European Commission

ISSN 1024-0802

RTD info 28

Magazine for European research

December 2000

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FIFTH FRAMEWORK PROGRAMME

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RTD *info* is a magazine on research and technological development supported by the European Union. It covers general aspects of Community research such as project results and research policy, as well as practical information including dates of calls for proposals, events, conferences, publications, and so on. RTD *info* is aimed not only at current and potential participants in Community research programmes, but also at a wider public of industrialists, decision-makers, students, and others who are interested in developments in European research. Published quarterly, RTD *info* is available in English, French and German. Subscription is free. To subscribe, fill in the form below.

RTD *info* is also available on-line on the European Commission's EUROPA server at:
europa.eu.int/comm/research/rtdinfo.html

Editorial Information

RTD *info* is published by the Communication Unit of the Research DG.
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Failure or impotence?

Published in the space of just a few days, two recent reports forecast some dark days ahead for mankind. The first, submitted to the British government by the official committee of inquiry into the BSE or 'mad cow' crisis, highlights the alarming consequences for public health resulting from poor management. The second, drawn up by the IPCC (Intergovernmental Panel on Climate Change) experts, upwardly revises the estimated impact of climate warming.

Although these two reports are not directly concerned with technoscientific applications, scientists are nevertheless implicated at two key and distinct levels.

First of all in relation to technical solutions, in which researchers are inevitably involved. Clearly much progress remains to be made. Whether it is prions or the climate, the current state of knowledge justifies a continued research effort. The second level concerns interactions between science and society, and thus calls into question the experts. Here too progress is (too) modest. In the case of BSE, scientific warnings were insufficiently heeded; in the case of climate change, the Member States are reluctant to take the steps which are now clearly necessary.

Faced with these two serious problems, one is tempted to ask: is the failure of technoscience to blame, or is it the inability of scientists to make themselves heard? Whatever the reason, the question of relations between science and democracy (the subject of a recent conference organised by the Commission – see page 6) is raised with the utmost pertinence. It also reflects one of the ambitions of the European Research Area, namely to develop and improve relations between science and society at the European Union level (see below).

An area on the move

Against the background of the new vision of the European Research Area (ERA), the EU's scientific and technological policy is currently engaged in radical reform. Last October the Commission submitted concrete proposals on the objectives and actions of this strategic renewal, which will determine the nature of the new framework programme covering 2002-2006.

At a time when science and technology are proving increasingly essential catalysts for the global economy and knowledge-based society, Europe's structural weaknesses in the field of research are a worrying handicap. In 1999 the US invested 70 billion euros more in research than EU countries as a whole. Put another way, whereas Europe devotes just 1.8% of its GDP to research, the United States devotes 2.7% and Japan 3.1%.

Producing a structuring effect

Such is the starting point for the ERA project. And the aim? To create a new dynamic enabling the European Union's public and private research efforts to be strengthened through increased cooperation and coordination.

This desire is today leading the EU to rethink the form and content of its research actions. Over the past two decades, the framework programmes have undoubtedly made a significant contribution to the development of trans-European scientific and technological cooperation networks. But the Union's efforts have tended to be "tagged on" as an appendage to the research policies of the Member States which have generally been pursued independently of one another.

The new dynamic which the Commission wants to see drive its research policy in the context of the ERA is based on a central leitmotif: by being more closely linked to national policies and other initiatives for European intergovernmental cooperation, the Union's actions must above all seek to have a structuring effect on Europe's scientific and technological potential.

Three principles and their application

Based principally on the recommendations of independent experts who carried out a qualitative assessment of previous framework programmes, the Commission proposes three principal ways forward:

- a genuine concentration of efforts on fields where Community action brings the most "European added value" compared to national actions;
- a closer partnership with the Member States, research institutes and companies in Europe by networking the principal players;
- a more efficient implementation, by concentrating resources on larger projects of longer duration.

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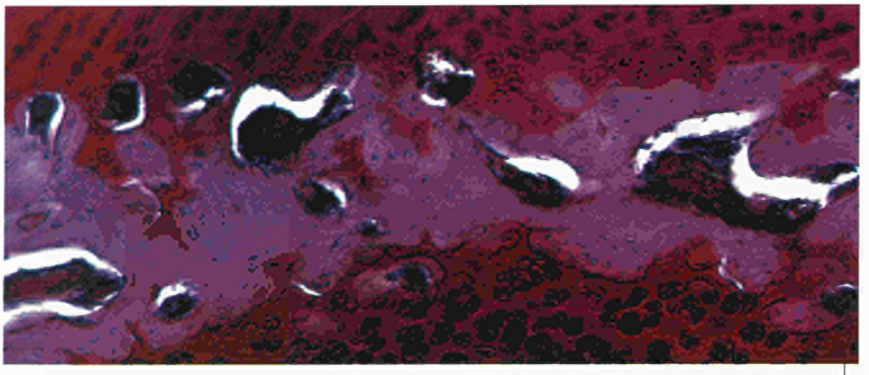


Wide-ranging consultation with the players will make it possible to identify the most significant fields of research.

•••

The practical implementation of these principles could give rise to actions of the following types:

- the networking of national research programmes by their mutual opening up and the Union's participation in programmes implemented in a coordinated manner;
- the creation of European networks of excellence by networking existing capacities in the Member States around *common programmes of activities*;
- the implementation of major research projects conducted by consortiums of companies, universities and research centres on the basis of global financing plans;
- increased support for regional and national efforts to support innovation and research by SMEs;
- the strengthening and diversification of support actions for research infrastructures of European significance;
- increased and diversified mobility grants for researchers coming not only from the European Union but also from other countries. Measures to promote human resources in the research field are also proposed, including a *women and science* action plan.
- actions to reinforce the social dimension of science, especially on questions of ethics, public awareness of science and stimulating interest in science among young people.

