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Transgenic plants

BREAKING THE DEADLOCK

ASTRONOMY

The great ESO adventure

Editorial

Science sidelined

What is the connection between last July's climate conference and GMOs?

In reaffirming their support for the Kyoto Protocol, the 186 countries of the 187 represented in Bonn saved the political process in which Europe is playing a vital motor role. But following the downward revision of the objectives, the environment is no doubt the real loser at this latest climate conference.

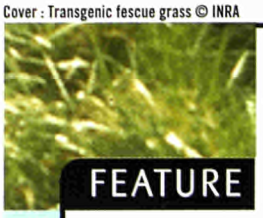
The experts were virtually unanimous, however, in stressing the growing scientific evidence that human activity is contributing to climate change. Should we therefore conclude that science is being silenced by the lobbies? That would be to forget the fact that, in the present context, research is of major political importance. It remains a powerful link between Europe and the United States. The best climate forecasting models are European. Scientific cooperation must therefore be maintained to either make a success of Kyoto or to arrive at a sound alternative.

The GMO question – approached in this issue by focusing on the controversial subject of transgenic plants – also has a sound scientific basis. The latest findings indicate that the risks posed by GM crops are either non-existent or less than the risks linked to present practices. Which means that in this case the principle of precaution is not pertinent!

Yet European society does not recognise the fact. Confronted by ideologies, science is finding it very hard to get its message across. The result is a double European exception: a deadlocked debate and *de facto* ban on field tests at a time when transgenic plant cultures are continuing to expand at world level.

Two questions which raise in the most concrete of terms the issue of dialogue between science and society. While of direct relevance to scientists, they also provide cause to reflect on the conditions which must enable this dialogue to exist at all.

Cover : Transgenic fescue grass © INRA



FEATURE

Genetically modified plants

Why is the debate on GMOs deadlocked? No doubt because it is being approached in the wrong way. The tendency is to present it as a single and homogenous issue involving all-out acceptance or rejection.
When in fact questions of risk management and precaution – as present whenever science impacts on society – must be assessed on a case-by-case basis.

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Managing editor: Jürgen Rosenbaum
Editor in chief: Michel Claessens
Editorial assistance: Stephen Gosden, Jutta Kastner
Tel: +32 2 295 9971
Fax: +32 2 295 8220
E-mail: research@cec.eu.int

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Rewarding decades of perseverance, the Very Large Telescope (VLT) has now come into service on the Mount Paranal site, at the heart of the Atacama Desert in Chile. This provides the European Southern Observatory (ESO) with the most powerful space exploration instrument in the world. We zoom in on a scientific 'epic' that is a flagship of European research.

The great ESO adventure

NO DOUBT the oldest of the sciences, astronomy, is unlike any other in that observation rather than experimentation provide the basis for progress. As a discipline concerned with unravelling the mysteries of time and shedding light on some fundamental human questions, it exercises a unique power of fascination. Few fields of knowledge can boast so many amateur enthusiasts and arouse such a lively interest among the general public. The reason why astronomy is today experiencing a genuine revolution is because society has no hesitation in granting it considerable human and technological resources – and this for research which is largely of a cognitive and non-utilitarian nature.

The world-renowned European Southern Observatory – most commonly known by its initials ESO – has played a key role in this revolution. To trace the history of this intergovernmental initiative one must go back to the end of the Second World War: a time when European astronomy was severely lacking in both human and material resources.

The age of the pioneers

'Inspired by what was happening in the field of physics at the time with the CERN project (European laboratory for particle physics), set up eight years before ESO, a handful of European astronomers led by the German Walter Baade and the Dutchman Jan Oort, were nurturing the idea in the early 1950s of pooling the strengths of several European countries,' recalls Richard West, who is both an astronomer himself and head of ESO's department of education and public relations. A decade later, the commitment and perseverance of these pioneers resulted in the creation of the European Southern Observatory, supported by France, Germany, Belgium, the Netherlands and Sweden. [1] The command centre of this new scientific institution was based in Germany (first in Hamburg and then, since 1980, in Garching, near Munich), but its specific objective was to develop space observation in the southern hemisphere.

But why the southern hemisphere? The northern hemisphere was already well endowed with observation equipment – especially US equipment – and there was a clear scientific need to

1963. Astronomers on the slopes of Mount Silla, in Chile's southern Atacama Desert, in search of favourable skies. ©ESO

At an altitude of 2 635 metres on Mount Cerro Paranal (Chile), at a site offering excellent astronomical observation conditions, is a very special European telescope. The Very Large Telescope (VLT) consists of four interconnected telescopes operating simultaneously to form the largest instrument of its kind in the world. ©ESO

install facilities south of the equator. After having first considered South Africa, ESO finally decided on Chile – where high altitude desert areas offer some of the best visibility conditions in the world, free from any light pollution. The contract signed with the authorities allowed the European body to acquire an initial site on the top of Mount Silla, in the southern Atacama Desert. Inaugurated in 1969, the Silla observatory continued to develop throughout the 1970s and 1980s. Today, a set of almost 20 telescopes forms a circle at the mountain's summit. The intense activity at this site over the past 30 years has made it one of the most important space observation points in the world.

The challenge of the VLT

Astronomy has few rivals when it comes to the quest for progress. Since 1977, European scientists – and the highly specialised engineers who produce the extraordinary complex instrumentation they use in their work – had

A tool of science

A scientific committee selects the scientific observations to be carried out at ESO's various sites and telescopes. 'The job of ESO is to be an organisation giving astronomers the chance to engage in scientific research by providing the high-tech tools they need. Given the many requests received, just one third of proposals are currently accepted,' underlines Richard West. 'Half the observations do not require any travelling on the part of the teams of observers, as they are carried out by ESO personnel on the spot. This type of organisation ensures efficiency. It permits a sufficiently flexible planning for the telescope programming to be adapted to atmospheric conditions in the interests of optimal visibility.'

ESO is currently at work designing a *virtual observatory*, for which the European Commission has contributed 2 million euros. The aim is to compile a vast databank of astronomical images, which will be made available to astronomers worldwide.

'This will enable us to make the very high quality images obtained with large telescopes available to those working on much smaller observatories,' continues Richard West. In addition to images from its own archives, ESO will also be making available images from the Hubble satellite through this service.

Technological feats

In producing mirrors measuring 8.2 metres in diameter for the four principal Paranal telescopes, the thickness of the glass had to be minimised in order to reduce the total weight. A German company, Schott, produced these high quality mirrors with a minimum dilatation coefficient, while a French company, Sagem (formerly Reosc), performed the meticulous polishing operations. Carried out micrometre by micrometre in a specially constructed factory using custom-designed robots, the process represented ten months' work per mirror.(1) ESO engineers themselves were responsible for designing and implementing an innovative technique for correcting any possible deformations, involving a system of thrusters operating at the back of the mirror to compensate for these deformations in real time.

The Paranal observatory also uses the advanced concept of *adaptive optics*. The main drawback of terrestrial telescopes – which does not affect space instruments and which explains the care taken in choosing the location of observatories – is that turbulence in the atmosphere distorts the wavefront from distant stars resulting in degraded images. To correct for this phenomenon, a sophisticated system of small piezoelectric activators is used to program minute deformations of just a few millimetres in the surfaces of the secondary receptor mirrors.

The VLT is also equipped with a range of the very latest imaging and spectroscopic instruments, operating within a wide range of resolutions to exploit the observation data.

(1) The French factory, located in Saint-Pierre-du Perray close to the town of Evry sur la Seine, has since received various polishing orders for other European and US telescopes. It also employs its know-how in the field of optical technologies for the microlithography of future generations of high-performance chips.

been wanting to develop a new-generation telescope of much greater magnification. Some suggested constructing a telescope with a mirror 16 metres in diameter, while others dared to imagine one 25 metres across. This was a truly huge objective considering the fact that the mirror in the largest Silla telescope, installed in 1976, measures just 3.6 metres. But these ideas all came up against the same physical obstacle: telescope mirrors must not be too heavy, and thus not too thick, otherwise there is the danger that they will deform under their own weight.

Given the scale of the technological challenge – and the cost – it was another ten years before a decision was finally made. After extensive studies, ESO opted for an innovative instrument known as the Very Large Telescope (VLT). The unique technological feature of this VLT lies in the fact that its light-capturing capacity is divided between four telescopic units, each fitted with a mirror measuring 8.2 metres in diameter, plus three smaller, movable 1.8 metre telescopes. These instruments can function either independently or in combined interferometric mode, in which the light beams of all four telescopes are integrated.

This interconnection of the instruments, progressively implemented from this year, will constitute a further major step forward. The VLT will then become the VLTI (VLT Interferometer), bringing a tenfold increase in the optical power of the overall installation. The VLTI will produce an image comparable to that of a telescope measuring 200 metres in diameter, making it the most powerful instrument of its kind ever built.

In the early 1980s, expeditions of astronomers, sometimes accompanied by mules carrying their instruments, set off to measure the quality of the light reception on the peaks of the mountains of the Atacama Desert. These meticulous readings were designed to identify the optimal site for the new observatory. After eight years of on-site meteorological surveillance, Mount Paranal, rising to 2 600 metres in the central coastal region of the Acatama, 700 km north of La Silla, was finally chosen. Construction work began in 1991. In this mountainous desert region, the first job was to build a road!

Meanwhile, ESO scientists and engineers, working with high-tech industries on the design and manufacture of the instruments, were realising some formidable technological feats in the process (see box). The Paranal site was officially inaugurated in March 1999. Initial observations were made in May 1988, using the first of the four large telescopes. The fourth instrument has been operational since September 2000.

The VLT marks a new chapter in the long history of astronomy. Over the past decade or more, the development of space observation instruments – in particular the famous Hubble jointly launched by NASA and ESA – had already considerably revolutionised man's ability to explore the cosmos. But the resolution of these instruments remained limited, while this new terrestrial 'giant eye' is now opening the door to exciting progress in our exploration of space and our deciphering of the secrets its holds.

See the Universe and understand

Scientific advances have been fast and frequent since the four Paranal telescopes became fully operational a year ago. With a distance viewing capacity 4 billion times that of the naked eye, they could spot a man on the moon more than 4 hundred thousand kilometres away.

These new powers of observation have provided support for many theories on the origin of the Universe. For example, previously impossible measurements of temperature changes in deep space constitute major new evidence to support the Big Bang theory. Spectrographic observation of the effect of microwaves emanating from this deep space on certain chemical elements from a distant galaxy has enabled a team of European astronomers to establish

that, at a time when the Universe was about 20% of its present age, this temperature must have been 9K, compared to the present estimated 3K. Cooling on this scale is in line with that included in models based on the Big Bang.

The VLT has also allowed the first direct determination of a lower limit to the age of the Universe, with the aid of radioactive clocks (as is done on Earth using carbon 14). Scientists made this measurement on the basis of two elements (uranium and thorium) observed in old stars that were present at the time of their formation. The value obtained is 12.5 billion years, although with an error margin of plus or minus 3 billion years. Such an evaluation has never before been possible on the basis of a scientific observation methodology.

Models have also made it possible to develop a theory that the structure of the Universe, far from being uniform, is part of a gigantic cosmic macramé – in which the objects can be envisaged as distributed along long filaments, with galaxies formed at the intersections. Thanks to the VLT, European astronomers believe they have identified the data that correspond to the signature of one of these very ancient cosmic filaments.

But deep space is not alone in benefiting from the capabilities of the VLT. It has also proved – in the words of Guy Monnet, director of ESO instrumentation division – an 'amazing success' in observation of the formation of the stars and galaxies. A particular field of research for which the scientists have high hopes is that of the exoplanets, which revolve around stars other than our own Sun. 'By means of indirect cross-checking, some 70 exoplanets have been identified since 1995,' Monnet notes. 'When it has reached its full performance potential, thanks to the use of interferometry, the VLT should make it possible to observe these exoplanets directly, or at least those circling the nearest stars. This holds out the hope of perhaps providing an answer to the key question: "Could there be extraterrestrial life?".'

'The progress made in under half a century is simply staggering,' believes the French astronomer Catherine Césarsky, general director of ESO. 'The extraordinary energy of all those who have come together to embark on this great European adventure on the other side of the world has now been more than rewarded. When Europe has the will, it can certainly find the way.'

(1) Since 1962, four other countries have joined ESO: Denmark (1967), Switzerland and Italy (1982), Portugal (2001).

Future challenges

There are no limits to curiosity, especially when trying to explore and understand the immensity of the cosmos. This is why astronomers are constantly seeking to develop the tools to satisfy their perpetual desire to know more, to see further. At the same time as developing the Paranal VLT, ESO also started work on two international 'megaprojects' known as ALMA and OWL; both represent major scientific and technological challenges.

The first stage in the post-VLT era – due to be completed at the end of the decade – is to produce the giant ALMA (*Atacama Large Millimetre Array*) radio telescope. It will result from the marriage of three similar projects running in Europe, the US and Japan. Japan's involvement, only finally agreed on 6 April, was sought as a means of strengthening its cooperation with the United States, which began two years ago. Final governmental approval should now quickly follow to enable work to begin on building the new observatory, scheduled for the years 2002 to 2008.

Seeing the invisible

'ALMA is not an optical telescope but a huge installation consisting of antennae able to capture millimetre and sub-millimetre wavelength radiation from deep space,' explains Peter Shaver, an astronomer at ESO. 'By studying these signals we will be able to make an astrophysical analysis of the most distant galaxies – and thus those which appeared at the very beginning of the Universe. These galaxies are shrouded in huge clouds of dust, making them invisible at optical wavelengths. The discoveries we expect to make by highlighting these dark regions of the cosmos will have an essential impact on our understanding of the structures of the Universe and their formation.'

Once again the Atacama Desert was chosen for its clear dry skies. The specific site is the Chajnantor plateau – which, at 5 000 metres, is twice as high as Mount Paranal. The observatory will cost an estimated 610 million euros and will consist of 64 12-metre diameter dishes distributed over a surface area of 7 000 m². All the antennae will be interconnected, forming a giant interferometer.

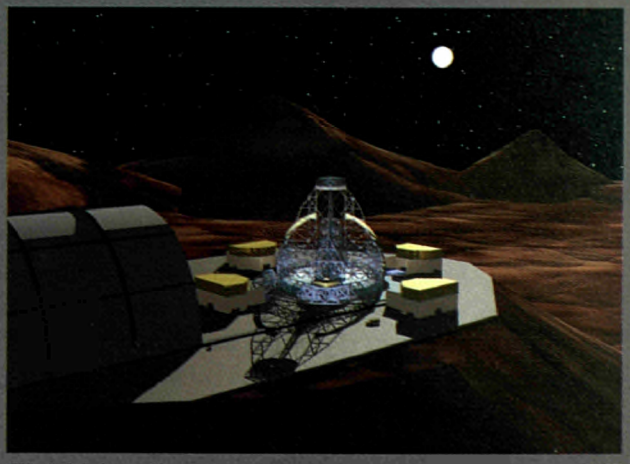
Lying just 6 000 light years from the Milky Way, the Crab Nebula was identified in 1054 by Chinese astronomers. Formed by the residue from a supernova explosion, it has been studied by generations of astronomers. (Image VLT 1999). ©ESO

The eyes of the owl

In the longer term (2015-2020), ESO is already thinking of a successor to the VLT, in the form of a gigantic optical telescope measuring 100 metres in diameter. It will be known as the OWL, after the bird that symbolises nocturnal vision.

The idea was launched seven years ago. 'The people who came up with this idea seemed crazy at the time. But the continuous developments in optics and materials since then have shown such an ambition to be feasible. We are now at the predesign stage,' explains Richard West. The present estimated cost is around 1 billion euros. OWL will consist of a mosaic of mirrors 2 metres in diameter. Needless to say, high-tech industrial partners with the relevant technological expertise will be much in demand for these projects.

Apart from pushing back the frontiers of our knowledge of the mysteries of the Universe's fantastic development and geometry, OWL will also be able to provide clearer images of extrasolar planets somewhat closer to home. And who knows, it may even be able to detect signs of life there.



OWL : Artist's impression. ©ESO

The Nobel Prize: 1901-2001

Robert Koch and his bacillus, Alexander Fleming and antibiotics, Thomas Morgan and his studies on the drosophila fly, Prusiner and the prion, Charpak and the exploration of the most minute particles of matter... Many advances in science are inextricably linked to the names of Nobel prizewinners. As it celebrates its centenary, we take a look behind the scenes of this renowned institution.

Nobel and bar

Marie Curie is not the only person to have been awarded two Nobel Prizes. Linus Pauling received the Nobel Prize for Chemistry in 1954 and later the Nobel Peace Prize in 1962. This scientist devoted the latter half of his life to campaigning for nuclear disarmament – playing an important role in adopting the 1963 international treaty banning nuclear testing in the atmosphere.

The price of fame

Just one man's opinion? 'Starting out from nothing, we have become like film stars. We have been subjected to what can only be called torture. We are not used to this public life which prevents us from continuing with our work. Our lives have been thrown into turmoil.' (André Lwoff, Nobel Prize for Medicine, 1965).

AN INVETERATE traveller, his motto is a familiar one: 'My home is where I work – and I work everywhere'. Born in Sweden in 1833, Alfred Nobel spent his childhood in St. Petersburg, made his industrial mark in Hamburg, settled in Paris, and died in San Remo, one 10 December, the day on which the Nobel Prizes for Physics and Chemistry continue to be awarded.

