150 YEARS ON,

The World According to DARWIN

ON LOCATION
GOCE Mission
Determining the Real Shape of Earth
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France on the Move

Anne Houdusse has been awarded the “FEBBS/EMBO Women in Science” prize, given every year to a woman who has made an exceptional contribution to the life sciences. Gérard Féray, from the Institut Lavoisier, has won the EIN prize for the protection of the environment, awarded by the eponymous Italian petroleum company, for his work on large-scale sequestration of CO₂. And Michel Dyakonov from LPTA received the American Physical Society’s “Beller Lectureship Award.”

Sébastien Candel, from the EMI Laboratory, has been elected as a foreign associate of the US National Academy of Engineering, while George Calas, from IAPMPC, has been made a Fellow of the Geochromatic Society and of the European Association for Geochemistry.

Last but not least, Gérard Mourou, head of LOA and professor at the Physics Department of the Ecole Polytechnique, has been elected to the physics section of the prestigious Academy of Russian Sciences. Mourou has made major contributions to the invention of the laser amplification technique, which has paved the way for new fields in optics and physics.

1. Ministère structure (CNRS / Institut Curie).
2. CNRS / Université de Montpellier.
3. Laboratoire de physique théorique et astrophysique (CNRS / Université Montpellier).
4. Énergie, matière moléculaire et macromoléculaire, combinaison (CNRS / Ecole Centrale Paris).
5. Institut de mécanique et de physique des milieux condensés (CNRS / Université de Paris-Sud, UMR 8212).
AERONOMY

Keeping a Close Eye on the Sky

Though its scientists are busy studying the atmospheres of celestial bodies or tracking down extraterrrestrial life, the Service d’aéronomie (SA) has its feet firmly on the ground. Celebrating its 50th anniversary this year, we get an exclusive peek at what goes on behind the doors of this prestigious lab.

A place that SA’s researchers will be leaving in 2010 to join up with some of their colleagues from CETP, in Grenoble (Isère), forming the new LATMOS lab. There, they will be gathering forces to elucidate more of our sky’s mysteries.

Jean-Philippe Balle

1. CNRS / Université Paris VI / Université Versailles St-Quentin. The laboratory was headed by Gérard Mégie. CNRS president from 1990 to 2000.
2. A plasma is a fourth state of matter: an ionized gas which is formed by a very good conductor and which emits electromagnetic radiation (well-known phenomenon like lightning or the aurora borealis).
3. Mercury’s atmosphere is so tenuous that it is usually referred to as an exosphere.
4. Hainu-Pukao (Oriens), Drummond d’Urville (Antarctica), Albatross (Netherlands), and the Enterprise (Indian Ocean).
5. CNRS / Université Versailles St-Quentin / Université Paris-VI.
6. Laboratory Atmospheric, Milieux, Observations spatiales et Spectrométrie à Recherche. www.polarcat.no/polarcat

References

1. Frédéric Campo. "Un plasma est un quatrième état de la matière qui est formé par un très bon conducteur et qui émet des radiations électromagnétiques (phénomène bien connu comme la foudre ou l’aurore boréale)."
3. La position est si ténue qu’elle est généralement appelée exosphère.
4. Hainu-Pukao (Oriens), Drummond d’Urville (Antarctique), Albatross (Pays-Bas) et l’Enterprise (océan Indien).
5. Spectromètre à Recherche. www.polarcat.no/polarcat
How Neanderthals Became Extinct

How Neanderthals Became Extinct

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aving inhabited Europe for over 200,000 years, Neanderthals were driven to extinction around 35,000 years ago, and the reasons behind their disappearance have been the source of considerable debate. The scientific community has long been split between those proposing Neanderthals’ inability to cope with dramatic climactic change in particular—a cold period about 35,000 years ago called Heinrich Event 4 (H4)—and those who consider competition with anatomically modern humans (AMH) as a more likely cause. Yet a recent study1 has attributed Neanderthals’ inability to survive to a multidisciplinary Franco-American research team, featuring experts in archaeology, ecology, and palaeoecology should put the debate to rest. It demonstrates that competitive exclusion, not climatic change, is indeed responsible for Neanderthal extinction.

Using an algorithm called GARP, initially developed to predict the impact of climatic change on biodiversity, the team showed that Neanderthals and AMH were exploiting almost identical ecological niches before and during the cold period. “The algorithm uses a host of data—carbon dating, geographic information, and climatic history across Europe—and matches it to the paleoenvironmental features shared by known archeological sites (belonging to either Neanderthals or AMH) to predict where these populations might have lived at any given time,” explains archeologist William Banks from the PACEA laboratory, who led the research. According to GARP’s calculations, Neanderthals should have continued to occupy the majority of Europe during Greenland’s temperature at 18,000 years ago (G18), the warmer period that followed H4. “But when we look at the actual sites dated to G18, we see that the regions occupied by Neanderthals had shrunken to southern Spain.” Banks adds. The algorithm results also showed that AMH’s niche had expanded during G18, thus making competition between the two groups—and AMH surro-

ging adaptation—the likely drivers behind Neanderthal extinction.

While several past studies have attempted to gauge the impact of climate change on human populations, the multidisciplinary approach made possible by GARP constitutes a significant breakthrough. As stressed by Francesco d’Errico, co-author of the study, “GARP combines archeological, chrono-

logical, and climatic data in a unique computational architecture.”

NANOTECHNOLOGY

Magnetic Nanoparticle Networks

Entirely made of iron, cobalt, or their alloys, magnetic nanoparticles can be used in a wide variety of applications to improve the performance of devices and to control new phenomena. Their potential for targeted drug delivery, non-invasive imaging, and other applications is being explored by researchers worldwide. Yet, to be fully effective, these magnetic nanoparticles must be precisely controlled and tailored to specific needs. The CNRS is playing a leading role in this field, both in terms of basic research and in the development of innovative applications.

Researchers at the CNRS have designed magnetic nanoparticles that can be used to create multiferroic materials. These materials can be used as sensors, actuators, and other electronic devices. The CNRS is also working on the development of magnetic nanoparticles that can be used for targeted drug delivery. These nanoparticles can be used to deliver drugs directly to specific sites in the body, allowing for precise and effective treatment.

Researchers at the CNRS are also working on the development of magnetic nanoparticles that can be used to create novel magnetic devices. These devices can be used in a variety of applications, including non-invasive imaging, data storage, and energy generation.

Individually designed to perform specific tasks, these magnetic nanoparticles are opening up new possibilities for devices requiring versatile and compact components. By specifically controlling the properties of these nanoparticles, the CNRS is able to create new materials that can be used to improve the performance of electronic devices and to control new phenomena.
Glial Cells Get Center Stage

For a long time, glial cells were overshadowed by neurons. Originally viewed as ordinary caretakers, their importance is now slowly emerging. In this context, two recent studies show how they participate in the brain’s self-repair and communication systems.

As described in their study, the researchers spent two years creating a fluorescent viral-vector aimed at the neurons producing cells—a particular type of glial cells called “astrocytes” (star-shaped cells that make up the “cement” between the neurons). The vector enabled them to locate astrocytes on mouse olfactory bulb slices. Using electrophysiology, they observed that fluorescent astrocytes developed the hallmarks of neurons. When the scientists damaged parts of the tissue, they witnessed a six or seven-fold increase in neuron production from astrocytes in that region, demonstrating that a lesion triggers neuronogenesis. “It’s interesting to see which regions of the brain might be involved in memory formation,” says Lledo. “We are now trying to discover if this inherent self-repair mechanism could be extended to other parts of the brain, when subject to lesions, trauma, or strokes.”

At a more fundamental level, another interesting finding concerns the mechanism by which astrocytes communicate among themselves and with neurons. According to CNRS researcher Christian Giaume, when neurons are active, their need for energy is passed on to neighboring astrocytes, which stimulate an entire network of astrocytes to route nutrients from the blood circulation towards these nerves. In a recent study, the researchers demonstrated that the network organization is key to an interplay between neurons and astrocytes.

Neurotransmitters are typically thought to be “up” quarks and one “down” quark,

Astrocytes and neurons are organized in a network whose mutual interaction is essential for functional synaptic communication within the brain.

Astrocytes transform into neurons.

After a chemical lesion of the olfactory epithelium in mice, stem cells from the subventricular zone (SVZ) located in the lateral ventricle (LV) grew into reactive astrocytes, whose electrical activity was not observed with neuronal markers. When grown on a collagen gel, astrocytes developed a hexagonal shape that was unique to neurons.

These results also helped establish techniques that can be used in other important endeavors, such as the search for new fundamental phenomena surrounding the weak interactions of quarks.

1. Perception et mémoire (CNRS / Institut Pasteur).
2. Laboratoire de Physique de l’Université Paris 13.
3. Unité 975 (Inserm / CNRS / Université Paris-Sud).
THz Lasers Are Cool

Ancient Forests Do Trap Carbon

Mechanical Pressure as Gene Regulator

A central question in developmental biology is how non-genetic phenomena such as mechanical forces regulate growth. Here are the most recent findings on the role of such forces in the development of different human tissues: human tumors, and plants.

For almost half a century, scientists believed that all the events that occurred during the development of an organism were solely the product of what was written in its genes. The postulate began loosing up only a decade ago, as biologists started demonstrating that non-genetic phenomena also affected development.

