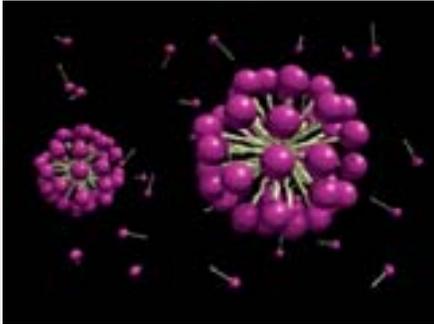


POCI camera.



POCI, SURGEON'S EYE

The miniature camera Poci assists surgeons during breast cancer operations. Developed by a team of physicists, doctors, and hospital methodologists, the camera can locate tumors tagged with radioactive tracers and thus contribute to their complete ablation. Tested on 200 patients, this device is already showing great promise.



Representation of micelles, example of a potential bioactive formulation.

> BIOACTIVE FORMULATION FOR MEDICATIONS

Bioactive formulation is starting out big. This novel strategy for preparing medications, developed by a team in Toulouse in collaboration with the Pierre Fabre laboratories, is based on the synthesis of an amphiphilic active ingredient, in other words, one that likes to surround itself with both water and lipids. It becomes its own formulation agent, since it possesses the useful ability to self-organize. Another asset of bioactive formulations is that they are developed from renewable resources, so they are environmentally friendly. One of these promising molecules is already commercially available for treating eczema.

SOURCE CHEMISTRY - A EUROPEAN JOURNAL

DATE APRIL 5, 2007



AN ULTRASONIC SCANNER THAT DESTROYS TUMORS

There are abundant innovations coming out of time reversal mirror technology. This technique makes it possible to return to the source of a signal with a high degree of precision, and then target it with other signals. Using this principle, researchers have developed an ultrasonic scanner capable of locating and destroying tumors. This application has been developed by the start-up Supersonic Imagine.

> GRAFTED NEURONS GET CONNECTED

Grafted embryonic nerve cells know how to connect. A team of biologists has shown that embryonic cortical neurons develop nerve fibers to appropriate targets when grafted into a damaged motor cortex. This work opens new possibilities for treating neurodegenerative diseases.

SOURCE NATURE NEUROSCIENCE

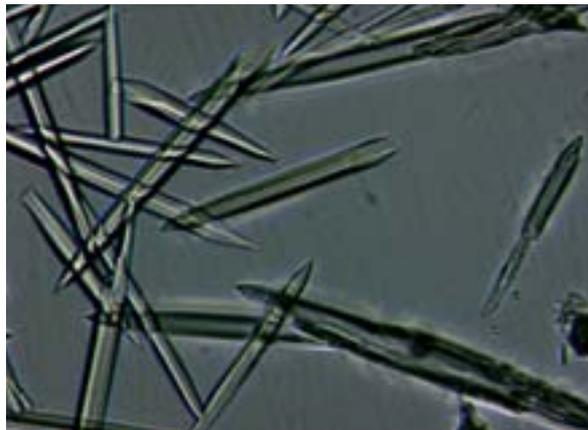
DATE OCTOBER 1, 2007

> MUSCULAR STEM CELLS REPAIRED

A French-Italian team has been able to repair muscle stem cells in patients suffering from Duchenne muscular dystrophy. With gene therapy*, human dystrophin – the protein that is missing in this disease – was made functional again. This new approach will allow patients to “rebuild” their muscles.

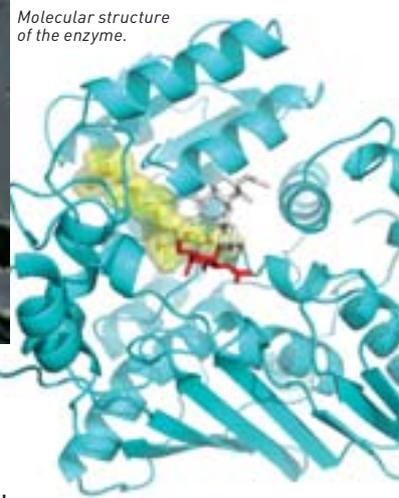
SOURCE CELL STEM CELL

DATE DECEMBER 13 2007



Enzyme crystals.

Molecular structure of the enzyme.



> TYPE O BLOOD FOR EVERYONE?

Bacterial enzymes have been used to transform blood types A, B, and AB into type O, the universal donor. More specifically, these enzymes eliminate the molecules that characterize the antigens of groups A, B, and AB from the surface of red blood cells. The enzymes, identified in the bacteria *Elizabethkingia* by ZymeQuest Inc., in collaboration with French, Danish, and Swedish researchers, are being analyzed to understand their three dimensional structure and mechanism of action, and to improve their efficiency. The results open the possibility of large-scale conversion of types A, B, and AB into type O, which would greatly simplify managing blood stocks.

SOURCE NATURE BIOTECHNOLOGY

DATE APRIL 2007

HOW DOES THE BRAIN WORK?

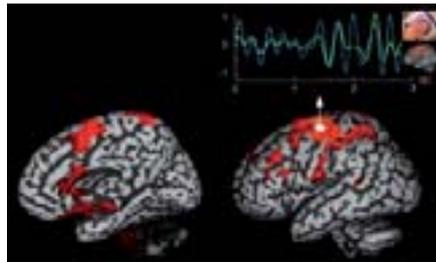
INFORMATION FLOODS INTO THE BRAIN FROM OUR WHOLE BODY. TO UNDERSTAND THE BRAIN IN ALL ITS DETAIL, RESEARCHERS STIMULATE OUR SENSES AND REVEAL THE WORKINGS OF THIS FASCINATING ORGAN.

> SEEING WELL HELPS YOU HEAR BETTER

To hear well, it helps to see well, according to a study on the mechanisms of audiovisual speech integration. Carried out in deaf patients with cochlear implants*, the study reveals that they have better aptitudes for merging visual and auditory information than people who can hear. These results show the potential of emphasizing visual and auditory interactions during speech therapy for patients with implants.

SOURCE PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES

DATE APRIL 2, 2007



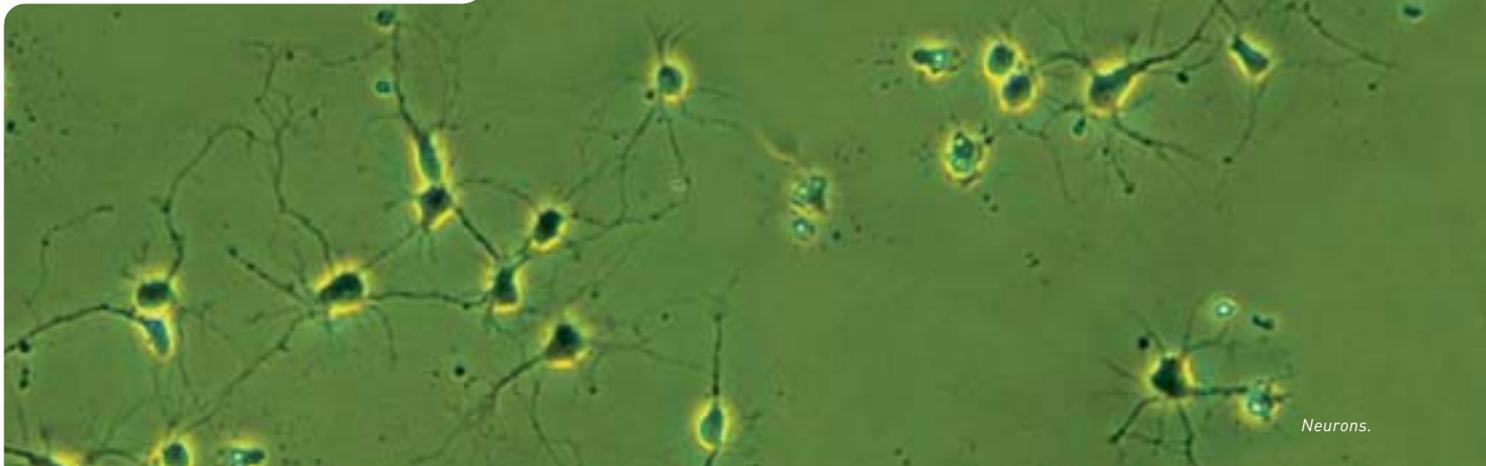
Display of brain activity with speed of hand movement. Seen from the side (left) and the middle (right).

> SEEING THE BRAIN IN ACTION

Using a mouse with a computer screen may seem like a simple task, but in fact it mobilizes numerous parts of the brain. Using a new imaging device that makes it possible to observe the brain in action at the scale of a millisecond, scientists have found that the cerebral regions activated during a motion are completely consistent with the speed of the movement.

SOURCE PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES

DATE APRIL 16, 2007



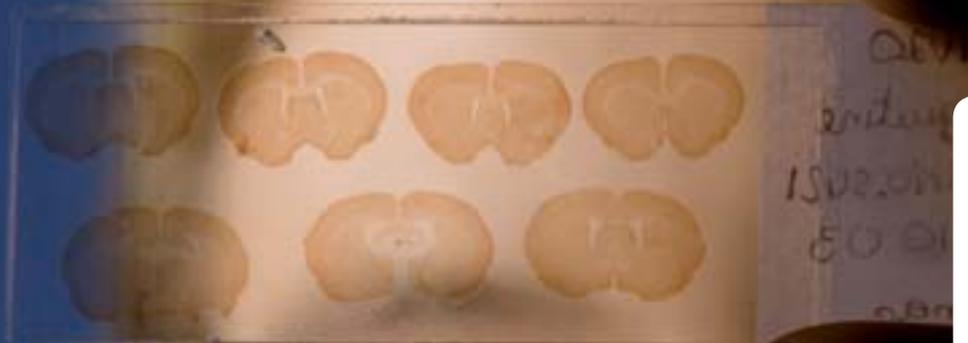
Neurons.

> CEREBRAL SELF-ASSESSMENT

How does the brain evaluate its performance? Studying neuronal function in one part of the prefrontal cortex* – the anterior cingulate cortex – has shown that neurons can detect success or failure of an action. This work is extremely important for better understanding obsessive compulsive disorders, in which this mechanism is weakened, and for improving its treatment.

SOURCE JOURNAL OF NEUROSCIENCE

DATE JULY 11, 2007



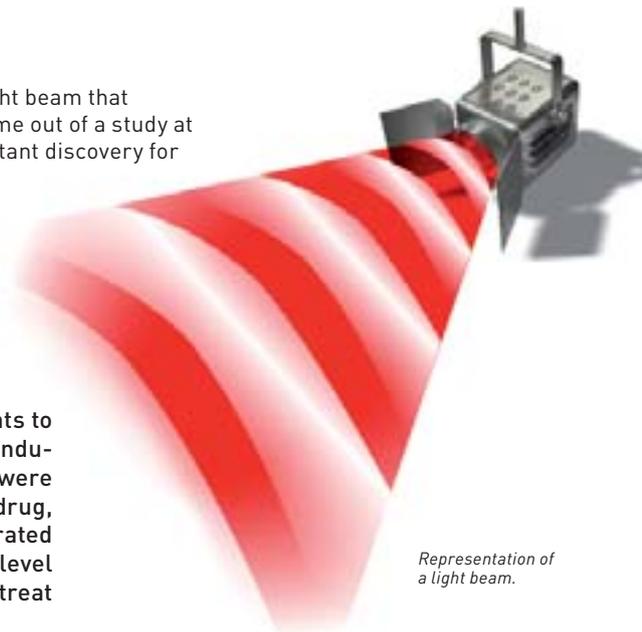
Slices of brains of mice, with lesions due to Huntington's disease (bottom) and without lesions (top).

> THE ATTENTION STROBE LIGHT*

Visual attention is like a flashing spot light in continuous motion, like a light beam that travels from target to target, seven times per second. This conclusion came out of a study at the interface of psychophysics and mathematical modeling. It is an important discovery for understanding how attention works.

SOURCE PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES

DATE DECEMBER 4, 2007



Representation of a light beam.

> ERASING BAD MEMORIES

Can bad memories be erased without altering good ones? After training rats to be afraid of two different sounds, neurobiologists gave them an amnesia-inducing drug and then replayed one of the sounds. In later testing, the rats were no longer afraid of the sound replayed while under the influence of the drug, but still feared the other sound. This is the first time it has been demonstrated that a memory can be permanently modified, even erased, at the cellular level without affecting other associated memories. The results could be used to treat post-traumatic stress.

SOURCE NATURE NEUROSCIENCE

DATE MARCH 11, 2007

> ADDICTED TO ANOREXIA?

Anorexia uses a mechanism similar to appetite suppression induced by drugs like ecstasy and cocaine. It involves the nucleus accumbens, one of the brain structures linked to pleasure and reward. Scientists at the Institut de génomique fonctionnelle have shown that this part of the brain has a high concentration of a serotonin receptor called 5-HT4. In mice, stimulating this receptor has the effect of suppressing appetite, while blocking the receptor leads to increased food consumption.

SOURCE PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES

DATE OCTOBER 9, 2007

THE LAND OF HISTORY

FROM AGRICULTURE TO MINING, HUMANS KNEW VERY EARLY ON HOW TO MAKE USE OF THEIR ENVIRONMENT. EXCAVATIONS ALLOW ARCHEOLOGISTS, HISTORIANS, AND BIOLOGISTS TO UNEARTH TRACES OF OUR ANCESTORS' ACTIVITIES AND RECONSTRUCT THEIR WAY OF LIFE.

Mining area, Cime du Fer, Mercantour National Park, Alps.



Sample collecting under aseptic conditions.

> MUSEUMS THAT DO NOT PRESERVE

The ground preserves the DNA* in bones better than museums do. Paleogeneticists have shown that fossilized bones lose 85% of their genetic material during archeological processing and conservation in museums. This discovery calls for a new methodology for treating and storing fossils.

SOURCE PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES

DATE JANUARY 8, 2007

> ARCHEOLOGISTS IN SEARCH OF BUGS

A new bioindicator for human activity has attracted the attention of researchers: oribatid mites, which feed on livestock excrement. Found in Peru by a team from the Centre de bio-archéologie et d'écologie in Montpellier, the exoskeletons of these mites have revealed four periods of great social change in the Inca empire, for which written records are lacking.

SOURCE JOURNAL OF ARCHAEOLOGICAL SCIENCE

DATE JULY 2007





Domestic cats,
Felis silvestris catus.

> CATS AND PEOPLE

In the Fertile Crescent of the Neolithic, cats were attracted by human activity and took up residence near people. Researchers have retraced the evolutionary history of cats: the feline's ancestor appeared 230,000 years ago and evolved into about thirty subspecies, most of which – except for domestic cats – are now threatened.

