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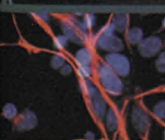
MAGAZINE FOR EUROPEAN RESEARCH

32

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INVENTING THE CAR OF THE FUTURE



STEM CELLS

Promises and
precautions



Society

A plural
Europe

Editorial

The dark side

The recent terrorist attacks and accidents have again cast the spotlight on what may be called the 'dark side' of progress. They serve as a cruel reminder that behind the benefits and opportunities of technology, there also lurk dangers and constraints.

Perhaps most surprising is that – despite the dramatic accidents which in recent years have dispelled the myth that 'technoscience' is infallible – on each occasion our societies seem to discover anew the existence of these dangers and risks which are particular to, if not inherent in, technology.

Is it the omnipresence of technology which causes us to ignore such matters? Is it a communication problem? Or one of culture? Unless it is quite simply a real ignorance of what technology is all about? A Eurobarometer survey published by the Commission shows that 45% of Europeans say they are neither knowledgeable about nor interested in science and technology.

But what changes we have seen in recent years! Along with a formidable increase in computing power, the global convergence of technologies witnessed at the end of the last century placed a limit on our command of them. We saw this with the year 2000 bug: this microscopic – even anecdotal – error took on, through the networks, an exaggerated importance which was only countered by considerable, if not ridiculous, investments!

The combination of technologies means the combination of their weaknesses. The globalisation of technology brings a globalisation of its effects. For better or for worse, as what will be perceived in one place as a benefit or progress will be perceived elsewhere as a disadvantage or decline.

An invention such as the Franklin lightning rod had only a limited effect in time and space. This is no longer true of today's technology. This is why technology and its risks need to be managed internationally. But even this is not enough.

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DOSSIER Automobile industry

The car is much more than a symbol of freedom and mobility. It also pollutes the atmosphere and consumes energy. Urban traffic reduces the quality of life and creates stress. Road accidents kill, injure and maim. In an attempt to combat these negative aspects of the motor car, research and industry are now pooling their efforts. Their goal is to develop cleaner, safer, more fuel efficient and *intelligent* cars. An in-depth look at the latest developments in the field.

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Managing editor: Jürgen Rosenbaum

Editor in chief: Michel Claessens

Tel: +32 2 295 9971

Fax: +32 2 295 8220

E-mail: research@cec.eu.int

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Stem cells: promises and precautions

Just three years after having been isolated in the human embryo and grown in culture, stem cells are now a very 'hot topic' among biologists. There is scarcely an international congress where the corridors are not buzzing with talk of the latest developments. Outside specialist circles too, in the world of media and politics and among the heavyweights of research and the pharmaceutical industry, fascination is growing at stem cells' surprising properties. But what is the reason for all the fuss? Quite simply, stem cells are the fundamental raw material on the basis of which all human organs develop – which means they hold the key to completely new kinds of treatment in the field of regenerative medicine.

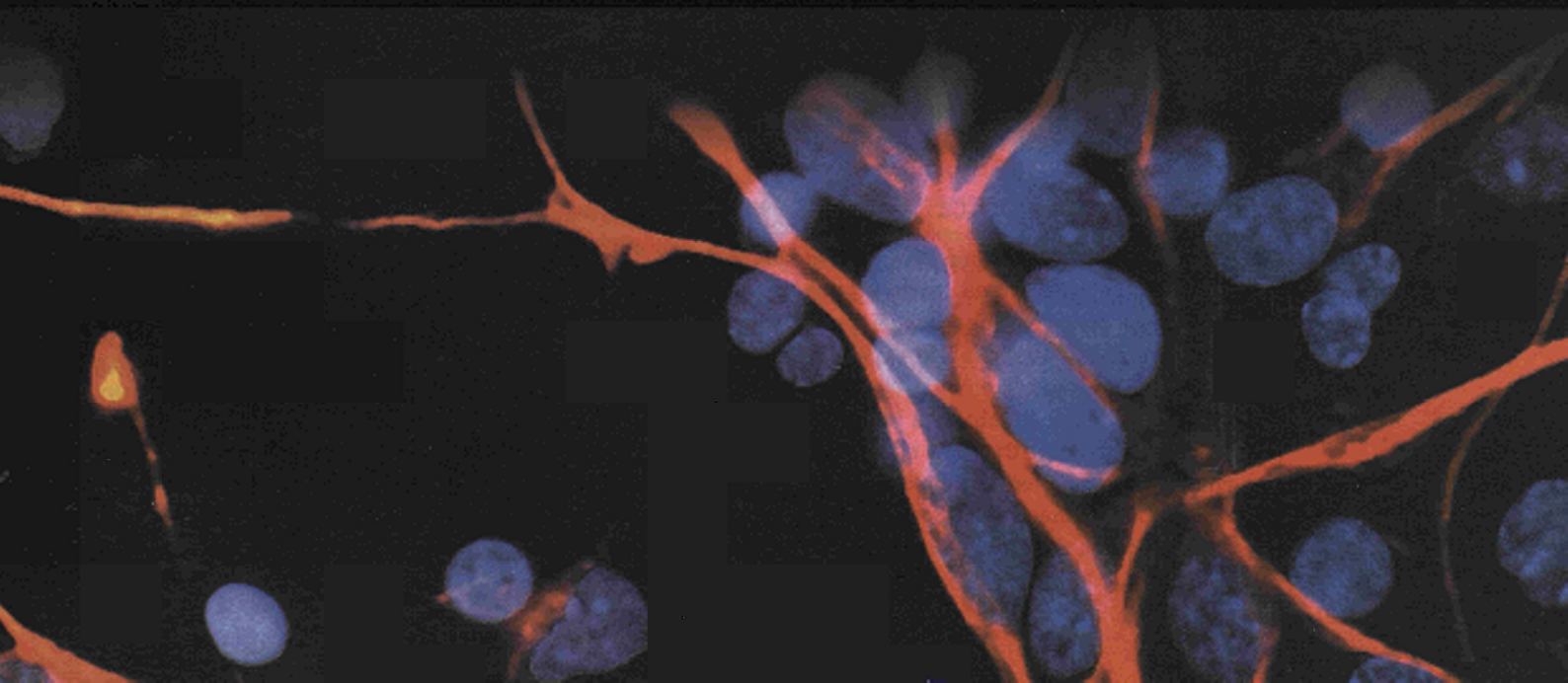
The list of diseases which potentially could be treated following developments in this emerging discipline is as long as it is varied. It ranges from certain kinds of diabetes – caused by lesions of the pancreas – to strokes, including cirrhosis and other liver diseases, hereditary immunodeficiencies (bubble children), cancers, Parkinson's and Alzheimer's diseases, and autoimmune diseases such as multiple sclerosis or *lupus erythematosus*.

Along with new hopes, a number of scientific and ethical questions are also being raised. The study of stem cells is still very much in its infancy and an enormous research effort is required. This immediately poses problems of priorities. This

sudden 'newcomer' on the treatment scene – which could produce its first applications in the relatively short term – is, in a sense, in competition with genomics, hitherto also the subject of very high hopes, but whose applications are likely to take a considerable time to develop.

As to the ethics of the matter, the use of stem cells is at present largely dependent on the possibility of using human embryos and raises the question of the legitimacy of so-called therapeutic cloning. Other sources of supply could possibly provide an alternative – such as blood from the umbilical cord or adult stem cells – but these fields of research remain largely unexplored territory.

Stem cells are now a subject of debate at European Union level. While determined to be actively involved in this very promising scientific field, the Union is nevertheless very aware of the need to respect the rules of prudence and ethics demanded by the general public. For this reason, the European Commission invited scientists, industrialists and politicians to attend a major forum in Brussels on 18 and 19 December 2001, entitled *Stem cells: therapies for the future?* The event is aimed at a cross-section of civil society, including specialists in the human sciences, lawyers, patients' associations, interest groups, students and teachers, educators and the media.



Stem cells are a double exception to the rule of cell specialisation – hence their interest. Not only are they able to reproduce identically (and exceptionally quickly) throughout their lives but, more importantly, they are able to differentiate to form several (sometimes in very large numbers) distinct cell types.

An exceptional

To find out more

Many stem cell links are accessible from the following address:
<http://europa.eu.int/comm/research/quality-of-life/stemcells/links.html>

These include educational sites permitting a better understanding of the fundamentals and context, research sites for news of the latest developments, information on ethical and legal debates, and articles from leading international newspapers. All in all, a mine of information.

Information

For more information on the conference which was held on 18 and 19 December 2001, organised by the European Commission, visit the site:
<http://europa.eu.int/comm/research/quality-of-life/stemcells.html>

At birth, human beings are made up of approximately 100 000 billion cells belonging to around 200 different categories (nerve, muscle, secretory, sense cells, etc.). Each of these groups is able to effect a number of very specialised tasks. As the body develops, the cells multiply by a process of division: when tissues deteriorate or wear out, it is generally the cells in the vicinity of the damaged zone which proliferate and try to compensate for the losses. Over time, however, this regenerative ability is progressively lost and ultimately disappears in many vital organs. Also, when the cells divide they are only able to produce *daughter cells* which are similar to themselves.

This is why the discovery of the role and properties of stem cells (known as *multipotent* when they can form several types of cells and *pluripotent* when they can form all of them)⁽¹⁾ brings new and exciting prospects. Tissues formed from cells so specialised that they are virtually unable to be renewed could – if damaged – be 'reconstructed' through the addition of a sufficient number of stem cells. In any event, that is the underlying idea of what it is hoped is a new field of medicine in the making: regenerative medicine.

From ideas to practice

In practice, however, things are not that simple, in particular because not all stem cells are the same. Their therapeutic value depends on a number of factors: accessibility, ability to proliferate and to differentiate, etc. The most promising are embryonic stem cells (ESCs). These are obtained from embryos at the *blastula* stage (hence the name blastocytes), when the embryos are about ten days old and comprise approximately one thousand cells. Some of them, although not totipotent (i.e. able to regenerate a complete

human being) are able to form any kind of cell if placed under the right conditions.

Obtaining this material with extraordinary properties means destroying a human embryo, even if it is created *in vitro* and is made up of just a few hundred cells. This clearly poses ethical problems (see article p.6) which have caused the scientific community to seek alternative products.

Various tissues rich in stem cells, taken from aborted fetuses, raise issues scarcely less sensitive. This is why research financed by the European Commission – leaving aside work on umbilical cord blood, a waste product usually destroyed at birth – is concentrating on adult stem cells which are present in virtually all our bodies.

The adult stem cell solution

Where are such stem cells found? Since the search really got under way, around 1999, they have been found concealed in the most diverse areas of the body. There are some – albeit not many – in the brain, and also in the bone marrow, blood, skin, and blood vessel walls. But it seems that these adult cells are more difficult to cultivate, are slower to reproduce and are only able to generate a limited number of tissues, when compared to embryonic cells. Or at least that was the belief until very recently. The fact is, we are no longer very certain about very much in this field as so much of what seems to have been established just two years ago has been overturned in recent months.

When placed in culture environments, neuronal stem cells have not only been able to form neurons but also cardiac, intestinal and renal cells. Similarly, haematopoietic stem cells (destined to form blood) have

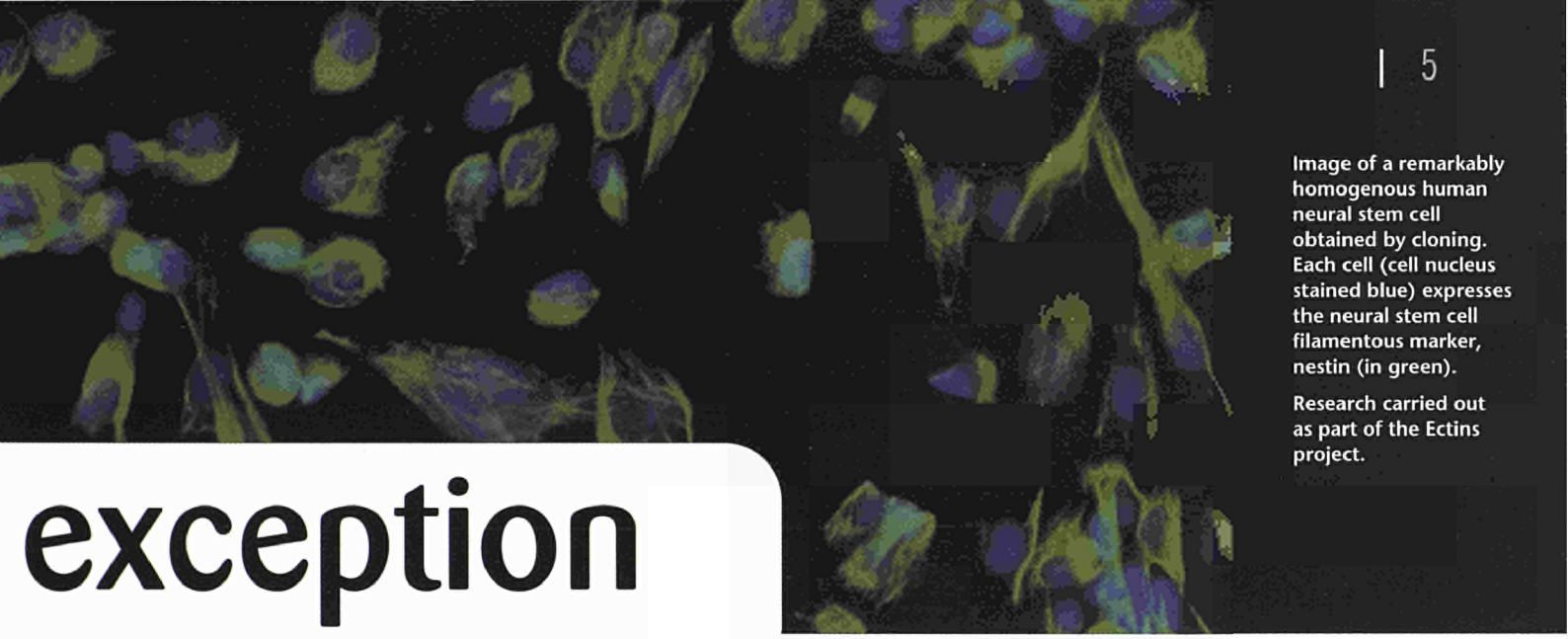


Image of a remarkably homogenous human neural stem cell obtained by cloning. Each cell (cell nucleus stained blue) expresses the neural stem cell filamentous marker, nestin (in green).

Research carried out as part of the Ectins project.

exception

proved able to produce hepatic, renal, muscular or neuronal tissue. What is more – and until recently this would have been judged the ultimate ‘heresy’ – the American Academy of Sciences has reported that ‘there are rare but well-documented examples of differentiated stem cells in developing mammals which change destiny and *transdifferentiate* into another cell type’. It therefore seems increasingly probable that by changing the environment in which cells live it is possible to influence their future role. Researchers are now looking for molecules (growth factors) which make it possible to ‘instruct’ a cell to evolve into what is required.

A revolutionary therapeutic tool

If these techniques could be mastered, they would certainly bring previously unimagined possibilities. One of the major problems of transplants, for example, is that the patient rejects the transplanted tissue as the body identifies it as coming from another person. If, on the other hand, the patient’s own stem cells were used to reconstitute the damaged tissue, such problems of rejection would disappear. This, in turn, has led to many discussions on the subject of ‘therapeutic cloning’ in which an ovule (ovocyte) is first extracted so that the nucleus of a cell taken from a patient can be inserted into it before the egg is then allowed to develop to the *blastula* stage. The embryonic stem cells thus obtained would, in theory, be able to reconstitute any patient tissue whatsoever.

Stem cells could also prove to be the elusive tool needed for successful gene therapy. Scientists are known to be trying to introduce genetically modified cells into the tissue of patients to correct certain malfunctionings. It is conceivable that stem cells could be taken from a patient, supplemented with one or more genes (to restore a lost biological function, for example) then multiplied and reintroduced into the affected tissue.

Caution

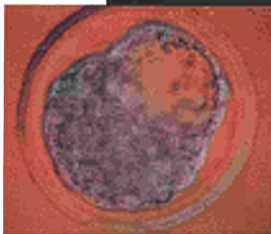
As always when a new field of research opens up, we must be prepared for all kinds of setbacks. Margaret Goodell, author of a key article on adult stem cells in 1999, recently told the journal *Nature* that: ‘Science does not at present justify what some people are saying, namely that adult stem cells can do everything.’ The truth is that at the present stage the exceptional results obtained on mice and sheep are sometimes impossible to reproduce in man. Molecules which appear very effective in the test tube may have no effect at all when introduced into a patient’s tissue, or alternatively may be accompanied by serious side effects. The multiplication techniques developed to proliferate stem cells are able to achieve their purpose, but they also have the unexpected effect of preventing any subsequent differentiation. Also, a success in one case does not mean that it can be reliably reproduced, or that all the stages can be controlled. What is more, the extraordinary dynamism of stem cells brings with it the fear that, under certain conditions, they could produce tumour growth.

Biologists therefore urge caution. There must be no repeat of the adverse experience of gene therapy when all sorts of wonders were promised before it was realised that it will be a long time before effective treatment becomes available. ‘It is no doubt the beginning of a new era, but at present there remain whole areas in which very little is understood. Above all we must persevere with our research,’ is how Eliane Gluckmann, coordinator of the Eurocord project (see page 7) sums up the situation. Hence the legitimacy of caution – not that it is likely to dampen current passionate curiosity. ▀

(1) As opposed to totipotent, meaning able to re-form a new embryo.

Facing omnipresent ethical problems

The moral status of the embryo, genetic engineering, ownership rights on living organisms... The use of stem cells is relaunching a number of sensitive debates initiated by modern biology.



The embryo at the blastula stage is approximately nine days old. At the centre of this cell mass there is a cavity filled with liquid. The few cells it contains – embryonic stem cells – are the cause of all the excitement among biologists.

© INSERM/M.CAZILLIS

As stem cells are the most recent consequence of ever-accelerating biological progress, it is not surprising that they are triggering most of the current heated debates in the life sciences sector – debates which must steer a course between two dangers. On the one hand, there is the risk of taking hasty decisions (in particular under pressure from international competition), and on the other of passing up the opportunity for therapeutic progress able to relieve suffering and save lives.

The embryo dilemma

Embryonic stem cells pose the most acute of problems. They can only be obtained from embryos aged approximately one week, at the *blastula* stage. Yet research on embryos is highly controversial, irrespective of the stage of its development. A report by British stem cell experts summed it up as follows: 'A significant body of opinion believes that, as a moral principle, the use of no matter what embryo for research purposes is neither ethical nor acceptable for the reason that an embryo should be recognised as having a full human status immediately it is conceived. At the other end of the spectrum, others claim that the embryo neither requires nor merits special status. Others accept the special status of the embryo as a potential human being, but maintain that the respect due to the embryo increases as it develops, and that in the early stages this respect must be set against the potential benefits of research.'⁽¹⁾

While some countries finance research on embryos,⁽²⁾ others refuse to do so, and some actually ban it outright (not counting those with no legislation in this field). In cases where such research is allowed, there is the question of where the embryos come from. Researchers who have developed existing stem cell lines (the exact number is not known, but it undoubtedly runs into dozens) have used surplus embryos. These were created then conserved by freezing with a

view to *in vitro* fertilisation (IVF), but then ceased to be part of a parental project, either because the couple had separated or the IVF was successful. They were therefore destined to be destroyed. It is not known how many embryos of this kind are available, and if a major research activity were to develop, there are some who inevitably envisage creating *in vitro* embryos specifically for scientific purposes. Once again, such a decision would have ethical implications as it would be seen as one more step in the direction of embryo reification. Although it may solve the problem of embryo supply, it would create another problem of ovary supply. A number of problems are also raised by the use of tissues from aborted fetuses as many individuals, and European countries, oppose abortion.

