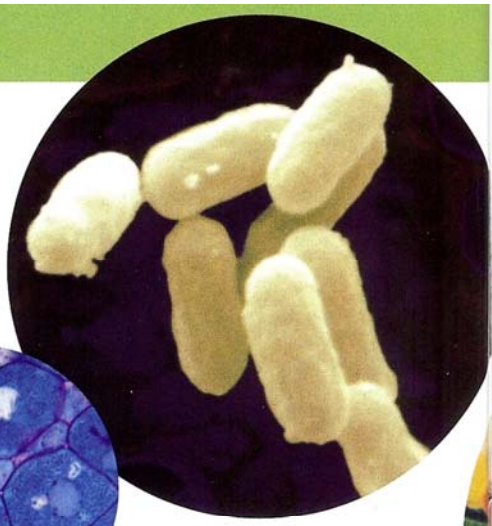
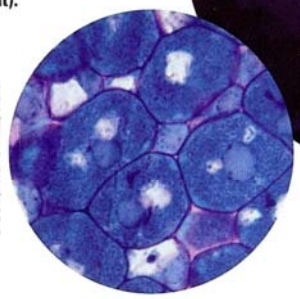
GENOMICS

Exploring the Soil's Genetic Biodiversity

The international TerraGenome consortium, led by a French team, is coordinating efforts towards the complete sequencing of the genome of all soil micro-organisms. An enormous task, but one that could open up countless new possibilities.





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Soil contains a multitude of bacteria, such as those that fix nitrogen for plants, like *Rhizobium leguminosarum* (below), and *Sinorhizobium meliloti* (right).

The bacterium *Escherichia coli* is used for cloning huge collections of DNA fragments from soil bacteria, which can then be sequenced.

Is it possible to completely sequence the genomes of the tens of thousands of bacteria, archaea, and fungi that inhabit a single gram of soil? "A few years ago, such a project in metagenomics–the analysis of the genomes of all living organisms in an ecological niche–would have been unimaginable. But progress in microbiology, sequencing, robotics, and bioinformatics now make it possible," explains Pascal Simonet, from the Ampère Laboratory.[1] And this is how TerraGenome–the international consortium for soil metagenomics–was born in December 2008, as an extension of Metasoil, a French research initiative dedicated to the sequencing of all microorganisms in a reference soil. With a budget of €2.2 million over three years, Metasoil brings together a number of French labs[2] and is coordinated by researchers from the Ampère Laboratory. TerraGenome is set to help scientists from other countries cooperate with the Metasoil project.

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The soil of the Park Grass plots at the Rothamsted Experimental Station (UK), was selected as a reference for the complete sequencing of the genomes of the various micro-organisms present in a soil, the objective of the international TerraGenome project.

Soil is the biggest biodiversity reservoir on the planet. "It contains bacteria and fungi which are a source of enzymes and other molecules with considerable industrial and pharmaceutical importance–in fact 70% of the antibiotics currently on the market are derived from soil bacteria," Simonet explains. "However, most of the total bacterial biodiversity is still unexplored, and makes up an almost inexhaustible reservoir of novel bioactive molecules, largely exceeding anything that could ever be synthesized."

On average, every gram of soil contains a billion bacterial cells, but it is still impossible to define the number of species present. "Partly because less than 1% of these micro-organisms can be grown *in vitro*," adds Simonet, "and partly because the soil is complex and heterogeneous: Some areas are like overpopulated megacities hardly accessible to research, while others are genuine microbial deserts. In addition, most of these species only comprise a few individuals."

This is why scientists opted for a metagenomic approach. It consists in directly extracting bacterial DNA without previous isolation of bacterial strains on culture media. "Once extracted and purified, the overall DNA can be either directly sequenced, or cloned as fragments of around 40 genes (40 kilobases) before sequencing. The first approach makes it possible to obtain an initial catalog of the genes present in the bacterial community, whereas the second approach gives more precise information, such as how genes interact with one another."

Launched last January, the Metasoil project is focused on analyzing the soil from one of the world's oldest agricultural research stations: Rothamsted (UK). A large amount of information about this soil is available: the climatic conditions, the crops grown, the treatments applied, etc.–and all this over the past 150 years. "Our sampling method will consist in taking around 20 samples distributed throughout various periods of the year. The first molecules of metagenomic DNA extracted at Rothamsted are already being sequenced, and the first million clones will be produced by the end of 2009," Simonet explains.

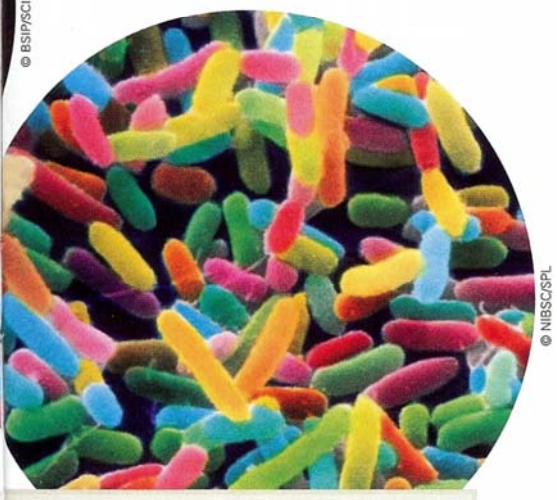
Rothamsted's biological resources will be made available to the international scientific community, which, through TerraGenome, will be given the job of completing the sequencing and analysis of the two million clones in the Metasoil DNA bank. "Two US labs have already applied for funding to collaborate on our project," Simonet adds enthusiastically. The work carried out on the reference soil should help us understand bacterial mechanisms of adaptation and evolution, and complete the inventory of bacterial functions. Such information will be very valuable to agriculture and industry, in particular to the pharmaceutical industry.