SOURCE SCIENCE

DATE JULY 27, 2007



HISTORIANS EXAMINE THE RESISTANCE

A collection of four documentaries co-produced by CNRS, Les Films de la Croisade, Yami 2, France 2, France 5 and CRTF, and two documentary fictions attempts to provide another view of the French Resistance. "La Résistance," written by Christophe Nick and Andrew Bampfield, retraces the history of this broad movement, based on the expertise of two CNRS historians. Between the image conveyed towards the end of the war (in 1944) of a population completely supportive of and involved in the Resistance, and a very different image in the 1970s, stressing the cowardice and collaboration of the French people, there is an intervening period that greatly interests historians.

Mining debris, signs of extraction (left), slag (right).



HIGH ALTITUDE MINES

Archeologists and geologists have located traces of mining and ironworking activities at an altitude above 2000 meters in the Alps. Dated to the period between the 2nd century B.C. and the 7th century A.D., this is the highest altitude ironworks site in Europe. It proves that people knew how to adapt this metalworking activity to high altitude and areas with limited access to resources.



CULTURAL

ARCHEOLOGISTS, HISTORIANS, AND ETHNOLOGISTS GO IN SEARCH OF EVERY SHRED OF EVIDENCE ABOUT LIFE IN ANCIENT SOCIETIES. FROM POMPEII TO THE HEART OF AFRICA, THEY HAVE IDENTIFIED A NUMBER OF CLUES ABOUT ANCIENT RITUALS AND THE BEGINNINGS OF SYMBOLIC THOUGHT.

> BLOOD RITUALS IDENTIFIED IN AFRICAN ART

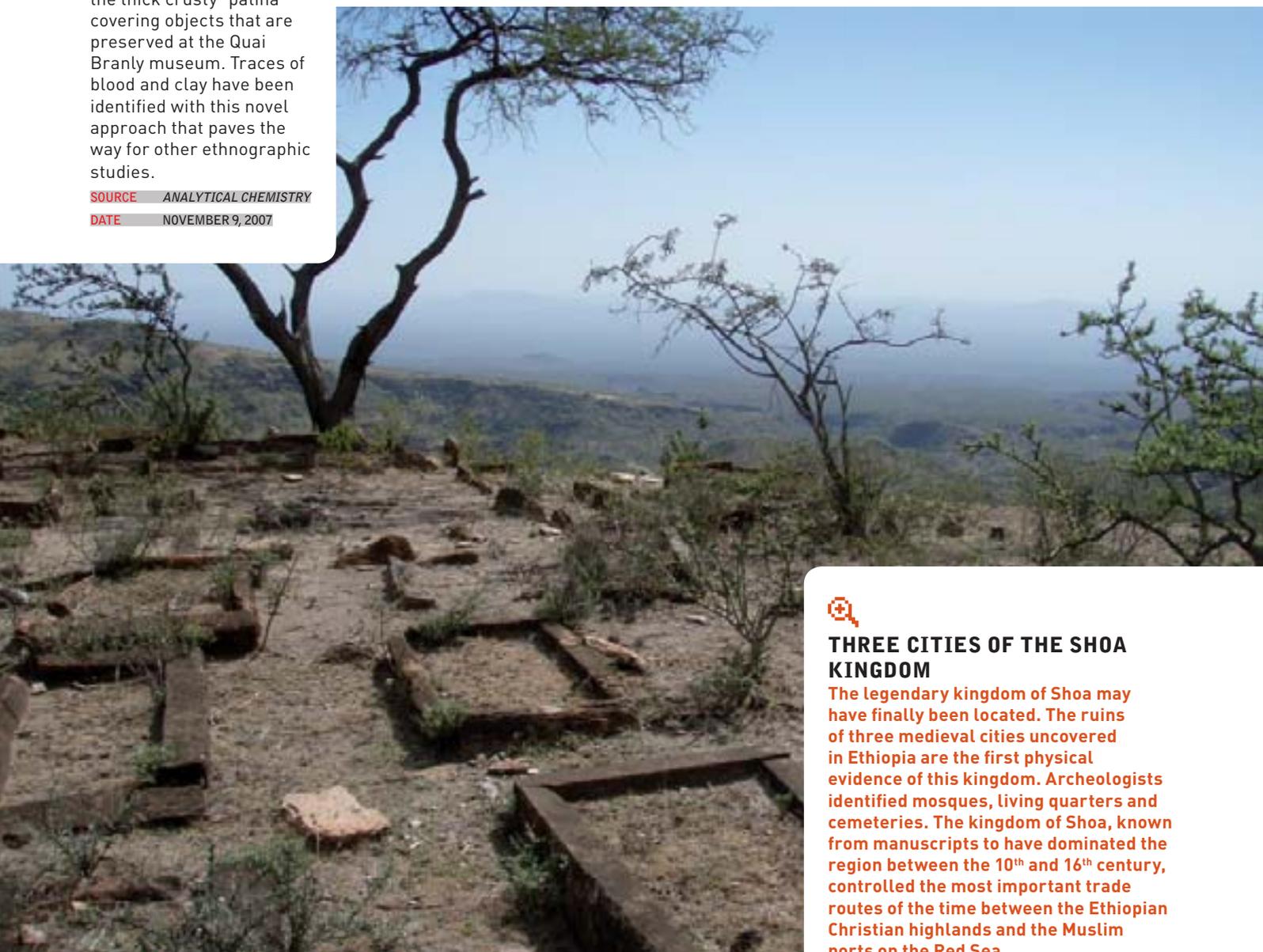
Ritual objects used by the Dogon and Bamana people of Mali have been closely examined. A combination of different chemical imagery techniques has been employed to provide a detailed analysis of the thick crusty "patina" covering objects that are preserved at the Quai Branly museum. Traces of blood and clay have been identified with this novel approach that paves the way for other ethnographic studies.

SOURCE ANALYTICAL CHEMISTRY

DATE NOVEMBER 9, 2007



Bovine-shaped boli (Bamana, Mali) and anthropomorphic dege figure (Dogon, Mali).



THREE CITIES OF THE SHOA KINGDOM

The legendary kingdom of Shoa may have finally been located. The ruins of three medieval cities uncovered in Ethiopia are the first physical evidence of this kingdom. Archeologists identified mosques, living quarters and cemeteries. The kingdom of Shoa, known from manuscripts to have dominated the region between the 10th and 16th century, controlled the most important trade routes of the time between the Ethiopian Christian highlands and the Muslim ports on the Red Sea.

Cemetery of Mäsäl, one of the cities in the Shoa kingdom.

ARTIFACTS



Fragment of the wall painting discovered under the Pompeii tannery.



ANCIENT ART HISTORY FINDS A “ZERO” REFERENCE POINT

A new pictorial treasure was exhumed in Pompeii. During a stratigraphic excavation under the Pompeii tannery, archeologists discovered a banquet room which would have been used by aristocrats from the 5th to the early 3rd century B.C. This room has a simple but elegant décor and is decorated with a style of painting previously unknown at this site – a style which is from an earlier period than the four known reference styles in art history. This style of painting had been previously found in the necropolis at Cuma and identified as “Style Zero.” It appears to be typical of Campania in the 4th century B.C.

Nassarius gibbosulus shells.



> OLD TIME JEWELS

The oldest adornments ever discovered have been found in the Cave of Pigeons in Taforalt, Morocco. Researchers unearthed ornaments made with 82,000-year-old shells. These small shells were gathered, perforated, and colored red, and they provide conclusive signs of the acquisition of symbolic thought and modern cognitive capacities.

SOURCE PROCEEDINGS OF THE NATIONAL

ACADEMY OF SCIENCES

DATE JUNE 4, 2007

Vincennes tower keep, after restoration.



THE VINCENNES TOWER KEEP REVEALS ITS HISTORY

So much has been learned about daily life among the former occupants of the Vincennes tower keep. A major, multi-year restoration project has been completed and archeological studies have uncovered details down to what food the occupants ate. The project undertook an exhaustive study of the medieval edifice and its history, from the Middle Ages to the present day.

Karnak archeological site.



NEW AGREEMENT FOR THE KARNAK TEMPLES

In December, the Centre franco-égyptien d'études d'archéologie et d'architecture des temples de Karnak (French-Egyptian Center for Archeological and Architectural Studies of the Temples of Karnak) turned forty and a new scientific cooperation agreement was signed between the two countries in Luxor. The main goal of the agreement is to develop collaboration between French and Egyptian archeologists and to promote the restoration and management of the Karnak temple complex.



TELEVISION DURING THE THIRTY GLORIOUS YEARS: CULTURE AND POLITICS

A new book, *La télévision des Trente Glorieuses: Culture et politique*, is based on what the French watched between 1945 and 1975, when television started producing social and political ties and inventing a new language. Written by historians, this book is a fascinating analysis of the birth of a medium which constructed a democratic ideal.

AUTHOR ÉVELYNE COHEN
AND MARIE-FRANÇOISE LÉVY
PUBLISHER CNRS ÉDITIONS
DATE SEPTEMBER 2007



HOUSEWORK INJUSTICE: WHY DO WOMEN ALWAYS DO SO MUCH?

François de Singly, assisted by young sociologists, carried out a study about housework. One thing is sure: household tasks fall very heavily on women. Although unhappy with this situation, some women paradoxically acknowledge finding excuses for their having to do the housework. In return, they expect other forms of attention from their husband.

AUTHOR FRANÇOIS DE SINGLY (DIR.)
PUBLISHER ARMAND COLIN,
COLL. "SOCIÉTALES"
DATE JUNE 2007



EMPLOYEES AND PRECARIOUS EMPLOYMENT

Precarious employment contributes to feelings of insecurity among salaried workers. Sociologist Serge Paugam reveals new harm stemming from precarious employment, which increases insecure feelings and reduces access to social rights. For this study, he examined more than a dozen big companies and interviewed a thousand employees. The author emphasizes the urgent need to promote job growth.

AUTHOR SERGE PAUGAM
PUBLISHER PUF, COLL.
"QUADRIGE"
DATE SEPTEMBER 2007



ACCESS TO SOCIAL RIGHTS

Why do some people who are eligible for social aid not ask to receive it? In his book, Philippe Warin explains the psychological reasons behind this phenomenon that is present in France and expanding in Europe, bringing to light voluntary individual withdrawal that goes beyond policy weakness. Access to social rights is not at all universal.

AUTHOR PHILIPPE WARIN
PUBLISHER PRESSES
UNIVERSITAIRES DE GRENOBLE,
COLL. "POLITIQUE EN +"
DATE JANUARY 2007



PROFESSION: POLICE OFFICER; GENDER: FEMALE

In just thirty years, women have progressively gained access to all the ranks and departments of the police. Sociologist Geneviève Pruvost considered the ways in which women – who have historically been excluded from law enforcement – have appropriated this power. The motivations women have for becoming police officers are very diverse, and include a vocation for police work, the love of adventure, and even job security.

AUTHOR GENEVIÈVE PRUVOST
PUBLISHER MSH, COLL.
"ETHNOLOGIE DE LA FRANCE"
DATE APRIL 2007



HISTORY OF THE BIG BAD WOLF: 3,000 ATTACKS ON HUMANS IN FRANCE

Why are we afraid of wolves? This question interested author and historian Jean-Marc Moriceau. Based on a long investigation and the analysis of 3000 death certificates from fatalities linked to wolves, his work brings in biologists, veterinarians and geographers. The study highlights the fundamental difference between a rabid wolf – which will attack any human – and a predatory wolf which chooses weak victims.

AUTHOR JEAN-MARC MORICEAU
PUBLISHER ARTHÈME FAYARD
DATE SEPTEMBER 2007

SOCIETY IN THE SPOTLIGHT

SOCIOLOGISTS, PHILOSOPHERS, AND PSYCHOLOGISTS STUDY PEOPLE AND BEHAVIOR FROM EVERY ANGLE. THEIR BOOKS OFFER A LOOK AT SOCIETY AND ITS UNDERLYING MECHANISMS.



GOOGLE ME, AMERICA'S SECOND MISSION

Google, the most famous search engine, sets forth two main objectives: "organize all of the world's information" and "do no harm." Barbara Cassin, philosopher and philologist, examines the two slogans as a way to tackle the significance of the Google phenomenon and its political, economic and cultural impact.

AUTHOR BARBARA CASSIN

PUBLISHER ALBIN MICHEL, COLL.

"BANC PUBLIC"

DATE FEBRUARY 2007



THE WAFFEN-SS. POLITICAL SOLDIERS IN A TIME OF WAR

Who were the SS? How were they prepared and conditioned to fight? What were their duties? How did they behave? Author Jean-Luc Leleu studied such questions by examining material from exceptionally rich German archives. His book won the military history prize awarded by the Defense Ministry and it is likely to become a reference on the subject.

AUTHOR JEAN-LUC LELEU

PUBLISHER PERRIN

DATE SEPTEMBER 2007



CHILDREN'S STREET, STREET CHILDREN

Whether in Yaoundé or Antananarivo, cities are closing their doors to street children. But why? The author, a geographer, followed street children in order to understand this phenomenon of marginalization. Her analysis throws light on new urban powers. Her moving account makes it possible to understand current issues facing African societies.

AUTHOR MARIE MORELLE

PUBLISHER CNRS ÉDITIONS,

COLL. "ESPACES ET MILIEUX"

DATE JULY 2007

OF ROBOTS AND MEN

IF INNOVATION IS FLOURISHING ANYWHERE, IT IS IN THE FIELD OF ROBOTICS AND VIRTUAL REALITY, WHICH ARE INCREASINGLY PRESENT IN OUR DAILY LIFE. YESTERDAY'S DREAMS ARE NOW WITHIN REACH.

Adept Quattro robot.



WORK FAST TO EARN MORE

An industrial robot needs to work fast and well. The fastest to date is called Adept Quattro. This four-armed robot, designed by researchers at CNRS and the Spanish foundation Fatronik, has just hit the market and it is twice as fast as the rest. The agricultural and health industries are interested in its potential use in their fields.



A NEW R2D2 COMES TO FRANCE

A second humanoid robot is coming to the Laboratoire d'informatique et de robotique in Montpellier. At 60 cm high and 8.8 kg and with a whole range of sensors, the HOAP3 robot is part of an experimental platform that will allow testing of ambulation and object manipulation models and command methods.



HOAP3 humanoid robot.



SPOTLIGHT ON VIRTUAL REALITY

Virtual reality has the place of honor in Marseille. After inaugurating a platform dedicated to analyzing human movement, the Laboratoire Mouvement et Perception organized a symposium at the end of October focusing on uses of virtual reality, notably in behavioral and cognitive sciences. The subject is also of interest to businesses.



ROBOT OLYMPICS

The RoboCup in Atlanta – from June 30 to July 10 – was the place to see all the latest innovations in human-robot interactions. Two cooperative robots developed at the Laboratoire d'étude des mécanismes cognitifs in Lyon were shown there. One demonstrated its visual and motor skills and the other its ability to imitate movements. Future prospects for these innovations include helping with physical therapy for stroke victims.

Photography and processing by the software.