A misanthrope sensitive to the ills of the world, a melancholic with more than a touch of irony, a pacifist who earned his fortune from explosives, Alfred Nobel led a strange life. Following an initial innovation based on nitroglycerine, Nobel went on to accumulate a huge number of patents (355 to his name) and factories (about a hundred), and a considerable fortune, all the while harbouring the hope of one day discovering a substance or a device with sufficient destructive power to banish war for ever.

Science and humanism

His desire was to reward those who 'have brought the greatest benefits to mankind', through their work in fields as diverse as the sciences, literary creation and peacemaking. The prizes for physics and chemistry were to be awarded by the Swedish Academy of Sciences, the physiology and medical prizes by the Karolinska Institute, and the literature prize by the Stockholm Academy. As to the peace prize, that was to be awarded outside Nobel's home country, as he preferred to entrust it to the Norwegian Parliament, the Storting, 'one of the few genuinely democratic assemblies in Europe', while the 'prize for economic sciences in memory of Alfred Nobel' was created in 1968 by the Swedish Central Bank.

And mathematics? Conspicuously absent – but not the mathematicians themselves. Most of them have been rewarded for physics (Lorentz, Planck, Einstein), some for economics (Tinbergen, Kantorovich, Nash), or even literature (Russell). As a fine example of disciplinary interaction, two mathematicians, Walter Kohn (USA) and John Pople (UK), were awarded the Nobel Prize for Chemistry (1998) for having enabled chemists to apply Schrödinger's quantum equation (concerning particles) to the behaviour of molecules.

Discretion assured

The procedure for awarding all these prizes is the same. The various institutions responsible elect a committee which, every year, invites experts and institutions from different countries to select a number of candidates (nobody can put his own name forward) whose merits are then considered by the committee members, aided by experts. They then submit a list of names (rarely more than five) to the Nobel body charged with judging them. The discussions are held in secret. In 1974, however, the Nobel Foundation changed its rules to allow a few science historians to study its archives.

The value of the prizes changes from year to year depending on the revenue earned by the Nobel Foundation, which manages a legacy that was worth 32 million kronor at the end of the last century. Since 1987, the general public have been able to buy into this capital by acquiring shares and bonds, this permitting a very rapid rise in the value of the Foundation's assets. Before this, in 1962, the Italian-Swiss International Balzan Foundation had awarded its first prize, worth 1 million Swiss francs, to the Nobel Foundation, and in 1972, Georg von Békésy, the 1961 Nobel prizewinner for medicine, had left all his fortune to the Foundation. In 1901 a Nobel Prize was 150 800 kronor. Today it is worth 10 million kronor.

Although those responsible for managing the Nobel fortune certainly seem to have been perceptive, what about the juries? A quick glance at the names of the Nobel prizewinners for medicine, for example, leaves no room for doubt. Throughout the years, the names of the prizewinners are inextricably linked to major advances in scientific knowledge. Tuberculosis and Robert Koch,

Alfred Nobel – 1833-1896 © The Nobel Foundation

vitamin C and Albert Szent-Györgyi, antibiotics and Alexander Fleming, the world of cells explored by Albert Claude and Christian René de Duve, the drosophila fly (one of the keys to genetics), a host of researchers working on DNA... the list is long.

Erring on the side of caution?

Yet for all that, the choices of the scientific juries are not altogether immune from criticism. Excessive caution is the charge sometimes levied when a Nobel Prize goes to already acclaimed figures whose work is well-established. Wilhelm Röntgen, who discovered X-rays in 1895, received many awards before being distinguished by the Swedish Academy in 1901. More recently (1988), the physicist Léon Lederman, rewarded for a discover he had made 20 years previously, commented that his Nobel Prize had 'had the time to mature'. The juries are also sometimes criticised for trying to make good past oversights, such as in 1921 when they honoured Einstein, not for the principle of relativity formulated back in 1905, but for clearly less significant work on the photoelectric effect and Brownian motion.

Some choices have also raised ethical questions, for example when Fritz Haber, Nobel laureate in 1918, admitted having been one of the principal supporters of the use of gases for military purposes. The list of Nobel prizewinners also includes very few women, particularly in the field of sciences. Out of 457 Nobel laureates, just 11 are women. The first woman to win the award was Marie Sklodowska Curie (1903), and the most recent the German biologist Christiane Nüsslein-Volhard (1995).

Another laureate is Irène Joliot-Curie (1935), the daughter of two prizewinners. This is not the only example of prizewinning running in the same family, with father and son teams being particularly prominent, such as Joseph John Thomson and George Paget Thomson (two British physicists), Hans von Euler-Chelpin and Ulf von Euler (chemist and physiologist), Niels and Aage Bohr (Danish physicists), and Sir William Lawrence Bragg of Great Britain who was just 25 years old when he shared a Nobel with his father William Henry Bragg (1915).

Then there are the 'master-pupil' connections, with no fewer than 12 former students of Ernest Rutherford (chemistry, 1908) going on to win a Nobel themselves. Certain universities (in particular Cambridge and the Massachusetts Institute of Technology in the US) also seem to be a breeding ground for Nobel prizewinners, while an impressive number of Nobel prizewinners have worked at CERN (the European laboratory for particle physics, in Geneva): Felix Bloch, Samuel Ting, Carlo Rubbia and Simon Van der Meer, Jack Steinberger, Georges Charpak; it is beginning to look a bit like a club. ◗

Making a mockery

Are some scientists secret surrealists? Every year, at Harvard University, a scrupulously formal ceremony is held to award the Ig Nobel (read ig-noble), in recognition of goofy ideas and flights of fancy. Exclusively in the field of science and technology. www.improb.com/ig/ig-top.html

Guided tours

Nobel Museum, Björkborn Manor, Sweden
http://www.nobels-bjorkborn.t.se/index-eng.html
The Big Idea, Ardeer, Glasgow
Exhibition on a century of discoveries and Nobel Prizes
http://www.bigidea.org.uk/
Cultures of Creativity: The Centennial Exhibition of the Nobel Prize – until the end of December 2001 – Norsk Folkemuseum, Oslo

Internet site

www.nobel.se

Philippe Evrard – 'At present there is an odious discrimination against the child and the pregnant woman. The pharmaceutical industry is simply not interested in the medicines which could be developed for them.'

* Professor at the Faculté de Médecine Xavier-Bichat and the Université Paris 7 Denis Diderot, Consultant at the Paediatric Neurology and Metabolic Diseases Department, Hôpital Robert Debré, Paris and Director of the INSERM E9935 Research Laboratory (Developmental Neurology)

A clinician, researcher and teacher, Philippe Evrard* is one of Europe's pioneer paediatric neurologists. For the past three decades he has been investigating the structure of the brain, the factors which could distort its development in the womb, the neurological handicaps which affect very premature babies and possible forms of preventive or curative treatment.

A prenatal passion

'THERE was a group of us who used to skip as many lectures as we could so that we could spend all our time in the laboratory, where we also spent a large part of our weekends and holidays. I was lucky in that in my second year at university I was granted the status of student-researcher, which existed in Belgium at the time.' Philippe Evrard got off to an early start, and under favourable auspices. After coming to the attention of Pierre Baudhuin and Christian de Duve, the future Nobel prizewinner, he worked for several years in their cellular biology unit while pursuing his medical studies at the University of Louvain. He then went on to set up his own clinic in paediatric neurology. That was in 1969, at the age of just 27.

Migrating neurons

Philippe was and remains fascinated by the human brain: 'I first wanted to be a generalist but when someone I knew spent three months in a coma, I was desperate to understand why.' He can speak at length and with an undiminished sense of wonder of the hundred billion neurons which, between the third and sixth months of pregnancy, migrate from the centre to the periphery of this mysterious organ, to form the successive layers of the cortex. 'It is a very long way – equivalent to us travelling 10 kilometres.' Each neuron – and they can be produced at the rate of 5 000 a second – must reach precisely its allotted place. 'Special cells, called radial glial fibres, nourish the young neurons and help them find their way. They are like cables, extending from the deep matricial bulb to the surface of the developing brain.'

But accidents occur along the way. Neuronal migration can, for example, be thrown off course by 'foetal alcoholism' or the consumption of cocaine. Since 1974 Philippe Evrard and his research team have been working on Zellweger's syndrome and other neuronal migration disorders. Some of these are the result of a peroxisome deficiency which upsets the flow of calcium through the neuronal membrane which controls the migration. 'When we increase or decrease the trans-membrane calcium flow on animal models, we halt the migration and cause brain abnormalities like those found in the brains of some epileptics. This research has allowed us to understand many errors which can arise in the construction of the foetus' brain, as well as the frequent cerebral lesions which appear in very premature babies. This fundamental research has allowed us to propose new tools for neuroprotection at this stage of life.'

Science or religion?

From his window in central Paris , Philippe Evrard looks out on a red, white and blue statue by Jean Dubuffet on one of the terraces. The Hôpital Robert Debré is built in a series of wide tiers laid out in a gentle arc, at the centre of which stands a rather surprising yet evocative feature: a church. 'This sparked a lot of debate. Should the church be demolished to make room for the hospital? Finally, Pierre Riboulet – a great architect – came up with this very successful planning solution.' Devoted to birth and children, this hospital is a place of joy and gaiety with its children's library where the sections are marked with large coloured spots, a corridor with a glass roof opening out on to trees ('we are just a stone's throw from the Butte du Château Rouge, where Jaurès gave his famous antimilitarist speech in 1913') and a painting by Ben, with just two words, in the distinctive rounded letters: Je vis ('I am alive').

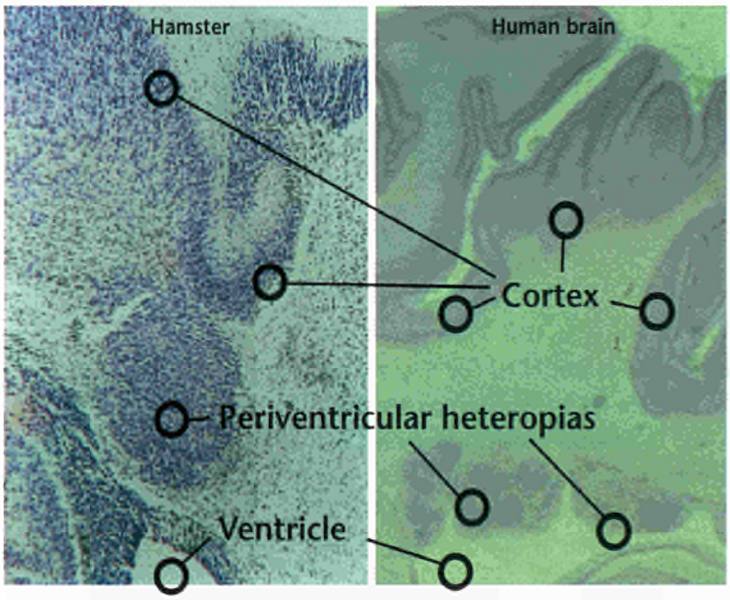
Life, that is what it is all about. 'In the most developed countries, about 3% of children are born with serious and permanent abnormalities of the nervous system. Many of these malformations originate at the foetal stage.' Care

Internet sites:

www.pediatr-neurology.org
www.neuropediatrie-metabolisme.org
www.pediatric-neurology-paris.org

for premature and disabled babies has nevertheless saved many children who would otherwise have died. This is why the prevalence of neurological handicap of prenatal origin is currently close to the level in the 1960s, after having previously fallen sharply. But who can deny the right to life?'

'There is something above the law, above morals even, and that is the obvious,' (Charles de Gaulle). Philippe Evrard likes quotations: 'I use a lot of them. Perhaps it is because I do not feel able to say things as succinctly, and then there are other phrases, that I must have read 25 years ago and absorbed to such an extent that I feel they have become my own.' To his mind (and no quotation this time), 'Morals are explained by history. Every European country is a kind of laboratory and I do not believe you should have too many common regulations. Any scientific question which raises ethical issues must be the subject of public debate and legal regulation. But one must also remember that these rules are always very provisional and that it must be possible to change them.'



On the right, the human brain with periventricular heteropias – migration disorders due to the stoppage of neuronal migration in the periventricular (germinative) zone. On the left, the same neuronal migration disorder reproduced in the hamster by increasing the transmembrane calcium flow at the NMDA site.
Research conducted by Philippe Evrard, Pierre Gressens and Stéphane Marret.

Small patients, small budgets

But Europe could play a major role in resolving an issue which offends paediatricians. 'At present there is an odious discrimination against the child and the pregnant woman. The pharmaceutical industry is simply not interested in the medicines which could be developed for them. If you discover a molecule in paediatrics, you will be asked if it could be used to treat Alzheimer's, because drugs are developed for the largest group – and that means an ageing population of consumers.'

The solution? The European marketing authorisations, which for many medicines are enough in themselves to lead to national authorisation. 'Our proposal is that when an application is submitted for an adult product, it should be accompanied by an application for a similar children's product. If the pharmaceutical industry believes this is impossible from an economic or practical point of view, or simply that it is not necessary, it should be required to present a well-argued case establishing the fact.' Philippe Evrard sees this research obligation on the part of the private sector as a just return for the public aid which supports the majority of fundamental research projects which precede the development of new drugs.

Philippe Evrard also believes that Europe can play a role in the developing public debate between science and society. 'This debate is essential, but it is of poor quality, quite simply because the public is insufficiently educated and informed.' Who is to blame for this? The researchers who are ineffective communicators? Journalists who fail to do credit to their profession? 'There are good journalists, but in the mass media they are given neither the time nor the space to express themselves.' He suggests that a public body (the European Union?) should in some way 'sponsor' quality information pages in the non-specialist media.

In the context of his own clinical practice, Philippe Evrard would like to see the Hôpital Robert Debré devote a page of its website to providing information to patients. 'Very often those who come in for a consultation have sought information on the internet and found some very simplistic sites. When we refer them to other more interesting sites, they come back and tell us, "We don't understand anything now, it's all much more complicated than we thought." But from that point we can start to discuss the matter on another basis.'

Researchers

At a time when the European Research Area is acquiring real substance, the European Union is preparing to welcome new members. Which raises the question of how to make the most of their potential scientific contribution. Meeting in Brussels this summer, researchers from this 'Greater Europe' looked at possible strategies to promote the essential movement of minds.

'IT IS IMPORTANT to recognise that when researchers travel and work in another part of Europe they are not only exposed to different ways of conducting and managing research, and to different research equipment and infrastructures, they are also exposed to different social and cultural experiences. Their increased awareness of these – and their recognition of their diversity across Europe – can be as important as their newly acquired knowledge and understanding,' believes Halina Koslowska of the University of Olsztyn (Poland). It is a view widely shared by participants at a conference entitled *An Enlarged Europe for Researchers*, which was held in Brussels in June.(1)

A scientific tradition

A Europe which includes the current 13 candidate countries will have a 30% larger population, including trained scientists and talented (future) researchers. At secondary school, there are more students strong in maths in the Central European countries than there are in the EU. What is more, these regions have a special strength when it comes to women scientists.(2) All the more reason, then, to be wary of the brain drain. 'The brain drain is a significant phenomenon, essentially to the United States,' explained one Romanian researcher. 'In Bucharest, the Canadian consulate has opened an office specifically to recruit young graduates. Another trend is to forsake the universities in favour of industry where researchers are better paid – but rarely work on subjects linked to their scientific education.'

Strategy

A Mobility Strategy for the European Research Area

This Communication, adopted by the Commission on 20 June, highlights four fields of action in creating favourable conditions for the mobility of researchers:

- information on the opportunities available – thanks to a specific internet gateway with details of posts, programmes, etc. – as well as improved statistics;

- the creation of 'mobility centres' providing researchers with practical assistance in their efforts to set up abroad;

- more coherent support mechanisms, at national and Community level – in particular based on the exchange of good practices;

- an improved legal status for researchers (visas, access to employment, social security, taxation).

http://europa.eu.int/comm/research/area/com2000-612-en.pdf

on the move

A European career?

It is true that the 'American dream', facilitated by a 'universal' language and an absence of red tape, can be very attractive. For Vytautas Daujotis, of the University of Vilnius (Lithuania), 'The standardised and very simple procedures for access to US research institutions make it possible to find work there. Whereas the diversity of cultures and scientific policies in Europe sometimes present insurmountable obstacles to foreign researchers.' The many legal, social and financial issues reflect the idiosyncrasies of the national systems and, as Daniel Cadet (CNRS/FR) explained, 'There is an urgent need to think of the concept of a European career.' Meanwhile Louise Ackers, professor of European law at Lancaster University, drew attention to the obstacles to mobility facing many married scientists, particularly if they have young children (child care costs, schools, etc.). Listening to the conclusions of the studies she has made of the subject, one realises how much easier it is to work abroad if you are single.

New initiatives

Simplified procedures, an ambitious mobility programme and new initiatives under the next framework programme should all facilitate the movement of researchers. 'The structure and organisation of research in an enlarged Europe will largely determine the Union's future competitiveness, as well as its attractiveness to researchers from all over the world,' pointed out Philippe Busquin. The European Commissioner responsible for research drew attention to a number of questions raised by the future integration of scientific research in Europe, in particular 'the risk of divesting the candidate countries of their infrastructures and best researchers, and thus introducing new forms of the brain drain.'