One team’s research, led by Emmanuel Farge at the Curie Institute in Paris has provided a major advance in the understanding of mechanical pressure on genetic expression and cell proliferation during embryonic development, and more recently during tumor formation.

Working on embryos of fruit flies, the first team demonstrated that the forces generated by the developing embryo influence the expression of genes in neighboring cells. “The growing tissues and the genes that are responsible for their architecture are in close communication,” says Farge. “It’s a sort of feedback loop indicating where genetic activation should be launched.” At the molecular level, they discovered that such mechanical pressure triggers the relocation, inside cells, of a protein called beta-catenin which is involved in cell-cell communication.

“We still have to elucidate whether the pressure generated by bowel movements can initiate tumor development,” says Farge. “In these cells, one copy of the APC gene is not enough to counter the mechanical-induced 8-catenin re-localization.”

The team also noticed that the relocation of beta-catenin is inhibited when pressure applied equaled at least that of bowel movements inside the colon. “We still have to elucidate whether the pressure generated by bowel movements can initiate tumor development in APC deficient cells, or if pressure is only involved in the amplification process—cells of a growing tumor pressuring a pre-disposed neighboring cell, thereby feeding a chain reaction.”

On the other side of the realm of developmental biology, researchers have discovered the role of mechanical forces in plant development. An international team of researchers including INRA, CNRS, and INSA scientists showed that the mechanical constraints generated by growing tissues determine the orientation of growth in neighboring cells. “Before that, we knew growing cells exert pressure on their neighbors, but we didn’t know how this pressure was integrated as a message,” says lead author Olivier Hamant.

For the first time, scientists have demonstrated that the application of external mechanical forces might also come into play in the development of some cancers,” says Farge.

In recent experiments, the team applied mechanical pressure on tissues of healthy mouse colon cells, and on tissues of mouse colon lacking one copy of the APC gene. Using fluorescence, they observed that pressure on healthy tissues did not induce the relocation of 8-catenin. However, in APC-deficient tissues, this protein did travel to the nucleus. “Mechanical pressure can thus contribute to the activation of oncogenes in cells genetically pre-disposed to cancer,” says Farge. “In these cells, one copy of the APC gene is not enough to counter the mechanically-induced 8-catenin re-localization.”

The team now hopes to study the interactions between mechanical forces influencing direction and other parameters such as growth speed and genetic pre-disposition.

Clémence Wallace

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Scientists have discovered that carbonatite melts are responsible for the mantle’s conductive properties. And this research has far-reaching implications in environmental sciences, from mapping out volcano carbon emissions to developing clean energy.

Various research areas have opened up in these carbonatites, and possible effects on viscosity. Ludger De Thé’s team was able to uncouple the effects of the two drugs. Retinoic acid alone brings about differentiation of APL cells, but not stem cells clearance or disease remission, which requires the synergic action of both drugs.

One third of all nitrates present in the Arctic atmosphere in spring come from the melting of the snow cover. This worrying news was published by a team led by Samuel Morin, after quantification of a process already known, the ‘‘travelling’’ of nitrate around the planet. Nitrogen oxides produced by natural phenomena like lightning and forest fires, but also by human activity, such as combustion and industrial activity, are rapidly oxidized to nitrate. Incorporated into atmospheric particulate matter, nitrate is transported by air currents towards distant ecosystems, like the Arctic, where it is deposited by snowfall or the Arctic Ocean.

In a non-pathological situation, BRCA1 (red) is located in the cell nucleus. In the presence of APL (green), BRCA1 (red) is kept out of the nucleus.

CANCER

IN BRIEF

Nitric Arctic

One third of all nitrates present in the Arctic atmosphere in spring come from the melting of the snow cover. This worrying news was published by a team led by Samuel Morin, after quantification of a process already known, the ‘‘travelling’’ of nitrate around the planet. Nitrogen oxides produced by natural phenomena like lightning and forest fires, but also by human activity, such as combustion and industrial activity, are rapidly oxidized to nitrate. Incorporated into atmospheric particulate matter, nitrate is transported by air currents towards distant ecosystems, like the Arctic, where it is deposited by snowfall or the Arctic Ocean. When the snow is exposed to solar radiation, the nitrate turns into nitrogen oxides that are emitted into the atmosphere. By measuring the isotopic composition of the atmospheric nitrate collected in the Canadian Arctic, researchers have shown that it comes in a large proportion from the ‘‘recycling’’ of nitrate from the Arctic pack ice. This study once more demonstrates the need for a global approach when it comes to environmental problems, due to the close links between the climate system (ice and snow-covered surfaces, temperatures, and solar radiation) and the presence of highly-reactive pollutants in the atmosphere (nitrogen oxides, ozone, and particulate matter).

3. From ENSS, CEA, and Hôpital Saint-Louis.
The job of the GOCE mission, just launched by the European Space Agency (ESA), is to measure the Earth’s gravity field at every point and with unrivalled accuracy. This fundamental yet poorly known data will help determine the true shape of Earth.

I Man first believed the Earth was flat, then round—we might be in for yet another surprise: its shape is actually that of a lumpy potato. There’s a hollow off South America, a bump near the north of Australia, and various lumpy bits here and there. This distorted shape is visible both to the Earth-bound traveler and to the astronaut observing the blue planet in its atmosphere—yet it plays havoc with a host of measurements, for instance those of ocean currents or the motion of the Earth’s crust. It is what makes the GOCE mission so important. This satellite will remain in orbit for 20 months. It will measure the gravity field, the cause of distortions, with the same precision (one part in a million) all over the surface of Earth, at a resolution of about a 100 km. Researchers from several CNRS labs are getting ready to process the data and include them in their models.

The quantity known as g—the acceleration due to gravity—is what relates mass to weight, and gives the Earth its shape. As if the planet isn’t a smooth sphere, it is because g doesn’t have materials of different densities. The presence in one place of a magma reservoir at a depth of a few hundred meters, and in another of a sinking oceanic plate means that the density of the material beneath our feet varies, and with it the value of g.

Determining these hollows and bumps, with differences of up to a 100 meters—with the same precision all over the globe—is no easy task. Indeed, local ground measurement can give the value of the gravity field with accuracy of one part in a billion, but for a large structure such as the Himalayas, it is necessary to have this type of high precision on a very large scale. “The aim is also to unify international reference systems so that, for example, the measurement of the altitude of a point means the same thing in Paris or Beijing,” adds Diament. To meet this challenge, GOCE is well equipped: on board, it carries a gradiometer, an instrument made up of six ultra-precise accelerometers built by the French Aerospace Lab (ONERA) and a GPS receiver. To preserve high resolution, GOCE was placed in a low orbit, at an altitude of 250 kilometers. At this distance, friction with the residual atmosphere makes it constantly lose altitude. The satellite therefore has to compensate for this by firing its small ion thrusters. “This is a top notch Earth observation satellite,” says Diament admirably. In fact, it was thought up nearly 20 years ago—in particular by Georges Balmaté, today a researcher at CNRS who has at last seen the fruits of his labor.

Azzar Khatlhalri

On this virtual Earth, the regions where the gravity field is weakest are shown in blue, and the regions where it is strongest in red—exactly the same value all over the surface of Earth: Mass is not equally distributed inside the planet, and every point on its surface is not subjected to the same attractive force. To get a better picture of the variations of g at the Earth’s surface, scientists use an imaginary Earth called the “geoid.” It is important to note that this lumpy image of our planet corresponds almost exactly to the same value all over the surface of Earth, at a resolution of about a 100 km. Researchers from several CNRS labs are getting ready to process the data and include them in their models.

The GOCE satellite’s (artist’s rendition), should be able to measure the Earth’s gravity field at every point and with unrivalled accuracy. This fundamental yet poorly known data will help determine the true shape of Earth.

Claire Voisin

Artist of the Abstract

Making algebraic geometry speak “volumes,” Claire Voisin has become a reference for specialists of the Hodge theory. But it is her work on Kodaira’s conjecture that won her the Clay Research award in 2008.

Very quickly, words no longer suffice.
Claire Voisin goes to the board, eraser in one hand, chalk in the other, and draws geometric figures side by side with complicated calculations. Voisin, a senior researcher at the Institut de mathématiques de Jussieu in Paris is a specialist in algebraic geometry. More specifically, she works on the study of the “topology of complex algebraic varieties.”

To introduce her field, she sketches a sphere that she cuts up in three-dimensional triangles along its edges, as if they had been shaped by the rounded surface. The result is that you can cover a sphere with triangles, which are themselves the “faces” of a pyramid, for example, “topologically speaking,” Voisin explains. “A sphere and the surface of a pyramid are therefore identical—though saying something like that is a bit absurd from the point of view of algebraic geometry,” she immediately points out. According to her, “this is also possible with an infinite number of triangles.” If “triangulated,” the result is a skeleton made up of 0-, 1- and 2-dimensional objects, together along their sides. A metric induced by the ambient space then gives rise to a complex structure, hence to the residual atmosphere makes it constantly lose altitude. The satellite therefore has to compensate for this by firing its small ion thrusters. “This is a top notch Earth observation satellite,” says Diament admirably. In fact, it was thought up nearly 20 years ago—in particular by Georges Balmaté, today a researcher at CNRS who has at last seen the fruits of his labor.