MEDIEVAL MONUMENTS REVISITED IN 3D

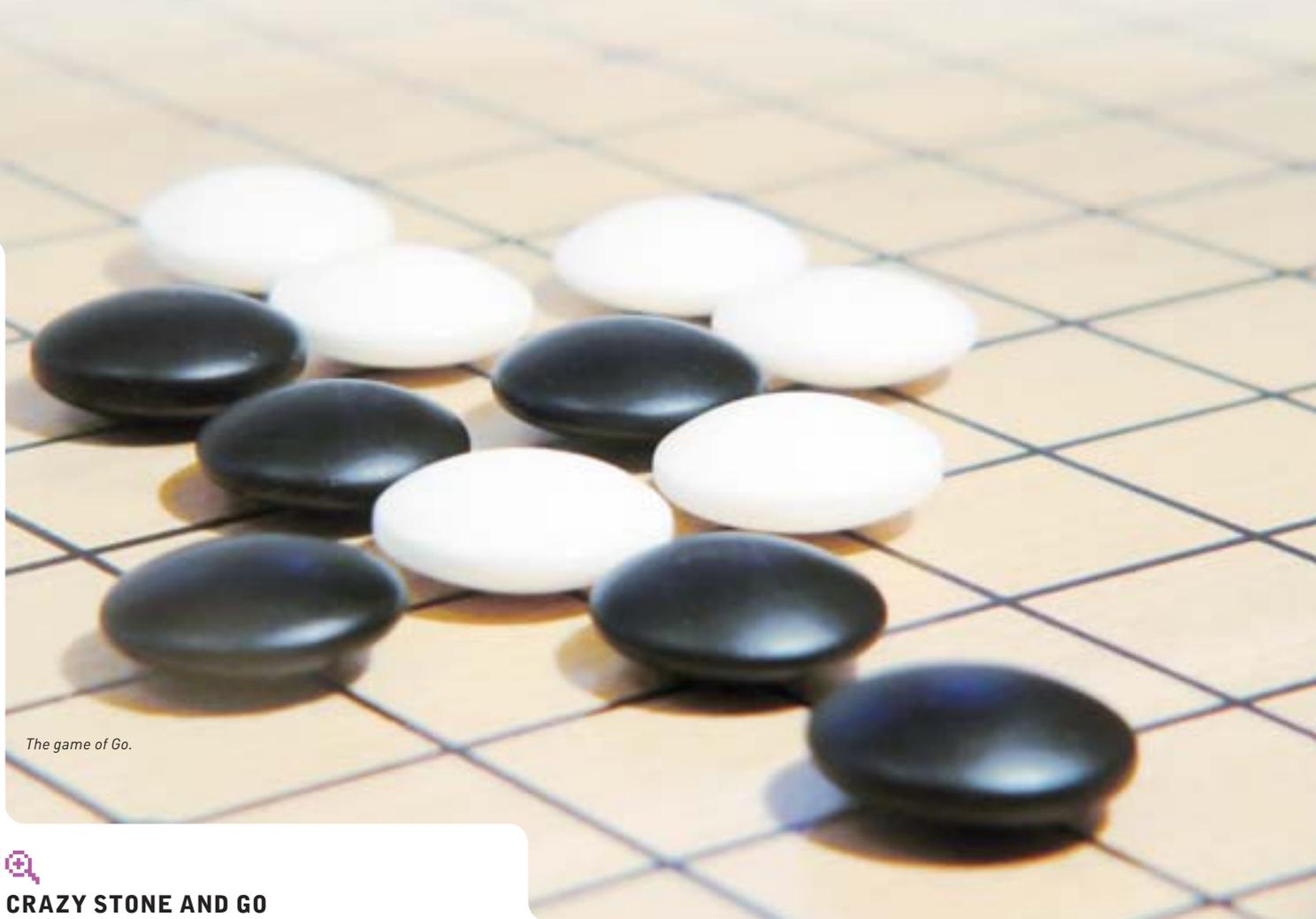
Researchers are using 3D to analyze medieval architecture. They use animation software that integrates digital photographs, sketches and measurements made on site, allowing them to construct a virtual model of the edifice. The objective is to identify the personal style of architects and to determine the authorship of certain works.

The Cooperator robot mimics human movements.



COMPUTER SCIENCE STRUTS ITS STUFF

WITH EVER INCREASING PERFORMANCE AND SPEED, COMPUTER SYSTEMS ACCOMPLISH FEATS SUCH AS TESTING STATISTICAL MODELS AND THERAPEUTIC MOLECULES AND GIVING ACCESS TO SHARED RESOURCES.



The game of Go.



CRAZY STONE AND GO

The game of Go is quite the puzzle for artificial intelligence. Indeed, with so many possible moves and the need to anticipate a significant number of them, creating an algorithm* is not easy. But Crazy Stone, a program developed by the Groupe de recherche sur l'apprentissage automatique, may get the better of Go. Thanks to random sampling of possible sequences – also called the Monte Carlo technique – Crazy Stone is a significant improvement over other algorithms and has even won its first Go tournaments against amateurs.



COMPUTER GRIDS FOR FIGHTING DISEASE

One of the key uses for grid computing* is to rapidly test medications against various diseases. This is how the international grid Egee came to sift through more than 500,000 potential molecules against avian flu in just two months. Another example comes from Wisdom, an international collaboration that centralizes a number of grids, including Egee. It virtually tests molecules by calculating the probability that they will bind to a target protein. This strategy has made it possible to analyze 4.3 million potential therapeutic molecules for malaria in 10 weeks. This is an efficient way to eliminate irrelevant molecules and concentrate on the more promising ones.



FREE TIME FOR CNRS SOFTWARE

Following the initiative of the Network unit, the Plume platform compiles and analyzes free software and then provides access to this software through a website. There is an obvious financial benefit for CNRS, as access to freeware is made much simpler for researchers. www.projet-plume.org



HUMANITIES AND SOCIAL SCIENCES GO ALL DIGITAL

The department of humanities and social sciences goes all digital with Adonis, a vast "virtual media library." With this new search portal for materials and tools, researchers will have access to scientific journals, audiovisual documents, and even data about the location of archeological digs. The goal is for this unique tool to become part of a European project. www.tge-adonis.fr

Adonis portal.



THE INSTITUT DES GRILLES CAN BE COUNTED ON

The Institut des Grilles (Grids Institute) was created in early September, bringing together fifteen laboratories. The new CNRS structure is involved in making extremely powerful computing tools available to the scientific community, in order to consolidate existing infrastructures and increase synergies between the different players. The work of the 150 people in this field will become more efficient and visible. The Institute is set to become the French and European leader in developing new grid technologies.



TRAVELING BY CHANCE

All roads lead to Rome...eventually. Physicists have been able to assess the time it takes to go from one point to another when traveling by chance. Their theory, which shows good agreement with real times observed, could make it possible to determine the speed at which epidemics spread or biomolecules react.

SOURCE NATURE

DATE NOVEMBER 1, 2007





THE “NANO” CHALLENGE

TO UNDERSTAND THE WORLD AT THE SCALE OF THE ATOMS THAT MAKE IT UP, RESEARCHERS HAVE TAKEN UP THE NANO CHALLENGE AND ARE EXPLORING MATTER THROUGH ITS SMALLEST COMPONENTS. STEP INTO THEIR UNIVERSE.

Above: PEGylated liposome, second generation drug delivery system.

Below: Liposome (100-300 nm) used as a drug delivery system.



ARE NANOTECHNOLOGIES DANGEROUS?

The Observatoire des micro et nanotechnologies (OMNT), a joint service unit of CNRS and CEA, has created a working group to study the effects of nanoparticles* and nanomaterials on health and the environment. This multidisciplinary team will be responsible for providing a scientific watch and keeping non-specialists up-to-date with nanotechnologies.



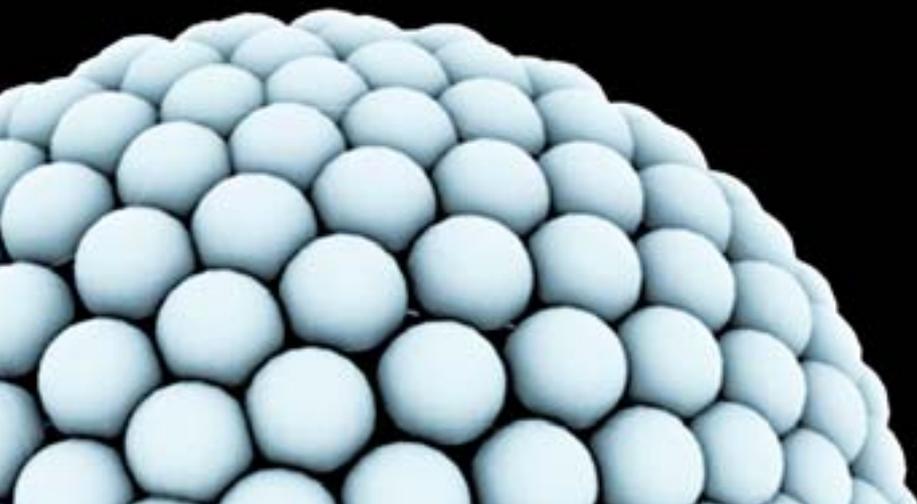
Variation in water flow in a pipe, modeling nanowire oscillation.

> NANOS KEEP “CURRENT”

The first alternating current nanogenerator has been created. The oscillating element – a nanowire of silicon carbide – is plugged into a source of direct current voltage, creating self-supporting oscillations. The next step is to design a completely autonomous nanogenerator to be used in portable devices.

SOURCE [NANO LETTERS](#)

DATE [AUGUST 8, 2007](#)



> COLORFUL NANOS

Mapping the color of nanoparticles* with several nanometers* resolution may seem like an impossible task, but it has been done. The technique employed – electron energy loss spectroscopy* – is better than all prior techniques and is enhancing our understanding of optical electronics*, the basis of fiber optic telecommunications.

SOURCE NATURE PHYSICS

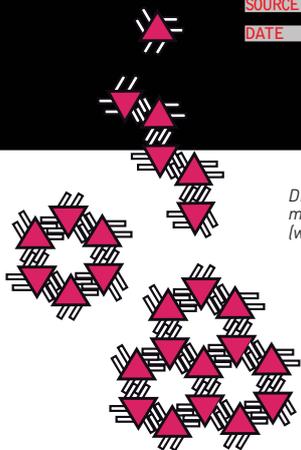
DATE MAY 1, 2007

> ON THE ROAD TO NANO-CARS

What do cars, astronomical clocks and adding machines have in common? The wheel. Today, this legendary invention is the new muse of nanotechnologies. A nanomachine composed of two molecular wheels mounted on a 0.6 nm axel has been synthesized, and for the first time, the rotation can be controlled thanks to scanning tunneling microscopy*. Depending on the conditions, the researchers can make the wheels turn independently from one another, or make the molecule move forward without turning the wheels. The ultimate challenge is to create a nano-car, a molecule-machine with a motor and four wheels.

SOURCE NATURE NANOTECHNOLOGY

DATE FEBRUARY 2007



Different structures made with clips (white bars).

> BUILDING A NANO-WORLD

Custom-building nano-objects is getting closer to child's play. Using the principle behind building sets, chemists have designed "molecular clips" which allow them to attach molecules together that are selected for their optic or electronic properties, for example, and according to a controlled structure. The work is paving the way for nanocompounds with new functions.

SOURCE ANGEWANDTE CHEMIE

INTERNATIONAL EDITION

DATE OCTOBER 1, 2007

> BUILDING NANOPARTICLES AT THE ATOMIC SCALE

Physicists at CNRS have managed to build nanoparticles* by adding atoms one by one. The hard part is to make each atom land softly so the edifice under construction does not explode. This skill will help improve understanding of the initial stage of gas condensation into droplets, and hence cloud formation.

SOURCE PHYSICAL REVIEW LETTERS

DATE NOVEMBER 9, 2007

Silica nanotubes*.

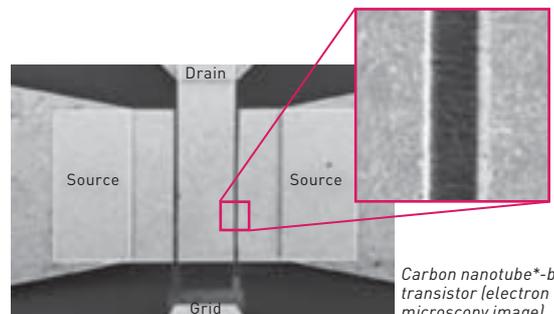


> SELF-ASSEMBLING NANOTUBES

Recipe for making glass nanotubes*: Mix together the therapeutic peptide Lanreotide, a silica precursor, and water. Then let silica nanotubes assemble themselves. Once this spontaneous mechanism has been explained, chemists and physicists hope to demonstrate that these nanotubes are as effective as sea sponge spicules*, renowned for being good light conductors.

SOURCE NATURE MATERIALS

DATE JUNE 2007



Carbon nanotube*-based transistor (electron microscopy image).

> CARBON NANOTUBES FOR TRANSISTORS

With their high electron mobility, carbon nanotubes* are the material of choice for making transistors at cutoff frequencies of 30 GHz. These transistors are generally used for automatic switches. To make them, researchers from CNRS and CEA deposited nanotubes on a silicon substrate. The technique, which works at room temperature, can be adapted to less expensive substrates such as glass or plastic, opening up new prospects for mainstream applications in electronics.

SOURCE APPLIED PHYSICS LETTERS

DATE JUNE 4, 2007

MATTER

FROM THE UNIVERSE TO THE ATOM, FROM THE INFINITELY BIG TO THE INFINITELY SMALL, RESEARCHERS MAKE THE LEAP AND IMMERSE US IN THE WORLD OF MATTER.



A SPECTROMETER THE WIDTH OF A HAIR

Swifts, the smallest spectrometer ever designed, has dimensions of 750 x 22 x 500 micrometers. Created by astronomers, the spectrometer's design is based on an original combination of interferometry* and microelectronics. Researchers are already imagining applications in astronomy, in the study of cancerous cells, and in the detection of dangerous gases.



EXTRAGALACTIC BOMBARDMENT!

Highest-energy cosmic rays that bombard the earth come from nearby galaxies*, according to scientists of the Pierre Auger Collaboration. This conclusion, based on observing the rays' trajectories, points to active galactic nuclei as prime suspects for the source. These nuclei are the most powerful sources of light in the Universe and sometimes expulse spectacular quantities of material, explaining cosmic bombardment. This work opens a window on the nearby Universe and an alternative approach to astronomy, not based on the study of light.

SOURCE SCIENCE

DATE NOVEMBER 9, 2007

Aerial view of Virgo.



VIRGO PROBES THE UNIVERSE

Virgo's mission is to examine the sky 24/7 for gravity waves from the nearby Universe. The interferometer is linked up with other detectors (American, British-German) to improve chances of detecting and analyzing the signals, which would enhance understanding of gravitation and general relativity.