To compensate for this, return grants (like those that already exist under the Marie Curie programme) should make it possible for researchers to return 'home' complete with new knowledge and experiences, thereby promoting the essential transfer of knowledge.

(1) Instigated by Romano Prodi and Philippe Busquin, An Enlarged Europe for Researchers was held on 27 and 28 June in Brussels. With the aim of assessing the issue of mobility in the context of enlargement, the conference included sessions on employment and social issues, free movement of people, financial aspects, infrastructures and networks, and the human element (e.g. research networks).
(2) Data published by the European Report on the Quality of School Education – Sixteen Quality Indicators which analyses the situation in 26 European countries (published in May 2000 by the Commission).

Virtual

There is also a virtual aspect to the integration of European research. Thanks to the GEANT project developed at CERN, a broadband telecommunications network will link European universities and research centres, enabling those working there to use the high technology of the grid. The successor to the web, this innovation should vastly increase the scope for cooperation and networking (see RTD Info 30).

Overcoming the obstacles

What are the obstacles to the mobility of researchers in Europe? Is the situation the same in each country? What lessons can be drawn from good practices in this field? After studying the problem in various EU countries, a group of experts identified a number of legal and administrative, socio-cultural, professional and intersectoral obstacles facing researchers seeking to work abroad.

The difficulties vary depending on the length of stay and the initial status of the researcher in his or her own country. Taxes and social security (e.g. medical insurance, pension rights, maternity leave), career opportunities and the recognition of diplomas, and bridges between research and industry (creation of spin-offs, intellectual property rights, etc.) vary enormously between countries.

This useful document summarises the various obstacles to mobility in the Member States and gives examples of good practices in the various fields.

High-Level Expert Group on Improving Mobility of Researchers – Final Report – 04/04/2001

http://europa.eu.int/comm/research/fp5/pdf/finalreportmobilityhleg.pdf

European Commission, Research Directorate-General
Contact: improving@cec.eu.int

Trouble

A wave of revolt is rocking the world of life sciences. An appeal for a boycott of scientific publishers who refuse to publish articles about research results on-line, quickly and without charge, has already collected more than 26 000 signatures in over 150 countries. Europe is now getting involved in the debate – initiated in the United States – and proposing a constructive solution to the conflict by launching the E-Biosci initiative.

PUBLIC Library of Science. That is the name of the campaign launched by a small group of US researchers in biomedicine in September 2000 with the demand that prominent scientific publishers should freely place all articles in the public domain – by placing them on the appropriate, readily accessible website – within six months of original publication. Failing this, they call on the worldwide biomedical community to boycott the publishers, by refusing to allow them to publish their results or not taking out a subscription to their publications. The appeal has met with a resounding international response, especially in Europe, where many signatures have been gathered.

The issue has been a matter of some controversy since the 1990s (see box). It first arose in the United States where, at the instigation of the powerful NIH (National Institutes of Health) and in particular Nobel prize-winner Harold Varmus, the first free on-line library, *PubMedCentral* (PMC), was started up – though not without causing a quite fierce counter-attack from specialist publishers.

Oligopolistic excesses

The world of scientific publishing has been charged with the mission of validating progress in scientific knowledge, guaranteed by peer reviews which give the green light to the publication of articles. Over time, this very long-standing tradition has given rise to powerful bastions in the form of 'economic empires' which jealously guard their integrity and prerogatives.

A number of major US and European publishing groups, enjoying a position of oligopoly, share control of a more-than-comfortable share of a global market in scientific publications with an estimated value of between 7 billion and 9 billion euros. This concentration has allowed them to exert constant upward pressure on the sales prices of these journals, increases averaging 15% annually over recent years, without any real justification in terms of production costs.[1] It's not only the scientists, other parties are also involved in this debate, in particular the heads of scientific libraries at universities and research bodies, whose budgets are under heavy pressure due to the exorbitant cost of subscriptions.

The post-Gutenberg era

The debate should not, however, be limited to the question of financial greed on the part of scientific publishers. It is part of a wider discussion on the way in which this historic structure – with its origins in the Gutenberg era – is ill-suited to the present age, which is experiencing an exponential increase in knowledge and a constant flow of

Launch

The launch of E-Biosci was officially announced on 6 September 2001 by Frank Gannon, EMBO director, and Philippe Busquin, European Research Commissioner. The European Union sees this virtual infrastructure as an essential project for the European Research Area. It has committed itself to providing funding of 2.4 million euros for the development of a prototype platform which will lay the foundations for this new service. The EMBO is working with seven partners on the project, based in Germany, Spain, France and the United Kingdom.

in cyberspace!

new opportunities opened up by the world wide web, including archiving, hyper-navigation and multimedia technologies.

New technologies are enabling science to produce ever more results and gather more data. The genome explosion, for example, is causing researchers to list millions of DNA sequences, access to which is only possible electronically. Science as a whole is therefore faced with a need to review the ways it communicates knowledge.

A European approach

To sort out the situation and move the debate forward in what Europe sees as a constructive manner, the *European Molecular Biology Organisation* (EMBO) has developed the E-Biosci concept and hopes the project will be able to involve all the parties: scientists who are facing the need to access and produce knowledge, publishers (including both non-profit-making scientific institutions(2) and commercial groups), and managers of scientific libraries who play a key role in access to knowledge, in particular at universities.

Born out of these conflicting interests, the E-Biosci project differs from its US counterpart, *PubMedCentral*. PMC is a kind of one-stop shop which assembles all the stocks of knowledge accumulated in publications on biomedicine. The drawback is that such an approach fails to reflect the increasingly complex organisation of knowledge networks. In the field of genomics, for example, scientific information clearly goes beyond the question of access to publications. Science today is working with a vast mass of 'information atoms' stored in multiple databases. It also uses increasingly sophisticated multimedia imaging tools served by specialised infrastructures.

Interconnection not centralisation

Rather than seeking to centralise, E-Biosci has opted to create a non-exclusive interconnection platform between all the important sites where knowledge is generated and stored in all its forms. Such an access portal clearly requires two essential elements: powerful search engines with which to navigate the maze of networks and a guarantee of the same quality traditionally provided by peer review.

Commercial and free access can co-exist in the healthy spirit of competition. E-Biosci is thus seeking to help improve conditions in the traditional scientific publishing market, which is – not without reason – criticised for being uncompetitive. The favourable reception this initiative has received on the part of major European groups shows that they are aware of the need for this improvement. ◗

(1) On the contrary, the most prosperous groups have reported annual profits up by between 33% and 120%! Some journals have even proposed that authors should pay to be published, at rates in the region of 2 500 euros per article, considering that this cost should simply be included in the budgets researchers request. A singular point of view when, in the vast majority of cases, these budgets come out of public funds.

(2) Many journals are published by scientific associations or universities whose main source of revenue comes from the development of their scientific activities. These are therefore reluctant to make their archives available free of charge.

Contacts

Les Grivell, EMBO
grivell@embo.org
www.e-biosci.org/
Carlos Martinez Riera, Research DG
carlos.martinez-riera@cec.eu.int

On the Web

Public Library of Science
www.publiclibraryofscience.org/

PubMedCentral
www.pubmedcentral.nih.gov/

SPARC (Scholarly Publishing and Academic Resources Coalition) European association
www.arl.org/sparc/

The argument

Researchers who criticise the world of scientific publishing believe that the stock of knowledge is a public asset which should be accessible to all. They point out that science is to a large extent financed out of the public coffers. They also stress that neither the authors of articles nor members of peer review committees are paid for their services and therefore condemn the copyright fees that certain publishers charge for consulting their records.

News in brief... News in

Survey

Science and Culture: test your level!

A lot is being written at present on the subject of 'scientific culture'. The reason is the results published over recent years which tend to show that it is currently at a pretty low level. According to some estimates, just 10% of the population can be considered to be *scientifically educated*. The picture becomes even blacker when you listen to the views of authors such as Lewis Wolpert who argue that little or nothing can be done about it as contemporary scientific concepts have become so complex that they will always remain an unfathomable mystery to the general public.

Of course, a certain caution is called for here. It is known that the methods used to determine scientific culture among the general public – essentially surveys during which the persons interviewed must answer multiple-choice questions – reveal only certain aspects of it. And, first of all, what is culture? What do we know about the average level of culture among the general public (including scientists) in other fields? Is it significantly higher than for science?

RTD info wanted to make a (small) contribution to this debate. We have therefore compiled a brief questionnaire concerning factual knowledge in several fields, while differentiating, among the respondents, between those who are deemed to be *scientifically educated* and the rest. We deliberately limited ourselves to this kind of indicator, which is of course no more than a very simplified approach to culture.

A pilot test on about 40 respondents would seem to indicate that the results could refute certain commonly held ideas – in particular the notion that 'scientific culture' is in some way the 'poor relation' of 'general' culture. But such a limited sample is insufficient basis for reaching any conclusions. That is why we invite *RTD info* readers to participate in this survey. Participants are asked to enter into the spirit and to reply quickly to the questions asked. The questionnaire can be obtained on request – just send an e-mail to:

michel.claessens@cec.eu.int

or download it at:

europa.eu.int/comm/research/rtdinfo.html.

Stem cells: therapies for the future?

Advances in our knowledge of the biology and development of stem cells of human origin are bringing the prospect of treatment for many degenerative diseases, such as Alzheimer's, Parkinson's and arthritis, as well as for 'repair' treatment on various organs. This new medical practice nevertheless raises a number of complex ethical questions.

Following last year's debate on Genetics and Europe's future, the European Commission – assisted by the eminent scientists of the *High-level group for life sciences* (europa.eu.int/comm/research/quality-of-life/genetics.html), founded in 2000 by Philippe Busquin, European Commissioner responsible for research – is organising a forum in Brussels on 18 and 19 December 2001 on the subject Stem cells: therapies for the future?

The aim is to launch and encourage a pluralist and informative debate between scientists concerned by the feasibility and consequences of these treatments, and a wide range of representatives of society interested by the possibilities and the risks.

In particular, the Commission wants to involve in this open debate the younger generations who, in the years to come, will be the main ones to benefit from these new treatments.

Contact

E. Balzi, Research DG

Elisabetta.Balzi@cec.eu.int

europa.eu.int/comm/research/quality-of-life/stemcells.html

A second Eureka spring

Two years after European ministers adopted a 'spring' scenario with the aim of revitalising the Eureka initiative that had been flagging somewhat over recent years, signs of a renewal are certainly perceptible. New projects are up by almost 20% on the previous year (nearly a record), several strategic initiatives have been launched, and two new members have joined (Slovakia and Estonia), bringing to 32 the number of members (31 countries plus the European Commission).

This was the report presented by the Spanish presidency at the annual ministerial conference held in Madrid on 27 and 28 June. Other activities initiated this year are the improvement of internal management, the creation of a contact group with the Commission, the launch of a strategic project on tourism and specific measures aimed at the services sector.

The presidency has also created the *Lynx* prize which rewards a company which has substantially increased its business following a Eureka project. The first to win the prize of 50 000 euros is the French company Coheris, which is active in the field of customer relations management. Since 1997, the year the company was founded and the Eureka project launched, Coheris has seen an average annual increase in turnover of 83% and its personnel increase from 35 to over 430 today.

It is now up to Greece, to which the presidency passes for a year, to consolidate these results and confirm that this upturn in activities reflects a genuine grassroots movement. But praise for peaceful cooperation and its benefits to society expressed by European ministers was unfortunately in marked contrast to the bomb which exploded in Madrid at the same moment.

www.eureka.org

brief... News in brief...

Europe and the US versus malaria

Every year, 2 million children, most of them African, die of malaria, a disease which affects between 300 million and 500 million people worldwide. 'Because this disease is a problem for developing countries, a political will is needed to combat it,' explains Soren Jepsen, who heads the European Malaria Vaccine Initiative. EMVI has just signed an agreement with two US organisations, PATH and USAID, to pool their research on developing a malaria vaccine, which they have been working on for several years. Aims include clinical trials on every continent on a scale which would be impossible for any one of the partners acting alone.

sje@ssi.dk
www.emvi.org

The yardsticks of European research

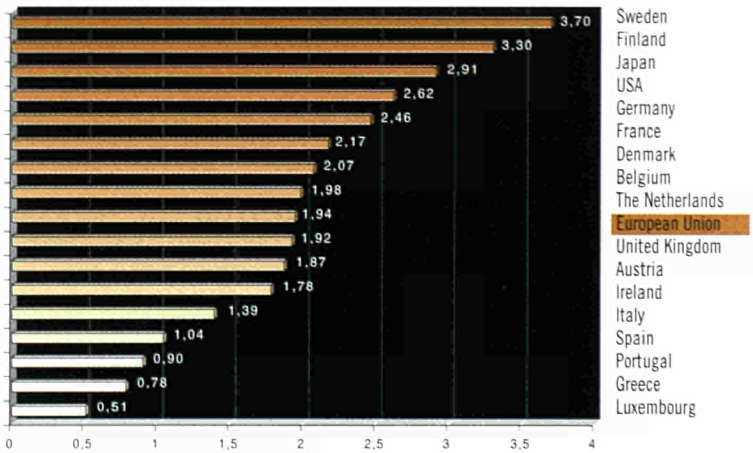
The European Research Area needs some 'yardsticks'. An initial exercise in benchmarking, aimed at comparing the state of research in the Member States with the situation in the United States and Japan, was submitted to the Council of Research Ministers in June. The type of benchmarking adopted (originally practised by companies) assessed four major characteristics of research potential on the basis of the strengths and weaknesses of comparable entities: human resources and the attractiveness of the scientific and technological professions, public and private investments in RTD, the productivity of research, and impact on economic competitiveness and employment.

At the EU level, the most striking finding is how the Scandinavian countries lead the field. Finland (top of the class) and Sweden, followed – or led – by Denmark on certain points, are the countries which have the most researchers, most young science PhDs, and boast the largest number of patents and publications. Greece and Ireland are notable for the major public financing of research by SMEs. Germany seems to be particularly interested in high technology, in terms of the added value and jobs it can generate. Although certain statistics are lacking for some countries, the picture obtained is clear anough to raise a number of questions and stimulate a desire to make a closer analysis of what is being done well in the interests of both national and European research policy.

As to its position in relation to its two main 'rivals', it will be no surprise to learn that Europe lacks researchers (5.28 for 100 working people in the Union compared to 8.08 in the United States and 9.28 in Japan), venture capital (half the level in Japan, one third the level in the United States), and dynamic industrial research (RTD represents 1.42% of turnover for companies in the EU compared to 2.1% in the United States and 2.5% in Japan).

Key Figures 2001 – Special edition: Indicators for benchmarking of national research policies – http://europa.eu.int/comm/research/area/benchmarking2001.pdf

Intensity of research and development (%) (1)



(1) Figures for the year 2000: D, A, P, FIN; 1998: NL, JP; 1997: EL, IRL, S. All the other figures, and the EU figures, are for 1999.
Source: Research DG

Read in the press

'The latest edition of the Commission's research magazine – *RTD info* – contains an article putting forward the argument for fusion research in general and the International Thermonuclear Experimental Reactor in particular. It kicks off with a rousing call to preserve the endeavour, jointly attributed to Umberto Finzi (adviser on fusion to DG Research) and Russian academic Yevgenii Velikhov. 'To back-pedal on ITER now would be to abandon for ever the control of this promising source of future energy, squandering the results of decades of research that would never come to fruition.'

Does this mean that without investment the results obtained so far will blink out of existence, like a short-lived heavy element? If the EU takes a ten-year break to fund research into a more feasible energy source, will all the fusion scientists refuse to work on it at a future date? Maybe, if we set aside a couple of fellowships for fusion – enough to maintain an intellectual "breeding pair" in Europe – this extinction could be avoided. So, help save fusion, before fusion helps itself, again, to a large slice of EU research funds.'

Published in Research Europe, n°105, 26/7/01

Calls for proposals:

Deadlines | **2001** | **2002**

QUALITY OF LIFE AND MANAGEMENT OF LIVING RESOURCES (www.cordis.lu/life/)

KEY ACTIONS	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	SEPT.	OCT.
Food, nutrition and health				31(6)								
Control of infectious diseases		18(2)										
The 'cell factory'			11(2)									
Environment and health				31(6)								
Sustainable agriculture, fisheries and forestry	18(2)			31(6)								
The ageing population and disabilities				31(6)								
Generic research	18(2)			31(6)								
Genomics & human health / Transmissible spongiform encephalopathies	18(3)											
Inclusion of partners from the new Associated Countries					15(4)							
Integration of the Newly Associated Countries in the ERA				31(5)								
OPEN CALLS	**OCT.**	**NOV.**	**DEC.**	**JAN.**	**FEB.**	**MAR.**	**APR.**	**MAY**	**JUNE**	**JULY**	**SEPT.**	**OCT.**
Training: Marie Curie individual fellowships	10(1)						10(1)					
SME Measures (cooperative research)					28(1)							
Accompanying measures	11(1)				8(1)							
Support for research infrastructure	18(1)				8(1)							

*(1) Call published on 06/03/99. (2) Call published on 15/11/00. (3) Targeted calls published on 31/05/01. (4) Call published on 31/05/01. (5) Call planned for 20/09/2001. (6) Provisional publication date 31/10/2001 * 2001 version of work programme.*

USER-FRIENDLY INFORMATION SOCIETY (www.cordis.lu/ist/)

KEY ACTIONS	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	SEPT.	OCT.
Systems and services for the citizen	17(4)											
New methods of work and electronic commerce	17(4)											
Multimedia content and tools	17(4)											
Essential technologies and infrastructures	17(4)											
Cross-programme themes	17(4)											
Future and emerging technologies	17(4)											
OPEN CALLS	**OCT.**	**NOV.**	**DEC.**	**JAN.**	**FEB.**	**MAR.**	**APR.**	**MAY**	**JUNE**	**JULY**	**SEPT.**	**OCT.**
Future and emerging technologies	Call open until 28/2/02(1)(2)											
Cooperation with Newly Associated States	Call open until 28/2/02(1)											
Various support activities	Call open until 28/2/02(1)											
SME Measures (cooperative research)				16(3)			17(3)					
Training: Marie Curie individual fellowships		15(5)										

(1) Call published on 27/01/01. (2) Submissions in 2 stages (3) Call published on 01/04/99. (4) Call published on 070/7/01. (5) Provisional date.