The GOCE mission is to measure the Earth’s gravity field by the European Space Agency (ESA), a smooth sphere, it is because g doesn’t have them in their models.

The GOCE satellite (artist’s rendition), should be able to measure the Earth’s gravity field at every point and with unrivalled accuracy. This fundamental yet poorly known data will help determine the true shape of Earth.

150 YEARS ON, THE WORLD according to DARWIN

The year 2009 marks both the bicentennial of Darwin’s birthday and the 150-year anniversary of the first publication of his famous work On the Origin of Species. Throughout the year, the world will celebrate the English naturalist who revolutionized the story of life with his theories of evolution and natural selection. And this is a well-deserved tribute. Indeed, his work laid the foundations for all the fundamental research carried out since then, to establish the relationships between species and understand their evolution over millions of years. But this celebration also responds to a need to reassert a number of scientific facts, at a time when Darwin’s critics, led by the creationists, seem to be making up lost ground. So just how did Darwin construct his theories? And how have they developed since then? Which new avenues are his followers exploring in their labs? CNRS International Magazine has been finding out.

The Origins of a Theory

As the surrealist Belgian writer Louis Scutenaire humorously noted, “the death of celebrities is always commemorated, but never their birth.” Yet at least 2009 will be an opportunity to celebrate in truly worthy fashion the bicentennial of the birth of this giant of modern science, Charles Robert Darwin. By a fortunate coincidence, it will also be the 150th anniversary of the first edition of his seminal work, On the Origin of Species by Means of Natural Selection.

It is hardly surprising that there is so much enthusiasm about Darwin today. His theory of the evolution of species has been constantly enriched, perfected, and fleshed out by generations of researchers on the basis of a huge amount of experimental work carried out both in the field and in the lab. What’s more, it now appears to have no serious rivals. So just what did Darwin state back in the mid-19th century? The Darwinian meaning of the term is currently the best conceptual framework that we have for a rational understanding of the instability of living organisms and for thinking about an essentially dynamic natural world.

The Fundamental Principles of Evolution

The explanation of the mechanisms of biological evolution formulated by Darwin and his successors is based on four fundamental principles. The first, as Guillaume Lecointre, a team leader at SAE explains, is that “among individuals that recognize each other as potential sexual partners, there exist variations (physical, genetic, in ability, etc.). Consequently, whatever the cause of such variation, living species have a natural ability to vary.” The second is that every species can be selected for. Horticulturists, who for instance create new varieties of roses by crossing older varieties, or dog breeders, who in a mere 11,000 years have produced dachshunds from wolves, know this only too well. “The simple fact that humans can change the morphology of a species at will shows that it can be molded,” as it were, and that it has the ability to be altered,” Lecointre points out.

The third principle is that all species reproduce as long as they can find food resources and optimum habitat conditions. They keep on reproducing so as to always reach the limits of these resources, or until they come up against other limits, like predation by other species. “There is therefore a natural capacity for over-population that can be observed, for instance, when non-native species suddenly invade a closed environment such as an island.”

The Origins of a Theory

Research in Evolution

When Controversy Rages

© Rue des Archives/Lebrecht ; The Bridgeman Art Library

One of Darwin’s many collections of insects, which gave him the opportunity to carry out extremely detailed real-life observations.

Dane en only published his theory of natural selection relatively late in life–when he was 50 and already an internationally renowned naturalist.

George Richmond’s 1860 portrait of Charles Darwin is, even here set as the bearded patriarch immortalized for posterity, but as a young and slim man.
that carry a heritable variation that minimizes the importance of natural selection. Darwin's innovative idea wasn't so much natural selection as descent with modification, in other words the fact that species have a history and are related. Le Gueydon points out. The now famous meeting organized in June 1860 in Oxford by Bishop Samuel Wilberforce concerned this point. Wilberforce, attacking the Darwinist Thomas Huxley, asked him if it was "on his grandfather's or grandmother's side that [he] claimed descent from an ape," and received the no less famous reply: "Better to descend from an ape than from a man who uses his God-given gifts to obscure the truth."}

**GENETICS TO THE RESCUE**

Darwin's theory, while updating the traditional Christian view of the world, suffered from a major handicap: the causes and laws of heredity, as well as the true nature of its material basis, were still unknown. Although his theory maintained that natural selection was the main mechanism of evolution, Darwin also believed that characters acquired during an organism's existence could be handed down to its offspring. "Darwin's theory of natural selection plunged into obscurity after his death in 1882," says Veillette. After the redécouvert of Mendel's laws on hereditary transmission in 1900, a new science, "population genetics," was to rediscover the importance of the notion of natural selection. The mathematical models proposed by Fisher, Haldane, and Wright were accepted by the scientific community in 1932. It was only then that researchers were able to turn population genetics into a practical discipline. The years 1940-70 saw the merging of population genetics with ecology, botany, and paleontology, which had hitherto ignored each other, giving rise to the "synthetic theory of evolution." As Lecointre explains, "its instigators attempted to unravel the mechanisms that gave rise to biodiversity, using the mechanisms described by population genetics enriched by what naturalists had discovered about natural geographical variations within species and about speciation."

**DARWIN'S DESCENDANTS**

Another modification of the theory of evolution was provided by the so-called "neutral" model of the Japanese geneticist Motoo Kimura. "Khirima believes that most changes observed between the genomes of various species are due to random changes, which impossibly alter the frequency of variations from one generation to the next, rather than to natural selection, whose existence he nonetheless recognizes," says Veillette. Over the last few decades, many other researchers have added weight to the synthetic theory of evolution and helped redefine it, starting with the paleontologists Stephen Jay Gould and Niles Eldredge. Their new model, the "punctuated equilibrium," explained why in the fossil record, species seem to happen in spurts interspersed with long periods of stagnation. During an event of population separation, a small group of "marginal" organisms becomes cut off from its original population when it occupies a new environment. The original population is stable in morphology while the marginal ones change at a faster rate. Furthermore, they show that certain species "version accumulates divergent. If it is successful, it extends its territory and may replace the original population in a region, as happened with the trilobites (marine arthropods) during the Paleozoic era." This would explain why an Unbroken evolutionary sequence, a species that has been stable for several million years is suddenly replaced by another. "Species recombination," is "the new method."

Working with Richard Lewontin, Gould subsequently contoured the optimistic view of the development of the synthetic theory. "It was much easier to place variants with a selective disadvantage continue to appear all the time, which led evolutionary scientists to put into perspective their impression that nature was a perfect construct," Lecointre explains. Furthermore, they showed that natural selection is not indispensable as an explanation, as a "handicap-like the fact that spotted hyenas give birth through the cloaca, which results in death for some of their offspring."

During his stay in the Galápagos, Darwin set out to study a dozen separate species of Passerine birds which were to become famous under the name "Darwin's finches."

In September 1835, Darwin was able to observe giant tortoises and lizards in the volcanic Galápagos islands on the equator.

Jean-Baptiste de Monet, Chevalier de Lamarck, helped introduce the idea of evolution into the scientific thinking of the early 19th century. There appears to be an obvious connection between his ideas and those of Darwin.

Darwin's voyage round the world on board the Beagle lasted five years, from December 1831 to October 1836.
Comparing the nervous system of jellyfish with the more complex systems of other animals helps us understand how the brain network developed during evolution.

The contribution of embryology

The oldest idea to the theory of evolution has been the rapid development of evolutionary developmental biology—informally known as “evo-devo,” a discipline focused on the identification of the genes behind embryonic development, the study of their distribution within the animal world, and their comparison. This should help to better interpret organism similarities between large groups of animals. As Le Guyader points out, “Darwin would have been delighted with this encounter between embryology (in which he was very interested) and genetics, which thrusts development and its associated genes into an evolutionary framework.”

All these areas of research show that the pioneering ideas of the great English naturalist were greatly enriched throughout the 20th century. “Today, evolutionary specialists can play a wide range of models and mechanisms to explain evolutionary phenomena,” says Michel Morange. “Their objective isn’t to prove Darwin’s theory wrong,” but rather to test the different models derived from his theory.

A dangerous crusade against Darwin

“I’m not a knight in shining armor fighting creationism, although the subject does need to be addressed,” answers Pascal Picq, palaeontologist at the Collège de France, slightly irritated that he has once more been asked to comment on the harm caused by the crusade currently waged by fundamentalist evangelical circles in the US.

“These Churches, which preach that the Universe and the Earth were created by a god around 6,000 years ago, are constantly gaining ground, and their goal is nothing less than to establish a theory,” he explains. “Europe is vulnerable. The revival of creationism that we’re seeing today is a real threat to secularism and democracy.”

Another current thought which has a knack for making evolutionary scientists angry is that of “Intelligent Design,” a neo-creationist belief that claims to be a science and states that certain evolutionary facts (such as the formation of complex structural and functional features like the eye) can never be explained by science, and that we should therefore seek non-natural causes for their appearance. “Intelligent Design involves the existence of a ‘superior intelligence’ to explain the incredible diversity of life,” Picq explains. So, what can be done to fight off the onslaught of creationism and Intelligent Design? Not support the resuscitation of the fundamental concepts of evolution in school curriculums as a starting point.