Fear of cloning

Another controversial subject is the transfer of the somatic nucleus, sometimes known as 'therapeutic cloning'. This involves transferring the nucleus of a normal cell to a previously enucleated egg, with the aim of creating an embryo carrying a patient's genes in order to extract stem cells compatible with his immune system. In this case, too, there are accusations of embryo reification and, what is more, of opening the door to reproductive cloning or, in other words, the universally condemned practice of creating an embryo carrying the genes of a single individual and then bringing it to its full development.

Finally, present research is taking place within a varied and changing legal framework. Questions are being raised about ownership of cell lines and the tissues they can create and eventually transplant (these cell banks will soon be a reality), and on the patentability of the products and techniques which originate during such research. ▀

(1) Taken from *Stem Cell Research: medical progress with responsibility*, UK Department of Health, 2000, point 17.

(2) In the United Kingdom, public financing accepts research along existing lines, but not the creation of new ones. The private sector is subject to the rules laid down by each Member State.

European projects

Europe seems determined not to miss the stem cell train. The European Union already funds – to the sum of 27.4 million euro – 15 research projects involving 117 laboratories in countries from Finland to Portugal. The next framework programme (2002-2006) will see efforts stepped up even more.

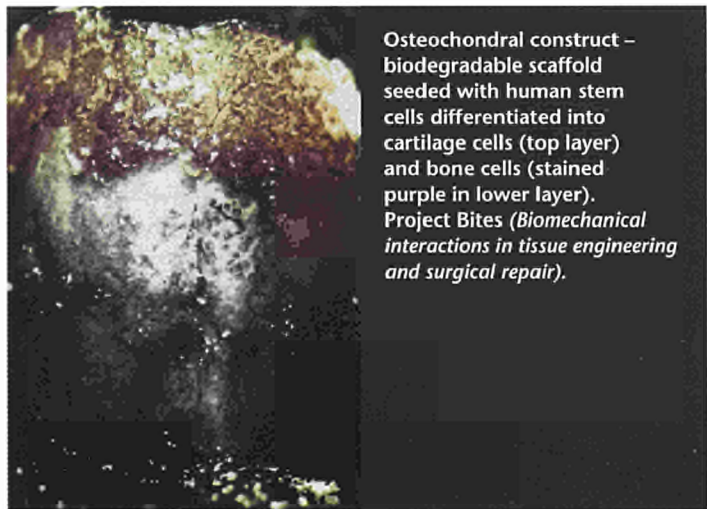
Given their many facets – in terms of origin, properties and therefore potential new treatments – stem cells require European research to operate on many fronts. Yet amidst this diversity, researchers are focusing in particular on two fundamental mechanisms: those which control their multiplication, and those which govern their differentiation.

Several stem cells types are currently the subject of European projects. Blood precursors (haematopoietic cells) seem particularly promising. They are found in bone marrow, where they renew red blood cells, white blood cells and platelets, and have long been recognised for their benefits in treatment, as illustrated by the dramatic increase in bone marrow transplants (currently about 10 000 a year). These transplants, which can treat various genetic diseases and cure patients who have been subjected to intensive therapies, for example, in treatment for leukaemia, pose a number of problems which current stem cell research could help reduce.

Combating transplant rejection

The main problem here is the immune system's rejection of the transplanted tissues, or Graft versus Host Disease (GvHD), which is a potentially fatal reaction. To overcome such problems, doctors seek donors compatible with the patients (such as family members), but nevertheless there are still many failures. Bone marrow transplants also have other drawbacks: the donor has to undergo a general anaesthetic and, most importantly, the patient receives a heavy immunosuppressor treatment, which often gives rise to other complications.

One solution would be to take the stem cells from the patient himself, multiply them *in vitro*, and then re-inject them into his body. Although there has been some success, researchers have not yet succeeded in multiplying these cells on a sufficiently large scale. However, an alternative approach with obvious poten-



Osteochondral construct – biodegradable scaffold seeded with human stem cells differentiated into cartilage cells (top layer) and bone cells (stained purple in lower layer). Project Bites (*Biomechanical interactions in tissue engineering and surgical repair*).

tial is now emerging: the transfer of blood from the umbilical cord and placenta of newborn babies.

The umbilical cord solution

'The umbilical cord blood has major advantages,' explains Eliane Gluckmann of the Hôpital St Louis in Paris, coordinator of the Eurocord project. 'The stem cells it contains have a greater division capacity than those obtained from bone marrow. Their immune reactivity is also weaker, with the result that they cause far fewer rejection reactions. Finally, as they come from tissues destined to be destroyed anyway, their use poses no ethical problems, providing the parents agree.'

Umbilical cord blood banks have already been set up and are linked to several continents. They contain more than 85 000 frozen transplants, all ready to be administered to patients who may need them, in line with their immune profile. The fact that they were obtained from a foetus means that it is 30 to 40 times easier to find an umbilical cord blood sample which is compatible with a patient than a bone marrow sample. ●●●



Genetic applications

A particularly spectacular use of umbilical cord blood is being studied by the Enfet (European Network for Fetal Transplant) project, which is devoted to the possibility of treating foetuses *in utero* through stem cell transplants (see box entitled *Delivering bubble babies*). Other European researchers are trying to explore a particularly original avenue for combating GvHD, in which a gene is introduced into the transplanted cells which causes their 'suicide' in the presence of a given molecule. In the event of rejection, this molecule could also be used to control the number of white corpuscles present in the patient.

Finally, as it is relatively easy to isolate haematopoietic stem cells and then to inject them into a patient, the question of their possible use in gene therapy has naturally been raised. One could imagine, for example, a gene being identified which could provide resistance to the AIDS virus – this is not inconceivable as it seems that certain individuals are resistant to the virus. Patients could then be injected with haematopoietic stem cells incorporating this gene, and would thus be able to retain their immunity. Researchers are also looking at viruses and protocols which would make it possible to introduce these genes into cells.

The neuronal aspect

After blood, it is no doubt the nervous system looks most likely in the short term to draw full benefit from treatments involving stem cells. Neurons are incapable of division. They are subject to many pathologies and forms of deterioration which are threatening to affect an increasing section of Europe's ageing population. The most studied and best understood of these diseases is probably Parkinson's disease (a million sufferers in the EU alone), caused by the deterioration of a particular kind of nerve cell, the so-called dopaminergic neurons, named after the chemical messenger they produce (dopamine).

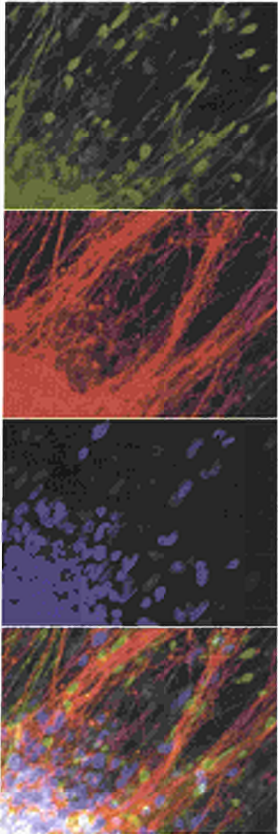
A Swedish team has treated patients suffering from this essentially incurable disease, transplanting nerve tissue from aborted foetuses (which are very rich in stem cells). Despite some failures, notable progress has been observed in patients and further work in this area certainly seems warranted. However, given the significant increase in the disease and the ethical problems raised by the use of tissues taken from aborted foetuses, it would clearly be preferable to have stem cell lines which are able to form dopaminergic neurons.

This is the aim of the Dance (Development of Human Dopaminergic Neuronal Cell Lines for Transplantation) project. 'Our aim is to create cell lines able to be produced on an industrial scale, offering better quality guarantees and which we could make commercially available,' explains Lars Wahlberg, a researcher at a small Danish biotechnology company and project coordinator. 'The neurons we are obtaining at present do not possess the right characteristics, but progress has been rapid and we hope to reach the clinical trials stage within the next three years.'

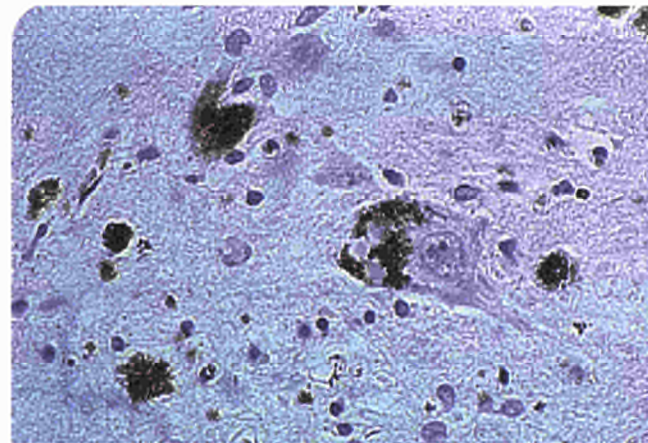
Multifaceted research

Another pathology, another strategy, another research project... The one coordinated by Monique Dubois-Dalcq (of the Institut Pasteur in Paris) is seeking a cure for multiple sclerosis, an illness caused by the destruction of the protective layer (myelin sheath) which partially covers neurons. We know that neuronal stem cells can sometimes migrate far into the brain to repair certain lesions. Scientists are therefore going to try to produce stem cells with an increased migration capacity, and also to identify and use the many chemical signals which trigger and direct this migration.

Many other European studies are concentrating on stem cell precursors. The Ectins project, for example, would like to introduce to promising stem cell lines a gene permitting the sustained *in vitro* proliferation necessary for industrial production. But this could be a proliferation which would stop after implantation to avoid the risk of tumour development caused by the potential dynamism of stem cells.



Triple labelling images of 'epigenetic' neural stem cells grown in aggregate culture. In blue is the cell nucleus, in green is nestin (neural stem cell marker), in red is GFAP, a marker of astroglia but also expressed in some neural stem cells. Ectins project.



The region of the brain that deteriorates among sufferers of Parkinson's disease. Three Lewy bodies (one very typically located at the centre) confirm the diagnosis of the disease. It is these bodies which contain abnormally high levels of iron and aluminium.

Delivering bubble babies

Some genetic blood diseases can be detected at a very early stage of pregnancy, most notably the rare disorder which forces children to live in a virtual bubble due to a severe immunodeficiency. It is usually treated a few weeks after birth by means of a bone marrow transplant.

Rhodri Jones of the Queens Medical Centre in Nottingham (UK), coordinator of the Enfet project, is trying to perfect an alternative treatment: 'In some cases, it is possible to introduce about 1 ml of a solution containing stem cells into the foetus' abdominal cavity. The operation is carried out *in utero*, guiding the needle by ultrasound. At this very early stage (13 weeks), the child does not yet have any real immunity. He learns to recognise the (exogenous) cells as if they belonged to him and produces no rejection action.' In theory, this would provide a means of avoiding the generally invasive treatment that infants suffering from this disease are currently exposed to, namely several weeks in a sterile bubble, a preparatory course of drugs, surgery and then the administration of immunodepressors.

About 35 transplants of this type have been carried out worldwide, most of them in Europe. They were not all successful, but the oldest patient is now aged 11. A genuine know-how has therefore been acquired which needs to be enriched with new knowledge of stem cells with a view to generalising the technique.



The genetic and cellular processing laboratory at the Inserm's unit 427. It is here that the cells injected into 'bubble children' are prepared.

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Some European projects

Eurocord – research on umbilical cord blood

Coordinator

Eliane Gluckmann
Hôpital St Louis – Paris (FR)
eliane.gluckmann@chu-stlois.fr

Enfet – *In utero* therapies

Coordinator

Dr Rhodri Jones
University of Nottingham (UK)
d.r.e.jones@nottingham.ac.uk

Dance – Making dopaminergic neurons

Coordinator

Dr Lars U. Wahlberg
Department of Cell and Preclinical Biology
Ballerup (DK)
luw@nsgene.dk

Eurostem – Research on ethical issues

Coordinator

John Harris
University of Manchester (UK)
John.M.Harris@man.ac.uk

Researchers working on the Neuropair project are concentrating in particular on the various signals which determine the destiny of a given neuronal stem cell (especially as it has just been discovered that these cells can create cell types very different to their original nerve tissue).

Ethical research

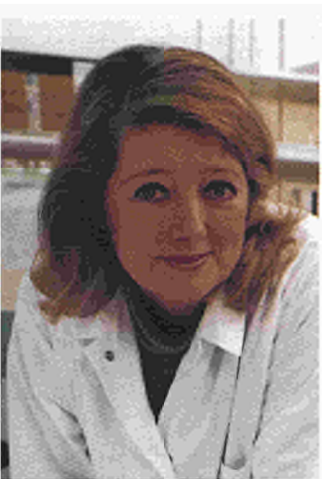
Of course it is not possible to pursue research in all the various directions without considering their means and objectives. Two of the 15 European projects are devoted to ethics. The researchers responsible for these projects will have to meet the various parties concerned by these technologies, compare their different opinions, examine what they have written, then publish certain opinions – all in the interests of organising the necessary debate.

For its part, the Commission has already assembled a European Ethics Group which, in November 2000,

produced a document⁽¹⁾ setting the limits within which research on stem cells should take place. It is known that the work financed by Europe during the next framework programme will exclude reproductive and therapeutic cloning, as well as the creation of embryos for research purposes.

As further studies are carried out, so it will be necessary to further pursue the debate. Society must be informed and, as far as possible, consulted on the choices made. This is indeed the purpose of the conference and debates organised by the Commission in December. Above all, it is the necessary condition to ensure that there is no divide between the general public and researchers, as any such split would be damaging to all concerned, especially the patients who are anxiously awaiting concrete progress in treatment. ▀

(1) http://europa.eu.int/comm/european_group_ethics/docs/dp15.pdf



Helga Rübsamen-Waigmann: 'It is important for university professors to be more open to the needs of the economy. I have long been criticised for working with industry.'

For the past 25 years, Helga Rübsamen-Waigmann has been at the forefront of the fight against cancer and AIDS. Her tenacity and scientific perspicacity today place her among the leading figures in the world of biochemistry. After several years in fundamental research – of which she holds the title special professor at Frankfurt University – this virologist now heads research projects on anti-infectives at the Bayer group.

The intuition of Helga

The Bayer pharmaceutical research centre at Varresbeck, in a green area of Wuppertal just outside Düsseldorf, is bathed in the light of an endless Indian summer. During this school holiday period which she devotes to her son Jens, 13, Helga Rübsamen-Waigmann kindly agreed to call into her office for this interview. Reconciling family and working life is a constant challenge for this hyperactive woman of science, but one that she is committed to meeting.

'At the age of 18 I first thought of medicine, but the idea of possibly making a mistake as a doctor caused me to look at chemistry. Finally, I returned to medicine by way of research,' she immediately explains. Her elder sister had preferred physics, making two 'women of science' in a family of engineers, architects and bankers. After her doctorate at Münster University, Helga Rübsamen-Waigmann already knew that, of all scientific fields, biology most fascinated her. She therefore decided to study virology at Giessen University. From Giessen she moved to Cornell University at Ithaca (New York) where she became familiar with the fundamentals of biochemistry.

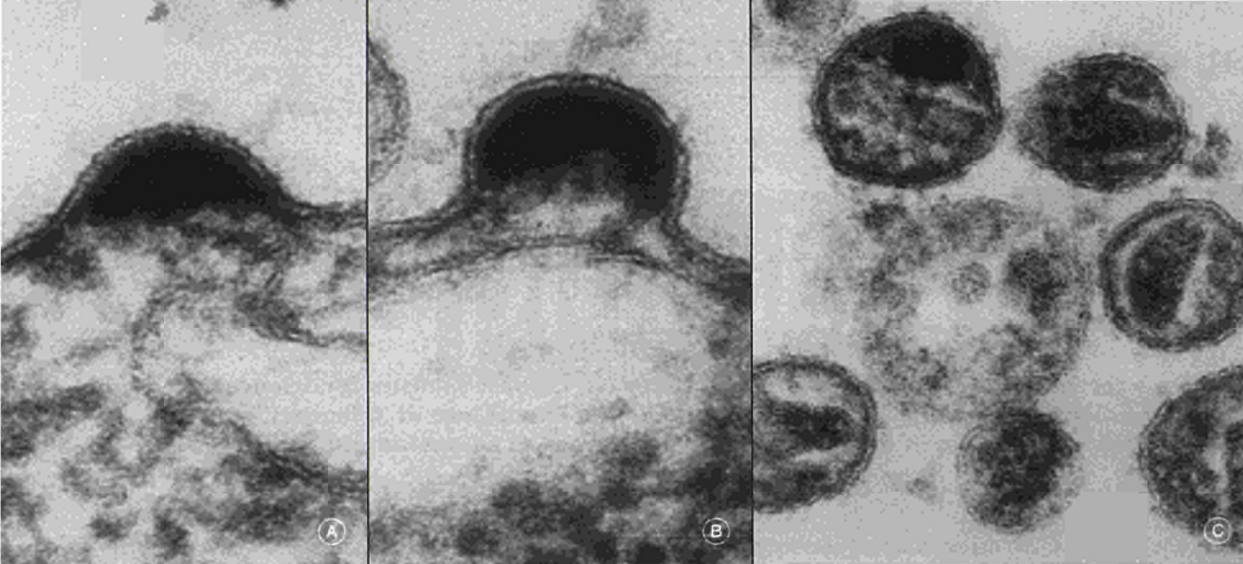
After completing her doctorate, she decided to enter cancer research. 'More than anything else, I wanted to explore and understand what can happen in a living cell when its functioning deteriorates.' The subject of her first project was the Rous sarcoma virus, a retrovirus involved in the pathogenesis of a specific cancer affecting poultry. She analysed the SRC oncogenous gene as well as its product, the pp60 v-SRC protein, one of the factors responsible for malignant mutations. At the end of the 1970s, it was not at all clear that retroviruses were pathogenic and when esteemed colleagues advised her not to

waste her time pursuing this avenue, she preferred – rightly as it proved – to follow her intuition. 'For me, retroviruses were a model in the sense that they permit an excellent comparison between healthy and diseased cells.'

A first makeshift laboratory

In the 1980s, she turned to virological research on AIDS. At the invitation of her colleague Eilke Helm she met patients being treated at the Frankfurt university clinic. 'In the light of such different manifestations of a same pathology, I thought that more than one virus was involved.' Her intuition proved right. Her work began on the basis of six samples of contaminated blood. After having first got rid of the mouse cages, she set up a makeshift laboratory in the cellar of the Georg-Speyer-Haus in Frankfurt, previously used for animal experimentation. At first the laboratory employed just three people with an annual budget of no more than 10 500 euro. Five years later she has turned it into a centre of excellence for AIDS research with 90 highly qualified staff. 'This was also made possible by the development and sale of patents for HIV tests,' she explains.