COMPETITIVE AND SUSTAINABLE GROWTH (www.cordis.lu/growth/)

APPELS CIBLÉS	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	SEPT.	OCT.
Measurements and testing research					15(3)							
					15(3)							
Inclusion of partners from the 'Newly Associated countries' (NACs)			13(4)									
Specific call for partners from the NACs	Joint call for which the dates have not been set yet.											
OPEN CALLS	**OCT.**	**NOV.**	**DEC.**	**JAN.**	**FEB.**	**MAR.**	**APR.**	**MAY**	**JUNE**	**JULY**	**SEPT.**	**OCT.**
Training: Marie Curie individual industry fellowships					28(1)							
SME Measures (cooperative research)					28(2)							
Accompanying measures					28(1)							

(1) Calls published on 16/03/99. (2) Call published on 01/04/99. (3) Call published on 16/10/01. (4) Call published on 01/09/2001.

ENERGY, ENVIRONMENT, AND SUSTAINABLE DEVELOPMENT (www.cordis.lu/eesd/)

KEY ACTIONS	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	SEPT.	OCT.
Sustainable management and quality of water	15(1)											
Global change, climate and biodiversity	15(1)											
Sustainable marine ecosystems	15(1)											
The city of tomorrow and cultural heritage	15(1)											
Cleaner energy systems, including renewables			14(2)									
Economic and efficient energy for a competitive Europe			14(2)									
Support for research infrastructure	15(1)											
Inclusion of partners from the 'Newly Associated countries' (NACs)					15(3)							
Specific call for partners from the NACs				31(3)								

(1) Call on the environment and sustainable development only, published on 15/11/2000. (2) Call on energy only, published on 24/10/2000. (3) Calls not yet published, closing dates to be confirmed.

overview

For the latest information on calls for proposals and calls for tender, see: **www.cordis.lu/fp5/src/calls.htm**

Deadlines | **2001** | **2002**

ENERGY, ENVIRONMENT, AND SUSTAINABLE DEVELOPMENT (www.cordis.lu/eesd/)

OPEN CALLS	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	SEPT.	OCT.
Generic research	15(2)		14(1)									
Training: Marie Curie individual and industry host fellowships						20(3)						
SME measures (cooperative research)					28(4)							
Support measures (without advanced courses)					15(2)		17(5)			12(2)		
Support measures: advanced courses						15(3)						

(1) Energy (E) only – Call published on 24/10/2000. (2) Environment and sustainable development (ESD) only – Call published on 15/11/2000. (3) ESD. Call of 15/11/2000. (4) Call published on 01/04/99; closing date to be confirmed. (5) Closing date to be confirmed.

NUCLEAR ENERGY (FISSION) (www.cordis.lu/fp5-euratom/)

KEY ACTIONS	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	SEPT.	OCT.
Nuclear Fission				21(1)								
OPEN CALLS	**OCT.**	**NOV.**	**DEC.**	**JAN.**	**FEB.**	**MAR.**	**APR.**	**MAY**	**JUNE**	**JULY**	**SEPT.**	**OCT.**
Generic research				21(1)								
Support for research infrastructures				21(1)								
Training: Marie Curie individual fellowships					9(1)							
Other training actions						25(1)(2)						
Accompanying measures						25(1)						

(1) Call published on 17/10/2000. (2) Special courses, training-research networks, cooperation with third countries.

INTERNATIONAL COOPERATION (www.cordis.lu/inco2)

CALLS BY COUNTRY GROUPS	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	SEPT.	OCT.
States in pre-accession phase		16(1)				15(1)				16(1)		
NIS & other CEEC		16(1)				15(1)				16(1)		
Mediterranean partners (INCO-MED)		16(2)				15(2)				16(2)		
Developing countries (INCO-DEV)		16(2)				15(2)				16(2)		
Emerging economies and industrialised countries	16(2)				18(2)				17(2)			
Fellowships for Japan						1(3)						

(1) Open call on 'Support for participation in conferences' (2) Open calls on 'Support measures'. (3) Call of 27/03/99.

INNOVATION / PARTICIPATION OF SMES (www.cordis.lu/innovation-smes)

OPEN CALLS	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	SEPT.	OCT.
SME Measures (cooperative research)				16(1)			17(1)(3)					
Innovation projects			15(2)									
					20(4)(5)							

(1) Call published on 01/04/99 – N.B. These two evaluations will probably be replaced by a single final CRAFT evaluation with the closing date of 28 February 2002. (2) Call for proposals scheduled for 15/09/2001 (subject to confirmation) – dates subject to change. (3) Note – Closing date for CRAFT call, final submissions possible! (4) Call for expressions of interest of 13/07/01. (5) Limited call for proposals to be made on 30/11/01 following call of 13/07/01.

HUMAN POTENTIAL (www.cordis.lu/improving)

OPEN CALLS	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	SEPT.	OCT.
Marie Curie individual fellowships						13(1)(2)						
Marie Curie industry host fellowships		3(3)										
High-level scientific conferences						1(1)						
Awards for first-class research						15(5)	5(4)					
Raising public awareness of science and technology							15(6)					
S&T policy strategy: Groups of experts (Strata)		Open until 30/09/02										
S&T policy strategy: Accompanying measures (Strata)			17(7)									
Joint basis of indicators for science and innovation: thematic networks and RTD projects	15(8)											
KEY ACTIONS	**OCT.**	**NOV.**	**DEC.**	**JAN.**	**FEB.**	**MAR.**	**APR.**	**MAY**	**JUNE**	**JULY**	**SEPT.**	**OCT.**
				15(9)								

(1) Calls published on 16/03/99. (2) Individual fellowships, return fellowships, experienced researcher fellowships. (3) Call published on 15/02/01. (4) Descartes Prize: call scheduled for 03/12/01 (subject to confirmation). (5) Archimedes Prize: call scheduled for 03/09/01 (subject to confirmation). (6) Call scheduled for 15/01/02 (subject to confirmation). (7) Call published on 01/02/01, early closing date to be published. (8) Call published on 16/01/01. (9) Call published on 24/07/01).
Reference: 6th edition of the work programme.

News in brief...News in

European Science Week – The 'Mainstream' and the 'Fringe'

• **Infoplanet** – 5-17/11/01: Inauguration in Rome (IT) of an exhibition and information programme on renewable energy sources, which will also be held in Thessaloniki, Oporto and Barcelona.

• **Energetic Friends** – 5-8/11/01 – Tallinn (EE) – Final of a competition between energy research projects – Partners in Finland and Latvia.

• **PUSH 2001** – 5-7/11/01 – Florence (IT) – Three information days on three major figures in the history of sciences – Da Vinci, Darwin and Linnaeus. Italian, Irish and Swedish partners.

• **Life in the Universe** – 8-11/11/01 – The final – certain of extensive media coverage – at CERN (Geneva, CH) of a major competition for young people aged 14-18 to create websites about exploring the possibility of other life forms existing elsewhere in the Universe – Organised by ESO, ESA and CERN – www.eso.org/outreach/press-rel/pr-2001/pr-16-01.html

• **Europe Biotech** – 5-11/11/01 – Multimedia presentation on plant biotechnology in Europe, presented in Brussels, London, Madrid and Munich.

• **Science and Technology TV Awards** – 5/11/01 – London, UK and 7/11/01 – Brussels (BE) – Final of a competition on the presentation of science and related questions in TV fiction productions.

• **Small is beautiful** – 5-11/11/01 – Manchester, UK – Exhibition and thematic day on the 'European Week on Microsystems Technologies – Chances, Changes, Challenges'.

European Science Week 2001 will be marked by events in 14 towns (Barcelona, Brussels, Florence, Geneva, London, Madrid, Manchester, Munich, Pembroke, Oporto, Rome, Tallin, Thessaloniki, Uppsala). Although the official programme is drawn up well in advance, any last-minute initiatives to participate in this open and often festive dialogue between science and the citizen under the banner of Europe are welcome, in particular in the regions where the main projects are taking place. Logos, posters and pins designed for the Week are all available. Last-minute participants can also be featured on the event's internet site, thus benefiting from a European 'label' and a higher profile.

Information :
melanie.kitchener@cec.eu.int
www.cordis.lu/improving/public-awareness/science.htm

Science and Citizens Meetings

This is the name given to the annual opportunity for genuine European dialogue between researchers in all fields and the general public, organised by the CNRS (Centre National de la recherche scientifique). In October, 450 'young people from the Old World' aged between 18 and 25 will participate in these discussion days. The CNRS will itself fund the trip for 150 of them from all over the Union.

The subjects on the agenda reflect key questions society is asking in the face of scientific and technological developments, with cloning and bioethics, globalisation, genomes and the (unlimited?) growth of data processing, and the crucial problem of water, all to be discussed. As are the answers offered by science and religion to the origin and end of the world, love in all its aspects (biological, cultural, psychoanalytical), drugs, and the responsibility of scientists for the use to which their research is put. This pluralist approach, bringing together specialists from a range of disciplines, is under the leadership of the sociologist Edgard Morin.

11th CNRS 'Science and Citizens' Meetings – Poitiers Futuroscope (FR) – Contact: Jean-Louis Buscaylet – jean-louis.buscaylet@cnrs-dir.fr or Martine Roche – martine.roche@cnbrs-dir.fr
www.cnrs.fr/cw/fr/tous/manif/sciecito2001.htm

Women and science, gender and research

What role do women play in science? Why are they so few and far between in certain fields of research and almost absent – as in so many other fields – from positions of responsibility? At a time of a very real brain-drain and worrying demographic trends, can Europe afford to ignore half its researcher potential? How to identify coherent policies and good practices which take account of the gender dimension in sciences? How to make young girls in primary school more aware of the science which surrounds them and later encourage them to opt for scientific subjects? What measures can be taken to help women researchers pursue their career rather than, as happens all to often, opting for other avenues?

These questions are all analysed in the *'Promoting excellence through mainstreaming gender equality'* report, drawn up by the ETAN net-

Request for free subscription to *RTD info*

Complete in block capitals and return to:

Research DG – Information and Communication Unit
Rue de la Loi, 200 – B-1049 Brussels
Fax: +32 2 295 8220 / e-mail: research@cec.eu.int(1)

Language version desired ❑ English ❑ French ❑ German

Name: ..... Organisation: .....

Type of activity (please indicate together with sector of activity and level of responsibility/qualifications if possible):

❑ University/Research centre ❑ Industry ❑ Services ❑ Public sector ❑ NGO
❑ Teacher ❑ Student ❑ Press/Media ❑ Other: .....

Sector (e.g. chemicals)/position (e.g.researcher) .....

Full address(2): .....

.....

.....

(1) If subscribing by e-mail, please indicate your activity (see categories above)
(2) If possible give tel./fax numbers and e-mail address

brief... News in brief...

work at the request of the Research DG's Women and Science Unit. Another initiative is the creation of the 'Helsinki group' of civil servants representing all the Member States and associated countries of the Fifth Framework Programme and charged with the task of developing comparative analyses of the situation of women scientists throughout Europe. Finally, recent years have seen increased efforts to involve more women in projects supported by the Union.

The Gender and Research conference, to be held in Brussels on 8 and 9 November, will assess these actions and look ahead to the tasks which remain, in particular in preparing the next framework programme and in line with the thinking behind the European Research Area. The afternoon of the first day will be given over to presenting the results of a series of studies on the gender effect and how this dimension was taken into account in the Fifth Framework Programme. Day two will see a number of thematic sessions covering topics such as political approaches to the question of women and science and ways of increasing awareness of science subjects, through actions in schools, events aimed at the general public, etc. Women scientists will speak of their own experiences and a special session will be devoted to identifying research to arrive at a better understanding of the notion of gender and science.

Contact:
Linda Maxwell, Women and Science Unit
linda.maxwell@cec.eu.int
www.cordis.lu/rtd2002/science-society/women.htm

Science in the Mediterranean countries

The 'Rammal Award' was created in 1997 in honour of the remarkable Lebanese physician of the same name who died in 1991 at the age of 40. A brilliant teacher and researcher, this forceful personality was also an active campaigner for renewed dynamism in scientific exchanges in the Mediterranean Basin. To honour his memory and continue his work, the Rammal Award aims to honour the region's best researchers. Last year it was awarded to the Algerian Abderhamane Tadjeddine (now director of the LURE Laboratory in Orsay, France) for his work in physico-chemistry and the specialist in genetic diseases André Mégarbané (Lebanon). The Euroscience Foundation invites researchers from the Mare Nostra basin to submit details of their work. All scientific fields are eligible, including the human sciences.

Contact:
Dr. Rémy Lestienne, Euroscience
remy.lestienne@snv.jussieu.fr

Beijing office

China is taking its scientific and technical cooperation agreement with the European Union seriously. In June it opened the China-EU S&T Cooperation Promotion Office (CECO) in Beijing to help Chinese scientific organisations participate in research partnerships under the EU's framework programme and to provide information for European project coordinators. Mr. Wang Shaoqi, general director of the Chinese Ministry for Science and Technology, stresses that China welcomes on a reciprocal basis European partners seeking to cooperate on the Chinese Basic and High Tech Programme. However, although his administration systematically grants subsidies to Chinese teams who participate in European research projects, he expressed regret that no Union aid is available in the opposite direction.
CECO
office@ceco.org.cn
www.ceco.org.cn

New on the Web

Everything about the 'NFP' and 'ERA'

CORDIS, the reference site for the European Union's institutional information on research and innovation, has launched a new service which provides constantly updated and detailed information on the process – now well under way – of preparing the new framework programme (NFP) as well as parallel developments in the European Research Area (ERA) of which it is a part. Among other things, visitors to this new website can view the reactions and recommendations of all the parties which are consulted as part of this dual process – the Council, European Parliament and other Community bodies, Member States, candidate countries and representatives of European society.

www.cordis.lu/rtd2002/

Downloadable documents

- *Setting the standard: 25 years of quality measurements*
- *Women and Science: the gender dimension as a leverage for reforming science – ftp.cordis.lu/pub/improving/docs/g_wo_sec771_en_200101.pdf*
- *Key Figures 2001 – Special edition: Indicators for benchmarking of national research policies – europa.eu.int/comm/research/area/benchmarking2001.pdf*
- *Community Research on Pulp and Paper (6/7/01) – europa.eu.int/comm/research/growth/gcc/pressroom.html*

The latest news on Europa/Research

- Weighing the evidence: a thematic network set up to assist in the fight against fraud and crime (30/7/01) – europa.eu.int/comm/research/growth/gcc/projects/nite-crime.html
- European research opens up new prospects for agriculture – First sequencing of the genome of a nitrogen fixing bacteria (27/7/01) – europa.eu.int/comm/research/press/2001/pr2707en.html
- Updated version of the Research DG's organisation chart(17/7/01) – europa.eu.int/comm/dgs/research/organisation_en.html
- A new study reveals the real costs of electricity in Europe(27/7/01) – europa.eu.int/comm/research/press/2001/pr2007en.html
- Stimulating the creation of start-ups in the space sector in Europe – The Walloon model (3/7/01) – europa.eu.int/comm/research/press/2001/pr0307en.html
- EU signs scientific and technological association agreement with Malta (20/6/01) – europa.eu.int/comm/research/press/2001/pr2006en.html
- Revised versions of the discussion papers on Integrated Projects and Networks of Excellence (19/6/01) – europa.eu.int/comm/research/nfp/networks-ip.html
- EU to launch Advisory Council for Aeronautics Research at the Paris Air Show (19/6/01) europa.eu.int/comm/research/growth/gcc/projects/news-lebourget.html
- Commission supports genomics research by networking mouse model archives (11/6/01) – europa.eu.int/comm/research/press/2001/pr1106en.html
- Commission unveils next steps towards European Research Area (30/05/01) – europa.eu.int/comm/research/press/2001/pr3005en.html

Publications

Just published

Brochures, magazines, leaflets

- **Europe and Space: A new chapter** – *26 p. – research@cec.eu.int:*
- **Genetics and Europe's Future** *(Also available in FR and DE) – Two brochures summarising the public forum held in Brussels in November 2000 – quality-of-life@cec.eu.int – (see also europa.eu.int/comm/research/quality-of-life/genetics/en/*
- **Images of disease – Science, Public and Health in Post-war Europe** – *Barcelona (1998) – 382 p. – EUR-OP*