The place of humans in the tree of life

Phylogeneticists usually classify living organisms into “trees,” whose branches reveal the evolutionary relationships between groups of species. They divide into more and more branches as organisms evolve and new species appear. The part of the tree of life shown here contains the sancrophylaxs, which include mammals and therefore humans. It was Darwin who first suggested classifying living organisms genetically. However, there are as many different trees as there are ways of analyzing characters that are common to species.

Research in evolution

It is unsurprising that scientists from every discipline are still unable to explain all the facts of evolution. How could it be otherwise, given that only a few decades have gone by since the discovery of DNA and the fundamental molecular mechanisms of life. Yet facing the complexity of the task, researchers are using all the means at their disposal to unravel the events set off 2.5 billion years ago. “Such questions form one of the most far-reaching and exciting scientific fields. Moreover, beyond its academic and practical interest, studying evolution provides us with the keys we need to forecast the impact of current global change on organisms and ecosystems,” says Jean-Christophe Auffray, director of ISEM in Montpellier.

On the trail of biodiversity

Trying to understand how biodiversity emerges and maintains itself is Nicolas Galtier’s specialty at ISEM. “Evolution can be studied at different levels of organization,” he explains. “It can be studied on the scale of ecosystems, of species, of organisms, or of genomes, which is what I do. I watch sequences of DNA evolve, both within current populations and between species that are very far apart, such as bacteria and mammals, knowing that certain genes—like those that regulate the transcription of DNA into RNA and the translation of RNA into proteins—are common to all living organisms.” This is the art of making genes “talk,” to decipher the relationships that unite all living things and to reconstruct the evolutionary history of species.

However, why is it that the genomes of some species (humans, for instance) evolve at a slower pace than others (like the fruit fly)? Nobody knows. Such a differential evolution rate between species remains largely unexplained. “Several known as ‘molecular clocks’ exist,” Galtier explains, “involving various parameters such as the spontaneous appearance of genetic changes from one generation to another, the efficiency of repair of damaged DNA, the average lifespan of a generation of organisms, or even the ability of different species to eliminate deleterious disadvantageous mutations.”

Working on the methods and mechanisms of evolution can also include studying the genetic traits that give organisms resistance to insecticides. Phyllotectists usually classify living organisms into “trees,” whose branches reveal the evolutionary relationship between groups of species. They divide into more and more branches as organisms evolve and new species appear. The part of the tree of life shown here contains the sancrophylaxs, which include mammals and therefore humans. It was Darwin who first suggested classifying living organisms genetically. However, there are as many different trees as there are ways of analyzing characters that are common to species.

NEW DISCOVERIES IN THE LABS...

Uncovering the secrets of the evolution of living organisms also means finding out its impact on biodiversity. To tackle this issue, the ecologist Nicolas Mouquet, who works at ISEM, has been working with the bacterium Pseudomonas fluorescens. The experiment he carried out...
LACTASE EVOLUTION
If there is one example that shows that cultural differences can lead to biological alterations and affect the genetic diversity of Homo sapiens, it is that of lactase, an intestinal enzyme that makes it possible to digest the lactose (a sugar needed for children’s growth) present in milk. “This enzyme,” explains Évelyne Heyer, from MNHN, “is generally inactivated in mammals after weaning, which makes them unable to drink milk in adulthood. However, in certain human populations, especially in Northern Europe (Sweden) and in East Africa (the Tuva), a high proportion of adults (as many as 90%) have active lactase.” To what extent these groups have in common? All of them are made up of herdsmen or descendants of herdsmen, and milk has played a major role in their diet for several thousand years. Heyer explains that “when these populations begin to drink large quantities of fresh milk, individuals who were able to digest it possessed a selective advantage (better absorption of calcium, better resistance against tuberculosis, etc.). The tools of population genetics even allow us to date the moment when this mutation began to increase in frequency.” The European Neolithic age is estimated to be approximately 8000-9000 years old, dates which are consistent with the fact that this enzyme was necessary to the domestication of livestock.

POLLUTION’S IMPACT ON EVOLUTION
What is the impact of air pollutants from road traffic on female fertility and, therefore eventually, on the evolution of the human species? A study published in Atmospheric Pollution and Human Fertility, in which CNRS researcher Liliane Rossetta is taking part, should shed more light on the question. A thousand French women aged 18-44 not using contraception and attempting to become pregnant took part in the survey. “We asked the women to send us urine samples collected every other day during a complete menstrual cycle,” Rossetta explains. “We are currently determining the hormonal profiles of estradiol (a hormone secreted in large amounts just before ovulation) and progesterone (secreted after ovulation) in the biological samples.” The same women were also asked to provide a sample of hair to determine the quantity of pollutants it contained. The aim is to find out whether the cycles of these women were disturbed, and if so, to what extent this anomaly could be linked to air pollution in their immediate environment.

In terms of evolution, Rossetta says, there is every reason to think that air pollution does affect, and actually decreases the eventuality of giving birth. “Each woman will have a distinct advantage over less fertile ones, for which it will be harder to reproduce.” The definitive results are expected to be available in 2010.

1. Laboratoire Dynamique de l’Evolution humaine, populations, espèces (CNRS). Contact: Liliane Rossetta, loro@mrcoacs.orsl.fr

The effect of air quality on human reproduction is of increasing interest to scientists.
When Controversy Rages

A number of evolutionary theorists have attempted to apply Darwinism to human societies. Born in the ferment of debate sparked by the publication of Charles Darwin's On the Origin of Species, the social sciences in the second half of the 19th century the proponents of “social Darwinism”—which sees human society as an animal species whose “health” requires the elimination of the most unproductive individuals, such as criminals, alcoholics, the disabled, etc.—are a source of endless controversy. At issue is the exact role played by Darwin’s ideas in the emergence of detectable ideologies like eugenics, which calls for “artificial selection” of human beings. The philosopher Patrick Tort, the founder and director of the International Charles Darwin Institute and a tireless defender of Darwin, categorically denies that the British naturalist had anything to do with the emergence of such ideas (see box below).

And yet Pichot, however, is far less charitable to Darwin and goes so far as to say: “Darwin was neither more nor less racist, sexist, or a supporter of slavery than his contemporaries.” Pichot explains: “But Darwinism gave rise to all sorts of sorts of ideological and political theories that made competition, war, and mass slaughter the classical examples of principles of societies, and their evolution. You only have to read what was written before and during the First World War, right up to the 1930s, to see how many scientists and philosophers were protesting against the eugenic and racist ideas of his cousin Galton. And his own son, Major Leonard Darwin, was for many years the president of the International Federation of Eugenics Organizations.” This issue led us to remain controversial.

Nonetheless, according to Dominique Guillo, from GEMAS, “whatever the truth of the matter, the social sciences, after having been initially closely connected to biology and its offshoots, progressively severed their links with the life sciences and became an independent discipline at the beginning of the 20th century. Admittedly, social, eugenic, racist, and imperialist ideas derived from Darwinism continued to proliferate, acting for example as a source of inspiration for the horrors of Nazism. But for many decades, ‘on the whole, academic sociology and anthropology kept their distance from biology, hiding behind the principle of an insurmountable barrier between nature and culture.’ Guillo explains.

FROM NATURE TO CULTURE

This separation was questioned in the mid-1970s by neo-Darwinian theories of culture, especially as promoted by the American anthropologist Edward O. Wilson, whose Sociobiology: The New Synthesis. Darwinism to human societies. This is currently being undertaken by the Slatkine Centre, which concludes, “to finalize the question of the respective influence of biological and cultural factors in human evolution.” This tendency continues, above all in France, with the recognition that genetic factors are involved in many human practices, in situations to which cultural evolution is totally independent of genetics. For the American anthropologist William H. Durham, “a cultural revolution is characterized, which is gained by genetic mechanisms and the principle of natural selection, not only in animals, but also in humans.” Wilson sought to adopt the foundations of Darwinian logic to a whole series of human social and cultural phenomena: moral codes, religion, the division of labor between men and women, etc., “says Guillo. For Wilson, social norms, such as the avoidance of incest, are the biological tendencies rooted in genes that were probably selected for in our ancestors, throughout prehistory, for the advantages they conferred. The reductionist determinantism formulated by human sociobiology gave rise to another, apparently softer version: evolutionary psychology. The implications of this ideology are that things do get a bit complicated with regard to the human species, where it isn’t possible to disentangle the complex mechanism of memes and the importance of cultural and social transmission. But the basic principle remains the same: “For these theoreticians,” Guillo insists, “behavior in animal and human societies is in the first analysis governed by genes or else indirectly, by specific genes retained by natural selection.”

Another even more distant cause of sociobiology, to which it is even totally opposed on certain points, is eugenics, which emerged from the work of the English intellectual Richard Dawkins. This line of thinking, which has many followers in the U.S., applies the evolutionary mechanisms modeled by Darwin to human societies, but safely as an analogy. For Dawkins, Guillo explains, “there exist basic ideas—call them memes—that are specific to each culture: the idea of God, a song, a certain way of cooking, etc. These memes work like genes. They jump from one brain to another, spreading out through populations and multiplying, competing with each other to ‘colonize’ the maximum number of brains. They mutate when someone introduces a technical innovation in an industrial process, or invents new styles of clothing, etc. Such mutations can either disappear rapidly (as in the case of fashions), or establish themselves long-lastingly (such as the meme of the idea of God).” In other words, memes, like genes, undergo a process of selection. In memetics, Guillo points out, “it’s essentially the study of memes that have been carried over time by humans, with the mutations and natural selection that these mutations can undergo, thanks to the human ability to adapt and change the world around them.”