After these years spent on fundamental research, in 1994 Helga Rübsamen-Waigmann was appointed head of the Bayer group's department of research into anti-infectives, where she manages a budget of 17.5 million euro. 'The transformation of a chemical substance into a medicine is a process which has always fascinated me,' she explains.



Electron micrographs of HIV budding from host cells
 a) early step of budding
 b) shortly before release of HIV from host cell
 c) mature extracellular HIV.

Source: HIV-infected cell culture prepared by Prof. H. Rübsamen-Waigmann, Georg-Speyer-Haus (Frankfurt) – Electron microscopy done by Prof. H. Gelderblom, RKI (Berlin).

Rübsamen-Waigmann

What does a pot of yoghurt contain?

At the age of 52, Helga Rübsamen-Waigmann is full of dynamism and is concerned about young people's lack of interest in science. She does not believe it is enough to try to work out how to reorganise European universities: an in-depth study of the content of school programmes is her priority. 'Chemistry experiments and computers should replace Goethe and Schiller in primary school... Our children are being confronted with the world of technology at an increasingly early age, which is why it would be a good thing for them to learn how to use that technology as soon as possible. Teachers should introduce them to the joys of scientific discovery.' An example? As part of a German pilot project, children are told to compare diet yoghurt with ordinary yoghurt, and to determine what differentiates them. They discover that a sweetener is present in diet yoghurt, which they then isolate and study. 'Young pupils suddenly see chemistry from a new angle and the sciences become fascinating.'

Thinking about Europe

A visiting professor to Harvard, Helga remains loyal to Europe and is one of the team of 45 researchers who sit on the European Research Advisory Board (EURAB) set up by European Research Commissioner Philippe Busquin. Among the questions studied by the EURAB is the 'brain-drain'. 'Four of my best students went to the United States and have not come back. We need more funds for return grants to motivate the best brains to return to Europe.'

EURAB members are also looking at the balance between aid for industry and fundamental research. 'It is important for university professors to be more open to the needs of the economy. I have long been criticised for working with industry,' admits Helga Rübsamen-Waigmann. 'Too many scientists are essentially concerned with their publications and too little

with registering patents. In Europe, it is only recently that specialised bodies have got together with researchers to look at how to patent their discoveries. The income generated by patents makes it possible to offer good working conditions, as is the case in the United States.'

She is also convinced of the need for mobility for young people in Europe. 'It is crucial to encourage young graduates to work in other countries.' She sees the doubling of European funds devoted to the mobility of scientists, as announced under the new framework programme (2002-2006), as 'a step in the right direction'.

Old boys network

In the corridor outside her office, a poster entitled *Women in Science: Careers Past, Present and Future* announces an upcoming congress in Cologne, at which Helga Rübsamen-Waigmann will be speaking of her experiences. 'The place of women in the world of science is far from comfortable and they are not given an easy ride.' But a glance at her CV nevertheless shows an illustrious career. 'I have been able to successfully complete everything I started,' she acknowledges. 'But it is absurd that more than half of our country's women graduates stay at home,' she continues. 'In Germany, the most able do not always get the best positions and the old boys network is particularly strong in the world of medicine.' At Bayer she is a member of the 'Equal Opportunities Circle' and is actively involved in the campaign to reinforce the place of women in research, in particular as vice president of the Union of German Chemists (*Vereinigung Deutscher Chemiker*).

Helga Rübsamen-Waigmann has invited all her male colleagues who sit on the board of directors of this giant of the pharmaceutical industry (Bayer ranks 15th in the world) to attend the Cologne congress. 'We will see if any of these gentlemen cares to visit us...'

Research without frontiers



Xu Guanhua

"We need to take advantage of researcher exchanges to improve scientific and cultural understanding between China and the EU."

On a recent European visit, Professor Xu Guanhua, Chinese Minister for Science & Technology, shared his views with RTD info on the importance of 'openness' and scientific partnership in promoting wider Sino-European co-operation.

What benefits does China expect from co-operating with Europe in the area of research?

Europe is a world leader in science and technology (S&T), so China has a lot to gain from closer ties with the EU. China is a large nation but still developing – albeit very rapidly.

I firmly believe that S&T paves the way for future economic development. China has strong economic co-operation with the States and Japan because we have many researchers working and living there. Many have now reached managerial level and, as managers, they represent Chinese business interests, which is important for us.

And what can Europe expect to gain from more research co-operation with China?

This is an interesting question. China is renowned the world over for its pure sciences – our strength lies in fundamental research such as in mathematics and biology, and we have good technical skills too. As a market for new scientific and technological applications we are also of value to Europe. Take the example of mobile phones and the Internet. Recent figures show China has around 128 million users, and about 20 million on the Net. I think for mobiles we might even be number one in the world.

Another key area for co-operation is the environment: we acknowledge – with China's economy developing the way it is – it will become critical. Right now, China is a major coal consumer, which puts pressure on the environment. Clean energy is the goal; in particular 'clean coal' methods such as coal-fired technologies and coal liquidisation. Also, as our economy grows, cars will become more common. If we continue to use traditional engines, the environment will pay the price. Developing electric cars could play a vital role in China's future.

What is the first priority in achieving better co-operation?

Quite simply, we need more exchange of researchers – the people factor. Through 'people exchange', we achieve greater scientific and cultural understanding. Previously, I think Chinese professors could only stay around one year [in Europe] compared with the States, where they can stay for an indefinite period. Europe has a high S&T level, but you could benefit from more researcher exchanges.

Europe is concerned about the opposite effect of 'brain drain', where researchers move to the USA and don't return. Can you explain this difference?

You know, China wants to show more openness after being closed for so long. So, firstly, we encourage more Chinese scientists to go abroad as a matter of policy. I don't think this is a bad thing. For instance a national initiative, backed by the Chinese Academy of Sciences, is the '100 Scientists Project', which provides a range of support measures to the best 100 Chinese science students abroad. The Education Ministry has also set up the 'Yangtse River Project', where we select and finance the best professors to further their research abroad. The students and professors can return to China or stay abroad – it's their choice.

Of course, in the long term, we would like them to return. I would say at the moment there are about 340 000 Chinese researchers and students abroad, of which one-third will probably return to China. The government has set up 'innovation incubator centres' to encourage this.

Without a doubt, Chinese scientists want to do research in the EU, but they need more support, such as through scholarships and projects. This is why my Ministry is supporting more co-operative projects between China and the EU. We already have some projects in place within the Fifth Framework Programme, but I hope to have more in the future.

You mentioned valid S&T and economic reasons why Chinese researchers would be interested in coming to the EU, but are there other – perhaps non-scientific or political – reasons?

Basically, I think China is a developing country. Of course, our economy and society is growing quickly – faster than even we expected – but what we really need is lasting peace to sustain this economic momentum. This is why it is vital to have good relations with countries around the world, especially with the EU where we enjoy very positive political relations.

It is therefore important to communicate to all scientists in the EU that China welcomes them: to travel, to sightsee, or indeed to work. China needs it, and I think Europe does as well.

A plural Europe

Racism and xenophobia are deeply rooted in Europe's history. Paradoxically so, as Europe is also traditionally a melting pot of peoples and cultures. Today's Europe could draw on this colourful past in building a pluralist, multicultural and tolerant society.

'We live in a world in which migration is part of the lives of many of us. Migration brings the challenge of integration and means moving away from the ideal of the homogeneous society to one of cultural diversity and pluralism,' believes Göran Rosenberg, a Swedish sociologist and one of the researchers invited to the conference on racism and xenophobia organised by the European Commission last April (see box).

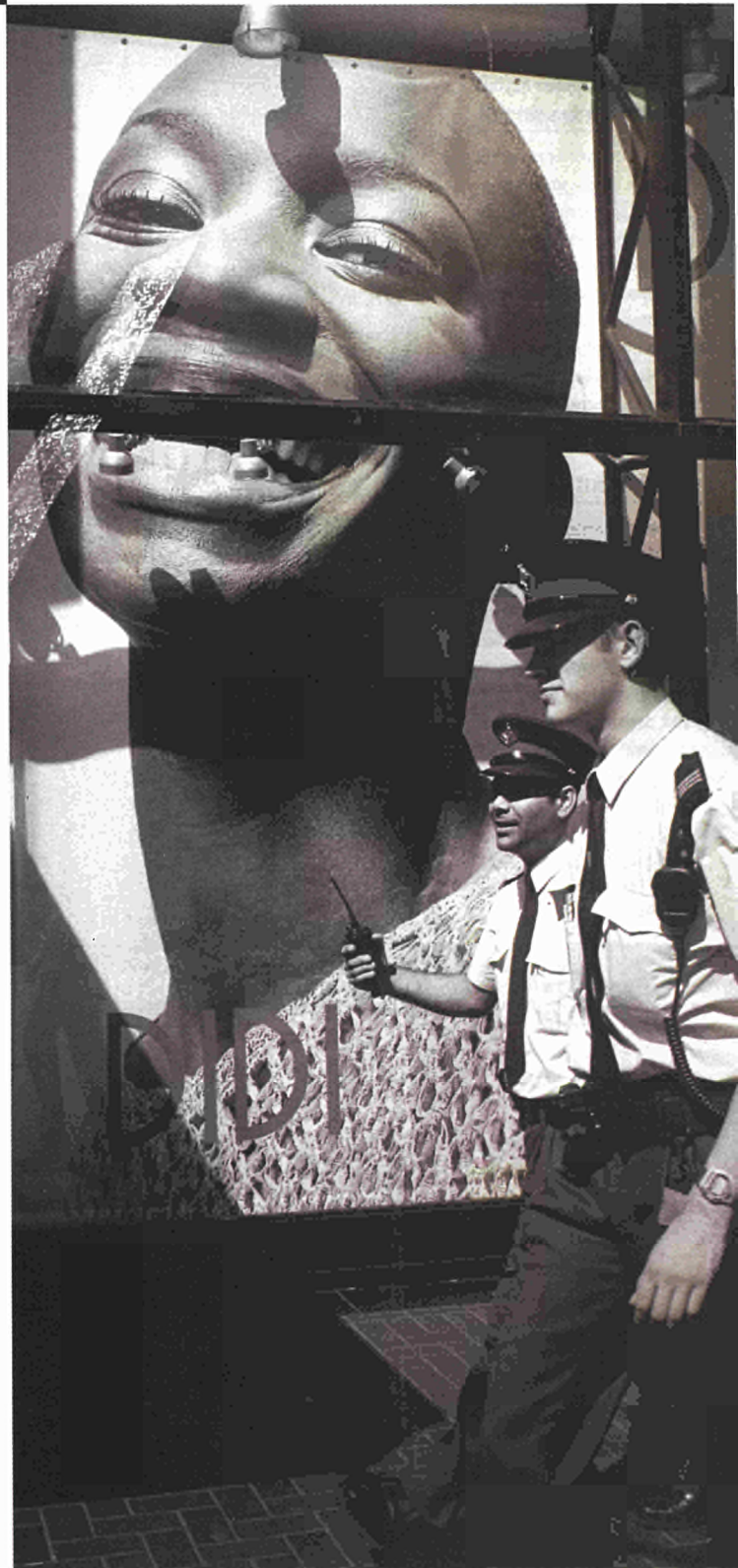
Are these new values gaining ground? A survey carried out by Eurobarometer⁽¹⁾ for the European Monitoring Centre on Racism and Xenophobia (EUMC – see box) showed that two out of three people interviewed believe that the co-existence of different races, religions and cultures enriches a society. The Swedes (77%), Spanish (75%) and Dutch (74%) are most inclined to believe that their society can draw real benefit from diversity. Ironically, this same survey showed that a growing number of Europeans are concerned at the presence of minorities who they feel could pose a threat to their 'well-being'. Despite this, EUMC director Beate Winkler believes these results show that attitudes towards immigrants and minorities have developed positively in many Member States. 'Over the past three years Europeans have become more favourably disposed to policies aimed at improving the common living conditions of majority and minority groups.'⁽²⁾

Good practices

Different countries have opted for different legal measures and social initiatives in response to the problem. Sweden and Portugal have a mediator for ethnic discrimination. In Belgium, magistrates, police and gendarmerie officials follow a special training programme (*Immigrants and justice: eliminating racism and xenophobia*). In Denmark, the social partners work together on improving employment prospects for immigrants. In Germany, intercultural education promotion uses

(1) Survey based on interviews with more than 16 000 people in the Member States. Four groups were identified: actively tolerant (21%), intolerant (14%), ambivalent (25%) and passively tolerant (39%).

(2) See annual EUMC report, 1999.



Rotterdam, August 2001

Figures and trends*

Most of the examples given below are taken from specific countries. But they are also very often indicative of a situation which applies beyond the borders of a specific Member State.

Internet

1429 sites which encourage racism, anti-Semitism and disseminate hate music – often based in the United States – were identified by the Simon Wiesenthal Centre in 1999 (compared to just one in 1995).

Employment

In Denmark, the unemployment rate for foreigners is 16.5% compared with 5.5% for the local population. There are also different patterns within the discrimination: 48% of Lebanese who applied for a position (for which they were qualified) were rejected, due to their ethnic origin, compared with 36% of Turks, 34% of Somalians and 17% of Bosnians.

'personalised' tools developed especially for young people (videos, music, etc.). Italy and Portugal have appointed 'cultural mediators' among members of the Romany, gypsy and traveller communities⁽³⁾ who provide support for children during their early years at school. Lastly, Finland has set up a national action programme entitled 'Towards a tolerant Finland.'

Persistent differences

Despite these initiatives aimed at removing differences, inequalities in terms of treatment and status remain. Even if they are not always terribly significant in themselves, they are nevertheless indicative of a form of discrimination. In Austria, for example, workers of immigrant origin cannot vote in trade union elections. In Germany, documents on citizens' duties and responsibilities are translated into various languages, while those on citizens' rights are available only in German. In Sweden, the law continues to differentiate between immigrants (invandrare) and Swedes (svenskar). In Italy (and no doubt virtually everywhere) 'the police rarely take action in response to the welfare of gypsies, immigrants and even the underprivileged when they are victims of racist attack or even accidents at work,' explains Salvatore Palidda of Genoa University (IT).

Identity, ambiguity

Why is there this incessant and omnipresent need to establish differences – even if only minimal – between people? Tom Burns of Uppsala University is a sociologist seeking to understand the concept of *otherism*, this strange need of human beings to always find an 'other' – an enemy, deviant, or simply someone different – in whom they see a potential source of danger and which allows them to forge their own links and strengthen their identity. 'Beneath the institutions of modern democracies there is always something informal, unwritten codes of belonging, but also barriers and more or less subtle mechanisms which discriminate against foreigners, Jews, gypsies, etc.,' believes Göran Rosenberg.

Klaus Eder, a sociologist at Berlin's Humboldt University, believes the key to this need for identity politics lies in Europe's history. The hierarchical systems in which kings and emperors acted as unifying symbols are no more. Our democratic societies have become associations of persons who have felt the need to define themselves and come together around a common link or place. 'The nation states used the logic of borders to create a *demoi*, a people united by virtue of their identity,' explains Eder.

By contrast, the transnational institutions have the major benefit of being able to mobilise groups in the name of an identity they do not possess. 'The European Union is in this position. While allowing borders to remain, it must create a European link, but without introducing a symbolic code which would separate citizens. There are several national and regional *demoi* in Europe. It is in the interests of those who belong to them to share, not a symbolic community, but an area of freedom and social justice.' This logic of justice – and not of identity – could provide the basis for a genuinely open transnational area.

A multicultural citizenship

'The former objective of social equality is evolving into the challenge of accepting cultural difference', believes Gerard Delanty, a sociologist at Liverpool University. He believes that the apparent absence of a strong European identity is an advantage which could ultimately give birth to 'a new cultural model which could be well suited to a transnational democratic multiculturalism.'

(3) According to a US State Department report, some 25 000 nomads see themselves as an ethnic group, defined as 'travellers'.

EUMC a European observatory

The European Monitoring Centre on Racism and Xenophobia (EUMC) was set up in Vienna in 1997 to assist the Union in developing, on the basis of a global strategy, concrete measures to combat racist tendencies. To do so, it continuously monitors signs of racial discrimination (race, origin, religion, etc.), the evolution of related issues and measures to correct these situations. This is also why the EUMC launched the RAXEN network with the task of collecting national data on racism, xenophobia and anti-Semitism in the Member States.

The EUMC's latest annual report (1999) seeks to take stock of these issues, insofar as statistical comparisons and the available data permit.

Contact

information@eumc.eu.int
RAXEN@eumc.eu.int
http://eumc.eu.int

Two study days

Racism and Xenophobia: Key Issues, Mechanisms, and Policy Opportunities was the title of a 'dialogue workshop' for social science researchers and representatives of NGOs, held in Brussels last April by the *Improving the socio-economic knowledge base* programme. The meetings focused on four subjects: the concepts and models able to explain racism and xenophobia; the identity-forming processes among immigrants and host populations as well as the ambivalence and conflicts which can exist in their relations, especially in border areas; racism and xenophobia as a challenge to the process of European integration, including enlargement; the construction of pluralist, tolerant and democratic societies. During this two-day meeting, some 30 European researchers, most of them sociologists, summarised their views and/or submitted concrete examples illustrating their research on identity, difference, multiculturalism – and various questions indicating the perception (actual and desired) of the 'other' throughout Europe.

All the researchers cited in this article were present at the meeting. The workshop was the first in a series of meetings, two of which have already been held in Uppsala and Cyprus.

Information

Fadila Boughanemi

fadila.boughanemi@cec.eu.int

Angela Liberatore

angela.liberatore@cec.eu.int

www.cordis.lu/improving/socio-economic/conf-racism.htm



Brussels, 'Marché du Midi', March 2000

But what multiculturalism? We are all familiar with the American liberal model of a vast but positive 'melting pot' in which (white) immigrants of different origins come together to build a new society. But how should we conceive of a European multiculturalism? That is the fundamental question which underlies many others. 'How are the dynamics of integration and exclusion forged, at local, European and even global level? Do these reflect a genuine change in society's political organisation? Should we then consider that these dynamics are leading us towards a process in which citizenship is redefined in opposition to that imposed after World War II? Is there today a coherence between the idea of citizenship which seems to be gaining ground within local European societies and wider Union citizenship?' asks Salvatore Palidda.

Although some observers believe that multiculturalism must encompass culture in the widest meaning of the term, by embracing all minority groups (religious, linguistic, elderly or disabled people, etc.), Gerard Delanty stresses the need 'to find a common basis, at the social rather than the cultural or political level.' The anchor of this new European multiculturalism would be the desire for a flexible, transnational citizenship which respects mobility – in particular of nomadic groups such as gypsies. 'One must build on common links rather than create policies which could be divisive,' he explains. 'Europe's objective should be pluralism rather than assimilation or integration.' ▸

Wages

In Greece, the wages of skilled immigrant workers are comparable to that of Greeks. Unskilled foreign workers, however, earn about 30% less than Greek nationals for the same work.

Racist crime

Police and judicial reports give an idea of the number of racist attacks and underlying trends. They are becoming increasingly numerous and violent in Sweden, rising in many countries (Denmark, France, Spain, Ireland), stationary in the Netherlands and generally falling – but with increased violence – in Germany.

Media

The Centre international de recherche, de promotion et de coopération (CIPIE) reports that the Spanish press makes negative comments on immigration and racism in three-quarters of cases. During the first quarter of 1999, a survey of ten newspapers, five TV stations and six radio stations showed that 78% of reports on the subject were negative. At the end of the same year – due to changing news stories – the rate had fallen to 68%.