- **Agricultural research in the European Research Area** – *leaflet – 4 p. – quality-of-life@cec.eu.int*

Growth in action – *The Competitive and Sustainable Growth Programme Magazine – no. 2 – 24 p. – growth@cec.eu.int (see also europa.eu.int/comm/research/growth/*

- **Integration of renewable energy sources and distributed generation in energy supply systems** – *16 p. – eesd@cec.eu.int*
- **Clean and efficient energies for Europe – Socio-economic impact of energy research projects** – *32 p. – EUR-OP*
- **Qualitative assessment of non-nuclear energy research proposals selected in FP5** – *20 p. – EUR-OP*
- **Partitioning and transmutation – Towards an easing of the nuclear waste management problem** – *12 p. – eesd@cec.eu.int*
- **Reflections on the role of research infrastructures in the European Research Area** – *Strasbourg (September 2000) – 80 p. – anna-maria.johasson@cec.eu.int*
- **Science and governance in the knowledge-based society (II)** – *Special issue of the IPTS report– n°55 June 2000 – www.jrc.es/pages/f-report.en.html*
- **Women and science: making change happen** – *229 p. – nicole.dewandre@cec.eu.int*
- **AIRES in ERA – A global strategy for atmospheric interdisciplinary research in the European research area** – *58 p. – giovanni.angeletti@cec.eu.int*
- **On the good use of geographic information systems in archaeological landscape studies** – *155 p. – OPOCE*
- **The impact of human activities on the marine environment quality and health** – *77 p. – OPOCE*
- **Impressions of Olmany – Life in the areas contaminated by the Chernobyl accident** – *99 p. – inco@cec.eu.int*

...and as a reminder

- *Research and technological development in Europe – Examples of projects – volume 3 – 78 p./ Presentation of 36 research projects in a range of disciplines and fields – Available in FR (EN and DE versions available shortly) – research@cec.eu.int*
- *'European research in action' series – 10-page leaflets on the responses of European research to the principal challenges of our times/ Subjects available: natural disasters, water resources, global change, employment, health, road safety, protection of cultural heritage – Available in 11 languages from – research@cec.eu.int – Can also be browsed on the Research DG Website (europa.eu.int/comm/research/leaflets/)*
- *Towards a European Research Area – Full text of the Commission communication – Available in 11 languages – 52 p. – On the web, with all the latest documents on the ERA: europa.eu.int/comm/research/area_en.html*

EUR-OP is the Office for Official Publications of the European Communities. To order a publication, please visit the site at: eur-op.eu.int/general/en/s-ad.htm

A complete list of new scientific publications from the RTD programmes is placed on the research website every two months: europa.eu.int/comm/research/pub_rtd.html

Diary

Research meetings under the Belgian presidency

www.cordis.lu/belgium/fr/
eu-presidency@belspo.be

- *For a European research which is open to the world: excellence, mobility, exchanges – 17-18/9/01 – Brussels*
- *Celebration of the 30th anniversary of COST – 10/10/01 – Brussels*
- *European initiative 'Global Monitoring for Environment and Security (GMES): towards implementation' – 15/10/01 – Brussels*
- *Research Council – 18/10/01 – Luxembourg*
- *Unity and diversity: the contribution of the social and human sciences to the European Research Area – 29-30/10/01*
- *Best international practices for evaluating research at public institutions and universities – 12-13/11/01 – Brussels*
- *The role of SMEs in the European Research Area and the new framework programme – 19/11/01 – Liège*
- *Descartes Prize – 27/11/01 – Brussels*
- *European Biodiversity Platform – Scientific tools for the conservation of biodiversity (models, surveillance and experiments) – 2-4/12/01 – Brussels – www.cordis.lu/belgium/en/02122001.htm*
- *Research Council – 10/12/01 – Brussels*
- *Popularising science and technologies in Europe and its regions: drawing closer to society – best practices, benchmarking and regional diversity – 17-18/12/01 – Brussels*

Other events

- *Integrating sustainable energy sources – 25-26/9/01 – manuel.sanchez-jimenez@cec.eu.int*
- *1st Annual European and Transport Summit Conference – A safer tomorrow – 18-19/10/01 – Barcelona – christine.cordie@cec.eu.int*
- *11th CNRS 'Science and Citizens' Meetings – 26-28/10/01 – Poitiers Futuroscope (FR) www.cnrs.fr/cw/fr/tous/manif/sciecito2001.htm*
- *Biomechanics and Biomedical Engineering – 31/10-3/11/01 – Rome (IT) – www.uwcm.ac.uk/biorome*
- *Gender and research – 8-9/11/01 – Brussels – http://www.cordis.lu/improving/women/events.htm*
- *FISA 2001 – EU research in reactor safety – 12-14/11/01 – Luxembourg – www.cordis.lu/fp5-euratom/src/ev-fisa.htm*
- *Safety of industrial automated systems – 13-16/11/01 – Bonn (DE) – www.hvbg.de/d/bia/akt/sias/akt2.htm*
- *IST 2001 Technologies Serving People – 3-5/12/01 – Düsseldorf (D) – www.cordis.lu/ist*
- *Stem cells: therapies of the future? – 18-19/12/01 – Brussels – europa.eu.int/comm/research/quality-of-life/stemcells.html*
- *Astronomy, Cosmology and Fundamental Physics – ESO-CERN-ESA Symposium – 4-7/3/02 Garching (DE) – www.eso.org/gen-fac/meetings/symp2002/*

Grist to the mill

In permitting synergy between complementary sources of financing, the cooperation agreement between the European Commission's Research DG and the European Investment Bank (EIB), signed in June, is designed to stimulate investment in research and innovation.

THE CURRENT situation is well known: although European science is highly regarded around the world, the Union's global research effort (1.9% of GDP) lags behind that of the USA (2.6%) and of Japan (2.9%). This relative weakness also explains why Europe is less able to generate innovation and commercial successes.

It is against this background that an agreement was signed on 7 June between the European Commission and the EIB to increase resources for research and innovation. The aim is to increase the synergy between financial support from the Commission's framework programmes, and action under the *Innovation 2000 Initiative* (i2i) launched by the EIB last year (see box), in order to better meet the needs of research organisations and companies.

Synergistic financing

The first requirement is to increase the resources made available to research projects, in particular for downstream development and the exploitation of results. The subsidies made available by the EU's framework programme are necessarily limited by budgetary constraints and are often insufficient to cover the complete R&D cycle.

EIB loans and/or direct participation by the European Investment Fund (EIF), the Bank's venture capital arm, could provide a valuable additional source of risk capital. The resources of the EIF are to be increased from 1 billion to 2 billion euros to meet its mission of playing a key leverage role in generating funds in high-tech companies and start-ups[1].

The second priority is aid for research infrastructure. As a general rule, Commission support is limited to participation in operating and maintenance costs, as well as the access of researchers to installations, or is targeted at research projects initiated by these infrastructures. EIB loans could, by contrast, meet major long-term financing needs, in particular those linked to equipment investment.

This new co-operation between the EIB and the Commission opens up interesting prospects of access to additional financial support for all the players in the European Research Area. They must now seize the opportunity. ◗

(1) As its principal mission is to support SMEs, the EIF does not invest directly in company capital but has a policy of participating in venture capital funds, which invest in high-tech companies.

To find out more

About financing possibilities
europa.eu.int/comm/enterprise/funding/index.htm#Financing
europa.eu.int/business/en/topics/finance/
www.cordis.lu/finance/home.html

About the EIB
www.eib.org

About the EIF
www.eif.org

The Biotechnology / Finance forum
europa.eu.int/comm/research/biotech/finance.html

The new i2i factor

Launched following a mandate given to the European Investment Bank (EIB) by the Lisbon European Council (March 2000), i2i is designed to promote investments in five key fields: the development of SMEs and the spirit of enterprise; the diffusion of innovation; research and development; information and communication technology networks; and human capital formation. The initiative has a considerable budget, providing for a 12-15 billion euro lending programme spread over three years (2000-2003). In addition, the EIB can inject capital into venture capital funds that in turn invest in innovative SMEs, via its European Investment Fund (EIF).

Transgenic plants

Breaking the deadlock

GMOs, and more specifically transgenic plants, have come to symbolise all that is wrong in the relationship between science and society. While their most ardent supporters present them as heralding a brave and wonderful new world, a radical opposition views them as an ecological and health time-bomb irresponsibly exploited by life science multinationals for their own ends. Hardly surprising therefore that a general public caught in the crossfire is growing ever more uncertain of just who to believe.

Although demonstrations by anti-GMO militants remain fringe phenomena, the repeated destruction of experimental crops of transgenic plants – the latest example being in June in the United Kingdom – nevertheless reflects an increase in disconcerting forms of 'anti-science' violence. In no case were these crops being grown for market, but rather as part of strictly controlled risk-assessment projects implemented by public research bodies. These guerrilla tactics have simply added to the sense of confusion and bewilderment among a section of the scientific community who, feeling they are being unfairly accused, are tending to relinquish the mediating role that is expected of them.

Yet between the somewhat irresponsible *laissez-faire* policy advocated by certain GMO 'crusaders' and the radicalism of a minority among their opponents, is there not an urgent need to find room for a reasonable compromise, founded on sound and measured scientific arguments of risk management? That is the question that will be posed in the following pages.

Also, the very fact that the gulf has widened to such an extent in itself gives cause to consider that it is high time the scientists raised some questions about the limitations of their own approach. In an age which preaches the need for multidisciplinarity, the current presentation of progress in life sciences has failed spectacularly to take account of the social and psychological dimensions of its acceptance. If public opinion is concerned by the 'marketing' of life or if it attaches an ethical – or even religious – value to its relationship with nature, then it is raising legitimate questions, questions which science philosopher Bernard Feltz will seek to answer at the end of this feature.

But one thing is certain. Although at a global level the cultivated area given over to transgenic plants has greatly increased over recent years, the present deadlock in the debate can only be damaging to Europe and must, sooner or later, give way to coherent and sustainable action.

Neither scientism nor extremism

Why is there deadlock in the debate on genetically modified – or GM – plants? No doubt because it is being approached in the wrong way. The tendency is to present it as a single and homogenous issue, when in fact GM plants should be evaluated on a case-by-case basis, in the same way as any technology in which risk management is involved.

TO MANAGE a risk, one must first endeavour to quantify it, then decide whether it is one worth taking on the basis of the costs and concrete, expected benefits. When a young person asks his parents to buy him a motor vehicle, they weigh up the pros and cons, assessing the relative dangers and costs of two-wheeled as opposed to four-wheeled transport and the usefulness of the expense. The debate revolves around risks, costs and benefits and not the legitimacy of the combustion engine.

This is the way logic would dictate the GM plant debate should proceed. The nature of the risk and expected benefits vary considerably from one product to another. 'What is the connection between GM maize, which is resistant to a herbicide, produced by a multinational which markets this same herbicide, and GM papaya produced by a university in Hawaii which is resistant to a virus?' This was the question posed in an impassioned plea by three well-known geneticists in the French daily *Le Monde*.(1) 'In the first case, everyone knows that it is a private company capturing a market, while the latter addresses a pressing social need on the part of small local farmers in despair at seeing their crops regularly destroyed by disease.'

Top, colza (rape) infected by the Turnip Yellow Mosaic Virus. Bottom, tobacco infected by Potato Virus Y. In both instances the inoculated transgenic plant (on the left) is resistant, while the non-transgenic control specimen (on the right) presents severe infection symptoms of infection.
VRTP-Impact project

Another example: when it comes to genes escaping into the environment, the problem is altogether different for maize, for which there is no related plant in Europe, and colza (oilseed rape) which is known to cross-breed readily with several wild species.

A legitimate technique?

The first genetically modified micro-organisms appeared on the scene about 30 years ago. As the EMBO (European Molecular Biology Organisation) explains *'...human insulin produced by genetically modified bacteria quietly replaced the declining stocks of beef and pig insulin which was used to treat growing number of human diabetics.'* (2) In this case genetic engineering is clearly legitimate and it is unlikely that in the current climate even the supporters of Deep Ecology (3) would advise a patient to return to beef insulin.

If we go back in time we can see how, in the course of several thousand years, livestock and arable farming has modified the genes of animals and plants by means of patient selection. In this respect all of today's cultivated plants have been genetically modified compared with their wild ancestors, although it is true that genetic engineering goes further in that it crosses the species or even kingdom barrier, transferring animal genes to plants or bacteria. But does that make it a 'violation of nature'? The unity of life is such that creatures far apart on the

evolutionary scale share a great many genes: 30% in the case of man and yeast for example. So there is nothing 'monstrous' about taking a gene from one species and introducing it into another.

Living with GM plants

The picture in Europe would suggest that GM plants are destined for lengthy purgatory in the laboratory. With a *de facto* ban on their marketing, there is virtually zero commercial cultivation. 'GM-free' has in fact become a sales argument for supermarkets and most of the agri-foodstuffs groups.

But worldwide the picture is rather different. The ISAAA (International Service for the Acquisition of Agri-biotech Applications),(4) estimates that 44 million hectares were given over to transgenic plants in 2000 (almost twice the surface area of the United Kingdom) and that since 1996 the total cultivated area under transgenic plants has increased by a factor of 25. Although the rate of growth has slowed over the past two years, large countries such as Argentina, China and India have all become involved in transgenic cultivation.

In such a context, will Europe be able to remain an exception for long? As the debate continues, it seems reasonable to begin to think of ways to allow Europeans and genetic engineering to live together democratically.

Independent research

If public opinion is to accept transgenic plants, it must believe they pose no threat either to their health or to the environment. To answer the legitimate questions raised, Europe must not only maintain but increase the high-level scientific expertise it has developed over the past decade or more so as to understand better the relationship between transgenic plants, the environment and biosafety.

An essential condition for winning this trust is for the expertise to be recognised as genuinely independent. Scientists charged with assessing whether or not a practice is acceptable must have no moral or financial links to private economic interests. There is also another sensitive point: the development of these technologies must not aggravate inequalities by increasing the domination of large companies over farmers, or of the North over the South. Even if Europe supports some projects devoted to plants and farming practices in developing countries these are still too rare.

(1) Les OGM entre science et démocratie, by Jean-François Briat, research director at the CNRS, Pierre-Henri Gouyon, professor at the Université Paris-XI, Francis-André Wollman, research director at the CNRS, vice president of the Initiative Citoyen en Europe (ICE). www.lemonde.fr/article/0,5987,3232--173149-,00.html
(2) EMBO: www.embo.org
(3) Deep ecology: a movement founded in the 1970s by Arne Naess, a Norwegian philosopher and celebrated mountain-climber.
(4) ISAAA: www.isaaa.org

Freedom of choice

GM plants will be accepted by consumers if they have a real choice as to whether to use them or not. This implies a separate route to market for clearly and coherently labelled products, plus control mechanisms able to detect possible error or fraud. According to European Research Commissioner Philippe Busquin, 'Confidence requires the development of dependable methods of analysis permitting the identification and quantification of GM plants present in foodstuffs.'

This is a very complex task given the sometimes minute quantities of substances involved and the transformations undergone by the products in the course of industrial processes. The Commission's Joint Research Centre (JRC), a leader in this field, is the world's first producer of certified reference materials for the detection of GM plants. The JRC also works with the WHO in organising training courses in GM plant detection.

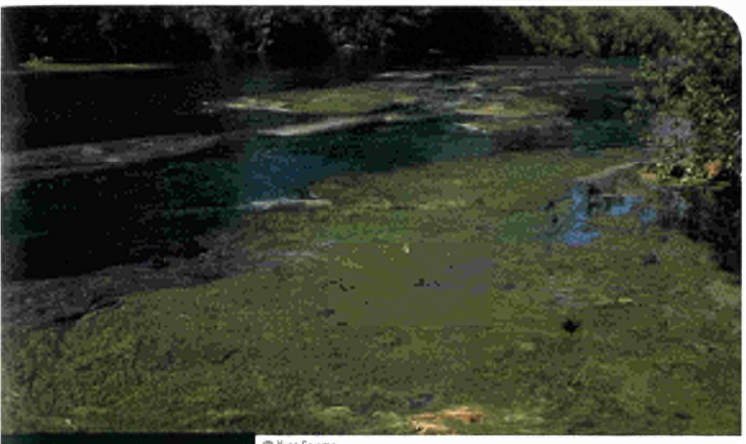
Info:

European research
EC-Sponsored Research on Safety of Genetically Modified Organisms – A Review of Results
A report on more than a decade of research under the European Union's biosafety programmes – and for GM plants in particular – is available at: http://europa.eu.int/comm/research/quality-of-life/gmo/
he paper version, on the point of being printed, can be ordered from: quality-of-life@cec.eu.int

JRC site
ihcp.jrc.it/theihcp/Activities/ACTGMOs.html

FAO documents
ee the Plant science and production > lant genetics and breeding section on the FAO site at www.fao.org/waicent/

Will clean agriculture be transgenic?



© Yves Sciama

The abnormal development of cladophores in a river. These filamentous algae indicate the presence of excess nutrient in the water. Genetically modified plants could provide a means of combating this type of pollution.

The strongest resistance to GM plants is based on environmental concerns. Yet it is in this very field that they offer most benefits. Thanks to various promising avenues of research, transgenic plants could champion the cause of 'cleaner' agriculture. This is a major asset when you consider that population growth will require a doubling of the world's cereal production over the next 50 years.