RACISM: DARWIN CLEARED

Was Darwin a racist? Can his theory of evolution be accused of bolstering the racist undertones that could lead to the horrors witnessed during the First World War? For the philosopher Patrick Tort, the answer is no. He argues that “Racism reflects the inherent inequalities of the ‘race’ and of mankind: a marriage between a Parisian and a ‘black’ is not possible, unlike a marriage between a Parisian and a ‘white’.” He points out that The Origin of Species was first published in 1859. So as not to damage the chances of his ideas being accepted, “Darwin adjusted his theory to make all public statements on the subject of human races for a long time. And yet he was precisely during those ten years that the English philosopher Herbert Spencer developed his system of ‘synthetic philosophy,’ which led to a social theory that celebrated the triumph of the ‘surviving’ races, as well as the refusal to help the poor.” During the same period, Darwin’s young cousin, Francis Galton, invented eugenics. Referring to Darwin, both Spencer’s and Galton’s theories “converged” towards the principle of the necessary elimination of the weak. “Yet Darwin saw the protection of the poor as an indication of the ‘degree of civilisation,’ and innovocally dismissed Galton’s eugenics in Chapter 5 of The Descent of Man,” says Tort. “Which is why it is necessary.” Tort concludes, “to realize the unpersuaded French translation of this notion. This is currently being undertaken by the Slatkine publishing house.”

CONTACT

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The Century of
CLAUDE
LÉVI-STRAUSS

Claude Lévi-Strauss celebrated his centennial on November 28, 2008. This renowned anthropologist, a tireless social theorist and founding father of structuralism, has had considerable influence on contemporary thought.

T hose who have crossed his path have never run out of praise: "a man with an exceptional flair for ethnology," “a lively, modest personality, with a great sense of humor,” “the author of one of the greatest contributions to 20th century French thought.” Winner of the CNRS gold medal in 1967, he has made throughout his career an indelible mark on ethnology and anthropology. “His body of work has fertilized major studies in the human sciences—those of Foucault, Deleuze, and Bourdieu,” notes Frédéric Keck of the Institute Marcel Mauss in Paris, 1 who was involved in the publication of his major works in the “Bibliothèque de la Pléiade” edition, a collection of great works of literature and philosophy. “His work has had a spectacular influence internationally.”

Levi-Strauss, a professor at the Collège de France, the author of more than 20 books, including the famous Tristes tropiques (1955), La pensée sauvage (1962, The Savage Mind, 1966), and Mythologiques I-IV (from 1964 to 1971), and founder in 1960 of the Laboratory for Social Anthropology is best known for having introduced structuralism, a method borrowed from linguistics, into the field of anthropology. Social phenomena such as kinship systems or myths are no longer to be studied as independent entities each with their own significance, but rather as part of an organized system where connections are revealed by differences, not commonalities, exposing at the same time the structures of unconscious thought that are common to all human beings. “Structuralism provided a way out of a kind of determinism...”

ETHNOLOGY

Claude Lévi-Strauss was born in Brussels in 1908. After studying in Paris, he was successively a professor of philosophy, sociology, and finally anthropology.

1 Claude Lévi-Strauss was born in Brussels in 1908. After studying in Paris, he was successively a professor of philosophy, sociology, and finally anthropology.
2 Lévi-Strauss, shown here with his second wife, Monique, was elected to the Académie française in May 1972.
3 These who have crossed his path have never run out of praise: “a man with an exceptional flair for ethnology,” “a lively, modest personality, with a great sense of humor,” “the author of one of the greatest contributions to 20th century French thought.” Winner of the CNRS gold medal in 1967, he has made throughout his career an indelible mark on ethnology and anthropology. “His body of work has fertilized major studies in the human sciences—those of Foucault, Deleuze, and Bourdieu,” notes Frédéric Keck of the Institute Marcel Mauss in Paris, who was involved in the publication of his major works in the “Bibliothèque de la Pléiade” edition, a collection of great works of literature and philosophy. “His work has had a spectacular influence internationally.”
4 Levi-Strauss and Dino, his first wife, in their camp in Amazonia. They had both graduated in philosophy and she actively participated in the ethnographic research trips.
5 For Levi-Strauss, the Bororo Indians formed a “knowledge-based” and extremely hierarchical society. It was divided into two rival “moieties,” the Cera and the Tugare, each of which was subdivided into four hierarchical clans. Here, a Cera woman wears a ceremonial dress.
6 This headdress, 62 centimeters in length, made from a twig to which large red and blue ara feathers are attached, was brought back from Amazonia by Levi-Strauss. It is part of the Levi-Strauss collection at the Paris Quai Branly museum, which includes 1479 items.
7 While in exile in New York during the Second World War, Levi-Strauss, along with Andre Breton and his Surrealist friends, bought several items made by the Indians of the American northwest and by the Inuit, including this decorative item made of carved wood and green mother-of-pearl.
First Joint Unit in Africa

Pollution, global warming, urbanization… the world is facing major environmental challenges. An ambitious French-African research group has just been formed to study these phenomena and their consequences on health.

In January 16th, the first ever international joint unit (UMI) between CNRS and Africa was signed into existence. This UMI, which goes by the name “Environnement, santé, sociétés,” brings together researchers from France, Burkina Faso, Mali, and Senegal to work in a high-priority field: environmental change and its impact on health.

“Through this first major initiative for CNRS in Africa, our goal is to set up a strong, balanced partnership between researchers from the North and South,” stated CNRS president Catherine Deléage during the ceremony. Joining her were the heads of the three other founding organizations: Senegal’s Université Cheikh Anta Diop in Dakar (UCAD), Mali’s University of Bamako, and Burkina Faso’s National center for scientific and technological research (CNRSRT).

The researchers have their work cut out for them. Their primary goal is to investigate the relationship between environmental changes and health. For example, the way that pollution brings about new respiratory diseases, or the precise role that global warming plays in the diffusion of epidemics, or in food crises. But they will also look at the sanitary problems raised by the migrations, and at demographic evolutions, including aging. Finally, they will evaluate how hospitals and health centers function, to improve medical care. All these topics will be studied at the local level in Africa, but also on a world scale.

“With global warming, for instance, diseases currently present in southern countries may very well spread to northern countries,” says Gilles Boetsch. UMI director and president of CNRS’s scientific board. “The issues that this group will tackle are therefore global and relevant to researchers all over the world.” And these issues involve many scientific fields: the five main research topics (see box) will rely on 40 or so specialists in environmental science (climatologists, ecologists), health sciences, as well as in the humanities and social sciences (anthropologists, sociologists…). This type of interdisciplinary research is essential, according to Yannick Jaffré, from CNRS: “Who will be one of the five deputy directors of the UMI.”

Everyone knows how important the life sciences are to studying malaria. In other words, the social sciences are crucial to these issues.

Apart from their recognized scientific expertise, the UMI’s researchers have another asset: almost all of them know each other, some quite well. “Most of the teams making up this UMI have already worked together for several years,” says Abdou Salam Sall, president of UCAD. This is because a number of African researchers and UMI team leaders first pursued research in CNRS labs, and, once back in their home countries, continued to work together. Their collaboration needed to be formalized, and this took some work. “It’s tricky enough forming a lab involving just two countries, so imagine one involving four…,” adds Boetsch. But the work has paid off, and the UMI has been created for four years (renewable) at four geographical sites: Marseille (France), Ouagadougou (Burkina Faso), Bamako (Mali), and Dakar (Senegal). “This is like the embryo of a global lab,” says Basile Guissou, delegate general of CNRSRT. “It will enable us to share infrastructures, but also to be everywhere at once, so to speak.” Another undeniable advantage of the lab is its visibility, useful for responding to important international calls for proposals. The rector of Bamako’s university, Cézette Silly-Bellegarde, has an optimistic outlook: “Each partner brings his own skills to the mix, his desire to work with others on unifying topics. I have no doubt that the results of our work will be up to our expectations,” she enthuses, confiding that she hopes that the project will extend to neighboring countries.