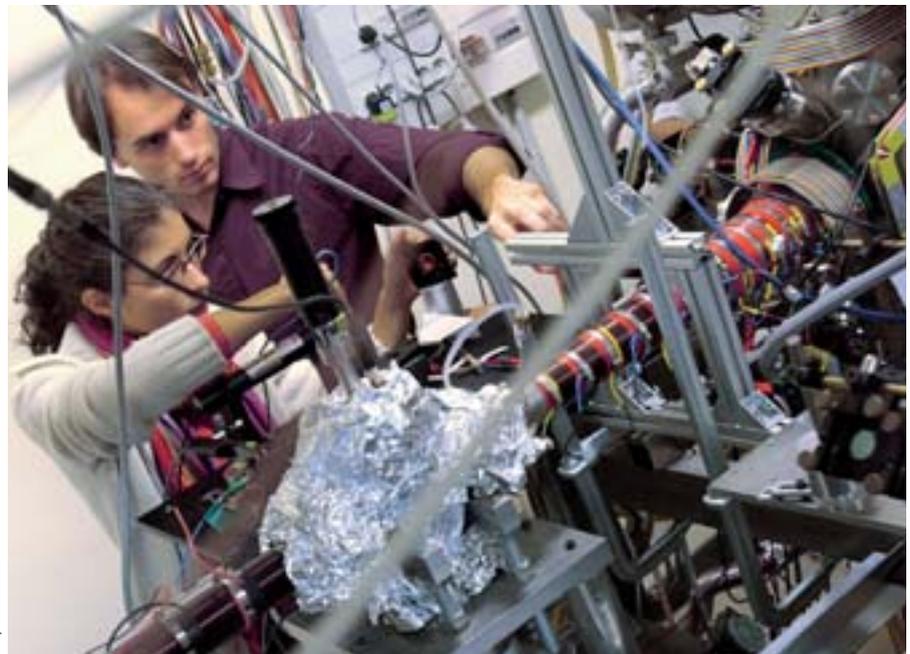


FERMIONS PREFER SOLITUDE

Fermions* of a feather don't flock together. These elementary particles avoid each other because of quantum interferences observed for the first time at the Institut d'optique. In a jet of particles, fermions follow the crowd, but do not get within 1 millimeter of each other.

SOURCE NATURE

DATE JANUARY 25, 2007



Vacuum chamber which allowed the behavior of fermions* to be observed.

REVEALED

> SILICON-42 IS A UFO!

Neither experimental results nor theoretical predictions had been able to reveal whether the nucleus of silicon-42 was spherical, until physicists at Ganil showed that it has the flattened shape of a flying saucer. The achievement is all the more remarkable because only very small quantities of this exotic nucleus can be produced.

SOURCE *PHYSICAL REVIEW LETTERS*

DATE JULY 12, 2007

> 3D PHOTOGRAPHY OF PROTONS

Two-proton* radioactivity has revealed some of its secrets to researchers at Ganil, who devised a detection chamber allowing them to image the trajectories of charged particles in three dimensions. The two protons emitted from the decay of iron-45 have been detected and "photographed" in 3D. Two-proton radioactivity could lead to discoveries about proton pairing in the nucleus.

SOURCE *PHYSICAL REVIEW LETTERS*

DATE SEPTEMBER 7, 2007

> A LITTLE BIT OF NEUTRON STAR IN THE LAB

Atoms of the hydrogen-7 isotope* have been generated at the Ganil facility, with a revolutionary experimental set up. Studying hydrogen-7, which is even richer in neutrons* than neutron stars, could improve understanding of the forces that bind atomic nuclei.

SOURCE *PHYSICAL REVIEW LETTERS*

DATE AUGUST 9, 2007



> SINGLE PHOTON UNDER SURVEILLANCE

Einstein's dream of trapping a photon* and watching it for a half second has now come true, thanks to the "photon box" devised by physicists at the Kastler Brossel Laboratory. This ingenious technique involves making a photon bounce back and forth more than a billion times between two mirrors facing each other. Atoms crossing the device indicate the presence of the photon without destroying it. Researchers were therefore able to observe the same photon more than a hundred times before it escaped. Observing the life and death of a photon is a big step towards quantum information processing.

SOURCE *NATURE*

DATE MARCH 15, 2007

PROPERTIES OF MATTER

UNDERSTANDING THE STRUCTURE OF MATTER TO IMPROVE OUR CONTROL OVER ITS SOMETIMES ASTONISHING PROPERTIES IS ONE OF RESEARCHERS' FAVORITE AREAS OF STUDY. TAKE A LOOK AT SOME SPECTACULAR RESULTS.

> THE SURPRISING PROPERTIES OF QUASI-CRYSTALS

The relationship between how atoms are arranged in a quasi-crystal* and its physical properties has intrigued scientists for 20 years. Experiments on a metallic alloy quasi-crystal, coupled with numerical simulations, give a peek at its surprising properties as a thermal insulator.

SOURCE NATURE MATERIALS

DATE DECEMBER 1, 2007

> WHEN POWDER BECOMES CRYSTAL

Researchers at the European synchrotron facility in Grenoble have analyzed the structure of microcrystals whose grains are so small they resemble a powder. They determined the structure of crystals that were approximately one cubic micron, gaining a factor of 1000 on the size of analyzable grains.

SOURCE NATURE MATERIALS

DATE SEPTEMBER 16, 2007

> PRUSSIAN BLUE INFORMATION STORAGE

One of chemistry's challenges is to succeed in storing information at the atomic scale. By replacing iron atoms with cobalt in Prussian blue, researchers obtained a new compound that can act as a switch when exposed to light. It could be a good candidate for those storage bits in future computers.

SOURCE ANGEWANDTE CHEMIE

INTERNATIONAL EDITION

DATE JANUARY 9, 2007

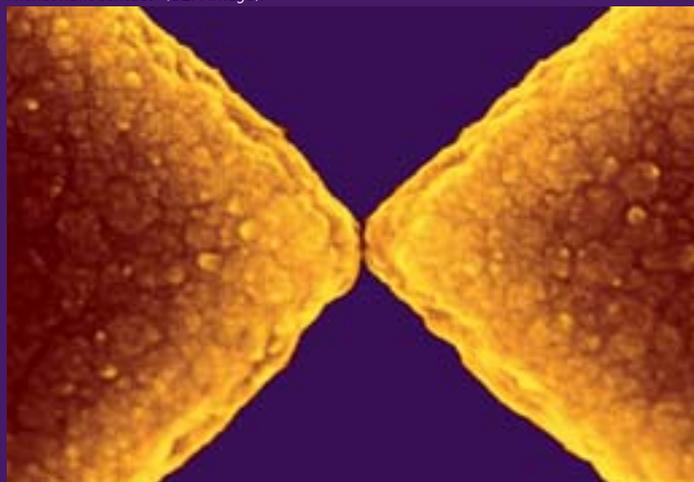
> AXE FOR SPLITTING BONDS

Chemists from Lyon have, for the first time, succeeded in breaking the triple bond of the dinitrogen (N_2) molecule with a single metal. This is one of the strongest chemical bonds known, and breaking it – to make ammonia for instance – is a highly energy intensive process, and the reaction previously required catalysts made up of several metals. This achievement paves the way for using less energy when synthesizing nitrogen products.

SOURCE SCIENCE

DATE AUGUST 24, 2007

Nickel nanocontact* (SEM image).



> NANO MAGNETORESISTANCE, IT'S GIANT!

Resistance in magnetic material varies by several percent when the direction of the magnetic field is changed. At the nano scale, the effect can be much more drastic, as a team at the Institut de physique et de chimie des matériaux in Strasbourg has shown using cobalt nanocontacts*. The resistance becomes "quantized," i.e. it changes in a stepwise manner. Theorists predicted this behavior and it has already been observed for electrical conductivity. Around the corner... further development of spintronics, which uses quantum properties to store information.

SOURCE NATURE NANOTECHNOLOGY

DATE FEBRUARY 25, 2007

> SERIAL CHIRALITY

Chirality is contagious. Nucleic acid asymmetry is transmitted to inorganic material over several hundred nanometers* to form silica molecules. This new discovery paves the way for synthesizing new membrane materials that are as effective ionic conductors as DNA* or RNA.

SOURCE ANGEWANDTE CHEMIE

INTERNATIONAL EDITION

DATE JUNE 4, 2007

> ON AGAIN, OFF AGAIN

Researchers are developing nanometer-sized contacts that react to variations in temperature, pressure, and magnetic field by changing from an "on" state to an "off" state. A material that can store binary information paves the way for very high density computer memory, especially since the on/off transition takes place at room temperature and is reversible.

SOURCE ADVANCED MATERIALS

DATE JULY 17, 2007

Structure of a deep-breathing crystallized solid.



> SOLIDS BREATHE TOO

Not all solids are necessarily rigid. The proof has been provided by chemists from the Institut Lavoisier who found certain crystallized solids that can triple in volume... because they breathe. Like our lungs that expand with a breath of air, these solids absorb liquids or gases and change volume while maintaining a constant overall form. The combination of organic and inorganic molecules that this represents is very promising, because this "respiration" is reversible and selective. Some of these compounds are already being produced at the industrial scale to store hydrogen or CO₂, while others could be used to separate solvents.

SOURCE SCIENCE

DATE MARCH 30, 2007

CLEAN ENERGY FOR TOMORROW

ENERGY MANAGEMENT IS THE MAJOR CHALLENGE OF THE TWENTY-FIRST CENTURY. IN THE FACE OF THREATS TO THE ENVIRONMENT, SCIENTISTS ARE STUDYING "CLEAN" ALTERNATIVES THAT COULD REPLACE FOSSIL FUELS.



Reactor converting organic matter into electricity.



Electrode surface colonized by bacteria.



ENERGETIC BACTERIA

Bacteria are being put to use in batteries. The device, developed by two researchers, uses the energy produced by bacteria breaking down organic molecules to produce electricity. Such a system in purification plants, for example, could contribute a non-negligible portion of their electricity supply.



Fuel cell*-powered scooter.

> COOLER FUEL CELLS

Working towards increasingly efficient fuel cells*... Researchers at the Laboratoire des sciences chimiques in Rennes have synthesized a completely new iron-strontium oxide* that optimizes fuel cell functioning. To do this, they replaced the traditional reducing agent* - hydrogen - with calcium hydride. This let them control oxygen mobility, which is necessary for the functioning of the fuel cell, at much lower temperatures (around 280°C instead of 450°C). This property could be exploited to reduce the working temperature of oxide-based fuel cells.

SOURCE NATURE

DATE DECEMBER 13, 2007

Solar panels providing electricity for a seismometer in Antarctica.



SOLAR THERMAL SYSTEMS ON THE TEST BENCH

A new instrument for testing solar collectors, invented at the Institut national de l'énergie solaire, will enable manufacturers of solar equipment to measure their product's performance or to do digital simulations of the system's environment.

> HIGH ENERGY NANOPOWDER

A powder of porous silicon nanostructures, containing hydrogen, was created at the Institut des nanotechnologies in Lyon and could be used in fuel cells*. An environmentally friendly source of hydrogen, its large storage capacity meets the needs of miniaturization. Its performance is already three times better than traditional batteries.

SOURCE *PHYSICA STATUS SOLIDI*

DATE APRIL 10, 2007

> ENERGY IN HORNS

How can hydrogen be stored safely? One solution could come from carbon nanohorns. Researchers have shown that there are stronger hydrogen-carbon interactions in nanohorns than in nanotubes*. It is a promising result for safe storage of clean energy.

SOURCE *PHYSICAL REVIEW LETTERS*

DATE MAY 25, 2007



GREEN PLANET

AT A TIME WHEN THERE IS INCREASING PUBLIC CONCERN OVER THE ENVIRONMENT, RESEARCHERS ARE WORKING TO BETTER PROTECT IT BY JOINING FORCES THROUGH PARTNERSHIPS AND SCIENTIFIC ORGANIZATIONS.

Artist's conception of the Ecotron.



ECOTRON: ECOSYSTEMS UNDER A DOME

Construction of the Montpellier European Ecotron began on October 2. This facility, built and financed by CNRS, the Languedoc-Roussillon region and the General Council of Hérault, will enable scientists to isolate portions of ecosystems in chambers and to subject them to climate variations and diverse stresses. Scientists will measure greenhouse gas emissions and look into the role of biodiversity* and changes to it, and the facility should provide answers to environmental concerns. After raising awareness about the impact of human activities on the environment, it's time for action.



Aerial photograph World War I trenches (Kobarid region, Slovenia).



LiDAR digital terrain model.



Digital terrain model processed using an algorithm developed by ModeLTER.*



MODELING LANDSCAPES

A new French-Slovenian European virtual laboratory was created in February to study the transformation of landscapes and areas over a time scale of several thousands of years. ModeLTER, as it is called, seeks to improve understanding of socio-environmental dynamics, useful indicators in sustainable development research.



TOWARDS SUSTAINABLE CHEMISTRY

ChemSud, the “European Chair of chemistry for sustainable development,” was inaugurated on October 2 in Montpellier. Its goal is to become a hub of exchanges, meetings, teaching, and research supporting the emergence of a new chemistry that develops in harmony with humans and the planet.

Immersed in hydrocarbon-polluted water, this cylinder made up of carbon nanotubes absorbs the pollutant.*



NEUTRONS USED FOR TREATING NUCLEAR WASTE

How can we get rid of nuclear waste? It could be incinerated with high energy neutrons*. By projecting the world’s most powerful proton* beam onto a liquid metal target, the pioneering Megapie experiment has been able to produce such neutrons. With their high energy, they have been proposed as the future source in a reactor capable of transforming long-lived waste radioactive elements into short-lived or stable elements.



OUR SOCIETY’S ENVIRONMENT

“Climate-environment-society,” created in April, is a new scientific interest group. It brings together CNRS, CEA (the French atomic energy agency), Ademe (Agency for Environment and Energy Management), Université de Versailles Saint-Quentin en Yvelines, Université de Pierre et Marie Curie and École Polytechnique, to create synergy from the participants’ expertise in order to study climate change and its consequences on the environment and society.



Ostracod fossils.

> WHEN LIFE LACKED AIR

Why did it take so long for biotopes* to recover after the Permian-Triassic crisis 250 million years ago, compared to other mass extinctions? A study of fossil ostracods (microscopic crustaceans) has revealed that it was because of a lack of oxygen. This anoxia* can be partly explained by significant changes in sea level.

SOURCE HYDROBIOLOGIA

DATE JULY 2007

BLUE PLANET

ALTHOUGH OCEANS COVER 71% OF OUR PLANET'S SURFACE, TO HUMANS THEY ARE STILL *TERRA INCOGNITA* WITH DEEP BORDERS, INHABITED BY YET UNDISCOVERED SPECIES WHICH WILL NEED TO BE PROTECTED.

Arcachon Bay mussels used as bioindicators.



> ACID ATTACK ON MUSSELS AND OYSTERS

When the ocean becomes more acidic from increasing atmospheric CO₂, mussels and oysters pay the price. According to a recent study, at the CO₂ levels expected for 2100, shell growth rate in mussels decreases by 25%. A decline in these mollusks would have serious repercussions on coastal biodiversity*.