PESTICIDES, herbicides, nitrogen or phosphate fertiliser... all these products which have contributed to the extraordinary growth in agricultural productivity also cause great upset to ecosystems. One third of Europe's watercourses (the final destination for all these 'inputs') are eutrophic, i.e. saturated in nutritional matter of human origin; another third are seriously threatened. This is hardly surprising when every hectare of cultivated land receives up to 200 kg of nitrogen fertiliser every year. Fertilisers are also responsible for 80% of phosphate consumption and result in increased cadmium levels in the soil.

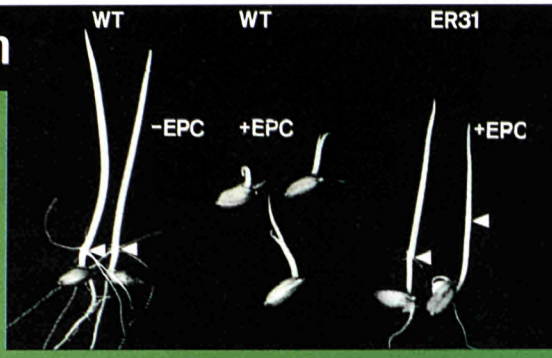
As to pesticides and other plant health products, we are only now beginning to monitor their presence systematically in natural environments. What is more, all these inputs consume energy and raw materials at their production stage, adding further to their ecological cost.

Hybrid resulting from a cross-breeding sunflowers and *Helianthus argophyllus*. Pot experiment to test tolerance to drought. On the left, two rows of sunflowers, and on the right a row of hybrids.
© J.MORIZET/INFRA

Going easy on the chemicals

Many European laboratories are seeking to develop plants which require fewer such additives (with resulting economic benefits for the farmers). For the first time, European research has succeeded in isolating the proteins responsible for a plant's nitrogen absorption.[1] These transporter genes are found in the membranes of the cells which form the fine root hairs of plants. 'Some transporter genes have been selected and over-expressed in transgenic plants so as to assess their role in ammonium absorption from the soil. The results obtained to date provide us with a basis for controlling nitrogen flows in many different systems,' explains Nicolaus von Wiren, a researcher at the University of Tübingen (DE). The aim is to

The antibiotic problem



Comparison between genetically modified (ER31)and non-genetically modified (WT) rice plants under the effect of a carbamate-based herbicide (EPC). On the left, the untreated WT plant; in the centre, its growth stopped; on the right, the ER31 plant, insensitive to EPC. Research carried out under the EcoTub project

In addition to the 'useful' gene, GM plants contain another so-called marker gene which serves to recognise easily specimens in which transgenesis has been successful. The marker is often a gene resulting in resistance to an antibiotic, a practice strongly condemned as it could pass on this resistance to pathogenic bacteria. The risks of such a scenario are controversial, but a number of studies are trying to find alternative marker genes or to eliminate these genes after use. The EcoTub project, on which three European laboratories are working, is pursuing research in this direction. 'We are working on an original marking technique,' explains Peter Nick of Freiburg University (DE), the project co-ordinator. 'Rather than introducing a foreign gene into the plant, we slightly modify a gene that it already possesses which codes for molecules that are found everywhere in living organisms, tubulins. The result is that any interference with the genome is kept to a strict minimum.'

EcoTub: *An ecologically safe selection system for transgenic crops based on modified plant-tubulin genes – pnick@ruf.uni-freiburg.de*

GM plants and biodiversity

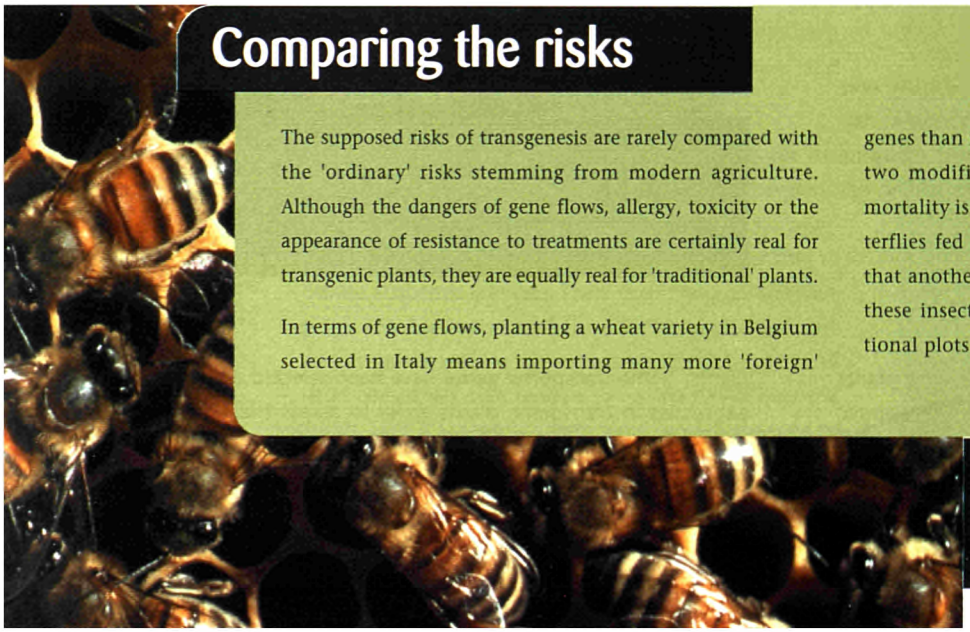
GM plants have been accused of threatening biodiversity. There are two underlying fears. The first is that new 'super' weeds may appear with a transgene able to eliminate their natural competitors. This supposes two conditions which are rarely found in practice: the transgene must first be able to penetrate the genome of the wild plant and then bestow upon it an advantage in its environment. Yet many transgenes lend characteristics which are of little use under natural conditions. This risk is nevertheless taken seriously and is the subject of important research.

The other way in which GM plants could reduce biodiversity would be to produce seeds with a sufficient superiority to result ultimately in the disappearance of competitors. This is a more real danger, but one which is true of globalised industrialised farming in general. Various species conservatories are already trying to find a solution to this potential problem.

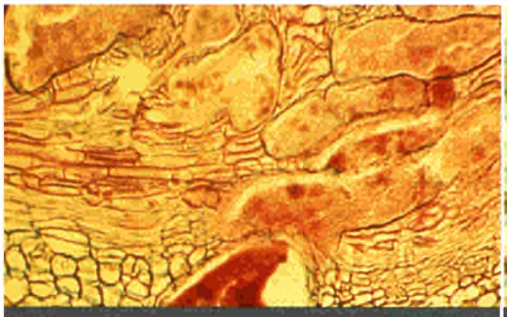
Comparing the risks

The supposed risks of transgenesis are rarely compared with the 'ordinary' risks stemming from modern agriculture. Although the dangers of gene flows, allergy, toxicity or the appearance of resistance to treatments are certainly real for transgenic plants, they are equally real for 'traditional' plants.

In terms of gene flows, planting a wheat variety in Belgium selected in Italy means importing many more 'foreign' genes than in the case of a transgenic rape with just one or two modified characteristics. Similarly, when non-zero mortality is observed in the laboratory on US monarch butterflies fed on transgenic pollen, it must be remembered that another study showed that in the field the density of these insects is higher on transgenic plots that on traditional plots treated with insecticide.

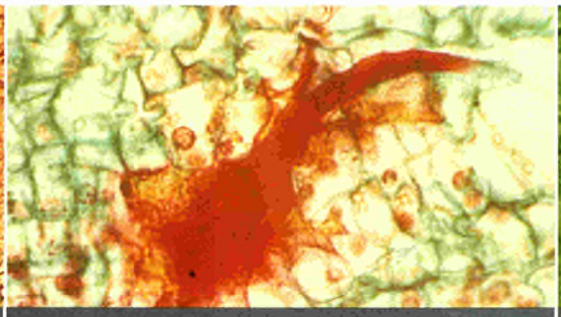


It has been shown that the doses expressed by proteinase inhibitors genetically coded in transgenic plants are not harmful to bees.
Environmental impact of transgenic plants on beneficial insects project



Research on the reaction of plants to nematodes. Shown here is the formation of giant nutrient cells in *Capsicum annuum.*

A DALMASSO/INFRA



Research on the reaction of plants to nematodes. Shown here is hypersensivity in *Capsicum annuum.*

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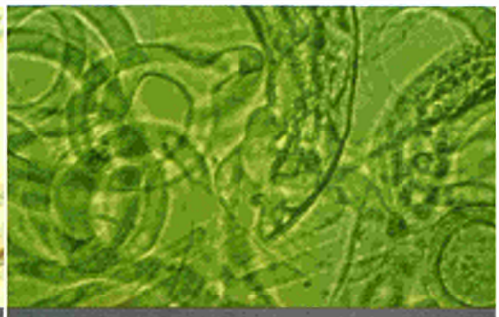


Nematode captured in the Arthrobotrys network.

© J C CAYROL/INFRA

increase the nitrogen absorption rate and thus quality and yield for a given level of fertilisation.

Similar research concerning phosphorous is also being conducted in Germany by the Max Planck Institute.[2] It seems that the citric acid secreted by plant roots increases the availability of phosphorous in the soil. When a gene governing this acid's production was introduced into the tobacco plant, the effectiveness of phosphate fertilisers clearly increased. Other research is being conducted elsewhere to develop plants with herbicidal properties. These are based on the ability – well known to gardeners – of certain plants to inhibit the growth of competitors by root secretions.

Finally, scientists are seeking to develop plants requiring less water, in particular through the use of enzymes to affect the process of photosynthesis and also by creating plants which can tolerate drought. Although these are primarily of interest to countries with limited quantities of water, they can also help reduce large-scale irrigation, a process which harms groundwater and river water quality even in regions where the resource is plentiful. Plants which are more resistant to heat or the presence of salt are also being studied, as they could benefit southern countries.

© J GASQUEZ/INFRA

Research on colza plants resistant to two different herbicides.

The war on nematodes

Research is also being conducted on a number of fronts in the fight against crop-destroying pests. One example is the development of plants which are resistant to nematodes, the very small worms (under a millimetre) present in the soil which feed on root systems. They are estimated to destroy crops worth around 80 billion euro worldwide every year.

There are few effective weapons against these pests, apart from highly toxic and not very selective chemicals, and researchers have found it difficult to decode the complex enzymatic interactions between the parasite and plant. According to Godelieve Gheysen of the Department of Plant Genetics at Ghent University (B), 'The recent cloning of genes governing the protein secretions of nematodes, and a detailed analysis of the plant's reaction, thanks to a combined effort by various European laboratories, now holds the promise of introducing resistance to nematodes in cultivated plants.' [3] A particularly intelligent and ecological response on which researchers are currently working would be to develop a nematode-destructive gene which is only activated when actually attacked and then only at the point of infection.

Some European projects *

[1] Ammonium transport in plants: strategic role in nitrogen efficiency (Euratine)
frommer@uni-tuebingen.de

[2] Phosphate and crop productivity
riesmeier@mpimp-golm.mpg.de

[3] Basis and development of molecular approaches to nematode resistance – lighe@genwetl.rug.ac.be

[4] Interactions Between Microbial Inoculants and Resident Populations in the Rhizosphere of Agronomically Important Crops in Typical Soils (Impact)
www.ucc.ie/ucc/research/biomerit/

[5] Environmental impact of transgenic plants on beneficial insects
pham@jouy.inra.fr

[6] Safety assessment of the release of transgenic crops: spread of herbicide resistance genes from wheat and foxtail millet to weedy species
henri.darmency@dijon.inra.fr

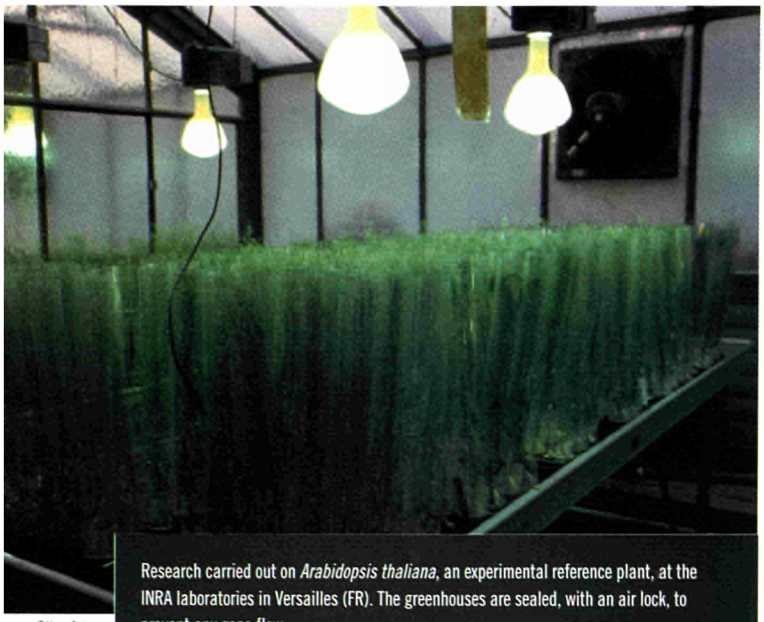
[7] Virus-resistant transgenic plants: ecological impact of gene flow (VRTP-Impact)
mark.tepfer@versailles.inra.fr

[8] Plastid transformation in crop plants – pjdix@may.ie

[9] Introducing and controlling asexual reproduction through seeds in apomictic systems and sexual crop plants (Apomixis)
www.apomixis.de/EU-CA.htm

[10] Effects and mechanisms of BT transgenes on biodiversity of non-target insects: pollinators, herbivores and their natural enemies
n.g.hogenboom@plant.wag-ur.nl

** The project numbers correspond to footnote references in the article.*



©Yves Sciama

Research carried out on *Arabidopsis thaliana*, an experimental reference plant, at the INRA laboratories in Versailles (FR). The greenhouses are sealed, with an air lock, to prevent any gene flow.

There are also a number of protocols concerned with the possible effects on the fauna and flora of the rhizosphere (the part of the soil close to the roots) of plants with a gene rendering them resistant to nematodes, insects or mushrooms.[4] The aim? To check exactly to what extent GM plants may upset these ecosystems and to compare this with the impact of traditional treatments.

The success of the Bt toxin

Better known, having already shown its worth, is the Bt toxin gene which has been successfully introduced into commercially grown transgenic plants, notably cotton and maize. This gene is obtained from a bacterium (*Bacillus thuringiensis*) which possesses natural insecticide properties that have long been used in organic farming. The toxin produced, which is harmless to vertebrates, is mainly active against larvae of the order Lepidoptera, in particular the maize pyralid (or European corn borer).

Voices have been raised in criticism of this success by genetic engineering, claiming that the increase in plants expressing the Bt toxin will favour the development of resistant insects and cause problems for organic farming as a result. This risk can be reduced by taking various utilisation precautions – precautions which must always be taken in any event when using an insecticide, whether transgenic or traditional. The effects on harmless phytophagous insects and the pollinators (in particular bees) of various plants modified with the Bt gene are also being studied.[5]

GM PLANTS - HEALTH

Harmful or beneficial?

Although not insignificant, risks to human health linked to the consumption of GM plants (or products based on them) are comparable to those present when any new cultivated plant is introduced. On the other hand, their benefits could prove considerable, even if they are still hypothetical.

WHAT could be the impact of GM plants – or certain GM plants – on health? An initial danger evoked is the appearance of harmful proteins in the plant, in certain cases the genome modification possibly having unforeseen consequences. This risk – albeit low or zero – can be managed by making a minute analysis of the modified plant's composition and by checking the stability of this composition.

The allergic risk

But this is not in any way a risk specific to GM plants. Every time a seed producer develops a new plant variety, whether by crossing or selection, he risks introducing a toxicity.

The same can be said of the allergic risk (linked to the above), which is often raised in relation to transgenic plants. This risk exists and justifies caution. For example, when a gene from the Brazil nut was recently introduced into soya, this proved to be allergenic and was consequently never marketed.

As the FAO stresses in its position on GM plants: 'All products that contain allergens, irrespective of their origin, should be managed similarly – for example by labelling – to ensure the consumers' right to informed choice and the possibility to avoid allergens in foods.'

Many plants which can be the source of sometimes lethal allergies (such as the groundnut – peanut – for example) are in fact freely on sale.

Gene flows

At the same time as this research to create economic – or ecological – plants, a number of projects are seeking to assess (and reduce) the supposed risks associated with introducing GM plants into the environment. Many studies are being carried out on gene flows, for example.

The ability of genes to 'escape' into the wild is a legitimate public concern. It is known (thanks to experiments carried out in the early 1990s with European funding) that genes carried by pollen can be transmitted to related plants, at least within a radius of several dozen metres. But this has only been confirmed for a few species, in particular rape and beetroot.

Research is now trying to quantify these flows for other species, in particular corn and millet.[6] Attempts are being made to assess the impact of certain genes if they were to enter the fields. Would this result in the appearance of resistant pests and 'super weeds'? Would they progressively disappear into the environment, by means of genetic dilution? And what factors could tip the balance one way or the other?

Nine European laboratories are working on the VRTP Impact project,[7] which is trying to determine the effects of gene flows caused by cultivating transgenic virus-resistant rape and beetroot. Will this resistance be passed on to wild plants? Will we see the appearance of new viruses resulting from recombinations? All these questions are rarely asked when a new pathogen-resistant variety is introduced that is not the result of genetic engineering. 'In general, transgenic plants are clearly studied with a meticulousness which has never been applied to traditional plants,' believes co-ordinator Mark Tepfer of INRA (Versailles/FR).