Matthew Ravaud

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THE HEALTH AND ENVIRONMENT

FIVE TOPICS OF RESEARCH

- Pollution, health and society
- Environment, cognition and society
- P athogenesis, social dynamics, prevention and society
- Technical care spaces and society
- Ways of life and health, influence of migration and demographic transition

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Matthew Ravaud
They chose France

Marcello Solinas
Research Addict

am interested in everything, as long as something is at stake behind the work,” enthuses Marcello Solinas. “I am happy to understand drug addiction, its pathophysiology and the influence that the environment plays on it. It’s an enjoyable task but the results are already coming in. With his colleague Mohamed Jabar, Solinas has recently shown that a passive and stimulating environment helps defeating cocaine addiction. And the 34-year-old Italian scientist, who arrived 5 years ago at the IPBC* in Potters, has absolutely no intention of stopping such promising research. Interestingly, his encounter with both neuroscience and France go back to 2001. Attracted to languages and history, the young Sardinian chose classical studies, “ideal for developing a reasoning mental structure.” But at 18, he changed course. His family owned a pharmacy so he opted for a doctorate in the field of pharmacy so he opted for a doctorate in the field of pharmacy at the University of Cagliari. This gave him the opportunity to meet Professor Gaetano Di Chiara, a world-renowned specialist in drug addiction and dopamine. “I only discovered how fascinating he was later on. But he impressed me with his lectures on the cerebral circuitry common to natural rewards and drugs, and on how the brain suffers from addiction.” This rapidly evolving sector of neuroscience gave Solinas ample avenues for exploration. He subsequently wrote a dissertation on the changes in dopamine neurotransmission in the brain areas linked to addiction. In 2004, with this degree in hand, he had one goal to cross the Atlantic. He landed in Baltimore at the National Institute on Drug Abuse (NIDA). It is there that he embarked on four years of research on subjects ranging from the mechanisms of action of caffeine to the role of the human brain’s “endogenous cannabinoid system.” Counting several molecular entities, this system is involved in pain inhibition, coordination, and even appetite control. Cannabis acts on the same system, excessively mimicking the effect of the molecules secreted by the brain. “Like cannabis, this system can regulate the activity of the brain’s dopaminergic systems but without producing the sensation of pleasure, therefore without risks of addiction.” This explains why he took the initiative to develop a new class of differently coloured to newly developed cannabinoid tools, capable of providing only the positive effects without abuse liability. “It would be a treat to discover a depression–characterized by low motivation–or anxiety–determined animals, and even appetite control. Cannabis

Nathan McClenaghan
Molecular Language

How can two apparently solitary neighboring molecules be made to communicate? Again, his aim is to provide a challenging idea raised by young scientist Nathan McClenaghan, a recent recipient of the ERC Starting Grant Moda-Bio project, the ultimate demonstration of his capacities adapt during the “conversation,” thus enabling small-scale computation or even the instantaneous diagnosis of certain diseases, for which he has been awarded a European grant, he is indeed trying to establish communication links between certain molecules, simply by using light. Just 35, he understands the full scope of this particularly innovative type of research, and takes it in stride. In fact, Brussels has just granted him a total of €1.35 million over a five-year period, to pursue this work. France was the perfect environment for Nathan to develop the international context of the ERC young researchers program. CNRS, the Aquitaine Region, and the University of Bordeaux are also providing strong support for the project.

And this son of a Northern Irish engineer is confident, having nurtured the idea for a long time. During his thesis work in Belfast, where he worked on developing light-sensitive (photosensitive) molecules, he already had his eye on mainland Europe, and particularly the work by French teams based in Bordeaux. Following an initial postdoctoral stay in Italy, he moved to France, the country where he would later meet his wife. He rapidly mastered the French language and pursued his scientific interests, first at Bordeaux chemistry laboratory where he focused not only on isolated molecules, but also on supramolecular architectures and later at the ISM in Bordeaux in the Nanostructures Organiques (NFO) group, and started his initial research on molecular language. To establish inter-molecular communication, his current methodology involves pointing a light source directly at the molecules, forcing them to modify their molecular and electronic structure. This action can release ions, which act as messengers that are then caught and gradually released by other molecules. “This process is inspired from living organisms,” explains McClenaghan. “Vision is a good example. When your eye is exposed to light, photons are absorbed by retinal pigments which change shape and trigger the gradual release of ions to the brain, which in turn records the message. This is a simple but efficient form of communication. I am now trying to determine the extent to which this can be reproduced and used, at the nanometer scale, in the laboratory.” And this time, using light-driven ions and small designer molecules. This is molecular communication that can be followed in real-time using photosensitive molecules whose properties adapt during the “conversation,” thus enabling small-scale computation or even the instantaneous diagnosis of certain diseases. In the long run, one possibility might be to treat certain diseases by photo-activating defective channels. The COMMOTION team is now being formed, and should bring together about a dozen students and CNRS researchers, specialists in the fields of chemistry, biology, and physics. We shall certainly be hearing a lot more about this very ambitious project in the near future.

Séverine Duparaz

WORKING IN A FRENCH LAB, PRACTICAL INFORMATION:

Foundation nations Alfred Knobler (FRANCE)
Helps foreign researchers settle in France and maintains contact with their departure.

www.fraca.fr

Foreign embassies and consulates in France:

Association Bernard Gregory
This association helps young PhDs from any discipline make the transition into business

www.association-bg.org

France Contact will help plan and arrange your stay in France:

www.francecontact.net

French embassies and consulates abroad

www.ambafrance-aus.org/annuaire/annuaire.htm

Éduscol
Information on France’s higher education programs–course enrollment, grant and fellowship applications.

www.eduscol.fr

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1. European Research Council.
2. Institut des sciences moléculaires (CNRS / Universités de Bordeaux-I and CNRS / ENSCF Bordeaux).

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Éducation
E Belgi is a non-profit organization that manages French government international mobility programs. Many funding opportunities are listed. Most content is in English.

www.educate.be

Marie Curie Actions
This EU program provides numerous fellowships and grants focused on research mobility in Europe.

http://ec.europa.eu/education/index_en.cfm?l1=0&l2=0&l3=0

Égide
Égide is a non-profit organization that manages French government international mobility programs. Many funding opportunities are listed. Most content is in English.

www.egide.asso.fr

Éga

CNRS-GERMANY AGREEMENT
CNRS and the Danish National Research Foundation (DNRF) have concluded an agreement to strengthen scientific cooperation between France and Denmark. It includes a mobility program that provides support for travel expenses, accommodation, and running costs. Applications can be submitted throughout the year three months prior to the intended date of travel.

www.dg.dk

EUNAKOS
This portal provides information on grants, fellowships, or positions available throughout Europe as well as acting as a gateway to other opportunities (education, childcare and schools, healthcare...) for each country.

http://ec.europa.eu/education/index_en.cfm?l1=0&l2=0&l3=0

ÉGIDE

4TH STIC-AMSUD PROGRAMME
Calls for submission of research-development projects in all topics related to Information and Communication Sciences and Technologies were just issued. Preferred topics are “strategic links between two participating South American countries, and one team of French scientists.

Deadline: May 15th, 2009

www.sticamsud.org

Éga

Égide

Éva

CNRS International Magazine n°13 April 2008
Argentina, which produced two Nobel science prize-winners in the 20th Century, is a country with huge potential: It is the second biggest country in South America and one of the continent’s largest economies, with an educated workforce and considerable natural resources. Yet its troubled past, including several military dictatorships and public finance bankruptcies, prompted a significant brain drain among the neglected scientific community. The government now wants to encourage their return. It has placed R&D at the heart of the current program for national development, together with improving the resources and pay of researchers.

This budding renaissance also centers around a strong development of international scientific cooperation in which France is a major partner. “There is a long tradition of French presence in Argentina,” comments Claire Giraud, deputy director of CNRS International Relations at CNRS. “Argentines represent the majority of CNRS’ foreign researchers in Latin America, and they now lead many of our joint projects.” The current revival followed one of the country’s worst crises: In December 2001, the economy collapsed due to record debt defaults and currency devaluation, the country witnessed a remarkable turnaround, 2002. In 2006, Argentina government announced the launch of a 10-year plan to double the proportion of GDP spent on scientific and technological R&D, from 0.5% to 1%. One of Mrs Kirchner’s first moves was the creation of the Ministry of Science, Technology and Productive Innovation (MINCYT), which devises and leads national research policies. Significantly, she appointed a scientist, Dr. José Lino Barale, to run it. Mrs Kirchner, who described science as “key to the nation’s economic future,” also set aside funds to increase researcher salaries by 30%, and boost public funding of competitive research grants by 40% in 2009.

A national level, the National Council of Scientific and Technical Research (CONICET), headed by the MINCYT, manages the financial organization of specific research activities. Created in 1958 and based on the same organizational structure as CNRS, it currently has a yearly budget of about $110 million and employs researchers in both its own and associated research centers—many of whom conjointly hold university posts.

Research is centered around five major fields: agronomy, engineering and materials, biology and health, natural and exact sciences, and human and social sciences. Under the terms of a development plan launched in 2005, the CONICET annually provides 200 permanent positions (300 newly-created and 200 replacements). It also manages 1000 grants for doctorate and post-doctorate studies, which would be located in year-round projects in the country. Finally, this year marks the 10th anniversary of the EOSC program (orientation and evaluation of scientific cooperation). This program offers France’s Ministry of Foreign and the Ministry of Higher Education and Research fund some 15 joint lab projects in Argentina, of which about 60% involve CNRS teams. Projects currently include research in bioinformatics, architecture, and mathematics.

IN FIGURES

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Finally, separate to the MINCYT structure is the National Atomic Energy Commission (CNEA), a government-run body responsible for management, research, and development of all the country’s civil nuclear activities. Placed under the authority of the Energy Secretariat and the Ministry for Federal Development, Public Investment and Services, the CNEA has several research centers at its disposal. These include the Centro Atómico Constituyentes near the capital Buenos Aires, involved in fundamental and applied technology, and the Centro Atómico Balbín, in Patagonia, which enjoys a longstanding history of cooperation with the CERN. CNRS researchers were also involved in year-round projects in the country.