** These figures are taken from the 1999 Annual Report, Diversity and equality for Europe, published by the EUMC.*

News in brief

A 'Science and Society' action plan

Science and technology are playing an increasingly vital role in the workings of society. This development – in theory intended to improve the quality of life but also bringing increased complexity – is giving rise to a perception among the European public which combines hope, concern and often a certain ignorance. Whatever else, this poses the very real problem of transparency – i.e. the need to inform and involve the general public – regarding the scientific and technological challenges of our age. European Union officials are convinced of the political importance of renewing a healthy dialogue between science and society and have instructed the Commission to adopt it as a priority for the European Research Area. The Commission must therefore put forward a concrete action plan to meet this challenge.

This must:

- promote the scientific education and culture of European citizens, in particular by promoting dialogue and the role of the media as an interface between the two, while encouraging new approaches in science teaching;
- encourage the general public to be more involved in the debates raised by scientific progress;
- focus more attention on the ethical considerations which must be at the heart of scientific strategy, as well as on a new approach to 'risk management' and the essential role of experts in decision-making;
- help more women to become involved in science, a field in which they are at present under-represented.

Contact:

Philippe Galiay
philippe.galiay@cec.eu.int
europa.eu.int/comm/research/

New impetus for agricultural research



Euragri – a group of national research directors of agricultural research in the Member States – has presented Commissioners Busquin (research) and Fischler (fisheries and agriculture) with a series of possible avenues to be explored in achieving a European Agricultural Research Area. These include the coordination and mutual opening up of national programmes, the creation of European networks of excellence in key fields (agriculture-environment interaction, biodiversity, bio-

nanotechnologies, ethics in food production, etc.) and recognition of a European doctorate in food sciences and agriculture. The 'Safe Food in Europe' initiative, a network of British, French and Dutch researchers, was cited as an example. Euragri believes that networking certain programmes, which receive major national support, such as in the field of 'green' farming, would substantially strengthen research possibilities. The association also proposes to set up a discussion forum for all parties involved and to organise a conference on the development of sustainable farming practices.

Information:

xabier.goenaga-beldarrain@cec.eu.int



Conference on the launch of the Sixth Framework Programme

In this last quarter of 2001, three-way discussions between the Commission, Council and Parliament on the Sixth Framework Programme for Research and Development for the years 2002-2006 are making good progress. Final decisions on its general structure – in the context of achieving the European Research Area – are expected at the end of the year or early in 2002 at the latest.

There is already broad consensus on the overall form of this new 'FPRD', which is expected to be allocated a budget of 17.5 billion euro. The two main pillars will be direct and indirect research activities in priority fields for the European Research Area (approximately 60% of financing) on the one hand, and horizontal actions (mobility of researchers, measures for SMEs, international cooperation, scientific infrastructures, activities of the JRC, etc.) on the other.

Rendez-vous in November 2002

Following the 'European Research Assembly' – held in Essen (DE) in 1999 to launch the Fifth Framework Programme and attended by 5 000 participants – between 11 and 13 November 2002 the Information and Communication Unit of the European Commission's Research DG will be holding a major conference in Brussels to mark the launch of this Sixth Framework Programme 2002-2006. Priority fields of research and rules of participation will be presented at the various sessions.

Another important aspect of this meeting will be the many symposiums, workshops and round tables – not forgetting the stands and posters – giving all the interested players (university scientists, industrial researchers, bodies or associations involved in research) the chance to present their specific activities in the framework of the European Research Area, whether or not they are linked directly to European programmes. A call for proposals for selecting these 'bottom-up' proposals will be launched early in 2002, when the second conference announcement is published (see the website below).

There will also be a press service with press room, twice daily briefings, presentation of research results, distribution of documents and facilities for interviews.

Contact:

rtd-conference2002@cec.eu.int
europa.eu.int/comm/research/conferences/2002

Commission acquires new advisory body

Created in June, following a Commission decision, the European Research Advisory Board (EURAB) is now operational. Twenty of the board's 45 top European experts were appointed by the European Science Foundation (ESF) and represent the world of science and universities. The other 20 were chosen by the Union of Industrial and Employers' Confederations of Europe (UNICE) and represent industry.

EURAB is a multidisciplinary and independent body whose mission is to analyse the principal issues facing today's European research and which will be the subject of the

Union's strategy, such as links between research and education, stopping the brain-drain, mobility of researchers, etc. EURAB is free to co-operate with organisations and institutions interested in European research issues, to create working groups on specific themes and to consult other experts. Helga Nowotny, professor of philosophy at the Swiss Federal Institute of Technology, has just been appointed president, while Ian Halliday, president of the British Astronomy and Particle Physics Research Council, and Horst Sobol, director of research policy at DaimlerChrysler, are vice presidents.

europa.eu.int/comm/research/eurab/index_en.html



GMES: first action plan now operational

The first phase (2001-2003) of the ambitious Global Monitoring for Environment and Security (GMES) space programme, conducted jointly by the Commission and the European Space Agency (ESA), has been approved by Europe's re-

search ministers. A number of practical applications for the environment were identified as the priorities: the management of natural disasters (floods, earthquakes, fires, volcanic eruptions, etc.); global monitoring of oceans, vegetation and the atmosphere; support for regional development aid; the study of environmental pressure in Europe and changes in land use. On the security front, the first developments will be global satellite observations of refugee movements, optimising the supply of food aid and support for peacekeeping troops outside Europe.

http://europa.eu.int/eur-lex/fr/com/cnc/2001/com2001_0609fr01.pdf
<http://gmes.jrc.it>

Letter

About Man and Nature

I very much enjoyed the article 'Man and Nature', published in *RTD info* magazine in September 2001. I think it is a good idea to occasionally feature articles of a more philosophical or historical perspective. In an age where people concern themselves so much with the *how* – but have little to say about the *why* – an occasional reflective article creates a good balance ... and refreshes the mind.

The relationship between Man and Nature is a deep and fascinating topic. Often people do not even realise that they are living out purely Cartesian, reductionist ideologies, and the article points to the fact that we need to be more aware of our underlying assumptions or mind-sets. It is these that affect the atmosphere within which science is explored and technology is developed; and for this reason the paradigm shift of 'conquest' to 'balance' needs to be further articulated and explored.

In order to move from conquest to balance we should be more mindful of our actions, and as Bernard Feltz says, of 'reflecting on the implications of innovation before they become generalised'. Interestingly, this is in a sense a moral approach, and can be seen as a specification of Kant's 'act only on the principle which you can will to become a universal law'. This in itself suggests that a sense of balance will only come when we have a greater awareness of ethical principles – and how to put them into practice. I also liked Feltz's linking of nature to its aesthetic side.

The article raises two questions I would like to explore further: How objective are experts and how can we stimulate genuinely interdisciplinary debate? We should also listen to the voice of everyday people. In the words of Paul Feyerabend: 'The advice in all cases is to use experts, but never to trust them, and certainly never to rely on them entirely... science is not beyond the reach of the natural shrewdness of the human race.'

In the area of designing information technology for people, purely mechanistic (or machine-centred) thinking has also demonstrated its limitations. As a result, many human-centred approaches have come to the surface – such as a research initiative we launched on 'intelligent information interfaces' (i³) in 1995. The aim of i³ is to research and develop new human-centred interfaces, aimed at the broad population, for interacting with information. It turned out that a feature common to a number of the projects was to see how technology could be created with people rather than simply for them. Perhaps, in this way too, we can start to move towards a better sense of balance between people, technology and nature.

Contact:

Jakub Wejchert
Future and Emerging Technologies – IST Programme, European Commission
www.i3net.org

The opinions expressed in this article are those of the author and do not necessarily reflect the position of the European Commission.

News in brief . . . News in

On-line bio-consultation

'The life sciences will be one of the motors for this century's technological and economic development. This is why Europe needs a solid strategy to exploit this new potential and to respond to ethical concerns. However, it would be a mistake and contrary to my principles of good political governance to develop such a strategy without consulting the citizens.' It was with these words, delivered at a conference to consult with 'the interested parties' (consumer and environmental defence groups, industrialists, farmers, health experts, academics, the media and popularisers of

science, MPs and representatives of the Member States and third countries), that Commission President Romano Prodi inaugurated an on-line public consultation exercise which was operational during the last three months of 2001.

On a 'Biotechnology' site created specially for the purpose (in 11 languages), the Commission first submitted a 'consultation document' as a basis for discussions, as well as conference reports. During these three months, the site has attracted a wide range of comments and contributions from the general public.

The trends revealed will help the Commission to present an orientation document with the aim of developing a medium- and long-term

strategic vision of the life sciences and biotechnology. Short-term action proposals will complete the picture.

europa.eu.int/comm/biotechnology/

The dynamics of regional initiatives

What can be done to encourage synergy between European regional initiatives which involve scientific and technological development? How do we create co-operation between regions which often have their own research programmes? The communication entitled, The regional dimension of the European Research Area, which the

Commission has just adopted, seeks to stimulate measures – some of which will be included in the new framework programme – likely to facilitate relations, networks and regional co-operation. Such measures could include: recognition of the 'regional' aspect of researcher mobility (via specific grants for example); co-operation between the most developed regions and those receiving European Structural Funds; specific initiatives for outlying areas.

Information:

Robert Burmanjer
robert.burmanjer@cec.eu.int
europa.eu.int/comm/research/press/2001/pr0410en.html

Opinion

Dealing with anthrax

The best response to bioterrorism is not increased security, but reinforcing public health infrastructures to deal with such attacks – something neglected in the USA as well as in other countries. Indeed, the relatively small-scale anthrax attacks have shown obvious weaknesses in the public health system that need to be fixed.

Luckily, laboratories in Florida were quick to confirm anthrax, which was in part due to the fact that laboratory chiefs had just returned from bioterrorism training by the US Centers of Disease Control and Prevention (CDC). But, in New York, cutaneous anthrax detected in an infant was initially treated as a spider bite and one of the Washington postal workers who died of pulmonary anthrax was originally sent home from hospital diagnosed with the flu. Thus, doctors in hospitals and private practices need to be taught how to recognise an infection from a biological weapon.

But, on another front, public institutions must also educate the public about the potential threats of and therapies against bioweapons because only better knowledge will eventually prevent mass panic. Indeed, the CDC has already been criticised for not supplying enough information on bioweapons, and the US government conceded that its initial response to the anthrax letters had been too slow.

And the fight against bioterrorism should not stop at our borders. All countries must co-operate to prevent the production and spread of biological weapons. In this context, it is very disappointing that, on 25 July, the US government abandoned discussions about giving more power to the Convention on Biological Weapons – a decision that even dismayed Britain, America's closest ally and a strong supporter of the Convention.

Bioterrorism is so frightening because anthrax, plague, smallpox or ebola evoke fears far beyond the actual threat. It is not a wise strategy to give in to fear and to impose draconian safety measures. If we do this, we will surrender the very freedoms that characterise our democratic societies, and the terrorists will have achieved their goals. Instead, the response should be based on science and common sense, and thus, improving public health infrastructures makes much more sense.

Holger Breithaupt
 News Editor, EMBO reports

We welcome your thoughts and opinions which will certainly interest other readers. Please send your letters to Michel Claessens : michel.claessens@cec.eu.int – Fax: +32 2 295 8220.

Call for proposals overview

Quality of life and management of living resources (www.cordis.lu/life)

► Closing date 31/01/02

- Key actions⁽¹⁾

- Food, nutrition and health
- Environment and health
- Sustainable agriculture, fisheries and forestry
- The ageing population and disabilities

- Generic research⁽¹⁾

- Integration of the Newly Associated Countries in the ERA⁽²⁾

► Closing date 08/02/02

- Accompanying measures
- Support for research infrastructures

► Closing date 28/02/02

- SME measures (co-operative research)

► Closing date 10/04/02

- Training: Marie Curie individual fellowships

(1) Call published on 31/10/01

(2) Call published on 20/09/01

User-friendly information society (www.cordis.lu/ist)

► Closing date 21/02/02

- Key actions⁽¹⁾

- Systems and services for the citizen
- New methods of work and electronic commerce
- Multimedia content and tools
- Essential technologies and infrastructures

► Closing date 28/02/02

- Future and emerging technologies⁽¹⁾
- Future and emerging technologies⁽²⁾
- Co-operation with Newly Associated Countries⁽²⁾
- Various support activities⁽²⁾
- SME measures (co-operative research)

► Closing date 13/03/02

- Future and emerging technologies⁽³⁾

(1) Call published on 16/11/01

(2) Call published on 27/01/01

(3) Action lines VI.2.1 & 2 – FET.

Competitive and sustainable growth (www.cordis.lu/growth)

► Closing date 15/02/02

- Measurements and testing research⁽¹⁾
- Support for research infrastructures⁽¹⁾

► Closing date 28/02/02

- Training: Marie Curie individual/industry fellowships

- SME measures (co-operative research)

- Accompanying measures

(1) Call published on 16/10/01

Energy, environment, sustainable development (www.cordis.lu/eesd)

► Closing date 15/02/02

- Inclusion of partners from the Newly Associated Countries (NACs)⁽¹⁾

- ESD: Accompanying measures⁽²⁾

► Closing date 28/02/02

- SME measures (co-operative research)

► Closing date 15/03/02

- ESD: advanced courses⁽²⁾

► Closing date 20/03/02

- Training: Marie Curie individual and host fellowships⁽²⁾

► Closing date 12/07/02

- Call published on 15/11/2000

- ESD: Accompanying measures⁽²⁾

(1) Call published on 07/08/01

(2) Call published on 15/11/2000

Nuclear energy (fission) (www.cordis.lu/fp5-euratom)

► Closing date 09/01/02

- Training: individual Marie Curie fellowships⁽¹⁾

► Closing date 21/1/02

Call published on 16/10/01

- Nuclear fission key action⁽¹⁾

- Generic research⁽¹⁾

- Support for research infrastructures⁽¹⁾

- Inclusion of partners from the Newly Associated Countries (NACs)⁽¹⁾

► Closing date 25/03/02

- Other training actions⁽¹⁾

- Accompanying measures⁽¹⁾

(1) Call of 16/10/01

International cooperation (www.cordis.lu/inco2)

► Closing date 18/01/02

- Training & excellence

- States in pre-accession phase⁽¹⁾

► Closing date 18/02/02

- Accompanying measures⁽¹⁾

- Emerging economies and industrialised countries

► Closing date 01/03/02

- Fellowships for Japan

► Closing date 15/03/02

- Support for conferences⁽¹⁾
- States in pre-accession phase
- NIS and other CEEC

- Accompanying measures⁽¹⁾

- Mediterranean partners (INCO-MED)

- Developing countries (INCO-DEV)

► Closing date 05/04/02

- Shared cost and concerted actions, thematic networks⁽²⁾

- Mediterranean partners (INCO-MED)

(1) Call published on 18/09/01. Modification expected on 21/12/01

(2) Scheduled publication date 21/12/01

Innovation/Participation of SMEs (www.cordis.lu/innovation-smes)

► Closing date 20/02/02

- Joint research pilot action⁽¹⁾

► Closing date 28/02/02

- SME measures (co-operative research)

(1) Call scheduled for 30/11/01 following call of 13/07/01

Human potential (www.cordis.lu/improving)

► Closing date 15/01/02

- Improving the socio-economic knowledge base key action⁽¹⁾

- Marie Curie individual fellowships

► Closing date 01/02/02

- High-level scientific conferences

► Closing date 13/03/02

- Marie Curie individual fellowships

► Closing date 15/03/02

- Archimedes Prize⁽²⁾

► Closing date 05/04/02

- Descartes Prize⁽³⁾

► Closing date 15/04/02

- Raising public awareness of science and technology⁽⁴⁾

(1) Call of 24/07/01

(2) Call of 04/09/01

(3) Call scheduled for 03/12/01

(4) Call scheduled for 15/01/02

Full details of calls for proposals are available on: www.cordis.lu/fp5/src/calls.htm

News in brief... News in

Publications



- Science and young people** – Special edition of *RTD info* published on the occasion of European Science and Technology Week 2001 (Also available in French and German).
 Printed version: research@cec.eu.int
 Web: europa.eu.int/comm/research/rtdinfo.html

- Electro-magnetic fields and mobile phones** – Projects Catalogue 1999–2001
 Printed version: eesd@cec.eu.int.

- Gender in research** – Gender impact assessment of the specific programmes of the Fifth Framework Programme – An overview
 Printed version: nicole.dewandre@cec.eu.int
 Web: europa.eu.int/comm/research/pdf/gender-in-research-synthesis-report_en.pdf

- Innovation scoreboard 2001** – Special edition of ITT magazine
 Printed version: innovation@cec.eu.int
 Web: www.cordis.lu/itt/itt-en/01-5-spec/index.htm



- EC-sponsored research on safety of genetically modified organisms** – Results of more than 10 years of projects on GMOs
 Printed version: EUR-OP
 Web: europa.eu.int/comm/research/quality-of-life/gmo/

- Eurocean 2000** – Proceedings of the Hamburg conference
 Printed version: EUR-OP

- ASTAIRE, Atmospheric effects of aircraft emissions in the upper troposphere and lower stratosphere** – Proceedings of the EC advanced study course, Bergen, Norway, August 1999
 Printed version: Georgios.Amanatidis@cec.eu.int

- Quality of coastal zones: a priority for the EU** – Brochure published by the Environment DG
 Printed version: env-pubs@cec.eu.int
 Web: europa.eu.int/comm/environment/iczm/2000_brochure_en.pdf



- Antimicrobial resistance research** – Results of projects
 Printed version: EUR-OP

- Desertification Convention Data & information requirements for interdisciplinary research**
 Printed version: EUR-OP

- European research in action** – new leaflets (currently available in English, but soon in 11 languages) on the following subjects: Anti-doping – New medicine – Communicable diseases – Marie Curie Fellowships – Women and science – Recycling vehicles.
 Printed version: research@cec.eu.int
 Web: europa.eu.int/comm/research/leaflets/

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

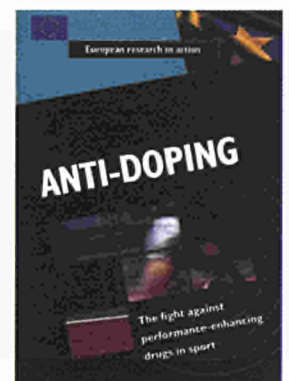
Teacher Student Press/Media Other:

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

Full address⁽²⁾:

⁽¹⁾ If subscribing by e-mail, please indicate your activity (see categories)

⁽²⁾ If possible give tel./fax numbers and e-mail address



Diary

► Multimedia content and tools –

Technology opportunities today supplement of Cordis focus, no.28, July 2001

Printed version:

innovation@cec.eu.int

Web: <ftp.cordis.lu/pub/focus/docs/res28.pdf>

► Clean and efficient energies for Europe – Results of individual projects

Printed version: EUR-OP

Web: www.cordis.lu/eesd/src/eng_results.htm



Printed publications accompanied by the mention of an e-mail address are free and can be obtained by sending a message to the address given. EUR-OP (Office for Official Publications of the European Communities) means that the printed versions must be purchased. To order copies please visit the website at: eur-op.eu.int/general/en/s-ad.htm

The publications mentioned are a selection. 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