Biological confinement

Researchers are also trying to reduce, or even render impossible, gene flows by means of 'biological confinement', given that physical confinement is an impossibility under normal farming conditions. A number of techniques are being studied.

One of them would be to introduce the genes not into the core of the plant cells but into their plastids. These are small 'bags', the most familiar of which are the chloroplasts (containing chlorophyll), which contain a small but functional DNA. When one plant is fertilised by another, the embryo contained in the seeds only contains the plastids of maternal origin, as the pollen (from the paternal plant) does not normally enter these structures. 'This method reduces the risks of dispersion by the pollen and provides a natural confinement of the transgene,' explains Irish co-ordinator Phil Dix. [8]

Other avenues are also being explored, often related to so-called GURT (Genetic Use Restriction Technique) technology – better known under the brand name Terminator. This latter innovation is a typical example of a commercial approach which failed to take account of the socio-economic impact of developing GM plants. As a result it bears much of the responsibility for the way they have been 'demonised', causing much controversy and a climate of suspicion. This process causes the plant to produce seeds which do not germinate. Although this enforced sterilisation raises various economic and ethical problems in connection with its dissemination in the Third World, it is undeniably effective in terms of gene flows.

Among other approaches, that of apomictic systems seems particularly interesting.[9] This is the ability of various wild plants (including some very common plants, such as the dandelion)

Production plots for fescue grass (clarine variety).

© M.NIQUEUX/INFRA

'Pharmafood' plants(1)

GM plants could nevertheless provide a means of significantly improving human health, first of all by supplying better quality food. Plants could be deprived of their most harmful ingredients (such as lipids which are bad for cholesterol) or enriched with molecules of nutritional benefit, the latter of particular benefit to southern countries. European laboratories recently developed a 'golden rice' enriched with carotene. This molecule is a precursor of vitamin A and could therefore help correct the nutritional deficiencies affecting millions of people. Another example is research aimed at increasing the lycopene content of tomatoes. This molecule has beneficial anti-oxidising effects which reduce the risk of prostate tumours.

Finally, transgenic plants would appear to offer very extensive possibilities in the pharmaceutical field. Many therapeutic proteins could be produced by genetically modified plants. This is also the case for various contraceptives of the oestrogen family, and even for human haemoglobin which researchers are trying to obtain from tobacco. The antibodies or planticorps manufactured by plants could reduce production costs by a factor of 1 000 while safeguarding the consumer against any fear of being infected with a prion-type animal pathogen. Trade agreements have also been signed for the production in transgenic potatoes of vaccines against hepatitis B. All of which is no doubt just a beginning.

(1) A neologism resulting from the combination of the two words pharmaceutical and food.

Food safety

Entransfood project (European network safety assessment of genetically modified food crops) – www.entransfood.com/

to produce seeds without being fertilised, thus independently of any pollen. These seeds germinate and naturally form clones of the mother plant. A number of genes which control this surprising characteristic have been isolated and ways of introducing them into cultivated plants are now being studied. This technology has all the benefits of the *Terminator* technique (no gene escape as the pollen is absent or sterile) but without the drawbacks as the farmer can replant his seeds without having to buy new ones. The operation is even beneficial as there is no loss of quality, as is often the case with present seeds.

Confronting the complexity

'There is a clear tendency to study systems of growing biological complexity,' stresses Mark Tepfer, alluding to another project [10] which proposes to 'explore the interactions within a *triple layer* system, involving a plant, a herbivorous insect, and a predator or a herbivore parasitoid, so as to study any negative effects of the transgenic plant on the predators.' These effects necessarily exist as the aim of the plant is precisely to stop the proliferation of populations at the intermediary layer. It is however interesting to look at the difference between a plot where traditional pesticides are used and another with plants which are genetically resistant to certain pests. 'The trend is for impact studies to be comparative, as any agricultural activity inevitably upsets the ecosystem it replaces. The invertebrate fauna of a field of maize is clearly not the same as that which inhabited the site in its natural state.'

GM plants against pollution

Arabidopsis halleri is a plant which tolerates heavy metals. When genetically modified, it is able to clean up contaminated soils.

A monitoring role – A Swiss team has succeeded in genetically modifying Arabidopsis plants so that they can be used to detect to what extent a given environment favours genetic rearrangements – in other words mutation. Plants growing close to the site of the Chernobyl nuclear plant showed a dense pattern of blue stains (visible to the naked eye) indicating radioactive soil. It is difficult to imagine an easier or cheaper test to detect the presence of radiation or chemical products favouring mutation.

Phytoremediation – A number of projects are trying to demonstrate that transgenic plants could also play a purifying role. Researchers on the Metallophytes project have shown that certain plants are able to grow on sites contaminated with heavy metals and contain some of these pollutants in their tissues.

Another idea is to identify the genes associated with tolerance to metals to introduce them subsequently into Festuca. These Graminacae with a deep root system and high biomass readily lend themselves to genetic engineering. Genes have also been added to them which trigger acid secretions by the roots to promote the release of metals trapped in the soil. The plants charged with metals are then periodically harvested and treated. Another project, co-ordinated by Ulrich Karlson at the National Environmental Research Institute of Denmark, is endeavouring to develop and test the internal bacteria of plants able to degrade the principal pollutants.

Green raw materials – Genetic engineering is also trying to provide industry with a number of 'greener' raw materials. Poplars that are genetically modified to produce less lignin reduce both pollution and the cost of removing it from pulp. Research into transgenic rape is also aiming to provide industry with fuel or lubricants which do not deplete fossil fuel reserves, nor – as a result – add to the greenhouse effect.

Metallophytes – An integrated approach towards removal by plants of toxic metals from polluted soils – biobase.dk/%7Epalmgren/metallophytes.html
Endegrade – Endophytic degrader bacteria for improving phytoremediation of organic xenobiotics – www.dmu.dk/1_viden/2_Miljoe-tilstand/3_jord/4_endegrade/
Mycorem – The use of mycorrhizal fungi in phytoremediation projects – www.uni-koeln.de/math-nat-fak/botanik/bot2/agbothe/mykorr/euproj.htm

Man and nature

©UCL

Bernard Feltz
Professor of science philosophy at the University of Louvain (UCL)

An inert matter, at man's disposal to manipulate and control at will. This Cartesian vision of nature prevailed until very recently. But we now know that we are part of the earth's ecosystem – and our very existence depends on it. Nature has therefore become inherently 'respectable'. At least this is the view of Bernard Feltz, a science philosopher at Louvain University (UCL).

Man has become aware that he is part of the Earth's ecosystem. He knows he shares a great many of his genes with organisms as 'primitive' as yeast. Does this mean that, partly due to science, he must rethink his relations with nature?

We are in a phase of major cultural change in terms of the relationship between man and nature. This is occurring within the field of science itself. If we look back, we see that, until the 19th century, physics was the mother science, the archetype of *scientificity*. Physics was founded on a kind of reification of nature, one corresponding to the mechanistic view of Descartes. For Descartes, the archetype of the living creature is the automaton in which the arrangement of the parts explains its functioning. The animal-machine and the concept of the body-machine of man corresponds to this vision. But the human being possesses a soul and a body, and this dualism places it 'outside nature'. From a Cartesian point of view, the human being alone is worthy of respect and science aims to achieve total mastery of nature, in the service of man. You want to cross a mountain? Then you build a tunnel. Nature is there to be overcome. This notion of conquest is deeply rooted in our Western culture where, very often, the aim is to leave one's mark, to appropriate a part of nature.

Molecular biology showed in a sense the pertinence of the mechanistic point of view in discovering that DNA was both a chemical product and the basic structure permitting an understanding of the whole structure of life. Most researchers working in the field of molecular biology adhere to this Cartesian conception of man's relationship to nature.

Does this mean we have scarcely changed our view since Descartes?

No, because our age is also the age where we are becoming aware of ecological problems and which has given birth to the concept of the ecosystem. Scientific ecology analyses interactions between human activities and the environment. The human species thus becomes a species like any other and we seem to be rediscovering a kind of *animality* in what constitutes a human.

In this way, evolutionary biology considers that man is the product of evolution and that human history is part of animal history. As for the neurosciences, they bring the prospect of a naturalisation of consciousness. When biologists of consciousness study the relationship between the brain and behaviour, they even speak of an animal consciousness, believing that consciousness itself is the result of an evolutionary process with well-defined stages. Man may have achieved a superior level of consciousness, but it is the result of a process which extends animal consciousness.

If, as a member of the ecosystem, human beings are just one of many species, could we not hope to see man's attitude to nature change, moving from one of domination to one of respect, for example?

'A plant or animal species is respected for what it is, independently of its function within the ecosystem, quite simply because it is a product of nature resulting from millions of years of evolution.'

The concept of nature can be significant in a number of ways. The minimal position expected would be for man to adopt a rationale for the survival and sustainable management of ecosystems. That is a minimal form of respect. However, as part of this same desire for sustainable development, should we fight to save species on the verge of extinction? From an ecological rationale of a strictly utilitarian nature, one could consider that the earth's ecosystem can survive perfectly well without the panda, the famous symbol of the WWF — unless perhaps we consider the need to maintain a certain degree of diversity in gene pools.

We move to a higher level when we consider that these threatened species must be protected for themselves. A plant or animal species is then respected for what it is, independently of its function within the ecosystem, quite simply because it is a product of nature resulting from millions of years of evolution. When you protect a work of art, you do not do it because it is worth 5 million euro, but because it is a work of beauty.

So this notion of beauty is also present in nature then?

There is certainly a relationship with the environment, which includes an evolutionary dimension and an aesthetic dimension. The increasingly recognised importance of landscapes has such a connotation. A lot of people smile when you speak of aesthetics, when in philosophy, since the time of the Greeks, the three major universals have been the true, the good and the beautiful.

But it is not because you introduce this dimension that you fall prey to Deep Ecology, a way of thinking which denies man's special characteristics and sees him as just another creature. More than that, man becomes a dangerous element which, like a cancer, is developing in an abnormal way within the host body. Nature has to be admired and not touched – it is the virgin forest. This leads to the impossibility of action, an impossibility of intervention which is untenable.

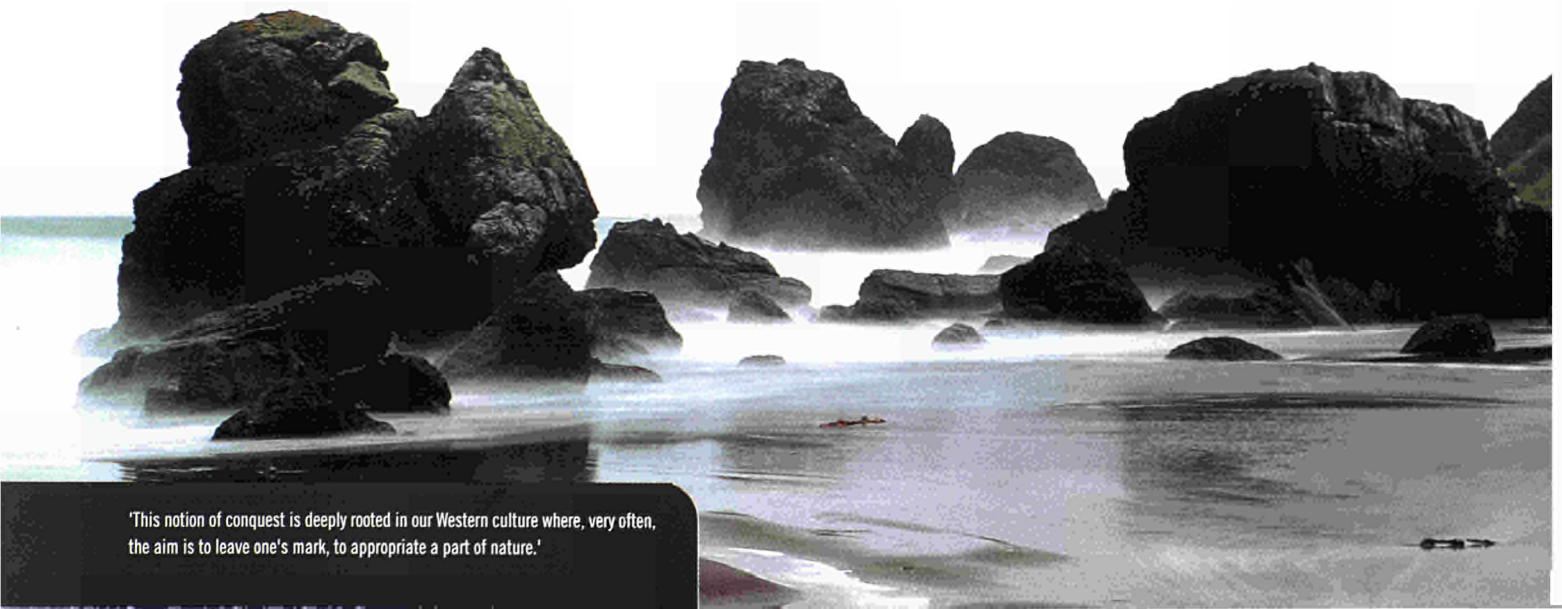
But how can one be sure that man's action on nature is 'tenable', or will not have a damaging impact?

The philosopher Jean Ladrière developed, at the theoretical level, the concept of critical science, that is a knowledge which tries to be attentive to the limits of its formulations. The critical moment is when you suspend your judgement and analyse. The practical equivalence of this idea lies in the notion of reflexive modernisation. It is no longer a question of following a purely voluntarist logic, but of reflecting on the implications of innovation before it becomes generalised.

Is this is where the precautionary principle appears and the experts come in?

The notion of the expert presupposes a possible neutral discourse on the part of science. The problem is that there are cultural differences within the scientific world. The relationship with nature very often depends on the particular discipline. These differences in fact have a decisive impact on the way in which committees of experts can be set up. In the case of GMOs, for example, one could imagine that a discussion solely among molecular biologists would produce few conflicting views. But if you include somebody concerned with the dynamic of populations in the evolution of ecosystems, the debate would be different.

Furthermore, all laboratories depend on the funds they receive for their research, a fact which clearly limits freedom of study. If we look at GMOs for example, the most able scientists in a field very often have contracts which enable them to work on this issue. Their room for manoeuvre in adopting a public stance is therefore very limited. This type of functioning reduces the scope for achieving a really open public debate. It is therefore essential to have genuinely interdisciplinary debates, at both the theoretical and institutional level, to permit a certain independence from the producers.



'This notion of conquest is deeply rooted in our Western culture where, very often, the aim is to leave one's mark, to appropriate a part of nature.'

Veleta Peak (Sierra Nevada, Spain) – One of the sites studied by the PACE researchers.

The permafrost is melting

Could the subsoil of high mountain areas 'melt'? Yes, and the result may be an increased risk of landslides with extremely damaging consequences. The culprit? Climate warming. The EU's PACE project is now hard at work developing the analytical tools to avoid the potential dangers stemming from this melting of the permafrost.

Borehole, meteorological station and data recorder – Stelvio Pass (Italian Alps).

FLOODS, storms, desertification, rising sea levels... It is now time to add to this list of harmful effects of climate warming a less frequently mentioned threat to high altitude areas and certain mountainous regions in the far north. 'In the summer months, although the so-called active layer of soils at high altitude melts on the surface, the ground beneath remains frozen, forming what is known as the permafrost. This underground foundation, made up of earth, sediment or frozen rocks as hard as concrete, suffers directly from the effects of warming, producing a serious risk of destabilising these steeply sloping landscapes,' explains Charles Harris of the Department of Earth Sciences at Cardiff University (UK), the co-ordinator of the Permafrost and Climate in Europe (PACE) project. (1)

Permafrost is found all over Europe, in different soil types, and at altitudes that vary with the latitude. In the mountains of Scandinavia, it is found above around 1 500 metres, in the Alps above 2 500 metres and on the peaks of the Sierra Nevada above 3 000 metres. On the island of Svalbard, in Norway's high arctic region, permafrost can even be found at sea level.

Disaster scenario?

Mountain permafrost is sensitive to warming because the average temperature in the subsurface frozen layer is only just below 0°C (minus 2°C or minus 3°C in places) and, if the frozen ground contains large quantities of ice, the ice may act as a binding agent. Should this binding agent liquefy, the whole mass becomes fragile and, under the force of its own weight, can slide down steep slopes. Furthermore, in some areas climate warming could produce heavier snowfalls in winter. In such cases, the effect of warming in summer would combine with the insulating effect of the snow cover in winter to impede the natural reconstitution of the permafrost.

Drilling samples from the Southern Alps in the mid 1980s, at Murtél-Corvatsch, close to the Saint-Moritz ski resort, showed an increase over the previous 15 years in the average permafrost temperature at a depth of 11 metres which was already close to 1°C. In the medium term, any melting of the permafrost in certain regions can only result in an increased frequency of natural disasters (landslides, rock falls or floods due to blocked river beds) and a less secure foundation for buildings and infrastructure.

It is the vast Alpine skiing regions that are most exposed to this threat. 'The slopes are very steep there, with villages, railways and roads located at high altitude. If the permafrost beneath these constructions were to deteriorate, the damage would be considerable. Future construction of new facilities must take into account the potential hazards associated with permafrost degradation. In Scandinavia, where the population density is less, the risk is not as high.'