Across its 10 joint projects based in Argentina, CNRS counts five International Programs for Scientific Cooperation (PICs), involving biology, mathematics, genetics, and social and human sciences, two International Research Networks (GRIDs), one involving extreme energy observation at the Auger Observatory, and another focused on water governance and access in the Americas, as well as an International Associated Laboratory (IAL) in nanotechnology. CNRS is currently involved in negotiations with the MINCYT to establish two Joint International Units (UMIs), one focused on technologies, astro-particles and sciences of the universe based at the Auger Observatory, the other involving climate studies, which would be located at the University of Buenos Aires.

Rooted in an agreement signed in 1985, CNRS and the CONICET together fund a yearly average of 15 cooperation projects, mainly in the fields of physics, mathematics, materials, information and communication technologies, and history, centered at the universities of Buenos Aires, La Plata, and Rosario.

Above: The fly larvae that infest domestic bees are the subject of one of the cooperative research programs. Left: Researchers collect bee larvae for their work.
Second Generation Biofuels

Producing second generation biofuels from residual agricultural and forest biomass is now seen by many as an environmental priority that is both technically and economically feasible. This is because first generation biofuels—such as bioethanol and biodiesel—consume food crops, which are not sustainable in the long term. Second generation biofuels are made from non-food biomass, such as forest thinnings, agricultural waste, and other sources of lignocellulosic material.

One of the companies working on this technology is Deinove, based in Montpellier, France. Deinove specializes in the development of biotechnology for the health and bioenergy sectors. The company’s founding philosophy is to identify new species of microorganisms that can withstand high radiation and other harsh conditions, and then use these organisms to produce biofuels.

According to Jacques Biton, CEO of Deinove, the company aims to produce biofuels from microorganisms that can thrive in extreme conditions. These microorganisms are able to withstand high radiation and other harsh conditions, which makes them ideal for producing biofuels.

Deinove’s research focuses on the use of microorganisms, such as Deinococcus radiodurans, to produce biofuels. Deinococcus radiodurans is a bacterium that is capable of surviving in extremely harsh environments, such as those found in the hotsprings of Yellowstone National Park.

Deinove has identified several microorganisms that could be used to produce biofuels, and is currently working on developing a process to convert these microorganisms into biofuels. The company is also working on developing a process to convert these microorganisms into biofuels, and is currently working on developing a process to convert these microorganisms into biofuels. The company is also working on developing a process to convert these microorganisms into biofuels, and is currently working on developing a process to convert these microorganisms into biofuels.

In conclusion, second generation biofuels offer a promising alternative to first generation biofuels, which are made from food crops. Second generation biofuels can be produced from non-food biomass, such as forest thinnings, agricultural waste, and other sources of lignocellulosic material.

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ACROGEOLOGY

The Strength Lies in the Plant

The success of any farm depends on the health of its crops. The use of biotechnology in agriculture has made it possible to develop crops that are resistant to pests, diseases, and environmental stresses. One of the key challenges in the development of these crops is the identification of markers that can be used to screen crops for resistance.

In recent years, there has been a lot of research on the development of markers that can be used to screen crops for resistance. These markers can be used to identify crops that are resistant to pests, diseases, and environmental stresses. One of the key challenges in the development of these markers is the identification of markers that can be used to screen crops for resistance.

A recent study has shown that a new marker has been developed that can be used to screen crops for resistance. This marker is based on the use of fluorescent tracers, which are molecules that are able to detect the presence of a particular marker in a crop.

The fluorescent tracers are able to detect the presence of a particular marker in a crop.

In conclusion, the use of biotechnology in agriculture has made it possible to develop crops that are resistant to pests, diseases, and environmental stresses. The development of new markers is crucial for the success of these crops, and ongoing research is needed to identify new markers that can be used to screen crops for resistance.

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Bacterial membranes (red) and DNA (green) in a colony of Deinococcus radiodurans (stained with FM4-64).
Europe’s Space Bound Program

Building on significant advances in the past 50 years, Europe looks set to keep its lead in space science with the Astronet program, a roadmap for the next two decades.

Astronet’s major role is to define priorities ensuring that the goals of the scientists meet those of the funding agencies. Two ground-based infrastructure projects emerge as top priorities: the European Extremely Large Telescope (E-ELT) and the Square Kilometre Array (SKA). The first, a very ambitious project driven by ESO (European Space Observatory), is already in an advanced stage of study, whereas the SKA—combining thousands of antennas making the total collect-

The E-ELT will be mounted on a central concrete pier ensuring a minimum clearance of 50 m above the ground.

space scientists. “We will train students, who are usually specialized in one or the other wavelength (X, Gamma, radio...), to be multi-scale oriented,” says Stéphane Corbel. A necessary skill when working on the two types of black holes: the stellar ones, produced in massive star explosions, and their heavy counterparts, a billion times more massive, found at the center of galaxies. 1. Astrophysique interactions multi-échelles (CNRS / Université Paris-VI / ESO/SA). Contact: Stéphane Corbel, ASI, Gil-air Prieto. stephane.corbel@iasf.ea.it

The SKA’s collecting area (spread over a million square meters) will be distributed over a number of groups of antennas, or “stations”—perhaps as many as a few hundred.

A black hole is a region of space in which the gravitational field is so powerful that nothing—not even light—can escape if once inside. Black holes are therefore “invisible” by nature—but not to astronomers, who detect events happening close by. “For instance, they eject powerful jets of plasma,” explains Stéphane Corbel, from the AOM laboratory. He is also the French coordinator of a new “Maria Carlo training network,” the Black Hole Universe Consortium—part of the 7th Framework Programme (FP7). For four years, it will associate leading astronomy institutions across Europe in order to train a new generation

The MMJNeT neutrino telescope, immersed in the Mediterranean sea, will be unique in sensitivity and resolution.

medium-scale projects include Gaia data analysis and processing (Milky way mapping), EUCLID (Dark Energy), or the Solar Orbiter, a mission devoted to studying the Sun. All these space missions are driven by the European Space Agency (ESA).

The role of existing observational facilities, in space or from the ground, is also considered in the roadmap, recommending the prolongation of the most successful space missions, and the review of all ground-based telescopes. A scientific group has already begun assessing the existing small to medium-size optical telescopes throughout Europe, with the objective of overall coordination and ensuring all these facilities (approximately 50) are useful.

“The roadmap also focuses on training education,” adds Jean-Marie Hameury. But it will also deal with public communication and will establish closer ties with European industry. Indeed, technological readiness is a limiting factor for many of these projects and a vigorous R&D program is needed, in concert with industry, to ensure technology transfer. This coherent plan should also be a strong asset in negotiating international partnerships for the largest projects. “To define a roadmap is the first step, but putting it into action is what really matters,” concludes Hameury. European astrophysics now has a clearer view of where it’s going.

Samantha Maguire

Focus on the Thalamus

A key component of the brain, the thalamus plays a role in many Allophysiological functions (sensori information processing, sleep, etc.) as well as in various pathologies. To better understand how it works, CNRS, the Pierre et Marie Curie University, and Cardiff University (UK) have set up the European Associated Laboratory (EAL) “Thalamic function in health and disease states-THD.” It brings together the Neurobiology of Adaptive Processes laboratory (CNRS / Université Paris-VI) and the Cardiff School of Biosciences.

Contact: Anne-Marie Bross, anne-marie.bross@ucl.ac.uk

UK

Joining Forces on Exotic Nuclei

The France-Poland European Associated Laboratory (EAL) COFPiGAL (COFPi-GANIT) cooperation on the physics of exotic nuclei was launched November 26th, 2008. It brings together CNRS’ National Institute of Nuclear and Particle Physics (IN2P3), the French large heavy-ion accelerator (GANIL), the French Atomic Energy Agency (CEA), and the Consortium of Polish Institutions for research in the field of nuclear physics (COPIP). Although the teams involved have long worked together on exotic nuclei—those of chemical elements that do not exist in a natural state on our planet—COPIP will encourage the joint use of infrastructures and the promotion of long-term strategies.

Contact: Francisca Grassia, francisca.grassia@cmi.gov.pl

IRELAND

Biological Imaging

A cooperation agreement on “biological imaging and translational research,” a link between fundamental research and clinical research, was signed in Paris on January 26th. It brings together the Institute of Functional genomics and the Royal College of Surgeons.

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ISRAEL

Strengthening Scientific Cooperation

On March 18th, in Jerusalem, CNRS President Catherine Bréchignac and Menahem Megidor, the president of the Hebrew University of Jerusalem, signed an agreement for the creation of a European associated research laboratory (EAL), the France-Israel Laboratory of Neuroscience (FLN). It brings together CNRS, the Victor Segalen University in Bordeaux, the Descartes University in Paris, and the Hebrew University of Jerusalem. It takes over, in renewed form, from the first France-Israel laboratory set up in 2005, the France-Israel Laboratory for Neurophysiology and Neurophysics of Systems. The FLN is dedicated to fundamental and clinical studies of the brain. Just beforehand, March 16th, the LEA NanoBio Science (NaBi) was inaugurated in Rehovot in the presence of Catherine Bréchignac and Daniel Zajfman, president of the Weizmann Institute. This LEA brings together for a duration of four years seven CNRS-affiliated laboratories and the departments of chemistry and physics of the Weizmann Institute. Research will focus on nanotechnology, photonics, and biological imaging.