SOURCE GEOPHYSICAL RESEARCH

LETTERS

DATE FEBRUARY 23, 2007

> NEW ALGAE

Picobiliphytes, a completely new group of unicellular algae in the picoplankton* family, were discovered when unexpected sequences in the DNA* of picoplankton were uncovered. Specific DNA probes* have made it possible to view the cells under the microscope and to estimate their abundance. The new algae appear to live in temperate and sub-polar zones and to possess phycobilins, pigments that are rather rare in algae. Other than these few characteristics, everything remains to be discovered about the algae, from their role to similarities with other groups.

SOURCE SCIENCE

DATE JANUARY 12, 2007

> FISH RETURN TO THE FOLD

Sixty percent of larvae from a fish cohort* colonize their original reef. This discovery challenges the current theory, which holds that larvae undergo a phase of dispersion in the ocean. Conservation strategies in protected marine areas will be informed by these observations.

SOURCE SCIENCE

DATE MAY 4, 2007



A shoal of white seabream.

> SEEDING IRON SOWS SEEDS OF DOUBT

Seeding the ocean with iron... also sows seeds of doubt. Phytoplankton is known for its ability to "pump" atmospheric carbon. The presence of iron multiplies phytoplankton growth and activates pumping. Thanks to the KEOPS campaign in the Southern Ocean, oceanographers have shown that the efficiency of fertilization, defined as the ratio between the amount of carbon sequestered in the deep ocean and the amount of iron added, is at least ten times higher when the fertilization is natural. It is a fundamental discovery that can be used against geo-engineering firms hoping to artificially activate the biological pump.

SOURCE NATURE

DATE APRIL 26, 2007



Installing a submersible pump.

Sea turtle outfitted with an Argos transmitter.

> TURTLES HAVE A COMPASS

Turtles have a sense of direction. To come back to lay their eggs on the same beach, they find their way using the earth's magnetic field. Researchers demonstrated this by attaching a magnet to turtles, which disrupted the animals' navigation. This result should help improve conservation plans for these threatened species.

SOURCE CURRENT BIOLOGY

DATE JANUARY 2007



DEEP SEA JACUZZI

The Menes caldera*, a depression 8 kilometers wide and 3000 meters deep in the Mediterranean off the coast of Egypt, was explored during the Medeco expedition. Sample collection and temperature measurements allowed researchers to identify the origin and composition of the mud, brine, and fluid mixture that escapes from the two muddy cones.

CLIMATE CONCERNS

WE ARE GOING TO HAVE TO ACT FAST TO FIGHT CLIMATE CHANGE. CLIMATOLOGISTS, GLACIOLOGISTS, AND GEOLOGISTS WHO STUDY THE "CLIMATE MACHINE" HAVE SHOWN US THE URGENCY OF THE SITUATION.

Icebergs off the coast of the Antarctic Peninsula.



River bank erosion along the Lena.



> ARCTIC PLANTS TRAVEL FAR

Arctic plant species have long arms. Indeed, with modifications in the climate, some can colonize areas as far as 1000 kilometers away. A Franco-Norwegian team has compared the genetic fingerprint of nine species, gathered from Spitzberg and regions surrounding this Norwegian archipelago. The researchers have shown that the archipelago has been colonized from Greenland, Russia, and Scandinavia several times. These results make it possible to validate models that use analysis of ecological niches* to predict future changes in plant distribution in this geographic zone.

SOURCE SCIENCE

DATE JUNE 15, 2007

> THE LENA, A SHIFTING RIVER

In Siberia, the banks of the Lena are eaten away in high water and islands move... These are the consequences of accelerating climate change-related erosion, documented by the analysis of satellite images and photographs and from field work. The changes are significant enough to render navigation charts obsolete.

SOURCE GEOPHYSICAL RESEARCH LETTERS

DATE JULY 18, 2007

> THE HIMALAYAS: AN EFFICIENT CARBON PUMP

Intense erosion in the Himalayas causes significant amounts of organic debris to be carried down to the mouths of big rivers. This debris then disappears into the Indian Ocean, a natural carbon reservoir. Researchers have quantified these mechanisms, which play a role in long term climate regulation, by assessing the geochemical balance* of the Himalayan basin.

SOURCE NATURE

DATE NOVEMBER 15, 2007





Mount Everest research expedition.

> ROOF OF THE WORLD SUFFERS FROM HEAT STROKE

The eternal snows of the Himalayas are not immune to global warming. Analyses of gases trapped in ice cores taken from Mount Everest have allowed researchers to trace the evolution of the glaciers over the past 2000 years. The results document an intensification of summer melt episodes in the 20th century.

SOURCE CLIMATE OF THE PAST
DATE FEBRUARY 7, 2007

> GREENLAND MELTING MORE RAPIDLY THAN PREDICTED

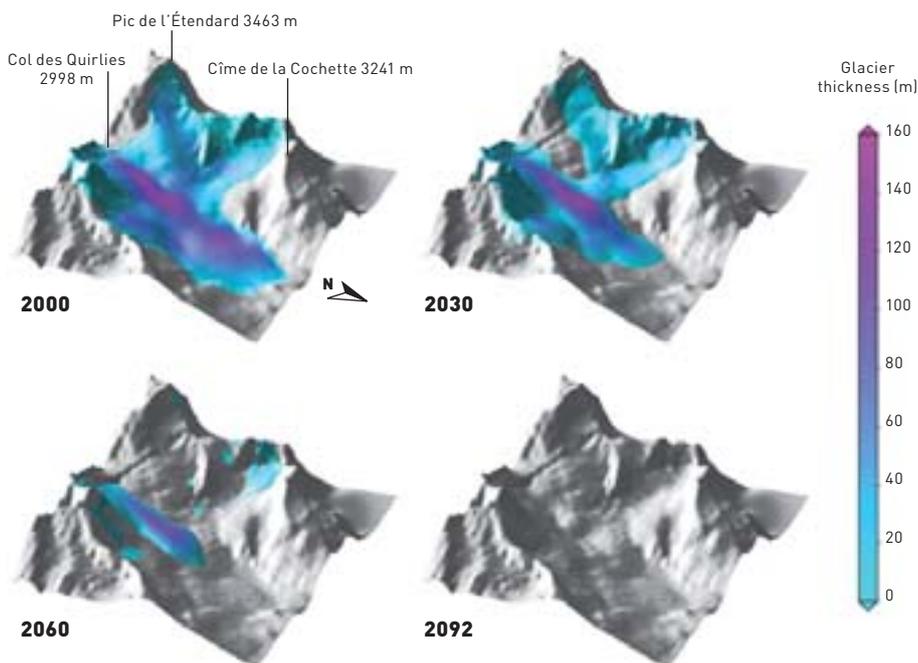
The melting of superficial ice in Greenland over the past 25 years has accelerated two times faster than predicted. Climatologists have obtained this result by combining a recent digital model that simulates regional climate with a new method of processing satellite data. This new approach makes it possible to estimate the state of the atmosphere, and of snow and ice with greater accuracy, and to correct for the masking effect that liquid water clouds produce on satellite data. The result is consistent with the estimated average summer temperature increases of 2.4°C for Greenland.

SOURCE GEOPHYSICAL RESEARCH LETTERS
DATE MARCH 14, 2007

> GLOBAL ALERT OVER CO₂

The increase in CO₂ emissions is more alarming than the worst-case scenario used by the Intergovernmental Panel on Climate Change, an international study has revealed. Another international collaboration has resulted in different numbers: with climate change, the CO₂ absorption capacity of the Southern Ocean, which stores about 15% of anthropogenic emissions every year, has slowed down.

SOURCE PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES
DATE MAY 2007
SOURCE SCIENCE
DATE MAY 17, 2007



Simulation of the disappearance of the Saint-Sorlin glacier.

> FROM GLACIERS TO ICE CUBES

Are mountain glaciers doomed to disappear? According to two studies, small glaciers at low and intermediate altitudes in the Alps could melt by 2060, while those at high altitudes would shrink. If the warming reaches the base of hanging glaciers, watch out for avalanches!

SOURCE EARTH AND PLANETARY SCIENCE LETTERS
DATE AUGUST 2007

THE ARCHIVES OF TIME

“TELL ME YOUR PAST, I WILL TELL YOUR FUTURE.”
THIS COULD BE THE MOTTO OF THE SCIENTISTS WHO FORECAST AND MODEL OUR CLIMATE’S FUTURE BY TRAVELING BACK THROUGH TIME.

> A FOREST IN GREENLAND

Before ice, there was forest. This is the conclusion of a study of ice cores taken from the base of the Greenland ice sheet. Under two kilometers of pure ice, researchers have identified organic molecules (DNA* and amino acids) whose plant origin has been proven by analyses from the Laboratoire d'écologie alpine (Alpine ecology laboratory). This basal ice would have formed 450,000 years ago in a mixed conifer and deciduous forest. Thus, Greenland did not lose its ice during the last interglacial period 125,000 years ago, as scientists previously thought.

SOURCE SCIENCE

DATE JULY 5, 2007



AFRICA: HOTSPOT OF CLIMATE CHANGE

Assessing the initial results of an intensive observation campaign was the objective of the second international conference on the AMMA program, which studies mechanisms of the African monsoon. One of the goals has been to work out climate change adaptation strategies for African countries.



KEEPING AN EYE ON THE SEASONS

The Observatoire des saisons has launched a campaign to build a vast national network of amateurs and professionals who will study the phenology* of plants, birds, and insects. The goal is to gather as much data as possible on flora and fauna, in order to increase knowledge about the impact that global warming has on changes in the species' seasonal patterns.



Southern scallops in an in situ measurement chamber in Adélie Land.



SHELLS AND ICY WATER

The southern scallop has the ability to record water temperature in the striae on its shell. Turning the scallops into a thermometer for the southern seas is the mission undertaken by a research team from Brest that is going to study the lifestyle and growth of this little Antarctic mollusk.

Volcanic rocks at the summit of Mauna Kea.



> TROPICAL GLACIERS

Hawaii was not always an exotic island. By analyzing glacial moraines* on the flanks of the Mauna Kea volcano, researchers have traced the history of the ice cap that covered the island 20,000 years ago. There were glaciers at a 3500 meter altitude up until 15,000 years ago. According to the researchers' calculations, a temperature 7°C below current temperatures would have been needed to maintain glaciers under these tropical latitudes. This figure will help improve atmospheric models which are indispensable for understanding regional changes due to current global warming.

SOURCE NATURE

DATE OCTOBER 4, 2007

> AN 800,000 YEAR VOYAGE THROUGH TIME

It is thanks to analyses of the deepest ice extracted from Dome C in Antarctica that researchers have been able to go as far back as 800,000 years for the first time. The work has provided precious information on the ancient climate, such as revealing the existence of an additional interglacial period.

SOURCE SCIENCE

DATE JULY 6, 2007



Extraction of an ice core from Dome Concordia, Antarctica.

ANATOMY OF THE EARTH

GEOPHYSICISTS TAKE US ON A VOYAGE TO THE CENTER OF THE EARTH WITH THEIR NUMERICAL MODELS OF REACTIONS THAT TAKE PLACE UNDER EXTREME CONDITIONS. THEIR RESEARCH IMPROVES OUR UNDERSTANDING OF WHAT MAKES THE EARTH "TICK."



FAULTS UNDER SURVEILLANCE

The area around Istanbul is at a high risk for earthquakes, so active faults in the Marmara Sea are carefully monitored. The MarNaut oceanographic campaign has been able to use the Nautilie submersible to prove that fluid emissions from deep sources are associated with active faults. These fluids are being analyzed to identify the depth of their origin.

> BETTER VIEW OF EARTH'S SUBSURFACE

The isotopic composition of mid-ocean ridge basalts is used to map the earth's mantle* under the oceans, and in a recent development, under the continents. Geologists have identified distinct isotopic signatures at different sites, enabling them to study mantle dynamics below the continents.

SOURCE **NATURE**
DATE JUNE 28, 2007

> HIGH-PRESSURE SYNTHESIS

Synthesizing post-perovskite – a component of the core-mantle* boundary – in the laboratory is difficult, because the reaction takes place at 2000°C. Researchers have met the challenge, and gone even further: They have studied deformations in its structure under high pressure and temperature using X-ray diffraction, and demonstrated that polycrystalline samples show a preferred orientation.

SOURCE **SCIENCE**
DATE JUNE 22, 2007



Disharmonic folds.

> NUMERICAL VOYAGE TO THE CENTER OF THE EARTH

What is 2900 kilometers under our feet, at the boundary between the Earth's mantle* and core? This question has long intrigued geophysicists who have not been able to explain seismic data from this zone. But recent work could change the situation: by inserting the results of quantum mechanics into a numerical model, researchers have simulated atomic scale deformations in minerals – the primary component of the mantle – at near-core conditions. In the long term, this work could explain the behavior of the whole mantle. The voyage to the center of the Earth may be numerical...

SOURCE NATURE

DATE MARCH 1ST, 2007



LIVE FROM THE AYSÉN EARTHQUAKE

On April 21, 2007, a magnitude 6.2 earthquake shook the Aysén region in southern Chile. A landslide followed, causing a tsunami. A team of seismologists and their instruments were on the spot at that moment and recorded everything. The resulting data will make it possible to study the earthquake in detail.



Setting up equipment the day before the earthquake.

> LIQUID DYNAMO

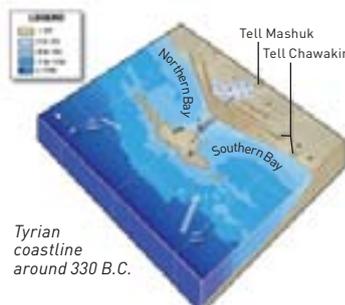
The Earth's magnetic field is created by highly disordered movements, known as the dynamo effect, of its liquid iron core. Over the course of geologic history, the magnetic field has undergone several erratic reversals. To study this phenomenon, physicists have reproduced it in the laboratory by creating a liquid dynamo from a turbulent flow* of liquid sodium. The resulting magnetic field can vary through time and reverse itself, like the irregular variations of the Earth's magnetic field, and like the regular variations of the solar magnetic field, which reverses every 22 years.

SOURCE EUROPHYSICS LETTERS

DATE MARCH 2007



Tsunami damage in Punta Tortuga.



Tyrian coastline around 330 B.C.

> ALEXANDER, BRIDGE BUILDER

To conquer the island of Tyre, Alexander the Great built a kilometer-long causeway. How could such a thing be accomplished in 332 B.C.? The engineers of the time exploited a tombolo*, a sandspit one to two meters below the surface of the water. Two bays formed, one on each side of the causeway, causing long-term modification of the coastline.

SOURCE PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES

DATE MAY 14, 2007

A STROLL THROUGH THE MILKY WAY

USING SOME OF THE MOST SOPHISTICATED TOOLS, ASTROPHYSICISTS – THE “SHERLOCK HOLMES” OF THE UNIVERSE – ARE ON THE LOOKOUT FOR CLUES ABOUT PREVIOUSLY UNKNOWN PLANETARY SYSTEMS, THE HISTORY OF THE UNIVERSE, AND EVEN EXTRATERRESTRIAL LIFE.