Research meetings under the Spanish presidency

Scheduled for first six months of 2002

- Informal research council – 01-02/02/02 – Gerona
 - Ethics of clinical trials in developing countries – date to be determined – February or March 2002 – Barcelona
 - Euro-Mediterranean conference of industry and research ministers – 09-10/04/02 – Malaga
 - Social sciences: European policies and institutions – 09-10/05/02 – Barcelona
 - Strategic platform for research on biodiversity – 12-14/05/02 – Almeria
 - Future research priorities – 13-14/05/02 – Seville
 - Science and the environment: accepting research risks to reduce societal risks – 30-31/05/02 – Murcia
 - Technologies for sustainable land and sea transport – 04-06/06/02 – Valencia
 - Women and science – 05/06/02⁽¹⁾ – Madrid
 - The ERA and the Sixth Framework Programme: research in Europe's most outlying regions – early June – Canary Islands
 - European platform for clinical trials in the field of poverty-related diseases – date not yet confirmed, linked to the EU-Latin America summit – Barcelona
- (1) To be confirmed in accordance with the Helsinki Group agenda

Other events

- **E-Santé: Médecine de pointe, Médecine de proximité** – 23-24/1/02 – Lille (FR)
www.novamedia.fr
- **Global Alternative Fuels Forum** – 12-13/02/02 – Stuttgart (DE)
wra@theenergyexchange.co.uk
www.theenergyexchange.co.uk/bookingdetail.asp?id=29
- **InfoTechPharma 2002** – World Informatics Congress for Biopharm R&D
13-15/02/02 – London (UK)
katie.evans@informa.com
www.infotechpharma.com/
- **Astronomy – Cosmology and Fundamental Physics** – ESO-CERN-ESA Symposium – 4-7/3/02 – Garching (DE)
www.eso.org/gen-fac/meetings/symp2002/
- **EU/ECC Cereal Conference 2002** – Implementation of the European Research Area – 6-8/3/02 – Vienna (AT)
Contact: Helmut Glattes
gen.sec@icc.or.at
- **40 years of the EORTC – Conference on the Future of Cancer Clinical Research in Europe**
26-28/3/02 – Brussels
www.eortc.be/
- **Dissemination Conference of Current European Research on Rice** – 6-8/6/02 – Turin (IT)
Contact: Elisabetta Lupotto
eurice.elu@spm.it
- **Biomass for Energy – Industry and Climate Protection** – jointly organised by: ETA-Florence and WIP-Munich – 17-21/6/02 – Amsterdam (NL)
http://www.wip-munich.de/conferences/biomass/amsterdam_2002/amsterdam.html
- **New trends in water and environmental engineering for safety and life: eco-compatible solutions for aquatic environments**
Capri (IT) – 24-28/6/02
www.capri2002.com/
- **1st World Wind Energy Conference and Exhibition** jointly organised by: ETA-Florence – WIP-Munich and BWE – 2-6/7/02 – Berlin (DE)
www.world-wind-conference.org/
- **Conférence internationale sur l'échantillonnage de l'ADN – International DNA Sampling Conference** – 5-8/9/02 Montreal (CA)
www.humgen.umontreal.ca/conference/fr/
- **Eastern Enlargement of the EU – Implications for development strategies and development co-operation in the 21st Century**
19-21/9/02 – Ljubljana – Slovenia
www.eadi.org/general/conference.htm
- **International Conference on Soils under Global Change – A Challenge for the 21st century**
Constanta – Romania – September 2002
Contact: Mihail Dumitru
m.dumitru@icpa.ro
- **PV for Europe – Conference and Exhibition on PV Science – Technology and Application** – jointly organised by: ETA-Florence and WIP-Munich – 7-11/10/02 – Rome (IT)
www.wip-munich.de/conferences/pv/rome_2002/index.html
- **Genomics and Forest Tree Stress Tolerance Short Course** – Chania – Greece – November 2002
Contact: Andreas Doulis
adoulis@maich.gr

New on the Web



► **SME TechWeb, the portal for SME researchers**

www.cordis.lu/sme/

European research programmes welcome SMEs, and specific measures to encourage their participation will be strengthened under the new framework programme for 2002-2006, with 15% of Community financing earmarked for them as a priority. The new SME TechWeb site (in English) provides useful information and offers active assistance for SMEs seeking to participate in EU research.

► **Energy research**

europa.eu.int/comm/research/energy/index_en.html

This new site (in English) launched by the Research DG presents information on the Union's policy to develop sustainable energy sources and European research programmes designed to implement it.

► **IDEA: Who's Who in Europe**

www.europa.eu.int/idea/index.htm

The electronic directory on the European institutions has been named IDEA. This valuable address gives the organisational charts of the various Community institutions and services – such as the Research DG, the Joint Research Centre, and European Parliament Committees on Industry, Foreign Trade, Research and Energy – with a search function by person. Accessible in 11 languages.

► **All about Russian science**

www.informnauka.ru/eng/

Informnauka is an on-line scientific news agency launched in 1999 by the Russian magazine Chemistry & Life, a magazine of popular science which has been read in Russia since the 1960s. This very lively and attractive site is produced by a team of excellent journalists who are well acquainted with academic and industrial research networks throughout Russia and in the Newly Independent States of the former Soviet Union. Essential for anybody interested in the enormous scientific potential of this region, from St Petersburg to Vladivostok.

► **The fascination with water**

www.sea-river-news.com

Originally in French, the weekly Sea-River newsletter has just launched a bilingual (French-English) European monthly supplement. Although its aim is not solely scientific (it also covers fishing and water tourism), this on-line (free) magazine is a mine of information on Europe's water resources and their protection.

Downloadable documents

► **Commission proposals for the rules of participation and dissemination of research results for the Sixth Framework Programme –**

COM (2001) 500 (10/9/01)
europa.eu.int/eur-lex/en/com/pdf/2001/fr_501PC0500.pdf



► **The Descartes Prize Winners**

cordis.lu/descartes

► **E-BioSci and the challenge of biological information management after the genomics revolution**

europa.eu.int/comm/research/press/2001/e-bioscipaper1.pdf

► **Gender impact assessment of the specific programmes of the Fifth Framework Programme – An overview**

europa.eu.int/comm/research/pdf/gender-in-research-synthesis-report_en.pdf

► **An information society for Europe (new on-line brochure on the Information Society Technologies Programme)**

europa.eu.int/comm/research/ist/leaflets/en/index.html

► **Final report on Improving Mobility of Researchers from the High-Level Expert Group**

europa.eu.int/comm/research/fp5/pdf/finalreportmobilityh-leg.pdf

► **Quality of Life Programme: Results of EC-supported research into the safety of Genetically Modified Organisms**

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

The latest news on Europa/Research

- **Calling a halt to climate change –** European research centre stage in Marrakesh (15/11/01)
europa.eu.int/comm/research/press/2001/pr1511en.html

► **Special dossier – The European Union supports the protection of Europe's cultural heritage**

(22/10/01)

europa.eu.int/comm/research/dossier/do1910en.html

► **The European Union and China are going to cooperate on material sciences** (18/10/01)

europa.eu.int/comm/research/press/2001/pr1810en.html

► **Spelt: a protein-rich cereal for animal feed and health foods**

(11/10/01)

europa.eu.int/comm/research/press/2001/pr1110-spelt-en.html

► **Development and assessment of methods for the detection of adulteration of olive oil with hazelnut oil** (11/10/01)

europa.eu.int/comm/research/press/2001/pr1110-oliveoil-en.html



► **32 young scientists awarded prizes by the EU – 13th EU Contest for Young Scientists, 18-21 September 2001, Bergen, Norway**

europa.eu.int/comm/research/press/2001/pr2109en.html

► **Strategies and methods to detect and quantify mammalian tissues in feedstuffs** (11/10/01)

europa.eu.int/comm/research/press/2001/pr1110-feedingstuffs-en.html

► **Special dossier: Research and cancer in the European Union**

(09/10/01)

europa.eu.int/comm/research/dossier/do0910en.html

Inventing the car of the future

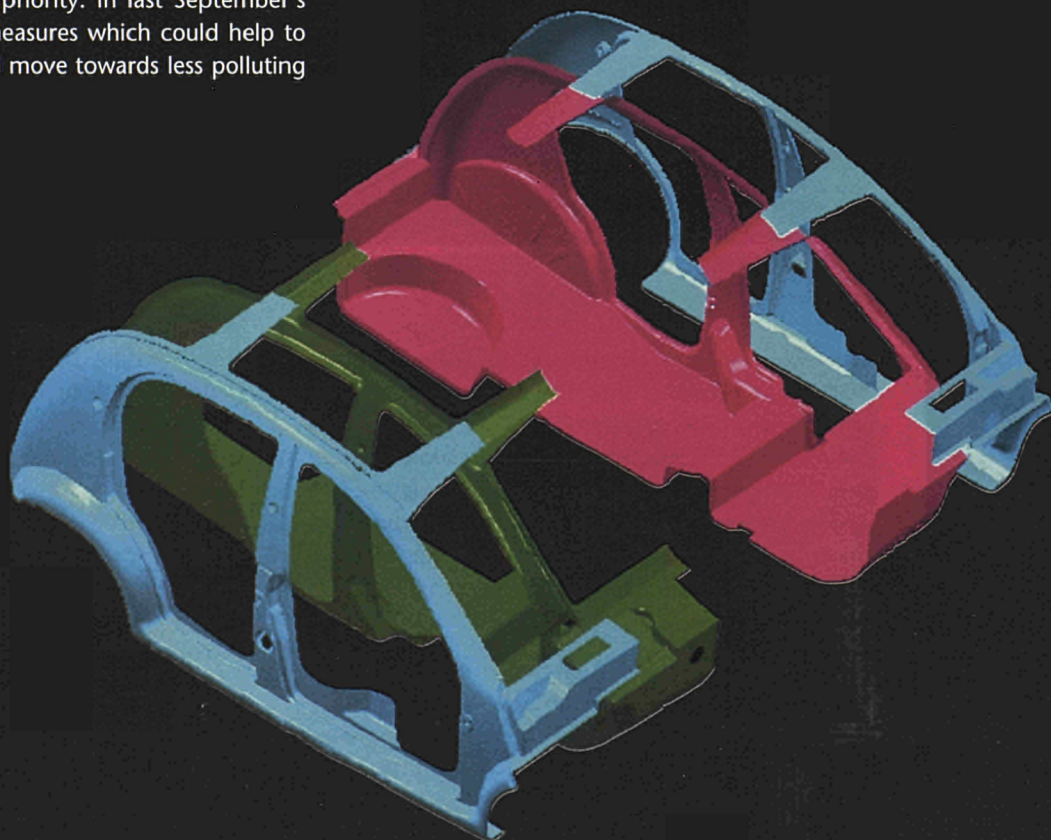
The motor car is without a doubt one of the most popular 'machines' of our age, a symbol of freedom, pleasure and social success. But in reality the automobile dream is more like a nightmare when one considers the damage it causes: pollution, urban congestion, noise and stress, slaughter on the roads. So, when conceiving the car of the future, performance is not the priority but increased safety, environmental protection and fuel efficiency. These are what are needed to enter a new age of 'ecological and sustainable mobility'.

Constructors have embraced these concerns. Their research efforts are giving priority to developing efficient, low pollution vehicles using alternative energy sources. Other research topics include noise reduction, accidentology and biomechanics, safety for child passengers, intelligent car control and anti-crash systems.

In adopting this new approach, the motor industry is reflecting the desire of the Gothenburg European Council which made transport a priority part of its strategy for sustainable development. The Commission, too, has made European transport policy a priority. In last September's White Paper it sets out 60 measures which could help to reverse the present trend and move towards less polluting

transport by revitalising the railways, encouraging waterway transport and improving links between different kinds of transport. Research and technology will also be employed in the interests of clean and efficient transport.

Between 1998 and 2002, the European Union will have invested approximately 1.7 billion euro in research on inter-modal transport, clean vehicles and telematic applications. While under the new framework programme for research (2002-2006), the emphasis will be on clean transport, safety and the intelligent vehicle. The automobile will benefit from research on energy (development of alternative fuels) and sustainable development (through new designs for clean vehicles), as well as projects on intelligent materials, production methods and the information society.

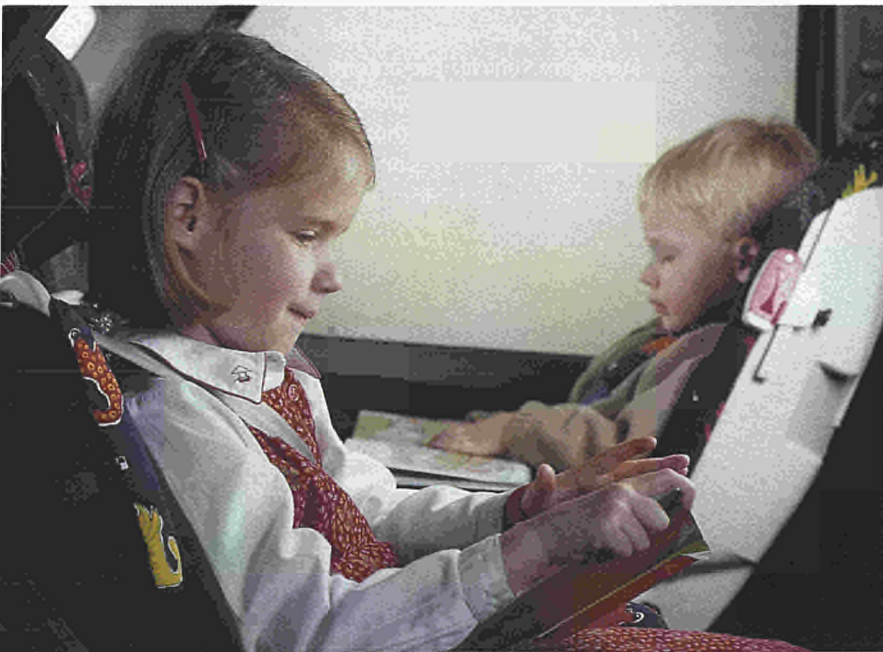


The concept of the composite vehicle, using thermoplastic PET – as used in plastic bottles – offers many benefits for the environment, in terms of production and recycling.

© DaimlerChrysler

Stress-free motoring

With more than 40 000 deaths, 1.7 million injured, and a social cost estimated at 160 billion euro every year, the roads exact a heavy toll in Europe. Nevertheless, despite a major increase in the volume of traffic, the roads are four times safer today than in 1970. Following further safety innovations, the number of victims could be halved by 2010.



After having long been reserved for luxury vehicles, airbags, pretensioner seatbelts, cabin side protectors and antilock braking systems (ABS) are now standard on most models. Electronics – the key component of the 'intelligent vehicle' concept – is also destined to play a greater role in the near future. Motorists will have braking assistance, stability control, steering correction devices, speed limiters and obstacle detection systems.

In addition to this research on 'active' safety (accident prevention), constructors are also focusing on the 'passive' aspects (reduction of consequences). Since 1998, the European Vehicle Passive Safety Network (EVPSN) thematic network has provided a link

between European projects working on automobile 'hardware', such as materials and external and internal vehicle design. Led by TNO Automotive (NL), it brings together 49 members from various backgrounds (manufacturers, safety system suppliers, research institutes and universities). 'It is not the purpose of the network itself to undertake research projects directly, but to promote synergies and project integration, facilitate the transfer of technologies, identify new research topics and disseminate results,' explains project coordinator Edgard Janssen.

Biomechanics, materials and compatibility

The EVPSN's primary task is to collect and collate data on the circumstances and consequences of road accidents and the type of injuries sustained (the Stairs project). Research on biomechanics, coordinated by the French Institut National de Recherche sur les Transports et leur Sécurité (Inrets), is seeking to achieve a better understanding of the lesional mechanisms and dynamic behaviour of the human body in the event of impact. This makes it possible to develop new test dummies to be used in various crash tests whose criteria are laid down by European directives. The Siber and Fid projects, for example, will develop dummies meeting the strictest biomechanical requirements for side and frontal impact.

Under the coordination of the Institut Fraunhofer IFAM (DE), researchers are also looking at the development of advanced materials – such as aluminium and titanium metal foam – which provide better energy

Height-adjustable
car seats for children
(Renault).

© Hervé Desdemaine, Studio Pons



Functioning of airbags in a crash test (Renault Laguna).
© Philippe Pons

absorption at the same time as reducing vehicle weight (Meteor project). Other research, such as that undertaken by Eamlife, is studying the shock absorption level of vehicle structures so as to improve passenger protection, as well as to reduce the impact on other so-called 'vulnerable' road users, such as pedestrians and cyclists.

'The current approach is not to be solely concerned with the impact behaviour of the various vehicle parts,' explains Dominique Cesari, director of the Inrets in Lyons and secretary of the European Enhanced Vehicle-safety Committee (EEVC), but also

to study closely all factors which could help protect users. The biggest progress in protection systems will be in their adaptation to individual characteristics (height, weight, driving position), whereas present passive safety devices are only optimal for males of average height involved in accidents at 50 km/h.

Another major theme of present research is the way systems react to the circumstances of the accident. There is a need to better understand interactions between vehicles of different mass and structure at the time of an accident, what is known as their 'compatibility'. 'This is a new approach insofar as we want to take into account

Internet sites

- European Vehicle Passive Safety Network
www.passivesafety.com
- European Enhanced Vehicle-safety Committee
www.eevc.org
- Euro NCAP
www.euroncap.com

To find out more

The European Commission has recommended measures so that the market shares of rail, sea and navigable waterways can return to 1998 levels by 2010.
europa.eu.int/comm/energy_transport/en/lb_en.html

Diary

A major conference entitled 'Land transport technologies for sustainable development' will be held in Valencia, Spain from 4 to 6 June 2002.

Testing passive safety

Thanks to the European New Car Assessment Programme (Euro NCAP), the Commission has been able to boost awareness among constructors and consumers alike of the passive safety measures offered by today's cars. Head-on and side collision tests have been carried out for six vehicle categories and the risk of injury in cars obtaining four stars in the tests is estimated to have been reduced by a half compared with vehicles marketed ten years ago. Most constructors support these tests (accessible at the Euro NCAP site), because their success makes good commercial sense to dealers.



Frontal impact test on a Rover 75 (Euro NCAP).

www.euroncap.com

Steering aid

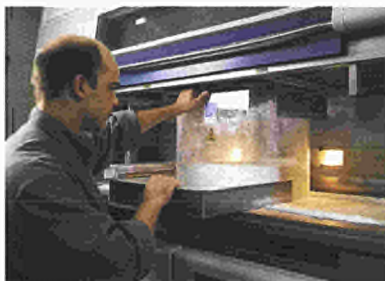
A microcamera located at the front of the vehicle films the road ahead while an image processing system analyses the vehicle position in accordance with the road configuration. If the vehicle draws too close to the white line and threatens to cross it, a 'supervisor' defines the corrections required to adjust the steering. An electric motor fitted to the steering column then transmits vibrations to the steering wheel to alert the driver, while a slight movement of the steering wheel indicates in what direction the steering must be adjusted.

the protection of passengers in third vehicles involved in an accident, whereas present systems are mainly effective for impact against fixed obstacles such as a wall or tree,' stresses Edgard Janssen. 'We must avoid designing cars which are so massive or rigid that they give no chance to the occupants of a third vehicle.'