Contact:
FLN: David Hansel, david.hansel@univ-paris5.fr, Thomas Boraud, thomas.boraud@u-bordeaux2.fr, Francesca Grassia, francesca.grassia@cmi.gov.pl
NaBi: Joseph Zys, joseph.zys@physics.columbia.edu, Francesca Grassia, francesca.grassia@cmi.gov.pl
At the forefront of French research and with direct ties to the world’s major cultural areas, the UMRIFRES (French Research Institutes Abroad) act as both vehicles for knowledge and springboards for scientific collaboration. We interviewed Marie-Claude Maurel, director of the French Center for Research in Social Sciences (CEFRES) in Prague.

**CEFRES in Prague**

At the forefront of French research and with direct ties to the world’s major cultural areas, the UMRIFRES (French Research Institutes Abroad) act as both vehicles for knowledge and springboards for scientific collaboration. We interviewed Marie-Claude Maurel, director of the French Center for Research in Social Sciences (CEFRES) in Prague.

What is CEFRES’ overall mission?

**M-CM:** To partake in the development of research networks in Eastern Europe. Although we work in Prague, we maintain very close links with our neighboring countries—especially Slovakia, Hungary, and Poland. These countries have a joint heritage in the cultural, political, and administrative fields, which justifies the presence of a center like ours. This unit, which is a true research and service platform, is constantly tied to local French research institutions, universities, and research institutions. We host approximately 20 fellowship holders, students, researchers, and assistant professors. Every year we organize conferences, talks, and training workshops open to French-speaking researchers.

What research are you carrying out and with what means?

**M-CM:** We are involved in an international program for scientific cooperation (PICOS) entitled “Local players faced with the European model.” Another of our projects, funded by the French National Research Agency (ANR), is concerned with the sound archives of the Soviet Gulag. Lastly, we are initiating a study—also funded by the ANR—on “Local action and territorial development in Central Europe.” For the first time, it brings together approximately 20 French, Polish, Czech, Hungarian, Slovakian, and Lithuanian researchers.

Séverine Lemaire-Duparcq

“With approximately 1000 researchers, the Fondation Sciences Mathématiques de Paris (FSMP) is one of the world’s largest breeding grounds for mathematicians. And it’s not only the numbers that are impressive. The prestigious medals and prizes that the Foundation has chalked up over a few years testify to its level of excellence.”

**Attracting the very best**

Though the French capital already enjoys great credibility when it comes to mathematics, maintaining it will require a major effort. “There are other cities in the world lusting in wait, like Beijing and Mumbai, where the number of mathematicians is constantly growing,” Chemin warns. Therefore, the Foundation is investing considerable means to attract the world’s top mathematicians. For instance, it recently created a chair of excellence intended for world-class researchers, the only individual chair in France entirely dedicated to mathematics. Fifteen postdoctoral researchers from other countries can also be hosted every year, which makes this the only post-doc program for mathematicians and fundamental computer science on this scale in the country. “To recruit them, we advertise the positions in 200 institutions around the world,” Chemin explains.

And there are other ways to attract talent. The Foundation Prize can sponsor for up to one year a promising young mathematician—who could one day become a leader in the field—and the world’s greatest mathematicians can be invited for two to three months to stay in Paris. “Funds can also be readily made available to host an exceptionally talented PhD student from abroad,” adds Chemin, citing the example of a young Australian prodigy who recently picked the FSMP over other tempting offers.

**A taste for maths**

Fostering general interest in mathematics is also one of the Foundation’s objectives—even though it’s a minor role in research. While Paris universities are typically not as affected, the overall outlook of math students has become a worrying trend. This has encouraged the FSMP to launch a “Paris Graduate School of Mathematical Sciences,” with grants for both Masters and PhDs. “Our goal is to host 20 foreign students at Master level at the beginning of the 2010 academic year, and then increase this to 50 students,” Chemin explains. Similarly, the Foundation is also committed to making science more accessible to the general public, through its website and various public lectures, like those that were held during its launch in 2005—hoping that a growing number of students will add up.

Jean-Philippe Braly

1. CNRS / Ecole Normale Supérieure / Université Pierre et Marie Curie / Université Paris-Diderot / Collège de France.

**CONTACT**

Jean-Yves Chemin, director of the FSMP

chemin@fsmp.cnrs.fr

www.fsmp.cnrs.fr
The Centre National de la Recherche Scientifique (National Center for Scientific Research) is a government-funded research organization under the administrative authority of France’s Ministry of Research.

Facts...

Founded in 1939 by governmental decree, CNRS has the following missions:

- To evaluate and carry out all research capable of advancing knowledge and bringing social, cultural, and economic benefits to society.
- To contribute to the application and promotion of research results.
- To develop scientific communication.
- To support research training.
- To participate in the analysis of the national and international scientific climate and its potential for evolution in order to develop a national policy.

CNRS research units are spread throughout France, and employ a large body of permanent researchers, engineers, technicians, and administrative staff. Laboratories are all on four-year, renewable contracts, with bi-annual evaluations. There are two types of labs:

- CNRS labs: fully funded and managed by CNRS.
- Joint labs: partnered with universities, other research organizations, or industry.

As the largest fundamental research organization in Europe, CNRS is involved in all scientific fields, organized into the following areas of research:

- Life sciences
- Physics
- Chemistry
- Mathematics
- Computer science
- Earth sciences and Astronomy
- Humanities and Social sciences
- Environmental sciences and Sustainable development
- Engineering

CNRS conducts some twenty interdisciplinary programs in order to promote exchange between fields, ensure economic and technological development, and solve complex societal problems.

The CNRS annual budget represents one-quarter of French public spending on civilian research. This funding comes from various sources:

- Government and public funding
- CNRS funds, primarily from industrial and EU research contracts and royalties on patents, licenses, and services provided

... And Figures

Budget for 2009: €3.36 billion of which €607 million comes from revenues generated by CNRS contracts

Personnel:
- 32,000 employees:
  - 11,600 researchers,
  - 11,400 engineers and technical staff, and
  - 6000 non-permanent employees

Organization:
- 9 thematic institutes,
- 19 regional offices,
- 1100 research units:
  - 589 are joint laboratories
  - 90% are joint laboratories

Budget for 2009
- 1680 contracts signed by CNRS with industry
- 30 current agreements with major international industrial groups
- 3100 patent families
- 729 licenses and other financially remunerating active acts
- €18.2 million in royalties
- 394 companies created between 1989 and 2008

Contact: Daniel Choquet, PCS, Bordeaux. dchoquet@u-bordeaux2.fr

DAE AND DRI, TWO OFFICES DEVOTED TO INTERNATIONAL RELATIONS

CNRS carries out research activities throughout the world, in collaboration with local partners, thus pursuing an active international policy.

The Office of European Affairs (DAE) and the Office of International Relations (DRI) coordinate and implement the policies of CNRS in Europe and the rest of the world, and maintain direct relations with its institutional partners abroad. The DAE and the DRI promote cooperation between CNRS laboratories and foreign research teams through a set of structured collaborative instruments developed for this purpose. At the same time, they coordinate CNRS actions with those of other French and international research organizations as well as the activities of the Ministries of Research and Foreign Affairs.

To carry out their mission, the DAE and the DRI—with head offices in Paris—rely on a network of eight representative offices abroad, as well as on the science and technology offices in French embassies around the world.

IN NUMBERS:
- Exchange agreements: 85 (with 60 countries)
- Foreign visiting scientists: 300 (PhD students, post-docs, and visiting researchers)
- Permanent foreign staff members:
  - About 170 researchers of whom more than 1200 come from Europe
  - International Programs for Scientific Cooperation (PCS): 36
  - International Associated Laboratories (EA + UCA): 89
  - International Research Groups (GDR + GDRI): 9
  - International Joint Units (UMI): 18

Contact: Isabelle Chauvel, isabelle.chauvel@dir.cnsa.fr

Tentacles of Thought

Electric seaweed? A mysterious creature of the underworld? Not quite. What you are looking at is a rat’s neuron at the moment neuronal communication occurs. In this picture, a research team from the PCS lab in Bordeaux used fluorescence microscopy (a labeling method using colored antibodies) to highlight the terminals of the pre-synaptic neuron (blue), and the post-synaptic neuron (red for a post-synaptic marker, green for glutamate receptors, and yellow for the nucleus). They observed an accumulation of neurotransmitter receptors at the tip of the dendritic spines—visible as white labeled dots, the result of colocalization of blue, red, and green fluorescence. The team believes these receptors’ mobility plays a vital role in the passage of nerve impulses from one neuron to another, and thus controls the reliability of data transfer. Their results pave the way for new therapeutic targets for Parkinson’s, Alzheimer’s, OCD, and other disorders that are caused by poor neuronal communication.

Lucile Hagège

1. Physiologie cellulaire de la synapse (CNRS—Université Bordeaux-II).