Artist's conception of the planetary system of red dwarf Gliese 581.

> A PLANET IN THE HABITABLE ZONE?

Some 20 light years* from us, there is an Earth-like planet. Discovered with HARPS, a spectrograph installed on the ESO telescope in Chile, the planet has a low mass, a real surface – unlike gas giants – and an estimated temperature between 0 and 40°C. These similarities with our planet suggest the possibility of extraterrestrial life.

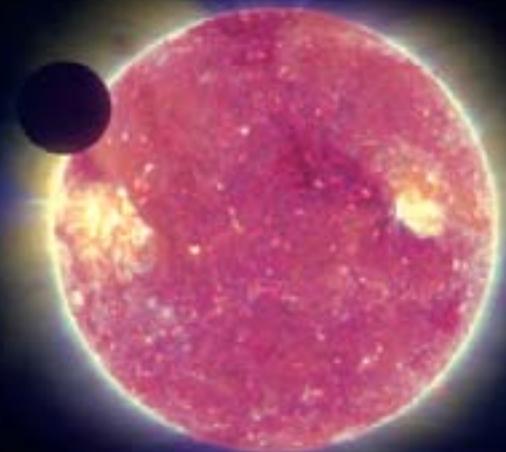
SOURCE ASTRONOMY AND ASTROPHYSICS

DATE JULY 2007



STELLAR 3D IMAGES

The very first 3D images of our star are out. This feat was accomplished by the NASA STEREO mission, involving CNRS researchers. The purpose of the project is to study coronal mass ejections* and their impact on the earth's environment.



Transit of the moon in front of the sun.

> THE MILKY WAY, NOT SUCH AN ORDINARY GALAXY

The Milky Way is no ordinary galaxy*. This observation challenges the idea that there is nothing special about our galaxy, to the point that it has been used as a reference to simulate the formation of galaxies. Astrophysicists have shown that, unlike the majority of galaxies which surround it, the Milky Way has a relatively small disk radius and low stellar mass. In addition, it contains old stars with low abundances of heavy-elements. Not without reason: over the last 11 billion years, the Milky Way has undergone very little fusion, the process which creates new stars. A quiet history compared to its neighbor, the tumultuous Andromeda.

SOURCE ASTROPHYSICAL JOURNAL

DATE OCTOBER 7, 2007

One of the four telescopes involved in the HESS (High Energy Stereoscopic System) experiment in Namibia.

> THE SOUTH POLE, NEPTUNE'S HOT SPOT

The VISIR instrument on ESO's telescope has enabled researchers to obtain the first high resolution mid-infrared images of Neptune's atmosphere. This data has allowed them to describe the temperature of the planet's troposphere and to reveal that its south pole is its warmest spot, which is not surprising after 40 years of summer. The troposphere also contains frozen methane, which in the south becomes a gas and escapes into the stratosphere. These results suggest that despite receiving little sunlight, Neptune's atmosphere is much more active than the atmosphere of Jupiter or Saturn.

SOURCE ASTROPHYSICAL JOURNAL

DATE SEPTEMBER 2007



WAY TO GO, COROT

Launched at the end of 2006, the Corot satellite is off to a good start with the observation of its first exoplanet. It was also able to study the core a solar-type star. It is hoped that this satellite will detect Earth-sized planets.

> ISOTOPE OF CO₂ DETECTED IN VENUS' ATMOSPHERE

What is the strange absorption signature recorded by the Venus Express orbiter during sunsets on Venus? When researchers compared the observations of Venus with those of Mars taken from Earth, they detected the same absorption band* at 3.3 microns. It is caused by a particular molecule of CO₂ that contains an ¹⁸O isotope* and contributes to the greenhouse effect on Venus.

SOURCE MEETING OF THE DIVISION FOR PLANETARY SCIENCES OF THE AMERICAN ASTRONOMICAL SOCIETY

DATE OCTOBER 2007

ALL EYES ON THE SKY

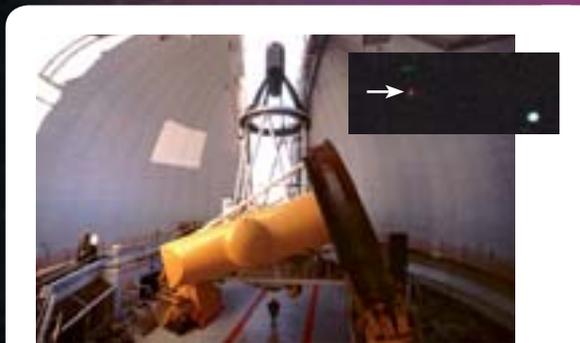
ASTROPHYSICISTS OPEN A WINDOW ON THE UNIVERSE FROM EARTH. INDEED, THE LATEST OBSERVATION AND MODELING TOOLS MAKE EARTH AN EXCELLENT LOCATION FOR STUDYING SPACE. TAKE ADVANTAGE OF THIS GREAT VIEW OF THE SKY.

> VERY OLD GALAXIES...

Using the effect of gravitation lensing* – the bending of light by clusters of massive galaxies* – astronomers have observed 6 galaxies that are 13 billion light years* away. This shows that there was a significant population of faint galaxies in this far distant past, when the Universe was less than one billion years old, that could have marked the end of the "Dark Ages" of the Universe.

SOURCE ASTROPHYSICAL JOURNAL

DATE JULY 2007



The Canada-France-Hawaii telescope.

> ... AND VERY OLD QUASARS

The Canada-France-Hawaii telescope has sharp vision: from 13 billion light years* away, it has detected the most distant black hole ever observed. This black hole formed when the Universe was less than a billion years old, and its light traveled for 13 billion years to reach us. This is an important discovery for understanding the period when there was an acceleration in the formation of galaxies*, stars, and black holes.

SOURCE ANNUAL CONFERENCE OF THE CANADIAN ASTRONOMICAL SOCIETY (CASCA 2007) IN KINGSTON, ONTARIO

DATE JUNE 2007

> MOLECULAR OXYGEN: PRESENT!

There is indeed dioxygen (O_2) in interstellar molecular clouds. It was detected by the satellite Odin, specially equipped with a receptor dedicated to this research. According to the observations, abundance levels seem to be a thousand times lower than expected, but new observations, at a higher resolution, will be made by the satellite Herschel, which will be launched in 2008.

SOURCE ASTRONOMY AND ASTROPHYSICS

DATE MAY 2007

Molecular cloud IC 5146 with its young stars.

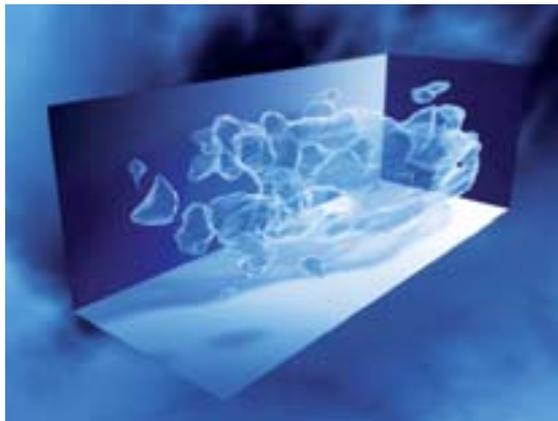


> COLD TEMPERATURES THAT...STIMULATE

At -260°C , the cold of interstellar clouds becomes the force behind fast reactions. Although cold temperatures generally slow down chemical reactions, physicists have identified new reactions that speed up at low temperatures. At high temperatures, fast-moving reactants bounce off an energy barrier without reacting, but at low temperatures, they travel slowly enough to bypass the barrier and form a new compound. Such research could help improve models of star formation.

SOURCE SCIENCE

DATE JULY 6, 2007



Three dimensional map of the dark matter in the Cosmos field.

> 3D MAP OF DARK MATTER

The dark matter in the field of galaxies* called Cosmos, which covers an area of the sky nine times the size of the moon, has been mapped in three dimensions. It shows, for example, that luminous matter concentrates along the densest regions of dark matter. Furthermore, the map traces the evolution of dark matter over more than half of the history of the Universe. In the coming decades, a map of the observable Universe might even be imaginable.

SOURCE NATURE

DATE JANUARY 7, 2007

ALBERT FERT, NOBEL LAUREATE IN PHYSICS

THE CROWNING OF SPINTRONICS

Albert Fert, inventor of a new field of electronics known as spintronics, received the Nobel Prize in physics on December 10, 2007, in Stockholm. This is not the first award for Fert, professor at the Université Paris-Sud 11 and scientific director at the CNRS/Thales Joint Physics Unit. The discovery of giant magnetoresistance and his contribution to the development of spintronics earned him the CNRS gold medal in 2003 and the Japan Prize and Wolf Prize in 2007. The Nobel Prize was jointly awarded to German scientist Peter Grünberg, whose team in Jülich simultaneously obtained similar results on giant magnetoresistance.

Albert Fert has been interested in the influence of magnetism on the movement of electrons* according to their spin* state since the 1970s when he was a doctoral student. He touched on the idea of giant magnetoresistance early on, but he could not create the appropriate systems without a missing essential component: ultra-thin metallic layers.

The problem was resolved in 1988, when Albert Fert's team, the CNRS Joint Physics Unit, began collaborating with the company Thales (formerly Thompson-CSF). The researchers made ultra-thin metallic "sandwich" layers whose electrical resistance could be varied significantly by changing their magnetic orientation. Known as giant magnetoresistance, this phenomenon makes it possible to control the movement of electrons in magnetic metals not by acting on their charge, but on their spin – like a compass needle for electron spin direction. This nanotechnology became integrated in computing with the development of read heads that could detect weak magnetic fields, such as those used to code the bits of information in computer hard disks. This technology increases the storage capacity in disks by a factor of one hundred.

> IPCC AWARDED NOBEL PEACE PRIZE

The 2007 Nobel Peace Prize was jointly awarded to Al Gore and the Intergovernmental Panel on Climate Change (IPCC). It thus honors thousands of scientists across the world who have been working for a long time on climate issues, including a number of CNRS researchers such as Jean Jouzel, vice-president of IPCC Working Group I, and Claude Lorius, who were jointly awarded the CNRS gold medal in 2002.



This discovery launched spintronics, a new and booming field in electronics that exploits the influence of electron spin on electrical conduction and promises numerous new applications in computing and telecommunications.

Albert Fert is the 12th French physicist to receive the prestigious Swedish prize. His work in fundamental research led to applications that could not have been foreseen at the start but that are now revolutionizing our daily life.

JOSEPH SIFAKIS, 2007 TURING PRIZE

RELIABLE COMPUTING TAKES THE PRIZE

For the first time since it was created 1966, the Turing prize has been awarded to a French researcher. This award – the “Nobel Prize” of computing – went to Joseph Sifakis, CNRS senior researcher and director of the Verimag laboratory in Grenoble. The prize was also awarded to Americans Edmund Clarke and Allen Emerson. All three were honored for the invention of model checking, an effective and reliable technology designed to test computer systems.

To explain model checking, Sifakis compares it to mechanics. “When an engineer builds a bridge, he has equations from mechanics to show him how to proceed so that the end product does not collapse. In computer science, however, when an engineer develops software,

a microprocessor, or the electronics for a camera, the only choice is to test its reliability after it has been built.” There was thus a need to develop tools to systematize tests on computer systems. The three researchers offer a testing method which operates on a virtual prototype modeling a real system.

The concept was developed in 1981, but at the time, the idea was still running up against some obstacles. For example, the method only allowed 10,000 system states to be tested in practice, even though in theory the number of possible states was infinite. Everything changed in 1989, when Sifakis presented seminal research in his field. Researchers and manufacturers became interested in model checking. Today its principal limitations have been overcome and model checking can now test between 2^{100} and 2^{300} system states. As a result, this technology is used in microelectronics, aviation, and automobiles...anywhere that there is computing.

Winner of the CNRS silver medal in 2001, Sifakis founded the Verimag Laboratory in 1993. This laboratory developed the Scade toolset used by Airbus for real-time design and validation of critical systems, and the laboratory has forged long term ties with businesses like France Telecom and ST Microelectronics. Sifakis is also the scientific coordinator of a European Network of Excellence which coordinates 35 teams designing high-performance and robust embedded systems for planes, trains, and rockets.



>
NOBEL PRIZE IN CHEMISTRY AWARDED TO GERHARD ERTL

Gerhardt Ertl, world expert in the physical chemistry of surfaces, was awarded the 2007 Nobel Prize in chemistry. CNRS is delighted that this award has gone to the former director of the Fritz Haber Institute of the Max Planck Society in Berlin. Six years ago, the Fritz Haber Institute became partners with CNRS and the Université Louis Pasteur when ELCASS, a European Associated Laboratory, was created. ELCASS pools human resources and materials in order to develop research on catalysis and surface sciences.

JEAN TIROLE, CNRS GOLD MEDAL WINNER

GOLD FOR A NEW ECONOMICS

In December Jean Tirole, a world renowned economist, was awarded France's highest scientific distinction: the CNRS gold medal. He had already received the silver medal in 2002.

Tirole, 54, director of the Groupe de recherche en économie mathématique et quantitative (Gremaq), carries out ground breaking work in the field of economics, most notably through his research on game theory and

information theory. A mathematician by training, he develops cutting-edge tools to describe, analyze, and forecast the strategies of different economic actors in complex situations.

Economics was not Tirole's first calling, and he did not even take his first class in the subject until the age of 21. It may have been a late discovery, but this discipline allowed him to combine his interest in mathematics with his long-held attraction for the social sciences.

Surrounded by the biggest names in global economics, he built a brilliant career in the U.S. at the Massachusetts Institute of Technology (MIT). In 1991 he joined Jean-Jacques Laffont in Toulouse in an ambitious project to transform Université Toulouse 1 into an international hub for economics. The project was successful, and the research complex "Toulouse Sciences économiques," which Tirole runs, is now one of the best European research centers in the field.

Tirole's research rapidly found numerous applications. His favorite field may be the New Industrial Economics. Among other things, he has worked on the economics of open source software, patent pools, and tacit agreements between corporations. His work makes it possible to understand economic models and plays a fundamental role in corporate antitrust law.

Tirole has wide ranging interests, and he has extended his research to sociology, psychology and political science. For example, he is working on the replacement for the Kyoto Protocol, which is set to expire in 2012.

www.cnrs.fr/fr/recherche/prix.htm 



In addition to the Nobel Prize, the Turing Prize, and the CNRS Gold Medal, 2007 was marked by the celebration of a great many more scientific results and current or former researchers at CNRS-supported laboratories. Here is just a small sampling.

— The 2007 “**Coups d’élan pour la recherche française**,” awarded by the Bettencourt Schueller Foundation, was given to three young CNRS teams noted for their excellence and the promising nature of their research: **Thierry Lepage**’s team from the Biologie du développement laboratory at the Villefranche-sur-Mer Oceanological Observatory, **Bénédicte Michel**’s team from the Centre de génétique moléculaire in Gif-sur-Yvette, and **Marco Pontoglio**’s team from the Institut Pasteur. The three teams will receive 250,000 euros each.