Another major challenge on which everyone is agreed is to provide the best possible integration of both passive (padding, seatbelts, headrests) and active (airbags) protection systems for vehicle occupants. 'A growing number of vehicles will be fitted with radar and sensors able to detect the risks of an accident and inform the driver,' continues Edgard Janssen. 'Electronic pre-crash sensing systems will play a vital role in adapting airbags and seatbelts to the circumstances of a specific accident.'

Adase II thematic platform today links the principal projects involved in developing advanced driving aid systems. Partners include motor manufacturers (DaimlerChrysler, Jaguar, PSA), parts suppliers (Clepa) and motorway companies (Cofiroute). The challenge at present is to integrate the new on-board technologies and telematic traffic management tools. This would enable the vehicle to gather information on the driving environment and inform the driver of dangerous situations, or even help him to react in the appropriate way. Research is concerned, in particular, with sensor technology (radar and lasers) and man-machine interfaces.

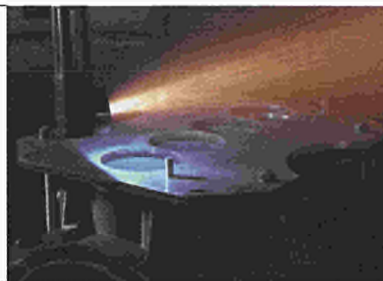
The Carsense project aims, for example, to improve the first auto cruise control (ACC) systems placed on the market in 1999. This objective will be realised by developing or improving several sensors such as the 'light



Research on three-dimensional components.



Bumper prototype using new materials.



Placing an antifriction film on lightened aluminium engine parts.



Use of laser technologies to measure disc brake vibrations.

AIDA

Applications pour l'Information des Autoroutes (AIDA) is endeavouring, on the basis of car-road interactivity, to have vehicles communicate among themselves via transmission markers positioned about every 10 kilometres along the road. The system has the advantage of automatic vehicle location, both issuing and receiving information.

Driving aids

Electronics and information technologies are certainly destined to be the car driver's guardian angels. Today, emergency braking assistance systems, combined with ABS, permit improved vehicle control in critical situations. Renault, for example, already offers systems such as electronic steering programmes (ESPs) for steering correction, or traction control systems to maintain vehicle road grip. To protect against below pressure tyres – a major source of accidents at high speed – automatic tyre pressure monitoring systems are gradually coming onto the market.

Following on from research and tests carried out to date, in particular in the framework of the European Union's Telematics Applications Programme, the

detection and ranging' (LIDAR) system, radar and cameras which will be used to ensure that drivers keep their distance from other vehicles. 'Various scenarios are being envisaged with the constructors to define the perception objectives of the new system,' an Inrets spokesperson explains. 'Particular attention will be given to detecting situations in which accidents are more likely, such as lane changes or the presence of motorcyclists when the vehicle is in assisted driving mode.'

Meanwhile, the Euclide project, with partners Fiat, CEDIP Infrared, Volvo and DaimlerChrysler, is focusing on the interaction between two sensor types – a long range radar and infrared camera – to help drivers in conditions of reduced visibility, such as fog, heavy rain or urban traffic.

Man/vehicle interaction (MVI) is also a key element in optimising these innovations. 'Some active driving aid systems can, paradoxically, interfere with the driver's concentration, at the expense of safety,' says Dominique Cesari. 'This means they have to be evaluated in terms of the mental burden they place on the average car driver. You can inform the driver, but not disturb him or try and replace him. The radar must alert the driver, but not actually brake for him.'

A European 'statement of principles' was adopted on the subject in December 1999, stipulating that on-board information and communication systems must be designed in a way which allows them to be used while driving, without the information impeding vision and ensuring that the interaction allows the driver to react decisively when faced with unexpected events. The Roadsense project, with partners Jaguar, Fiat, Porsche, PSA and Renault, is developing test and simulation methods to assess the various MVI systems proposed by constructors.

Speed and distance control

This allows the car to maintain a cruising speed with continuous and automatic speed correction in accordance with traffic conditions and vehicles in front which may be travelling at a slower speed. A radar fitted to the front of the vehicle analyses the road situation and tracks mobile targets. Relative speeds and distances are transmitted to a calculator which can act directly on the engine and brakes to maintain a safe distance.



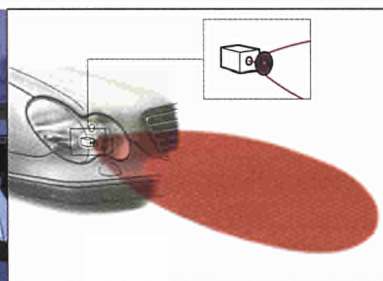
Testing a system of automatic distance control between vehicles (Advanced Highway System Information AHS-I).



Test with dual laser detection equipment.



Ergonomic use of virtual reality.



Infrared laser headlights.

© DaimlerChrysler

Pedestrians and cyclists

'Setting safety standards for the design of vehicle fronts could help save 2 000 lives a year' (White Paper on Transport). On the basis of a Commission communication⁽¹⁾, the European Union will have to decide whether or not automobile specifications should be regulated to protect pedestrians or if it is sufficient to have voluntary agreements, as signed last July by European (ACEA), Japanese (JAMA) and Korean (KAMA) constructors.

The European motor industry has agreed to comply, from 1 July 2005, with the demands proposed by the Joint Research Centre in its report of 19 Decem-

ber 2000. It will also be taking three other initiatives: the fitting of antilock braking systems (ABS) to all new motor vehicles from 2003, the fitting of daylight running lights (DRL) systems from 2002, and the cessation of sales of rigid bull bars (the huge bumpers found on some 4 x 4 vehicles) from 2002. All new types of vehicle will meet the standards set by the European Enhanced Safety Vehicle Committee (EEVC) for pedestrian safety from 2010.

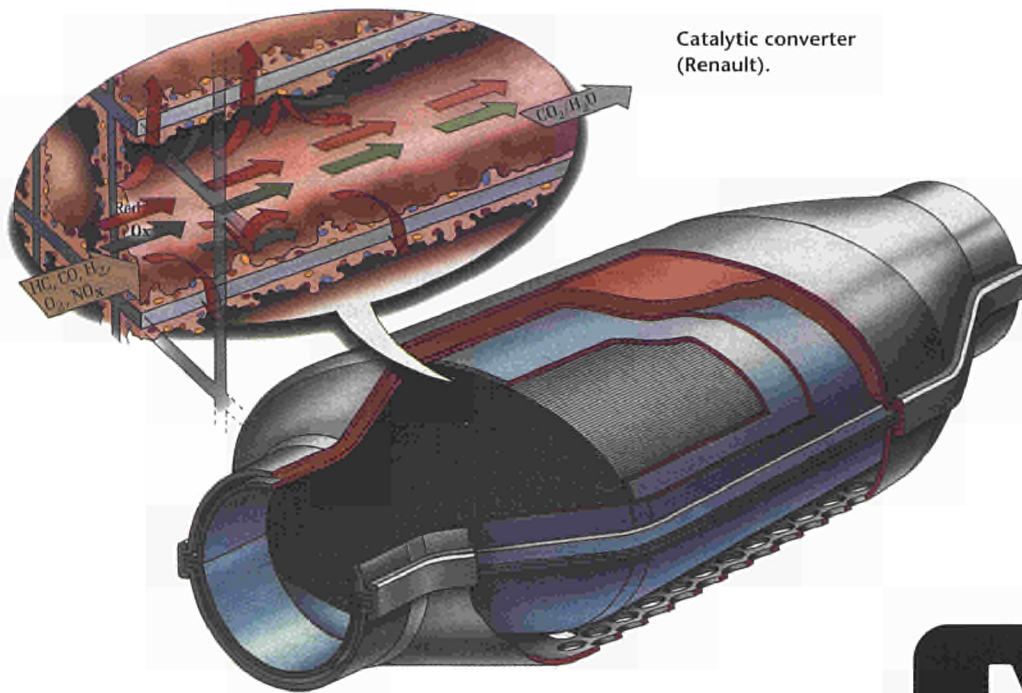
(1) Communication from the Protection of Pedestrians Committee: *Commitment of the European Automobile Industry* COM(2001) 389 final 11.7.2001 – See http://europa.eu.int/eurlex/en/com/cnc/2001/act389en02/com2001_0389en02-02.pdf

Anti-collision systems

An on-board camera supplements and correlates data recorded by the radar. In the event of imminent collision, the system warns the driver and, if necessary, activates emergency braking.

Stop & Go

This aims to increase driver comfort by managing vehicle movements in traffic jams. It stops and starts the car for the driver. This is made possible by short-range sensors fitted to the bumpers to supplement the radar.



Vehicles are becoming cleaner, but also more numerous. The result is that their emissions are still seriously compromising attempts to meet the Kyoto Protocol objectives. To correct the situation, manufacturers are working at three levels: on engines, fuel and emissions.

Meeting

Term 2001⁽¹⁾, a report by the European Environment Agency (EEA), has recently sounded the alarm bell. Pollution caused by the transport sector threatens to compromise Europe's commitments entered into at Kyoto, namely an 8% reduction in greenhouse gas emissions between 2008 and 2012. But not everything about the report is negative. It also points out that technological improvements and cleaner fuels have made vehicles less polluting – although cars have never been so numerous. Between 1980 and 1998 the number of cars in the European Union increased by 64%.

Over the past 15 years, the introduction of electronic injection systems, three-way catalytic converters, multivalve engines as well as exhaust gas processing systems have made a major contribution to the emergence of 'clean' cars. More than 275 million of the world's cars are today fitted with catalytic converters (55% of the global fleet and 85% of new cars). The motor industry claims that new models are 20 times less polluting than vehicles sold in the 1970s.

Harmful emissions by petrol and diesel vehicles are regulated by the Euro 3 standard (to be replaced by Euro 4 in 2005) which governs the quality of the combustion, post-depollution (catalytic converters, filters) and the 'cleanliness' of fuels. The aim is to find solutions which meet the air quality objectives set by the Auto-Oil II programme for five pollutants: benzene, carbon monoxide (CO), nitrogen dioxide (NO₂), particles, ozone.

Less CO₂

However, there is not at present any standard for carbon dioxide (CO₂) vehicle emissions, despite their role in creating the greenhouse effect. Motor manufacturers represented within the Association des Constructeurs Européens d'Automobiles (ACEA) have nevertheless given a commitment to reduce these emissions by 25% (from 185 to 140 g/km) by 2008. This effort will make it possible to stabilise the share of the road transport sector in 2004-2005, thereby contributing to 15% of the emission reductions required by the Kyoto Protocol.

Within Eurcar, the industry has set up a research project entitled 'CO₂perate', with the hope of achieving a CO₂ limit of 120 g/km in 2012. Investments of around 300 million euro have been earmarked through to 2004, in co-operation with research centres and the European Union. A total of 33 projects are currently running in this field, representing total funding of 108 million euro, 54% of which comes from the Union.

(1) Term 2001 – Indicators tracking transport and environment integration in the European Union – is the second joint EC and EEA report on transport and the environment in the Union.

<http://reports.eea.eu.int/term2001/en/term2001.pdf>

Tecabs, the light car

Launched last April with a budget of over 5 million euro, the Tecabs (Technologies for carbon fibre reinforced, modular, automotive structures) project is focusing on ultra-light vehicles. Headed by Volkswagen, in association with Renault and Volvo, the partnership aims to develop, by 2004, a vehicle prototype weighing 50% less than a present-day vehicle thanks to a carbon fibre body (chassis, side frame, roof, etc.). This car of the future would consume one litre of diesel per 100 kilometres, thereby reducing its CO₂ emissions by 40%. By using multifunctional parts and connecting elements based on innovative technol-

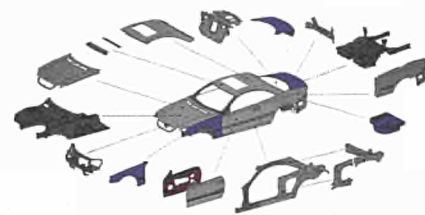
ogy, such a vehicle would be constructed of 30% fewer parts than a present-day car.

Supported by the Esi Group (FR), the Tecabs partners are developing simulation software and digital prototyping which will not only help manufacturers to incorporate composites in car design, but also to develop specific manufacturing processes, and even digital crash tests specific to composites.

Contact: Thomas Wirth, Volkswagen AG

Berliner Ring 2

D-38436 Wolfsburg



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Design of lightweight structures incorporating hybrid materials.

the emissions challenge

Engines, fuels and exhaust

Many research projects are also devoted to improving the compatibility between engines and fuels. The New Diesel Engines and New Diesel Fuels (NeDeNeF) programme at the Institut Français du Pétrole (IFP) is studying the impact of fuel properties on the injection system properties, combustion cycle and the electronic calibration performance of new high pressure direct injection diesel engines.

The development of new emission processing technologies – especially to reduce nitrogen oxides (NO_x) and particles – is, however, rendered difficult by the presence of sulphur in the fuel. The latter reduces the capacity of 'NO_x traps' (which is the reason for promoting sulphur-free petrol or diesel, as proposed by the Commission). The new systems of exhaust post processing (gas recycling, particle filters) are a third avenue being explored to cut pollution.

Premtech: an exemplary network

To optimise the results of these various lines of research, a certain degree of synergy is also required. The Premtech (Advanced propulsion systems and emission reduction technologies) network of constructors, parts manufacturers and R&D bodies active in the

automobile sector has developed some 40 projects in the space of three years aimed at perfecting 'intelligent' internal combustion engines with a high performance and low consumption, as well as emission levels close to zero. The Union, industry and research centres have provided in the region of 200 million euro in funding for these projects, on a parity basis.

This research has given rise to new technologies enabling the production of engines emitting less than 140 g of CO₂/km for cars and 670 g for trucks, in conformity with European emission standards as they will apply in 2005⁽²⁾. These engines will have performances which match today's engines, in terms of cost, reliability and safety.

Furthermore, to meet the increasingly strict standards in terms of consumption and emissions, Premtech has made it possible to monitor the latest developments and to identify technological gaps for which new research projects could be set up.

(2) Coordinated by Meta-Ricerche (Turin), these projects involved the Fiat Research Centre for the development of 4-stroke engines, DaimlerChrysler for diesel engines, the Technical University of Athens (NTUA) for engine parts control, and Volkswagen for emissions processing.

Contact: Giogio Cornetti, cornetti@iol.it

Some Premtech projects

- ▶ **Space Light** (Whole space combustion for diesel light duty vehicles) – Duration: 3 years
Coordinated by: Institut Français du Pétrole (IFP) with Common Rail Technologies, Lotus Cars, Opel, Renault. Objective: advanced diesel technologies with near zero particle and nitrogen oxide emissions.
- ▶ **4-Space** (4-Stroke Powered gasoline Auto-ignition Controlled combustion Engine) – Duration: Completed at the end of 2000
Partnership: DaimlerChrysler, Ford, PSA Peugeot-Citroën
Results: a new and remarkable concept of auto-ignition controlled engine making it possible to reduce petrol consumption by up to 20% and NO_x emissions by up to 99%.
- ▶ **Nofisdi** (NOvel concept Fuel Injection Systems for Diesel engines for passenger cars) – Research in the field of direct injection diesel.

► **Planet** (Platform on Auto-ignition Numerical Engine simulation Tools) – Coordinated by: Institut Français du Pétrole (IFP) with DaimlerChrysler, Fiat, PSA Peugeot-Citroën, Volvo. – Results: Development of auto-inflammation models for the simulation of new CAI petrol and HCCI diesel combustion processes.

► **D-ULEV** (Technological platform of the Growth programme) Duration: launched in January 2001 for 4 years. Headed by: Daimler-Chrysler in Stuttgart, with Centro Ricerche Fiat, Institut Français du Pétrole. Objective: a direct injection diesel emission level equivalent to that of Euro 4 for petrol engines. Results: technologies developed include injection, exhaust gas management, post processing of emissions, in particular through an NO_x trap. Budget: 5.71 million euro, including 3 million euro from the Commission.

► **GET-CO₂/Cluster ADIGA**
Lean burn petrol vehicles with CO₂ emissions comparable to that of diesel engines while respecting the 2005 standards.
Results: envisaged fuel consumption and CO₂ emission reductions: from 15 to 17%.

Transport in figures

- Energy consumption in the transport sector has increased by 47% since 1985, compared with a 4.2% increase in other economic sectors.
- Transport generates 24% of all anthropogenic emissions of carbon dioxide (CO₂) – the principal greenhouse gas – in the European Union. Road transport alone generates 84% of this percentage, with emissions up by 15% between 1990 and 1998.
- Between 1990 and 1998, acid forming emissions by the transport sector fell by 20% and polluting emissions causing ground level ozone concentration, known as smog – containing nitrogen oxide and volatile organic compounds – fell by 25%.
- 11.3 million cars were wrecked in the Member State countries during 1995; by 2015 the figure is expected to be 17 million.
- The number of cars in the EU increased by 64% between 1980 and 1998, to 451 cars for every 1 000 inhabitants.



- External costs linked to transport are estimated to be 8% of GDP. Private cars, lorries and air transport have the highest external costs per unit of transport. Several countries are in the process of developing taxation systems designed to include these transport externalities in the cost of transport.
- Road accidents are falling, but still cost 41 000 lives every year. The number of injured is about 40 times the number of accidents and is falling more slowly than fatalities.
- More than 30% of the population is exposed to noise pollution caused by traffic.

To find out more...

www.premtech.org

Stop the noise!

More than 30% of Europeans are exposed to noise pollution exceeding 55 decibels (the comfort threshold) and more than 4 million people are exposed to road noise pollution exceeding 75 decibels, which is a sufficiently high disturbance level to cause psycho-physiological disorders. Nevertheless, since 1970, noise from private cars has fallen by 85%. The permitted upper limit has been reduced, from 82 decibels in 1970 to 74 decibels in 1996, and the aim is ultimately to reduce it to 70 decibels.

Engines, vehicle vibrations and tyres are the main noise culprits. The directive adopted last June⁽¹⁾ covers a range of

noise factors (decibel values, tyre width, old and new tyres, safety tests) and lays down limits of between 72 and 76 decibels for car tyres (between 71 and 75 decibels from July 2007).

Three principal thematic networks are working on the anti-noise campaign. The RATIN project group (coordinated by Chalmers University and including Goodyear and Renault) is concerned with road/tyre interactions to assess the best way of reconciling noise reduction and road-holding performances. Visper is a project working on reducing noise caused by vehicle transmissions and exhausts, with the aim of achieving a 3

decibel – or 50% – reduction on the original noise level. This latter network is coordinated by AVL List (Austria) – one of Europe's best equipped centres of excellence in the field of acoustics – which also heads the CALM thematic research network on reducing all traffic noise, including air, road and rail.

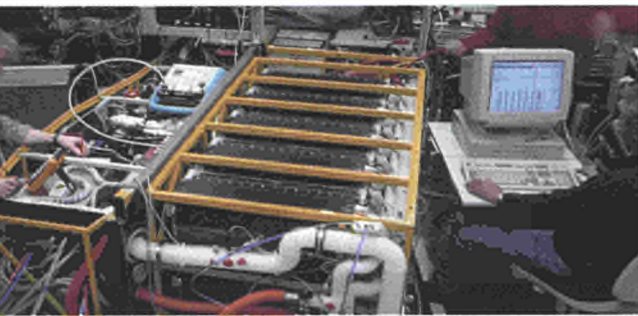
⁽¹⁾ European Parliament and Council Directive amending Directive 92/23/EEC on motor vehicle tyres and their trailers as well as their assembly.