Under close observation

Last March, in Rome, more than 120 scientists from all over the world attended the First European Conference on Permafrost. At the meeting, organised by the PACE project, the results of a European study were considered in the context of the newly established Global Terrestrial Network for Permafrost (GTN-P) organised as part of the World Meteorological Organisation's (WMO) Global Climate Observing System (GCOS) – a worldwide climate surveillance programme. Launched in December 1999 under the auspices of the European Union, the PACE project established a European Mountain Permafrost monitoring network based on deep instrumented boreholes, to study the distribution of permafrost in the mountains of Europe and to

measure its behaviour in the light of climate warming. Specific key objectives included identification of high-risk zones in specific geographical areas, monitoring their development and recommending strategies to reduce the risks associated with this sensitive permafrost terrain.

Under the PACE project, Earth science experts from seven countries carried out their observations at a series of selected sites in Norway, Sweden, Switzerland, Germany, Italy and Spain. In each case, 100-metre-deep boreholes were drilled to analyse the state and structure of the subsoils in their various configurations, and to install thermal sensors to monitor temperatures within this section of the permafrost. This monitoring will continue for many decades, and will provide an early warning of future temperature rises within the European mountain permafrost zone. The data obtained from these boreholes provides valuable information not only on the impact of future climate change, but also on the scale of changes that have occurred in the recent past.

In the laboratory, scientists from the Geotechnical Centrifuge Laboratory at Cardiff University developed centrifuge modelling techniques applied to soil samples to simulate the effects of permafrost on slope stability. This team worked on a wide range of soil varieties to evaluate, on a case-by-case basis, the risks of landslides. A second centrifuge modelling team based at the University of Dundee has investigated the destabilisation of frozen rock slopes by the warming effects of climate change.

Modelling of the distribution and structure of permafrost around monitoring sites in the Swiss Alps.

The Murtél-Corvatsch permafrost monitoring site (CH).

© Ketil Isaksen, Université d'Oslo

Permafrost drilling at Janssonhaugen (Svalbard – Norway) in May 1998. The borehole is now equipped with thermistors placed at intervals to a depth of 100 metres.

Distinguishing passing from permanent change

'One of the major difficulties encountered by climatologists is, in fact, to distinguish between the effects of transient increases in temperature and the effects of an overall upward trend. Variations in surface temperature cause disturbances in the geothermal gradient of the permafrost mass, the traces of which can persist for decades or even centuries. The researchers were able to show that, at all the PACE sites, the observed warming of the frozen layer corresponds to a temperature increase of between 1°C and 2°C at surface level over the past 100 years.'

The researchers also used geophysical and geomorphological surveys to map the distribution and character of permafrost around the boreholes. This work included study of the electrical characteristics of the terrain, and the velocity and refraction of seismic waves. In addition, earth movements associated with the permafrost terrain have been monitored.

Major concerns

In the light of the now proven and well-documented geological risks, scientists are concerned at the prospect of further temperature change in this frozen sublayer. The latest predictions of rises in the Earth's average temperature are increasingly categoric – the IPCC recently announced an upwardly revised figure of between 1°C and 6°C. 'There is no large-scale solution, apart from halting climate warming. The detection tools we have developed can only identify zones of potential risk. This will allow such zones to be avoided by future developments, and special engineering measures designed to ensure that permafrost degradation does not cause unforeseen damage and danger to life and property.' The incorporation of the PACE project data in prevention policy should give concrete shape to such ideas. ◗

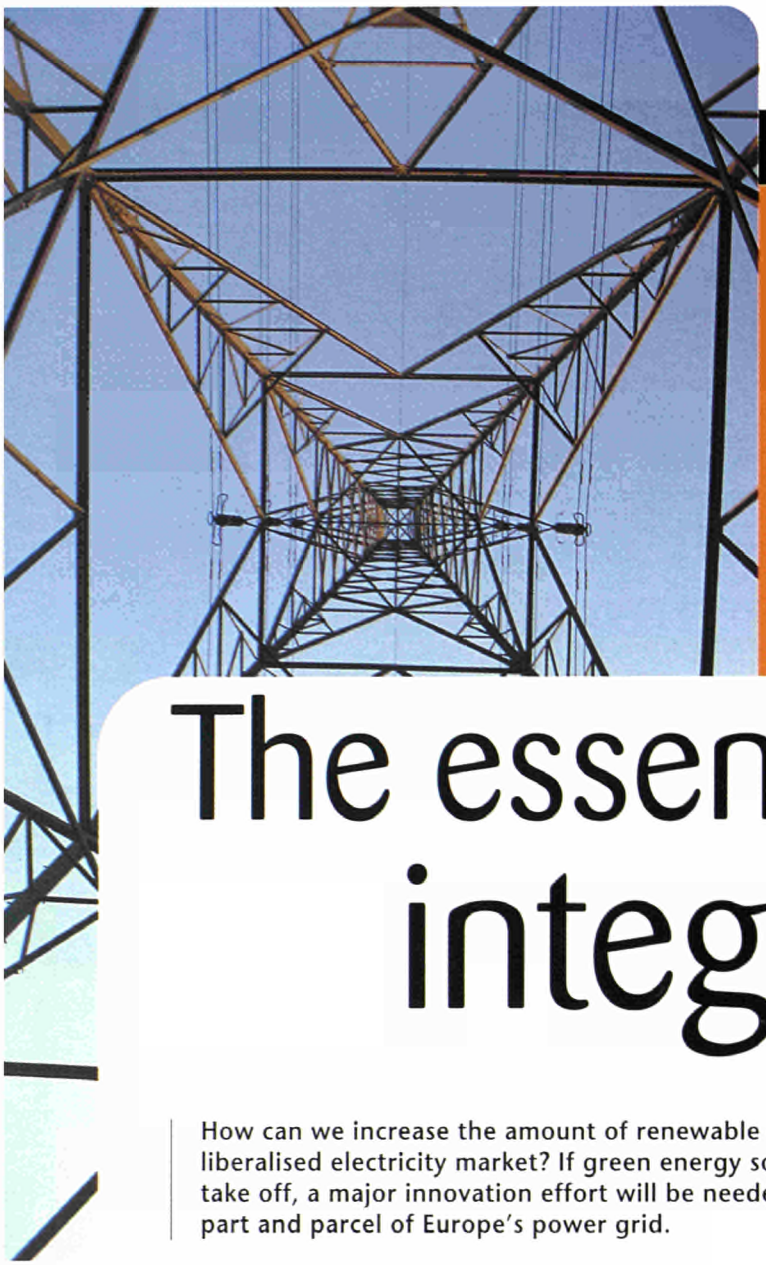
(1) All quotations from Charles Harris

Contacts

Charles Harris
harrisc@cardiff.ac.uk
Denis Peter
denis.peter@cec.eu.int

Internet site

http://www.cf.ac.uk/uwc/earth/pace/



'Renewable' tariffs

The Electricity Tariffs and Embedded Renewable Generation project is looking at the delicate issue of charges for energy that is produced on a decentralised basis. 'Decentralised energy production has a certain advantage. It is closer to the consumer, which permits savings in the electricity transport and distribution infrastructures,' explains its co-ordinator, Goran Strbac. 'But the present market organisation does not allow this benefit to be passed on to the consumer.' A significant conceptual contribution by the project has been to develop a framework for a cost-benefit approach to energy planning and tariffs.

strbac@fs5.ee.umist.ac.uk

The essential integration

How can we increase the amount of renewable energy sold in a liberalised electricity market? If green energy sources are to take off, a major innovation effort will be needed to make them part and parcel of Europe's power grid.

THERE can be no sustainable development without increased use of renewable energy resources. That is the maxim – now strengthened by the threat of climate warming – which has guided European energy policy for the past 20 years or more. The Union's objective is to boost the share of renewables to 12% of total energy consumption, or double the present level.

'There was an initial failure to fully gauge the extent of the problem,' believes Michel Crappe, a professor at the Electrotechnical Laboratory at the Faculté Polytechnique de Mons (B). 'To achieve a more sustainable energy model it was thought to be enough to make more efficient windmills, develop fuel cells and promote cogeneration. But if you want renewable generation – which by its very nature is highly decentralised – to become an increasingly competitive resource, then it must be integrated into the global electricity distribution system.'

The problem is that the logic of this system, being based on very large nuclear or fossil-fired plants generating upwards of 1 000 MW apiece, is the very opposite of that of renewable energy production. Connecting a very large number of small power plants – ranging from just a few dozen kW to 150 MW – to such a system is rendered all the more difficult as the power produced from sources such as the wind or sunlight inevitably fluctuates a lot.

Electrical solidarity

In an electricity distribution network it is essential for all the sources to operate at the same 'electrical speed' – the famous 50 hertz alternating current standard for which all European mains devices are configured. If a 1 000 MW power plant fails, the overload imposed on the other generating sources causes them to 'go slow', and this threatens the synchronisation of the network.

'Electricity is not a commodity like any other because it cannot be stored on a large scale, so supply must match demand at all times,' explains Michel Crappe. 'That's why we have interconnected our networks throughout Europe, from Stockholm to Lisbon and from Dublin to Vienna. This enables us to deal with consumption peaks and supply failures.'

This *electrical solidarity*, now centralised and fully automated, must not last longer than 15 minutes, as otherwise there is the risk of contagion as the strain is passed on to other parts of the system. This quarter of an hour allows the affected network to take the necessary measures to restore its autonomy, either by starting up reserve generators or disconnecting part of the network (some companies agree to be occasionally cut off in return for special low rates). These electricity trade-offs between the countries of the UCTE (Union for the Coordination of Transmission of Electricity) reached 173 TWh (terawatt-hours) in 1999, which is 8.4% of Europe's total electricity output.

Added complexity

Plant and equipment (generators, high-tension lines, transformers, circuit breakers, etc.), computer systems, control procedures, regulations: everything must be designed in accordance with the network structure, within which the location and power of the generating plants are carefully planned. The loads within this enormous grid are balanced by remote control from a central unit.

Decentralisation adds to the complexity of such an architecture, owing to the small size of the units. In the case of renewables, the geographical location of the generating plants is no longer determined by the network's overall needs, but according to local demands and the geographical availability of the resources, whether wind, sun, biomass or rivers. What is more, the fluctuating nature of these sources means that the networks must be able to absorb the decentralised production when it is active, and draw on alternative supplies when it is at rest.

As long as renewable energy sources make a negligible contribution to a system, these fluctuations are not really a problem. But above a certain threshold, managing the balance between production and consumption becomes difficult. The Danes, who are at the forefront of wind power, estimate this crucial threshold to be 20%. Above this, a probability-based approach to system management must be adopted, as well as great flexibility in the power flow between the centralised and decentralised parts of the network.

Research

Apart from the network operation design itself, the integration of renewables requires many specific technical adjustments. 'The lack of standardised interfaces between the decentralised production units and the distribution network is a particular problem,' explains Manuel Sanchez Jimenez, a scientific officer at the Research DG. 'Managing their integration also requires some major, complex computer developments.'

The Commission recently signed a research contract with 37 European companies and laboratories. Known as *Dispower*,(1) this four-year project represents a total investment of euro17 million. It aims to support the decentralisation of the electricity market on the basis of new knowledge and new technological developments. Its objectives include the development of hardware and software for the optimum functioning of a large number of decentralised electricity generators, the agreement of strategies for network stability and control systems, the creation of infrastructures to carry out life-size pilot tests, and training for electricity network operators.

Another aspect of research is focusing on the most promising new technologies for the storage of energy from intermittent sources. The *Investire*(2) network, for example, comprises 35 European companies and laboratories working in this field. 'To date, it is lead batteries which are most widely used for storing electricity, mainly of photovoltaic origin, as they provide best value for money,' explains Paul Lucchese (CEA – France). 'But new avenues are being explored, both in the form of electrochemical accumulation – lithium or nickel batteries which have shown their worth in portable electronics – and by using the energy to electrolyse water, producing hydrogen which can be stored and then generate a current in fuel cells. It is also possible to store the energy in supercapacitors, in flywheels or by compressing air.'

(1) Distributed Generation with a High Penetration of Renewable Energy Sources
(2) Investigation of Storage Technologies for Intermittent Renewable Energies

On the Web

Association of European Transmission System Operators (ETSO)
www.etso-net.org/
Cogen Europe
www.cogen.org/
European Renewable Energy Centres Agency (EUREC)
www.eurec.be
Union of the Electricity Industry (Eurelectric)
www.eurelectric.org/
Union pour la Coordination du Transport de l'Electricité
www.ucte.org/

Diary

The Research DG is holding a conference on the Integration of Renewable Sources and Distributed Power Generation in Energy Systems on 25 and 26 September in Brussels.

Contact

Manuel Sanchez Jimenez,
Research DG
manuel.sanchez-jimenez@cec.eu.int

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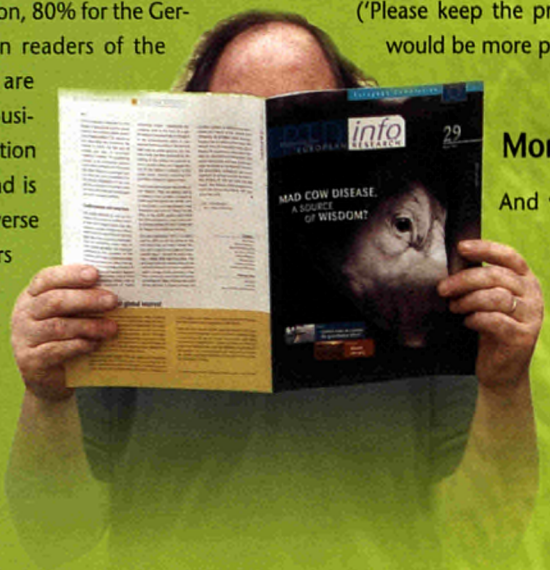
Snapshot of a magazine

Who reads *RTD info*? What do they think of it? What changes do they want to see? What purpose do they think it serves? Has it reached all its potential readers? In short, what is *RTD info* doing right, and what is it doing wrong? A questionnaire included with issue 29 (April 2000) answered these and other questions. Setting aside any false modesty, the overwhelmingly positive comments are as encouraging as they are constructive.

WITH a print run of 82 000 (compared to 48 000 in 1997), *RTD info* is distributed in 137 countries.(1) Most of its subscribers are in the United Kingdom, France, Germany, Italy and Belgium. The English version leads the field (47%), with the French (29%) and German (24%) versions virtually tied.

Who reads *RTD info*? Insofar as a poll based on just under 700 voluntary replies can reflect the true picture, its readers are aged between 32 and 61 (68% of respondents) and are predominantly male (82% for the English version, 80% for the German version, but with 32% women readers of the French version). The vast majority are involved in research, education or business and have a high level of education (41% have a doctorate). But the trend is for the readership to become more diverse and younger: 56% of new subscribers recorded over a three-month period (November 2000 – January 2001) were students and non-specialists.



A tool to be shared

This trend reflects a need. '*RTD info* is a very useful resource for my courses,' believes one teacher. 'I also circulate it among parents so that they can have a better understanding of the world around them.' One German reader suggests that copies should be sent to all secondary school students in his country. Another suggestion is to print a special annual edition explaining European research to children aged between ten and 12 years.

The special issues seem to go down very well (with a call for more), as do the 'big subjects'. Hedging between the long and the short, readers are most critical of the features on the one hand and the 'news in brief' – on the centre pages – on the other. Researchers appreciate the practical information such as the list of calls for proposals and contacts with e-mail addresses, and they use them frequently.

Most readers have a personal subscription, but share their magazine with other people (each issue being seen by an average of 4.8 persons) or send a PDF version to colleagues or students. There is a very broad consensus in favour of the paper version ('Please keep the printed version!'). The Internet edition would be more popular if it developed more services.

More of this, more of that...

And what about the magazine's general image? It is seen as a 'different' kind of European publication, with a serious content but at the same time attractive and readily accessible to the lay reader. A useful complement to other science magazines, the mix of precise writing and illustrations is much appreciated. But that does not mean there are no suggestions for improvement. Some would like more attention paid to certain fields of science or technology, or European research analysed within a more global context. Others would like to put more emphasis on practical information, with graphs, project results and management developments. At the same time there is a demand for more interviews with researchers and intellectuals in the interest of a deeper and more diverse investigation of the questions raised by science. Another suggestion is for reports in the form of a 'guided tour' of large laboratories, plus increased attention to research in Central and Eastern Europe.

More of this, more of that: it would certainly take some pages to please everyone! Nevertheless, the large number of highly constructive comments received provides valuable food for thought which will certainly help *RTD info* improve further.

(1) 60% of the copies are distributed to subscribers, the rest being given out by the Research DG at various events and meetings, and circulated within the Commission itself.

How the survey was organised

685 readers answered a questionnaire included with *RTD info*. Their comments came from throughout the European Union (principally Germany, France, Belgium and the United Kingdom), but also from as far afield as Canada, Iran, Iraq, Uganda and Malawi. To complete the picture, 19 in-depth interviews were carried out in the field among 'non-respondents' in various EU countries (IT, FR, BE, UK, IRL, GR, NL). Finally, a number of telephone interviews were carried out with readers in Central and Eastern Europe (Bulgaria, Hungary, Poland, Slovenia).