— In its fourth and final year, the **European Young Investigator Awards** honored twenty laureates, including four CNRS researchers. This year’s awardees, **Philippe Schlenker** (linguist, CNRS senior researcher), **Sylvia Serfaty** (mathematician, former CNRS researcher), **Terence Strick** (molecular biologist, CNRS researcher) and **Rufin VanRullen** (cognitive scientist, CNRS researcher), each received a sum of 1 to 1.25 million euros over five years to develop their research project in a European laboratory.



← The **Grand Prize of the Fondation pour la Recherche Médicale** was awarded to **Jean Weissenbach**, CNRS senior researcher

and director of Genoscope, the national sequencing center in Évry, for his major contribution to progress in medical research.

— The 2007 **La Recherche awards** went to a number of scientists working at CNRS. In the “human health” category, the prize was given to **Éric Honoré**, CNRS senior researcher at the Institut de pharmacologie moléculaire et cellulaire. **Jean-François Dufrêche** and **Natalie Malikova**, CNRS researchers affiliated with

the Liquides ioniques et interfaces chargées laboratory (L2IC) and the Léon Brillouin laboratory respectively, and the spokesperson for their study, **Virginie Marry** from the Université Pierre et Marie Curie, were recognized in the “Energy” category. For their work on the mechanical properties of concrete at the microscopic scale, **Nicolas Roussel**, from the Laboratoire central des ponts et chaussées (LCPC), and **Philippe Coussot**, also from LCPC, and **Guillaume Ovarlez**, CNRS senior researcher at the Laboratoire des matériaux et des structures du génie civil, were awarded the prize in the category “Sustainable mobility.” Lastly, the prize in “Communication sciences,” sponsored by CNRS, went to **Roxane Jubert** of Université Rennes 2.

— The **Dirac medal**, a prestigious award in the field of theoretical physics and mathematics, was awarded to **Jean Iliopoulos**, emeritus senior researcher at CNRS, and his Italian colleague **Luciano Maiani**, former CERN general director. The two men collaborated on developing a new concept in elementary particles: charm quarks.

— The **Ruth Lyttle Satter Prize**, awarded by the American Mathematical Society, was given to **Claire Voisin**, CNRS senior researcher at the Institut de mathématiques in Jussieu for her work in the field of algebraic geometry.

— **Jules Hoffmann**, president of the French Academy of Sciences and CNRS senior researcher at the Réponse immunitaire et développement chez les insectes laboratory, and his American colleague **Bruce Beutler** were jointly awarded the 2007 **Balzan prize** for their discovery of the genetic mechanisms responsible for innate immunity.

— The **Liliane Bettencourt Award for Life Sciences** was awarded to **Olivier Voinnet**, CNRS senior researcher at the Institut de biologie moléculaire des plantes. He was recognized for his work in plant biology.



— **Monique Combescure** received the 2007 **Irène Joliot Curie prize** for “female scientist of the year.” A CNRS senior researcher at the Institut de physique nucléaire in Lyon, she was recognized for her theoretical work in quantum physics.



SCIENCE MEETS THE PUBLIC

THROUGHOUT FRANCE, CNRS MOVES SCIENCE BEYOND THE LABORATORY WALLS TO MAKE IT ACCESSIBLE FOR EVERYONE. FROM JANUARY TO DECEMBER, YOUNG AND OLD ALIKE DISCOVERED THE WORLD OF RESEARCH THROUGH EXHIBITIONS, SYMPOSIUMS, OPEN HOUSE DAYS, AND MORE.



> Science Festival at the Cité des sciences in Paris.

> Science Festival in Languedoc-Roussillon.



> 17th CNRS Youth Conference "Science and Citizens".

> Science Festival

The 16th annual Science Festival, held October 8-14, was a great success with the public. Throughout France, CNRS organized conferences, exhibitions, and "open days" in laboratories. In the Rhône and Auvergne regions, for example, CNRS laboratories were involved in thirty projects taking place in a number of cities, including Lyon and Clermont-Ferrand. In Normandy, the project "Public Not Allowed," focusing on the synthesis of a nanomaterial and the mapping of the visual cortex in the brain were presented and broadcast in various cities in the region. In Isère, Savoie, and Haute Savoie, 350 CNRS staff members participated in thirty projects.

As it was International Polar Year, scientific expedition to extreme regions were the grand finale of the Festival. At the Cité des sciences in Paris, the CNRS booth, "Spotlight on Antarctica" gave particular visibility to polar themes, and welcomed 110,000 visitors, including 15,000 school children.



> "Sea Explorers" exhibition.

> Sea Explorers

From November 21 to December 2, a sea breeze blew over the Trocadéro Gardens where the "Sea Explorers" exhibition took place. CNRS and its partners, CNES (the French Space Agency), Ifremer (French Research Institute for Exploitation of the Sea), Météo France, and the Mairie de Paris welcomed some 15,000 visitors to the multidisciplinary world of marine research. With interactive exhibits and activities, the exhibition offered a venue for interaction between visitors and researchers. In 2008, the Trocadéro Gardens will host the exhibition "Colors/Bodies" from October 23 to November 9.

> 17th CNRS Youth Conference "Science and Citizens"

Around 450 European students took part in the 2007 national Youth Conference "Science and Citizens" at the Futuroscope in Poitiers where they debated with scientists about science and its impacts. "Biotechnologies and society," "Music in the Digital Age," and "Dreams and the Unconscious" were some of the program themes.

Some French regions organized local versions of this event, such as the Midi-Pyrénées region, which invited Spanish students to its second year of participation, and Brittany, where the debate focused on the theme of biodiversity and changing landscapes.

For 2008, the national conference will be held within the framework of the French EU Presidency, and will welcome students from all European Union countries from October 24-26, 2008.



> European Research and Innovation Exhibition.



> Geological tour of the Cassis rocky inlets.

> Field Trip to Provence

In its 7th year, the scientific field trip for young patients of the Robert Debré Hospital allowed them to explore Provence. With laboratory visits, the chance to explore Fort Saint Jean, and a geological tour of the Cassis rocky inlets by boat, the twenty teenagers immersed themselves, for several days, in the world of scientists.

> Pariscience Festival

CNRS, which has been with the Pariscience festival from the beginning, renewed its collaboration for the event's third year. A number of scientific films competed in front of a jury of middle and high school students, October 10-14, 2007, in the Jardin des plantes. CNRS awarded its screen writing prize, which recognizes the author(s) of a documentary for originality in highlighting research and spreading knowledge.

> Brain Week

From March 12-18, CNRS participated in Brain Week in a number of French regions. In Toulouse and Grenoble, among other places, numerous events were organized, including workshops, conferences, educational activities for school children and film screenings followed by discussions with the public.

ONLINE DOCUMENTS FOR ALL

If you want to keep up with science news or find answers to your questions, visit the CNRS web site. You're bound to find what you are looking for.

— Find the latest science news from CNRS labs in the *Journal du CNRS* and *CNRS International Magazine*. Read about the latest CNRS research as well as in-depth reports on current events in the science world (French version published monthly, English version quarterly).

+ www2.cnrs.fr/presse/journal/

— The *High School Science* collection presents a new educational site dedicated to the life sciences. It completes the series that already covers chemistry, physics, and earth sciences.

+ www.cnrs.fr/cnrs-images/sciencesaulyce.htm

— For young and old, connoisseurs and amateurs, the *Sagascience* multimedia presentations make science accessible to everyone. The site compiles a dozen thematic presentations on subjects such as nanotechnologies and health, climate, evolution, and more.

+ www.cnrs.fr/cw/dossiers/saga.htm

— Form an opinion about the impact that scientific and technological progress has on your life by reading the information kits available from *Science & Décision*. Organized under different subject headings, they offer clear and concise information in the form of short questions and answers that anyone can understand.

+ www.science-decision.fr

> Other events

CNRS participated in numerous other events, such as the Paris Book Fair and the European Research and Innovation Exhibition, which attracted more than 24,000 visitors and whose 2007 theme was fabrics of the future.

GOOD COMMUNICATORS AT CNRS

The 2007 European prize for the best science communicator was awarded to Jean-Pierre Luminet, CNRS senior researcher and astrophysicist at the Paris Observatory. He was recognized for his numerous activities promoting communication through print, television, exhibitions and the arts. In addition, scientists Christian Sardet, CNRS senior researcher at the Biologie du développement laboratory in Villefranche-sur-Mer, and a professeur at the Université Paris 7, Ali Saïb, from the Pathologie et virologie moléculaire laboratory both received an award from the European Molecular Biology Organization (EMBO) in recognition of their efforts to share their work in the life sciences with the general public.

CNRS AT THE POLES

THE POLES HELD THE PLACE OF HONOR IN 2007 DURING THE 4TH INTERNATIONAL POLAR YEAR. OF CLEAR SIGNIFICANCE IN THE RESEARCH WORLD, THE POLAR YEAR WAS ALSO THE IDEAL OPPORTUNITY TO RAISE GENERAL AWARENESS ABOUT CLIMATE CHANGE, BIODIVERSITY AND OTHER ISSUES THROUGH NUMEROUS PUBLIC SCIENCE EVENTS.



> "CNRS at the poles" exhibit.



> 10th "Images and Science" Conference.



> CNRS at the poles

From November 2007 through the end of January 2008, the CNRS photo library presented **CNRS at the Poles**, a photography exhibit displayed on the long walls of the Paris Montparnasse-Bienvenue metro station, used daily by 80,000 people.

An exhibit on the same theme will travel to various locations in France: Lorraine in April 2008, Montpellier at the end of May, Rennes in November, and the Côte d'Azur in October and November.

> 10th regional "Images and Science" Conference

CNRS organized the 10th "Images and Science" Conference on the theme **Research in Polar Areas**. The event took place in nine locations in the Lyon area from May 28 to June 9, offering film screenings, exhibitions and activities for children.

> Polar Warning

A series of video podcasts, **Polar Warning**, was produced by CNRS and the Institut Paul-Émile Victor, in partnership with the Ministry of Higher Education and Research and LCI.fr. With just a click, researchers provide visual answers to questions about climate change. CNRS polar year website address: <http://www.cnrs.fr/anneepolaire/spip.php?article16>

SCIENCE FESTIVAL

The Polar Year was the main theme of the Science Festival this year, which took place October 8-14. Numerous events throughout France were organized for the Festival. Here are a few examples.

> Spotlight on Antarctica

The booth **Spotlight on Antarctica** at the Cité des sciences et de l'industrie in Paris, provided a glimpse of research that has been carried out at the South Pole during expeditions. It allowed the general public to discover the work of researchers who drill ice cores or who monitor the populations of king penguins or elephant seals. Around 110,000 visitors, including more than 15,000 school children, visited during this open house weekend.

> Siberian Biodiversity

CNRS was involved in a number of projects in the Midi-Pyrénées region to promote the International Polar Year. In particular, CNRS organized a series of scientific lectures and co-produced the interactive exhibition, **Images and Culture: Biodiversity in Siberia**. This exhibition was the highlight of the 2007 Science Village, which welcomed 6000 visitors in Midi-Pyrénées, and it is now on tour in France (Strasbourg, Ne-mours...) and abroad.

> One World, Two Poles, and many People

The Jardin des plantes in Paris hosted a CNRS booth dedicated to the International Polar Year. The booth, entitled **One world, two poles, and many people**, offered a number of workshops and activities to teach young and old alike about polar research and the life of arctic populations.



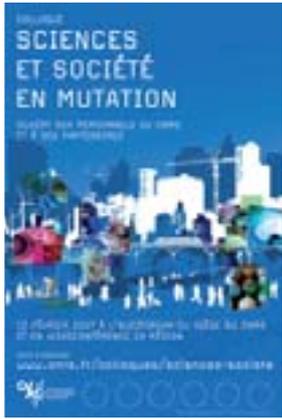
> Science Festival at the Cité des sciences in Paris.



> International Polar Year exhibition in Midi-Pyrénées.

HIGHLIGHTS FROM 2007

THROUGHOUT THE YEAR, THE CNRS ADMINISTRATION WORKS TO GIVE CNRS ITS STRONG INTERNATIONAL STANDING AND MULTIDISCIPLINARY FOCUS BY FORMING PARTNERSHIPS, CREATING LABORATORIES, AND DEVELOPING NEW EQUIPMENT.



> "Changes in Science, Changes in Society" Symposium.

> February 12 "Changes in Science, Changes in Society" Symposium

On February 12, CNRS organized a symposium called "Changes in Science, Changes in Society" at the Gérard Mégie campus which aimed to launch a discussion on the relationship between scientists and society. The symposium, broadcast live and online, was accessi-



> CNRS signs the Handicap Protocol.

ble not only to CNRS teams but also its partners in education, culture, and politics.

> March 6 French House of Science and Technologies opened in Hanoi

The French House of Science and Technologies was inaugurated in Hanoi on March 6 by Catherine Bréchnignac, president of CNRS, and the numerous partners of this new venture. The Vietnamese Vice Minister of Science and Technology, the president of the Vietnamese Academy of Science and Technology, and the French ambassador to Hanoi were present for the ceremony.

> June 15 CNRS signs the Handicap Protocol

On June 15, the CNRS Director General and the eight representative trade unions signed the "Handicap Protocol." This agreement demonstrates the commitment of CNRS to help people with disabilities integrate into the work place.

> July 30 Partnership framework agreement with CNES signed

Arnold Migus, Director General of CNRS, and Yannick d'Escatha, president of the French National Center for Space Studies (CNES), signed a renewable three-year partnership framework agreement on July 30.



> Visit to CNRS headquarters by the Chinese Minister of Science and Technology.

FRENCH-CHINESE RESEARCH GATHERING MOMENTUM

> April 18 International Associated Laboratory in particle physics created

> May 14 Cooperation agreement signed with the Chinese Vice Minister of Science and Technology

> September 17 Visit to CNRS headquarters by the Chinese Minister of Science and Technology

CNRS is strengthening its relationship with other countries, especially China.

On May 14, Catherine Bréchnignac and Arnold Migus signed a cooperation agreement with Mr. Wu Zhongze, Vice Minister of Science and Technology, to strengthen scientific collaboration between the two countries. On September 17, Mr. Wan Gang, the Minister of Science and Technology, came to France, and to CNRS headquarters, to meet principal players in the research world. Other signs of the vitality in French-Chinese relations: a Chinese chemistry laboratory at the University of Zhengzhou was created and placed under the direction of a CNRS senior researcher, and an International As-

sociated Laboratory in particle physics was set up, making a longstanding cooperation between Chinese and French researchers official.



> Aimé Cotton Laboratory turns 80.

> September 14

40th birthday for the Orléans campus

The biggest CNRS research campus, in Orléans, celebrated its 40th birthday on September 14. Arnold Migus, CNRS Director General, and Jean-Michel Bérard, regional prefect, presided over the official ceremony, and the mayor of Orléans, the president of the department council, and many others attended.