Air and water

By 2010, 7% of road transport fuel should be clean. By 2020, this should be 20%. Apart from the 'traditional' solutions – electricity, natural gas, biofuels, etc. – hydrogen fuel cells offer the 'purest' alternative, but it is perhaps not the easiest to manage.

Fuel cell research
laboratory.
© DaimlerChrysler

In a fuel cell, the energy is produced by the combination of oxygen and hydrogen atoms. The only emission is steam, hence there is zero pollution. Manufacturers seem to be increasingly placing their faith in this solution, with Daimler-Chrysler (DE) set to invest 1 billion euro in developing this alternative energy source between now and 2004. The group – which has formed a partnership with Canadian company Ballard and Xcellsis to develop a fuel cell-powered vehicle that has already received financial interest – unveiled its Necar 4 prototype, modelled on a Mercedes-Benz Classe A, in 1999. The fuel cell runs on liquid hydrogen contained in a tank placed at the rear of the vehicle. This experimental vehicle, which requires 6 litres of hydrogen to produce 1 kW of power, has a top speed of 145 km/h. The tank gives the 55 kW electric engine an autonomy of 450 kms, after which the driver has to fill up with more liquid hydrogen.



The race to production

For the past year, PSA Peugeot-Citroën and Renault have been engaged in a joint research programme on the fuel cell which should make it possible to acquire the know-how and determine the feasibility for such a vehicle to go into production by 2010 at the latest. PSA is also involved in a European project which, towards 2010, should produce a prototype fitted with a battery fuelled with gaseous hydrogen at high pressure. With an autonomy of 350 kms, the vehicle's performance will match that of a diesel vehicle of the same range.

Although BMW has opted for an internal combustion engine using hydrogen directly, it is also teaming up with Renault and Delphi in developing a small SOFC-type cell. With this technology, a small fuel cell supplies all the electrical energy necessary for the on-board network. Lastly, Opel – a subsidiary of General Motors – has also unveiled a prototype operating on the same principle.

The race to the production line is on. Honda has announced mass production of its first models in 2003, and Daimler-Chrysler in 2004, while other constructors have their sights on around 2010.

Where to store the hydrogen?

These clean and autonomous engines which emit only steam do, however, pose one major problem: how to store the compressed or liquid hydrogen, which must be handled with the greatest care. To obtain an autonomy close to that of a vehicle powered by hydrocarbons, the tank must provide almost perfect insulation to ensure the hydrogen remains in the liquid state at a temperature of under 253 degrees. This type of storage can cause explosions during a collision and also presents certain risks when refueling. It is possible to fill the car with traditional fuels (petrol, methanol or GPL) using a 'reformer' fitted to the car to extract the hydrogen. But in such a case CO₂ emissions would be between 85 (methanol) and 100 grams (petrol) per kilometre, which is almost half the emissions of a combustion engine. Producing hydrogen from methanol also consumes a lot of energy. Also, methanol attacks engine coating and seals and is also more toxic than petrol. The use of a reformer should in fact be a non-starter.

Researchers are therefore trying to come up with alternatives, such as carbon nanotubes. Some laboratories have managed to store up to 6 grams of hydrogen in 100 grams of nanotubes, but it is likely to be another 12 to 15 years before such technology is applied to an automobile. ▀

Micro-organisms

Stemming from a partnership between the Gesellschaft für Biotechnologische Forschung (GBF), and the large Czech chemicals manufacturer, SPOLchemie, a new type of cheap and efficient mercury decontamination process, which relies on the activity of harmless bacteria, offers an environmentally friendly solution to drastically reduce pollution of the River Elbe.



Chloralkali electrolysis factory at SPOLchemie. In the steel tanks are the mercury and the salt brine, from which chlorine gas is electrolytically produced. Electrodes can be seen connected to the power supply. The total amount of mercury in the hall on the picture is about 200 tons.

Contacts

- ▶ Irene Wagner-Döbler, GBF
(coordinator),
iwd@gbf.de
- ▶ Johannes Leonhäuser, GBF
jle@gbf.de
www.gbf.de
- ▶ Charles Kessler, Research DG,
charles.kessler@cec.eu.int

The chemical plant at SPOLchemie, located in the Czech Republic city of Ústí nad Labem, is truly vast – situated atop a vast brown coalfield in one of the most polluted parts of Europe. Countless reactor sheds meet the eye in every direction. The plant is a legacy of former communist times, an era of massive state control that forsook efficiency and good manufacturing practice in the pursuit of greater output. There is a lot of spare capacity now at SPOLchemie, once the largest chemical producer in the former Czechoslovakia. The company has made big changes in its determination to meet European Union production standards. It has closed down non-viable processes, made working practices safer, and made heavy investments in environmental protection.

There are over 500 products in the company's portfolio including basic inorganic chemicals, resins, dyestuffs, pigments and organic intermediates. The chloralkali facility, which produces chlorine and potassium and sodium hydroxides, accounts for more than a third of total turnover. It requires huge amounts of mercury – some 200 tonnes of the liquid lies in row upon row of metre-wide electrolytic trays. Unfortunately, the metal has been seeping out into the nearby River Elbe for decades – in Stalinist times as much as 2000 kg each year. The river winds northwards into the sea at Hamburg in Germany, where the sludge in the harbour became so toxic that it had to be dredged, at great expense. The mercury arrives from factories right across the former eastern European communist bloc, including SPOLchemie.

An essential need for action

In 1997, in order to tackle its own pollution problem at the source, the City of Hamburg donated a sedimentation tank to SPOLchemie – worth 150 000 euro – through which process water could pass before being discharged as effluent into the River Elbe. 'This installation alone cut mercury pollution from around 1 500 kg to 200 kg a year,' explains Karel Cipra of SPOLchemie.

'But it was still far too much, and double the limit set by Czech law. For every kilogram of mercury discharged, we have to pay a fine of over 500 euro. In addition, poisonous mercury vapour gets into the air, and we have to think of the health of our workers. So we had to take action,' added Cipra. 'We could have used existing mercury decontamination processes – columns filled with ion-exchange resins or the use of hydrazine – a hazardous chemical also used as rocket fuel – but these are very expensive. We realised that the GBF could offer us a good biological solution very cheaply if we joined in this research project. The company, nevertheless, outlaid a considerable amount to tackle the global mercury pollution problem, including the cost of more modern railcars to transport its chemical products, as well as repairs to plug leaks in the electrolytic cells themselves.'

Down to 60 kg

After initial lab tests in 1998 and the set-up of a pilot plant for our biological treatment process at the chloralkali company ECI Elektrochemie (Ibbenbüren, Germany), a real demonstration plant was installed at SPOLchemie and it has been operating for more than one year now,' says Johannes Leonhäuser of the GBF⁽¹⁾. 'We have helped to get the total amount of

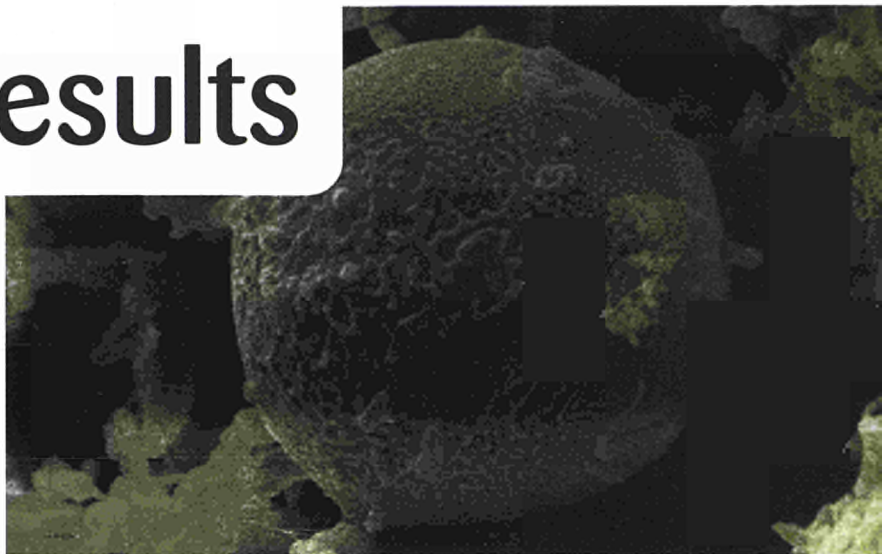
and macro-results

mercury in the effluent down to 60 kg a year. In fact, at present our process only attacks the waste mercury from the electrolytic cells, which is down from around 160 kg to just 20 kg a year. Another 40 kg a year is due to metal that has over the years permeated deep into the land on which the plant stands – via rain leaches. We are currently talking to a group of Czech consulting engineers about the feasibility of using it to clean up the soil here at SPOLchemie.'

The GBF water decontamination unit comprises a bioreactor packed with porous stone chips covered by an adhesive film of naturally occurring, non-pathogenic bacteria. These are a *pseudomonas* species resistant to mercury, which convert ionic mercury into the atomic, metallic form. First, the wastewater is neutralised by alkali so that the bacteria will not be killed. Then, the bacteria feed off an infused sugar solution while simultaneously converting mercury ions. Finally, an activated charcoal filter absorbs much of the remaining mercury in the wastewater, so that the concentration of the metal in the outflow is under 50 micrograms per litre. The unit can cope with an inflow loaded with up to 10 milligrams per litre of mercury. These figures are similar to those demonstrated by ion exchange systems. After about two years' use, acid poured over the bioreactor liberates the entrapped mercury from the packed chips. This can be recycled for use once more in the production process.

The GMO path

The GBF is currently working on another European mercury bioremediation project together with Glaxo-SmithKline in Belgium. This involves the development of innovative technology to extract organomercurials from vaccine production wastewater using a new type of ion exchange membrane and genetically engineered micro-organisms. 'At the beginning of the project with SPOLchemie, we also tried to use genetically modified organisms but our laboratory tests showed that they were performing no better than naturally



Scanning electron micrograph of a biofilm of mercury resistant bacteria growing on its carrier material. The big round droplet in the foreground is a droplet of mercury which has been formed by microbial reduction of ionic mercury.

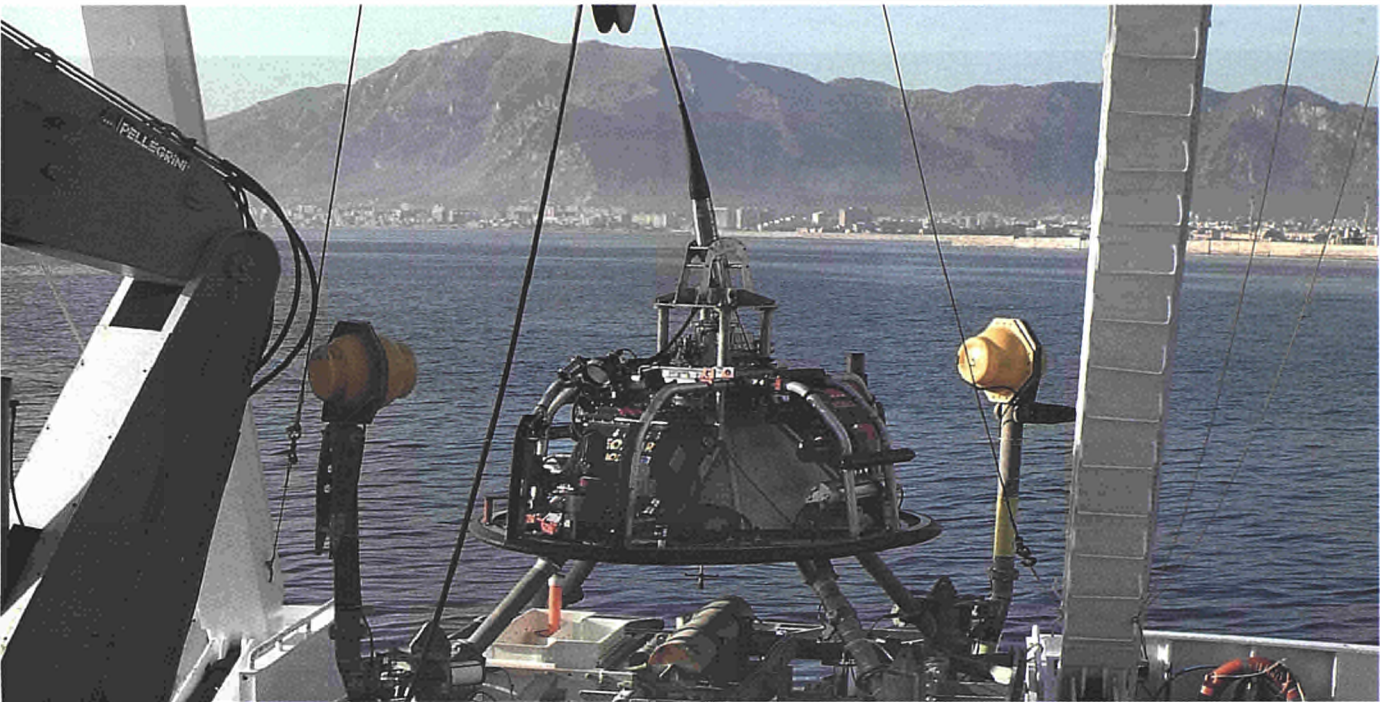
occurring bacteria,' explains Leonhäuser. 'We would like to see our bioremediation system used in other eastern European chloralkali electrolysis plants with similar problems...and perhaps take it to India.'

(1) As a partner of the project, Preussag Wassertechnik, Zwingenberg, Germany, was largely responsible for the construction of the mercury decontamination unit.

At the top in life science

The Gesellschaft für Biotechnologische Forschung (GBF) is based at Braunschweig. The German government supplies almost all its annual budget of some 40 million euro. During 2000, the GBF agreed to participate in nearly 200 research projects, over 60 of them with partners in industry. It offers a range of contract services, including biological preparations up to pilot scale and various laboratory analyses. It also possesses a network of data banks for bioinformatics. The GBF was actively involved in the international human genome project, and continues to work at the hub of German genome research. It is a part of the giant Helmholtz network⁽¹⁾, the largest scientific research organisation in Germany with approximately 25000 employees working on major national research themes.

(1) www.helmholtz.de



The star of the deep sea abyss

Four thousand metres under the sea, in the eastern Mediterranean, the ultra-sophisticated Geostar laboratory is discovering micro-organisms 6 million years old and trying to forecast what surprises Mount Etna may have in store.

'Cast off,' shouts Vincenzo Lubrano Lanadera from the bridge. The captain of the *Urania* is manoeuvring the Italian oceanographic vessel out of the Sicilian port of Messina. On board, along with the crew, are a team of 20 English, French, Italian, Greek and German scientists, European Commission officials, television crews and journalists. But the real star is the aptly named Geostar.

On the quarterdeck, beneath a crane with a five-tonne maximum load, the deep sea laboratory glints in the sun. After an initial successful mission lasting more than 200 days at a depth of 2 000 metres, Geostar is ready for the big one. Thanks to an innovative shuttle system known as *Modus*, it is going to spend nearly a year in unexplored waters 4 000 metres below the surface where the salt concentration is over 30%, pressure exceeds 300 bars and total darkness reigns. The dome-shaped structure stands on four legs and contains sophisticated scientific measuring equipment and an original system for collecting data and communicating it in 'packages' to the surface. Together with the shuttle, which docks on to the top, the total weight of this underwater lab can be as much as three tonnes.

How Geostar works

The Geophysical and Oceanographic Station for Abyssal Research (Geostar) consists of three elements: the *Modus* remote-controlled shuttle which deposits and recovers the bottom station; the bottom station itself (made of titanium and special plastics); the acoustic-satellite communication system, consisting of release buoys known as messengers and a relay buoy which transmits to a shore station.

The bottom station is equipped with data storage units and scientific instrumentation for the mission, such as magnetometers, geochemical sensors, currentmeters, gravimeters, seismometers, etc. It is able to take measurements and communicate them to an oceanographic vessel or shore station for up to one year.

The *Modus* shuttle was designed by the Berlin Technische Universität (TU) and Technische Fachhochschule (TFH). 'Thanks to this *Deep Sea Space Shuttle* it will be possible for the first time to place laboratories on the

A unique biotope

'We still know very little about the environment on deep sea beds which are rich in possibilities for new and exciting discoveries,' remarks Christian Paternmann, director of research on sustainable development at the European Commission. From knowledge of very ancient micro-organisms found in deep sea abysses to the exploitation of underwater resources, including an increased understanding of the origin of earthquakes or the formation of volcanoes, these ocean depths could shed light on some of the major unsolved mysteries of the blue planet.

Conditions in the Strait of Messina are ideal for oceanographic research. The waters of the south-eastern Mediterranean flow at the rate of three metres a second into the Tyrrhenian Sea, which drops to 3 500 metres. The water temperature here is a surprising 14°C, compared with the usual 2°C at this depth. 'This is a totally atypical and unique phenomenon in underwater biology,' explains Laura Giuliano, a microbiologist at the Istituto Esperimentale Talassografico di Messina (Sicily), coordinator of Biodeep⁽¹⁾, a major European project on oceanographic research.

'We discovered only recently several new substances with very interesting applications in pharmacy and the biomedical industry,' she continues. 'Antibiotics have already been developed from micro-organisms obtained from these deep sea waters of the eastern Mediterranean. Research is also being carried out on using them in developing new treatments for various kinds of cancer.'

The volcano and the sea

The *Urania* leaves the strait and sets a course for the Tyrrhenian Sea, its bow sending up showers of spray. The hills around Peritola recede into the distance as Etna looms ever larger. A cloud of sulphurous smoke is clearly visible, shrouding its summit which rises to 3 323 metres. Volcanologists hope that the data Geostar obtains from the ocean depths will improve their knowledge of this giant whose changing moods have such an impact on the life of the island. To the 300 000 people who live in Sicily's third largest town, it is like a sword of Damocles permanently hanging over them. The tragic eruption of 1908 which left 60 000 victims lives on in the collective memory. Francesco Maria Faranda, a researcher at the Istituto Nazionale di Geofisica (ING), explains how 'to monitor Etna, we are now going to search for indicators of its activity on the sea bed, at the point where the tectonic plates of southern Europe and North Africa meet. We hope that the recordings made over a long period by the seismometers and magnetometers on board Geostar will enable us to make earlier and more accurate forecasts of earthquakes and volcanic eruptions.'

● ● ●

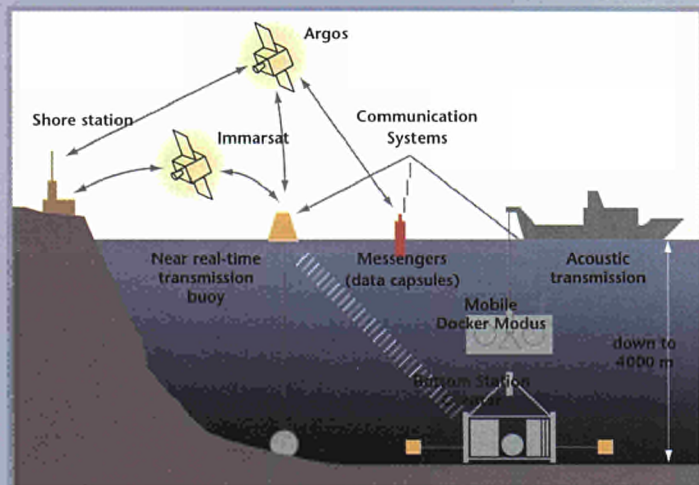
(1) From a Union budget of 500 million euro allocated to oceanographic research (1998-2002), 4.6 million are allocated to the Geostar and Biodeep projects.