Marie Lescroart

1. Laboratoire Ampère (CNRS / École Centrale de Lyon / Insa / Université Lyon-I).
2. The Ampère Laboratory, the Genoscope in Evry, Libragen, and a group of bioinformatics scientists coordinated by researchers at the Biometrics and Evolutionary Biology Laboratory in Villeurbanne.

A CENTER FOR BIODIVERSITY

Aware of the many threats to biodiversity, a number of partners, from both the public and private sectors,[1] have come together to create the Research center for biodiversity and marine biotechnologies. CNRS will be involved through the National Institute for Earth Sciences and Astronomy (INSU) and the National Institute for Ecology and Environment (INEE). With an initial budget of €11 million, this center located on France's southern "Côte Vermeille" (bordering Spain), should be operational by 2014. A number of research projects are already on the agenda. The private company Pierre Fabre, associated to Paris-VI University and CNRS, will actively search for natural active substances that could be used in therapeutics and cosmetics. Other projects involve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IN 2014

the development of biosensors to evaluate the health of ecosystems, detect toxic species or the presence of pollutants. Space will be allocated for the transitory housing of start-ups in the field. The center will also have a public information mission, with the creation of the "biodiversarium." This unusual aquarium, there to teach the general public about ecology and biodiversity, will recreate Mediterranean biotopes with local species. Approximately 110,000 visitors are expected in this tourist area.

I.T.

1. Pierre Fabre Laboratories, France's national, regional, departmental, and municipal administrative divisions, the city of Banyuls, Paris-VI and Perpignan Universities, and CNRS' INSU and INEE.

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INTERNATIONAL COOPERATION

SINGAPORE

Nanotechnologies

The International Joint Unit (UMI) CINTRA was created on october 7, 2009, between CNRS, the Nanyang Technogical University of Singapore, and Thales, one the main industrials in the field of nanotechnologies for electronics and photonics. This private/public sector association demonstrates the willingness of the partners to foster, by concrete actions, the cooperation between research, higher education, and the industrial players in both France and Singapore. CINTRA activities will be focused on the integration and interconnection of nanotechnologies, such as carbon nanotubes, semiconductor nanowires, and semiconductor nanowaveguides for applications in the fields of nanoelectronics, nanophotonics, and microwaves. This UMI represents a major asset for bridging science and technological breakthroughs with industrial innovation.

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PRIZE

Gargamelle Collaboration Rewarded


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The first example of the leptonic neutral current. An incoming muon-antineutrino knocks an electron forwards, creating a characteristic electronic shower with electron-positron pairs.

This year, the European Physical Society has awarded its prestigious High Energy and Particle Physics Prize (HEPP) to the Gargamelle collaboration for the "observation of the weak neutral current interaction"–interactions that involve no exchange of electric charge between the particles concerned. The Gargamelle experiment took place at CERN (European Organization for Nuclear Research) in the early seventies. It was carried out by a collaboration of seven European laboratories, including CNRS labs,[1] as well as guests from Japan, Russia, and the US.

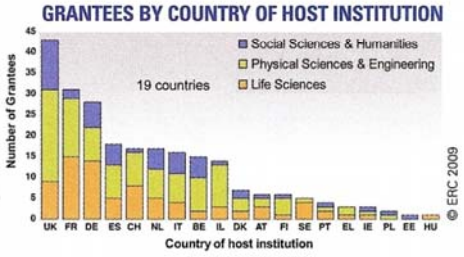
The HEPP prize is awarded every two years for an outstanding contribution to High Energy Physics in experimental, theoretical, or technological areas. It is the first time that the prize is awarded to a large collaboration. The prize was collected on behalf of the joint collaboration at the EPS HEP 2009 Conference in Krakow (Poland), and the medal will be attached to the Gargamelle bubble chamber, on display at CERN.

1. Laboratoire de l'accélérateur linéaire (CNRS-IN2P3 / Université Paris-XI) and Laboratoire Leprince-Ringuet (CNRS-IN2P3 / École polytechnique).

IN BRIEF

ERC Starting Grants Attributed

Of the 2503 applications received, 219 researchers were selected as recipients of the European Research Council's (ERC) second call for Starting Grants, and an additional 24 researchers are on a waiting list. The total budget is estimated at €325 million, which could bring the total number of confirmed grants to approximately 240.
Among the 219 grantees, 26 work in French institutions, including 9 researchers at CNRS (6 in life sciences, 2 in physics and engineering, and 1 in social sciences and humanities). Five other French researchers are currently on a waiting list. Altogether, France is second-ranked in number of grantees (after the UK), and ranks first in the life sciences with 16 grantees (14 on the main list, and 2 on the waiting list). The average age of grantees is 36 and around 23% are women (with large variations between the different research areas and panels). The grantees are of 33 nationalities and will be working in host institutions in 19 different countries. Nine grantees currently based outside Europe are moving to an EU Member State or associated country to take up their Starting Grant, thus fulfilling one the project's main objective: attracting top researchers to Europe.



> **http://erc.europa.eu**