> October 15

Aimé Cotton Laboratory turns 80

The Aimé Cotton Laboratory turned 80 in 2007. Catherine Bréchnignac, who used to direct the laboratory, was there to commemorate the event, along with Pierre Pillet, the current director and numerous scientists from the laboratory.

> October 17

Inauguration of the Institut d'Alembert

The Institut d'Alembert was inaugurated on October 17 on the ENS Cachan campus in the presence of Arnold Migus.

> October 22

Agreement signed creating a French-Japanese International Associated Laboratory

October 22, Catherine Bréchnignac traveled to Fukuoka, Japan, to sign an agreement with French and Japanese partners to create an International Associated Laboratory, "France Japan Magnetic Fusion Laboratory."



> Inauguration of the Nikon Imaging Centre@Institut Curie-CNRS.

> December 3

Inauguration of the Institut des grilles

The Institut des Grilles (Grids Institute) was inaugurated December 3 at CNRS headquarters in the presence of CNRS president Catherine Bréchnignac and Arnold Migus, Director General of CNRS.

> December 11

Agreement with Conicyt (Chile)

> December 14

Agreement with Conicet (Argentina)

On December 11, Catherine Bréchnignac and Vivian Heyl, president of the Comisión Nacional de Investigación Científica y tecnológica in Chile, signed a protocol of understanding between the two organizations. Several days later, in Argentina, she met with Eduardo Chareau, president of the Consejo Nacional de Investigaciones Científicas y Técnicas, to sign a cooperation agreement.

> December 13

Inauguration of the Nikon Imaging Centre@Institut Curie-CNRS

On December 13, the Minister of Higher Education and Research, Valérie Pécresse, inaugurated the scientific imaging platform, Nikon Imaging Centre@Institut Curie-CNRS, in the presence of Professor Claude Huriot, president of the Institut Curie, and Arnold Migus, CNRS Director General.

> December 20

Conference with 2004 Nobel Laureate in chemistry at the Gérard Mégie Campus

On December 20, Aaron Ciechanover, 2004 Nobel Laureate in chemistry, visited CNRS headquarters in Paris to participate in a conference organized in his honor. He presented his recent research on the protein ubiquitin, which earned him the Nobel Prize.

ABSORPTION BAND

Set of bands characteristic of a molecule or a substance detected on an absorption spectrum. An absorption spectrum is obtained when an electromagnetic wave, such as light, passes through a transparent or semi-transparent medium.

ALGORITHM

An expression, written in a well-defined language, giving a set of instructions that enables a problem to be solved through calculations. The word comes from the name Al-Khuwarizmi, an Arab mathematician of Persian origin.

ALZHEIMER'S

An irreversible neurodegenerative disease.

ANOXIA

Significant depletion in the amount of oxygen available in the form used by tissues in living organisms.

BIODIVERSITY

A neologism, from the words 'biology' and 'diversity'. Biodiversity is the name given to the diversity of the living world.

BIOTOPE

Set of factors characterizing a fixed and uniform physical-chemical environment with specific plant and animal species.

CALDERA

Large volcanic crater formed by the collapse of the upper part of the volcanic cone, following an eruption that emits a great quantity of material over a very brief time.

CHROMATIN

Basic substance of chromosomes in eukaryotes, formed by an association of DNA and proteins.

COCHLEAR IMPLANT

Implant that aims to restore a certain level of hearing in some deaf people by directly stimulating auditory nerve endings in the cochlea with surgically implanted electrodes.

COHORT

Set of individuals that have lived through the same event or during the same time period. Synonym: Group.

COMPUTER GRID

A computer grid is a shared network of IT resources that gives users open and simple access to huge processing power and storage.

CORONAL MASS EJECTIONS

Bubbles of plasma produced in the Sun's corona. These ejections are very large scale phenomena, with a size that can reach several dozen solar radii. They transport billions of tons of matter.

DNA

Abbreviation for deoxyribonucleic acid, the molecule that carries hereditary genetic information. DNA is one of the components of chromosomes. Genes are segments of DNA.

DNA CHIP

Solid material (strip of glass or plastic) on which thousands of fragments of known DNA sequences are evenly distributed. DNA chips make it possible to quickly measure differences in expression among genes, even at the scale of a complete genome.

DNA PROBE

Fragment of DNA specific to a region of interest in a genome and marked with a radioactive atom or fluorescent molecule.

ECOLOGICAL NICHE

Set of biological and physicochemical factors in an environment that enable a species to live in a biotope, and to eat, survive, and reproduce there in order to ensure the continuation of the species in the biotope (and not of each individual of the species). An ecological niche can also be thought of as the place a species occupies in an ecosystem.

ELECTRON

Elementary particle which carries a negative electric charge. One of the components of atoms, together with protons and neutrons.

EUKARYOTIC CELL

Cell with a nucleus containing the DNA, the nucleus being separated from the cytoplasm by a membrane.

FERMION

Particle whose spin value is a half-integer multiple of Planck's constant (1/2, 3/2, 5/2...), whereas bosons have an integer spin. Electrons, protons, and neutrons are examples of fermions. Unlike bosons, two identical fermions cannot have the same quantum state.

FUEL CELL

Battery that generates electricity from the oxidation of a fuel such as hydrogen coupled with the reduction of oxygen, for example, both reactions taking place on electrodes. These reactions consume gases and give off nothing but water.

GALAXY

A huge structure consisting of stars, dust, gas and dark matter held together by the force of gravity. A galaxy can contain several billion, or even hundreds of billions, of stars.

GEOCHEMICAL BALANCE

Synthesis of geologic processes and chemical reactions involving one or more selected molecules (for example, CO₂, organic carbon, etc).

GENE

Unit of heredity that controls a particular trait. The gene corresponds to a segment of DNA or RNA (viruses), located at a specific place (the locus) on a chromosome.

GENE THERAPY

Therapeutic strategy which involves introducing genetic material into the cells of an organism to correct an anomaly at the root of a disease. Often, a normal and functional gene is introduced into a cell with a damaged gene.

GLACIAL MORaine

Pile of debris and cobbles transported by a glacier or ice sheet and deposited at its edge when the ice retreats, advances, or melts.

GRAVITATION LENSING

Bending of the trajectory of light from a far-away object by the gravitation field of a very massive object (such as a black hole or a cluster of galaxies) situated between the distant object and the observer. If the distant object, the very massive object and the observer are aligned, the observer will be able to see multiple images of the distant object.

HIPPOCAMPUS

The hippocampus is a bilateral and symmetrical structure which belongs to the limbic system, which is a group of structures in the brain that play a very important role in behavior, and in particular in various emotions such as aggressivity, fear and pleasure, as well as in the formation of memory.

INTERFEROMETRY

Measurement method based on interference among several electromagnetic waves of the same frequency. Interferometry is used in astronomy and makes it possible to simulate very large scale observation methods (radio or optic) from a much smaller surface, by combining several telescopes or radio telescopes.

ISOTOPES

Chemical elements whose nucleus contains the same number of protons but a different number of neutrons.

LIGHT YEAR

A unit of distance used in astronomy. It corresponds to the distance light travels in a vacuum in one year. One light year equals approximately 9460 billion kilometers.

LEAD POISONING

Illness associated with chronic or acute poisoning from lead.

MANTLE

Layer of the Earth between the continental or oceanic crust and the core.

MASS SPECTROMETRY

Analytic technique that separates and identifies atoms or molecules as a function of their mass. In addition, mass spectrometry can also characterize the chemical structure of molecules by fragmenting them.

NANOCONTACT

Contact made by a nanometer-scale structure. In the case of ballistic magnetoresistance, two very thin magnetic metallic wires are connected by a nanometric size contact.

NANOMETER

A nanometer (nm) is a billionth of a meter. From the Greek nanos, "very small".

NANOPARTICLE, NANOTUBE

A nanoparticle is a particle whose three dimensions are on the nanometer scale. If only two dimensions are nanometer scale, they are referred to as nanowires (if solid) or nanotubes (if hollow). The best-known nanotubes are carbon nanotubes.

NEUTRON

Elementary particle with no electric charge. Neutrons and protons make up the nucleus of the atom.

OPTICAL ELECTRONICS

Combination of electronics and photonics. Optical electronics involves the study of electronic components that emit or interact with light. It is at the base of fiber optic telecommunications.

OXIDE

Compound containing oxygen and other less electronegative elements (i.e. any atom except fluorine).

PHENOLOGY

Study of the influence of climate on seasonal biological phenomena in the plant world (leafing, flowering) and animal world (migration, hibernation).

PHOTON

Elementary particle of light or any other electromagnetic radiation. Messenger particle—or quantum—of electromagnetic interaction. The photon carries an amount of energy equal to Planck's constant multiplied by the frequency of the radiation.



PICOPLANKTON

An array of small (0.2–2 micron) organisms living in fresh, brackish, or salt water, most often in suspension. Includes gametes, larvae, animals unable to fight the current, bacteria, and microscopic plants and animals.

PLANT TRANSFORMATION

Introduction of one or more foreign genes into the genome of a plant species.

PREFRONTAL CORTEX

Anterior part of the frontal lobes of the brain. This area is where various cognitive functions such as language, working memory, and reasoning take place.

PROTON

Elementary particle found in the nucleus of atoms. Its charge is positive and equal to that of electrons, but its mass is about 1836 times larger. The nucleus of a hydrogen atom is made up of a single proton.

QUASI-CRYSTAL

Material that is ordered over large distances but that is not periodic, as opposed to crystals, which have a periodic structure. In a quasi-crystal, the same pattern is repeated many times, no matter how large it is.

REDUCING AGENT

Chemical species (atom, ion, molecule) capable of donating one or several electrons.

SCANNING TUNNELING MICROSCOPY

Technique which allows the morphology and density of states in conducting or semi-conducting surfaces to be determined with a spatial resolution equal to or less than the size of atoms.

In a scanning tunneling microscope, a very sharp conducting tip is brought so close to the surface of the sample that electrons can pass from one to the other by a quantum effect, the tunnel effect.

SENESCENCE

Irreversible cell cycle arrest associated with morphological and functional modifications of the cell.

SPECTROSCOPY

Analysis of light by decomposition into elementary monochromatic waves. Spectroscopy allows the chemical composition of a body to be determined by studying the light that it absorbs and emits.

SPICULE

Structure with the form of a spike or spear, found in animals, plants, and minerals.

SPIN

Intrinsic quantum property associated with each particle, characteristic of the particle in the same way as mass or electric charge. A particle's spin is its "intrinsic angular momentum." Each particle can be pictured as a microscopic top with the spin characterizing the direction and intensity of the rotation.

SPLICING FACTOR

Macromolecular complex involved in splicing, the mechanism that enables RNA transcribed from a gene to eliminate particular sequences known as introns, in order to produce messenger RNA (which will then be translated into a protein).

STROBE LIGHT

Source of intermittent light.

SYNCHROTRON LIGHT

Light with exceptional properties, 10,000 times more intense than sunlight. Large spectral range, from infrared to hard X-rays. It is produced in particle (electron) accelerators.

TOMBOLO

Coastal strip formed by a sand bank that connects an island with a continent or other island.

TURBULENT FLOW

Flow with numerous vortices of continuously changing size, location, and orientation.

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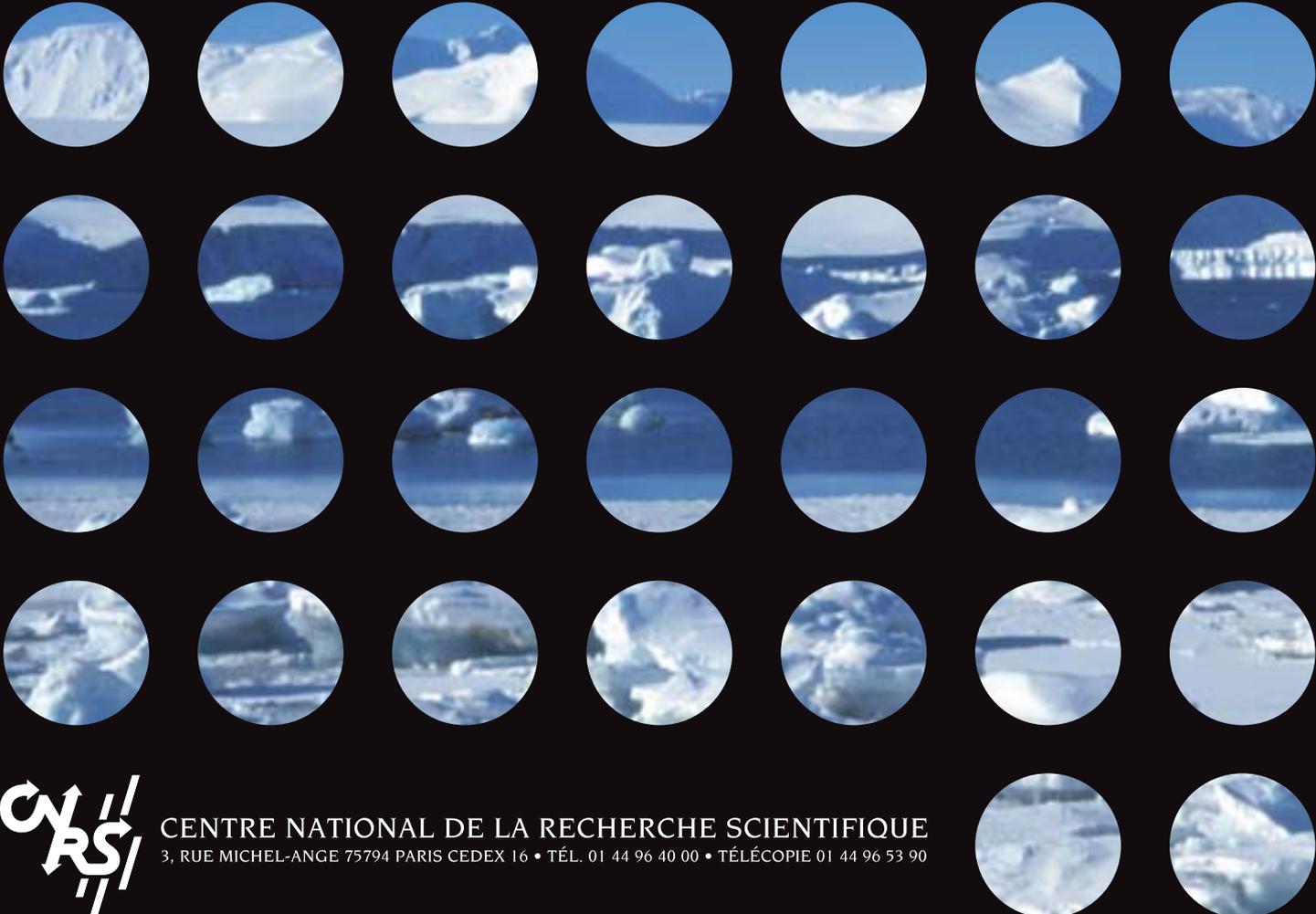
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