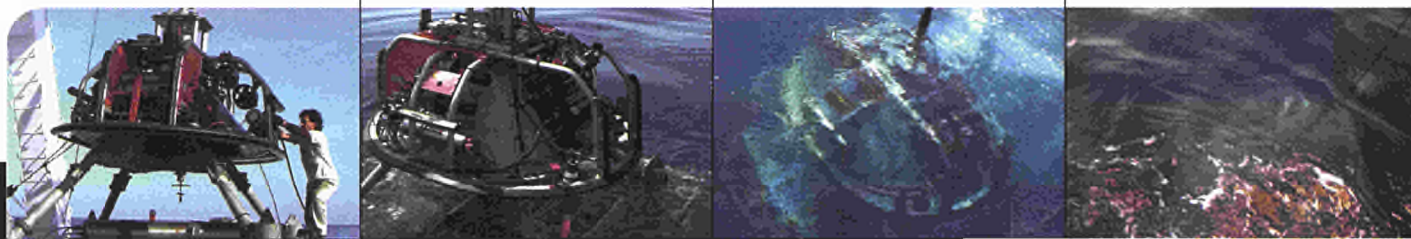
sea bed and then recover them one year later,' explains Günther Clauss of the TU Berlin.

Previously, every deep sea laboratory had to be equipped with a special installation system. *Modus*, on the other hand, makes it possible to deploy underwater stations at different depths and bring them to the surface again easily once the mission has been completed. 'The European Geostar system is therefore ideally suited to the long-term observation of oceanographic phenomena and is a first step in developing an international scientific network for research in deep sea abysses,' explains European Research Commissioner Philippe Busquin. Initial discussions on a co-operation agreement with the US-Canadian Neptune project have already taken place and Geostar's success has aroused great interest in the technology of European submarine laboratory deployment across the Atlantic.

After an initial mission between September 2000 and April 2001 at a depth of 2 000 metres, the Geostar

oceanographic observatory leaves the port of Messina on board the *Urania*. Bound for the Tyrrhenian Sea, not far from the island of Ustica, off the coast of Sicily, it will spend one year collecting data on the marine environment 4 000 metres under the sea.





It is a five-hour descent to a very special biotope in the Strait of Messina. It is here that the waters of the south-eastern Mediterranean flow at the rate of three metres a second into the Tyrrhenian Sea which is 3 500 metres deep. The temperature here is a surprising 14°C, compared with the usual 2°C at this depth. This provides ideal conditions for oceanographic research.

To find out more

www.ingrm.it/GEOSTAR

Partners

► Italy

Istituto Nazionale di Geofisica e Vulcanologia
Tecnomare SpA
Istituto per la Geologia Marina – CNR

► France

Ifremer
Institut de Physique du Globe de Paris
Laboratoire d'Océanographie et de Biogéochimie CNRS
ORCA Instrumentation

► Germany

Technische Universität Berlin
Technische Fachhochschule Berlin

Contacts

Paolo Favali
geostar@ingv.it
Gilles Ollier, Research DG
gilles.ollier@cec.eu.int



Discoveries at these depths can also add to our knowledge in completely different fields. Marine micro-organisms make it possible to develop new biological methods for purifying waste water. 'Until quite recently, the chemical processes used to purify these waters were often more toxic for men and animals than the pollution itself,' remarks Laura Giuliano. 'Similarly, some products used in offshore oil extraction are much more polluting than the hydrocarbons themselves. This is why we are trying to move toward clean biological substances which have proved to be more effective than traditional chemical products.'

A five-hour descent

The *Modus* shuttle disappears beneath the waves, diving to deposit the lab far below on the sea bed. The umbilical cord linking the *Modus* to the surface vessel includes a video system which allows the diving operation to be monitored on computer screens. 'The telemetric link gives four parallel images as well as sonar images that help us to guide the descent which lasts five hours,' explains Hans Gerber, a lecturer at Berlin's Technische Fachhochschule (TFH). As project leader, the institute has been responsible for the *Modus*' original technological concept since 1995. The *Modus* functions like a deep sea shuttle, depositing instrumentation stations at extreme depths and then returning to recover them when their work is done (see box). Once Geostar has been deposited on the sea bed, a system co-developed by the Institut français de recherches pour l'exploitation de la mer (IFREMER) ensures continuous communication between the surface and the submerged station, essential for the scientists' work.

First of all, an acoustic-satellite link fitted to a surface relay buoy positioned close to the station makes it possible, from the shore station (via Immarsat), to transmit instructions to the bottom station and monitor its status and data collected. Also, an innovative solution – crucial to the scientists' work – has been developed for storing the vast quantity of mostly seismic data collected by the underwater lab. Marker buoys, known as messengers, record the data collected and check the main station functions. These messengers are released automatically by Geostar when their memories are full. They rise to the surface where they immediately retransmit their data to the relay buoy via the Argos system. An acoustic signal emitted by a surface vessel above the station can also trigger the release of these data storage messengers. The data contained on a storage card are then retrieved.

Life of extremes

Is life possible under the extreme conditions found 4 000 metres under the sea? 'Nature magazine recently published the results of US research conducted off the Californian coast. In underwater basins scientists discovered bacteria several thousand years old, confirming the hypothesis that micro-organisms can survive in salt crystals,' explains Laura Giuliano. 'These basins were formed 6 million years ago and European scientists have found similar formations on the sea bed in the eastern Mediterranean. Sediments collected at a depth of 3 500 metres by the *Urania* oceanographic vessel during the Biodeep project suggest that bacteria can survive at these depths. Laboratory research will provide final proof.'



The return of the phenologists

In the 17th century people engaged in phenology, perhaps without knowing it, by studying the opening of buds and the gathering of migratory birds. Today, after several centuries of neglect, climatologists and meteorologists are turning to the subject with renewed interest, while data processing and satellite observation are giving it a new lease of life.

Phenology? 'The scientific study of the variations which different climates produce on the flowering and leafing of plants,' says the dictionary definition. A more precise, but also more complex, definition is given by the newly founded European Phenology Network (EPN): 'The study of the timing of recurring biological phases, the causes of their timing with regard to biotic and abiotic forces, and the interrelation among phases of the same or different species.' These *phases* are annual events which are sensitive to climate – and especially temperature – such as the budding or flowering of plants, bird migration and the appearance of insects. Some observers even include glacial fluctuations.

Whatever the definition, this observation discipline, which originated in the 17th and flourished in the

19th centuries, fell into neglect until the evidence of climate change – and the desire to understand better the major ecological mechanisms – recently led to renewed interest.

Discreet climate indicators

Arnold van Vliet of the Analysis of Environmental Systems group at the University of Wageningen (the Netherlands), founder of the EPN, believes that 'the creation of the study group on phenology at the 13th congress of the International Biometrology Society in Alberta, in 1993, gave the signal for the renewal': 'It was there that scientists acknowledged the value of phenology as an indicator of global climate change.'

To find out more

► European Phenology Network

www.dow.wau.nl/msa/eppn/

► Globe

www.globe.gov/fsl/welcome.html

► Positive

www.forst.tu-muenchen.de/EXT/LST/METEO/positive/

► De Natuurkalender

www.natuurkalender.nl

► Plantwatch

www.devonian.ualberta.ca/pwatch/

► UK Phenology Network

www.phenology.org.uk/

► International phenological gardens

www.agrar.hu-berlin.de/pflanzenbau/agrarmet/ipg.html

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Tim Sparks, of the Centre of Ecology and Hydrology (CEH, Huntington, UK), is convinced that 'phenology is an excellent vehicle for making the general public and policy-makers aware of how climate change has an impact on the natural world'. Arnold van Vliet speaks of 'the leafing dates of British oaks recorded between 1746 and 1948 in Norfolk and between 1948 and 1998 in Surrey, which show an exceptional precocity over recent years, as do the flowering dates of the fuchsia in Hamburg (Germany) recorded between 1945 and 1998'.

Phenology did not of course originate with such concerns. 'For 19th-century naturalists, it was a question of seeing how climate affects plant growth. While agronomists and horticulturalists wanted to be able to forecast cropping dates and organise the harvest,' explains Isabelle Chuine of the Laboratoire de paléoenvironnement et palynologie of the Institut des Sciences de l'Évolution (CNRS, Montpellier, France). To this day, agronomists and foresters remain major users of phenology. They use it to anticipate the likely dates of attack by pests and diseases, for estimating the harvest or growth of trees, or preventing possible frost damage. But there are also other fields of application, such as human health. Without phenological data, how would it be possible to forecast the start and duration of the pollination season and thus of hay fever, or the incidence of diseases such as malaria, which are transmitted by carrier organisms? Finally and more fundamentally, phenology is vital for an understanding of the dynamics of ecosystems, including interaction between species, competition, length of growing season, hydric balance, evolution of populations, carbon storing, etc.

Collecting, harmonising, communicating...

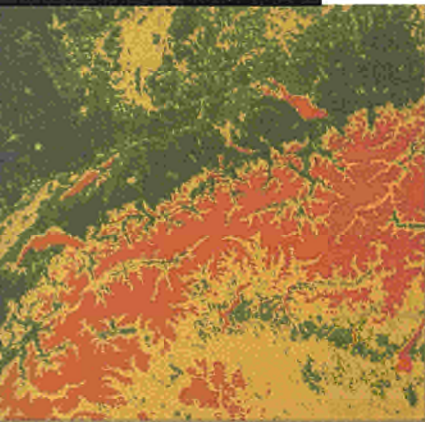
The long series of historical observations, carefully preserved in dusty registers and sometimes going back to the 18th century, are of little use in their raw state. 'Sometimes,' explains Isabelle Chuine, 'the corresponding temperature records are not known, or the time series are too short, or not all the stages in the plant's growth are recorded. Also, it is not always known on what element an observed date is based (a tree, several trees, a forest?). That poses the problem of significance.' In short, there is an urgent need to locate the scattered or forgotten data, harmonise them and then integrate them in a form which can be stored in databanks to which researchers from all disciplines can gain access, as they themselves need to exchange their knowledge and techniques. That is the aim of the European Phenology Network.

'It was when Dolf de Groot and I were working on climate change indicators in Wageningen that I first became fascinated by phenology. But I quickly noticed a lack of communication between existing networks and various user disciplines,' remembers Arnold van Vliet, who decided to launch the EPN project in January 2001.

Over the next three years the network will be organising specialised workshops and two European conferences.⁽¹⁾ It will compile a bibliographical base and a metadatabase of phenological data linking all existing

⁽¹⁾ The first conference was from 5 to 7 December 2001 in Wageningen (NL).

Satellite data



Using satellite data for the investigation of vegetation dynamics in Switzerland.

Source: www.eumetsat.de

In phenology, nothing seems to have the power to replace the eyes of a well-trained observer out and about in the field. Nevertheless, over recent years, artificial satellites have attracted increasing attention. Their main asset is the ability to monitor vast regions in a short amount of time and thereby plot large-scale maps of a country, or even a continent.

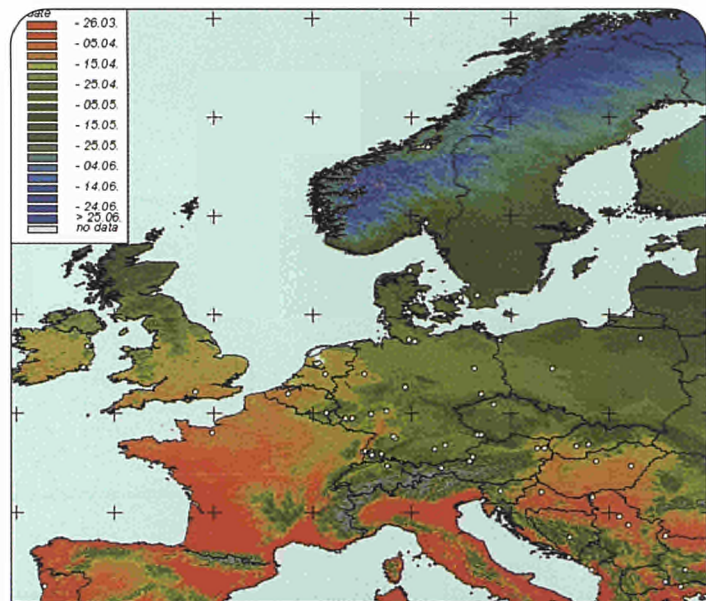
"Spot", for example, measures the quantities of infrared and red light reflected by the earth's surface – the 'pixels' measure one or several kilometres per side – which depend respectively

on the quantity of leaves and chlorophyll present. This makes it possible to identify the moment new leaves appear, but at present there are major methodological limits. The principle is of course that the satellite can only give a global result corresponding to all the plant species present at that time, both trees and shrubs. Other more technical problems, such as the influence of clouds, further limit the value of the data. The systematic comparison of field data with the Spot results – to validate and calibrate the latter – is one of the main objects of the Positive programme launched in 2000.

databases in Europe, and will launch actions to increase public awareness (aimed in particular at schools) in co-operation with the Globe educational project.

Models to forecast and explain

The exchange of methods between scientists is all the more necessary as phenology today is very different than in the past. Observation in the field undoubtedly remains essential, but other kinds of data are appearing, such as those collected in a greenhouse on plants cultivated under various 'climatic' conditions and satellite observations (see box). Above all, the subsequent processing of the data has changed fundamentally. There are now elaborate statistical analyses and computer models on how a given species behaves depending on climatic parameters. 'The first explanatory and forecasting models date back to the 1960s and 70s. Experiments under controlled conditions have shown that temperature is the principal parameter affecting flowering date, and mechanistic models have been constructed for different species,' explains Isabelle Chuine. But the step between constructing phenological models and using them on different scales in agronomy, ecology or human health has not yet been made and is one of the priorities of the Positive European Programme, launched in 2000 and which runs for two years. Phenological models are destined to be included in larger models, representing the functioning of plants, species distribution, agricultural systems, the ecological operation of an environment, etc.



The figure shows the average beginning of the growing season (BGS) in Europe. In this study the leafing dates of four species (*Betula pubescens*, *Prunus avium*, *Sorbus aucuparia* and *Ribes alpinum*) were combined in an annual leaf unfolding index to define the beginning of the growing season. The picture was recently published in Roetzer-T. Chmielewski-F.M. (2001): Phenological maps of Europe. *Clim-Res.*18(3), 249-257.

In short, a great deal of work remains to be done. But what is the most urgent need? 'Financing! More research is needed to link ground and satellite observations, and to show how a modified phenology can affect species' distribution or survival, population size and interactions,' stresses Tim Sparks. ▀

Reactivated networks

As is often the case, a number of countries, including England and France, claim to be the home of phenology. What is known is that in Europe – and much earlier data were recorded in China and Japan – the discipline emerged in the 1730s with the work of the Englishman Robert Marsham. After the naturalists, the agronomists embraced the discipline, followed by the learned societies who recruited many field observers. To this day, networks of enthusiasts continue to document the dates when the first buds appear or the swallows gather on the telephone wires, especially in Scandinavia and North America. These amateurs or school pupils place their observations directly on the Internet.

In the Netherlands, for example, the former *De Natuurkalender* network (1896-1968), placed under the aegis of the Dutch Royal Meteorological Organisation, was relaunched earlier this year by the European Phenology Network coordinator Arnold van Vliet. In the United Kingdom, the Woodland Trust has teamed up with the Centre for Ecology and Hydrology (CEH) to launch the UK Phenology Network. In Canada, Elisabeth Beubien, a researcher with the Devonian Botanical Garden (University of Alberta), launched Plantwatch in 1996, which works with schools to record the flowering dates of common species such as the lilac and poplar.

The species studied are generally chosen for their ease of identification, widespread distribution, rapid reaction to climate changes and, wherever possible, a long history of recorded observation. However, they are not always the networks used by scientists (with the exception of Plantwatch). The latter have their own networks, such as the International Phenological Gardens, founded in Germany in 1957 and now active at the European level, which only recruits professionals (agronomists, meteorologists) and studies about 15 species. To ensure results are not influenced by the genetic variability of individual species, these researchers observe the behaviour of clones transplanted to various European sites.

Flans of the euro

This way for your euro coins...

Setting aside the socio-economic and political dimensions, the switch to the euro is an unprecedented industrial challenge for coin manufacturers. For this reason, a joint Spanish and German project – under Eureka's Production Technologies Programme – has developed innovative, automated processes and quality/security control measures.

About 50 billion coins are needed for the launch of the euro in 2002. This is an unprecedented quantity which poses many capacity problems, especially for producing the 'flans' or disks on which the coin design is stamped.

'Our study estimated a potential production shortfall of some 35 000 tonnes, not just in Europe but worldwide,' explains Jose Francisco Garrido, director of purchasing at the Fábrica Nacional de Moneda y Timbre (ES), which specialises in coin minting technologies. 'We wanted to help make up for this shortfall through innovations offering increased security and flexibility, at a reduced cost.'

The 'flan' stage

The CeCo factory, specialising exclusively in *intelligent* technologies, was established in 1998 on the outskirts of Madrid as a joint venture with Euro-Coin – a Deutsche Nickel (DE) subsidiary which produces alloys. It is here that the new processes developed by the Eureka co-operative research project *Factory CoinBlank* are achieving results.

There are several stages to flan production: cutting the metal, placing it in the oven and, finally, washing. Production conditions are determined by a number of parameters linked to the type of alloy being used, such as cutting and

stamping speed, oven temperature, acid quantities, immersion time in the water bath, etc.

'We sought to innovate at every stage of the process,' explains Jan Siebert, who initiated the project at the German partner company. The level of automation – almost 100% – is a measure of the project's success. The whole process is computer controlled, from the introduction of the metal strips to the finished product, with all the important quality controls included.

'It is the first of its kind in this sector. It cuts production costs and the time between stages, thereby reducing stock requirements. The system should ultimately be able to auto-programme,' anticipates Jose Francisco Garrido. 'When working with such sensitive material, automation offers perfect security. The number of people actually working with the system is very limited.'

Another challenge was the need to produce different coin sizes at the same site. 'Competing companies can produce various coins. But thanks to the specific design of our production lines we are today alone in being able to produce all eight euro coin formats using the different alloys.'

Better than that, while some traditional lines allowed certain parameters to be changed during production, this new

system makes multiple changes possible on-line during the same shift. Sets of 10, 20 and 50 cent coins can be minted in just a few hours, for example.

After the euro rush

The bottom line is that the technologies developed by the new CeCo plant are two to three years ahead of those of its competitors, including the most efficient US and South African mints. The coins currently being produced – and harnessing a capacity close to 15 000 tonnes a year – will of course enter circulation when the euro is launched. The new plant will meet more than 40% of Spanish demand, estimated at 7.1 billion coins. Also, a growing share of the flans made in Madrid are being used indirectly to produce euro coins in Germany, Italy, France, the Netherlands and Belgium.

In the longer term, when the 'euro rush' is over, the two partners hope to export more than 70% of their production, half of it to South America where they are already active. ▀

► Contact

Jose Francisco Garrido
jgarrido@fnt.es
At the Eureka site (search project 2224):
www.eureka.be