These new methods of intervention will result in new methods of management permitting larger projects and simplified procedures.

Steps on the road to the ERA

On 18 January 2000 the European Commission adopted the Communication entitled *Towards a European Research Area*. This was widely discussed, in particular with representatives of the European Parliament and the European Council.

On 23-24 March, the heads of state and government ratified the project at the Lisbon European Council.

On 18 May, the European Parliament adopted a resolution expressing its support.

On 15 June, a Council Resolution invited the Member States and the Commission to take the necessary measures to begin implementing the ERA.

In October 2000, taking into account comments made, the Commission submitted a second Communication (see article above) on future directions for the Union's actions in the field of research in the new context of realising the ERA.

On the basis of the various consultations under way, the Commission will submit formal proposals to the Council and Parliament for the Sixth Framework Programme at the beginning of 2001.

What priorities for the future?

What major research priorities will the European Union's scientific and technological policy concentrate on in the years to come? At the present stage, the Commission's proposals are more concerned with defining the criteria of *European added value* which must guide such a choice. The choice itself will only come after wide-ranging consultation with European research players, due to start early in 2001 with a view to preparing the Sixth Framework Programme. The Commission nevertheless cites, by way of example, fields which are emerging as of significant importance for the future of European research:

- *post-genomic* research and research on major diseases, due to the scale and complexity of the task and the need for Europe to make a coherent contribution to the international effort in this field;
- nanotechnologies, a research field with many applications and considerable impact;
- the research necessary for the development of the information society;
- research and development which a country or company could not undertake alone in fields of fierce global competition, such as aeronautics and the space industry;
- research to support European policy decisions in fields with considerable uncertainties and major risks;
- research to support the Community policies necessary to implement a sustainable development model in the widest sense.

The complete texts of the two Commission communications on the ERA can be downloaded from the Research DG's site at: *http://europa.eu.int/comm/research/area_en.html* ■

European tools for science

Last September more than 400 scientists from all disciplines met in Strasbourg for a passionate discussion on the development of major European research infrastructures. Enric Banda, general secretary of the European Science Foundation (ESF) and the initiator of the event, summarises this wide-ranging debate held in the new context of the European Research Area (ERA).

In the context of the ERA, do scientists see infrastructures as a priority field in which the Union should adopt a much more pro-active policy?

Enric Banda: The Europeanisation of the major research infrastructures is an essential condition for scientific excellence on our continent - and political will is clearly necessary to achieve it. Take CERN for example. For more than 40 years, all the contributing states have agreed to support this essential tool for research on fundamental physics. The result is that CERN is now the infrastructure leader in this field at world level. Europe attracts American and Japanese scientists who believe it is at CERN that they will find the best facilities for research on particle physics. Another example is the Grenoble synchrotron, a valuable high-tech tool for specialists in the life sciences as well as materials researchers. It is therefore excellent news that in launching the ERA the European Union is giving political priority to infrastructures.

But what common infrastructures do we need the most?

The two examples I have just mentioned are 'giants' which correspond to the traditional image of infrastructures. While the need for specialist equipment of this kind remains, infrastructure is now also taking on a wider meaning, including non-physical fields. Science today is based on the management of an exponential mass of data stored in bases scattered across Europe and the world. If you do not create a virtual infrastructure allowing researchers to continuously exchange these data, they will not be able to work. This is why the call to set up the grid - the wideband communication network giving scientists immediate access to all knowledge bases irrespective of location - is so important.(1)

© CERN

Continuously supported for the past 40 years by a group of states convinced of the value of such a scientific tool, CERN is the symbol of a European public research infrastructure which plays a leading role worldwide in advancing knowledge in fundamental physics.

Another kind of EU-level virtual infrastructure must meet the essential challenges posed by problems of society. At the ESF we are totally committed to the project we call 'a European synchrotron of the social sciences.' The many different national approaches are a great obstacle to research in this field. It is very important for a Europe in search of its identity to have a global understanding of the aspirations of the people living in the countries of which it consists.

The scientific community seems to favour a 'variable geometry' approach, that is support for infrastructures by limited groups of partner states which do not necessarily include all the EU members.

Yes, because as Europe is not a federal entity, it is on this realistic basis that this system has functioned to date. But a new dynamic is needed for these 'clubs' to be as open as possible. And the new - and very important - element provided by the ERA is that the EU itself can become part of this. It can provide very concrete encouragement for transnational partnerships allowing Europe to play its role as interlocutor in major world programmes. Its more active involvement in designing and managing 'variable geometry' infrastructures will also provide a guarantee of non-discrimination against those states that are 'outside the geometry'. This is a particularly vital point for those Central and Eastern European countries which are due to join the EU. ■

(1) In March, the European Council in Lisbon explicitly charged the Commission with ensuring that Europe acquires such a research network as quickly as possible.

The demands of democracy

Europeans have mixed feelings about certain scientific advances. They are suspicious of the way in which decisions with serious - or even unforeseen - consequences are taken by politicians behind closed doors. We look at the new relations which must be established between scientists, decision-makers and citizens.

New developments in science and technology are coming thick and fast, sparking ethical debates and sometimes bringing irreversible consequences. Meanwhile the general public too often has the impression that choices are being imposed from above. How can the sensitivity of society to the changes proposed be taken into account? How can the democratic debate be strengthened, responsibilities be defined, and sometimes contradictory scientific opinions and real economic objectives be presented transparently? And how can decision-makers think in terms of prudence and sustainability and act openly in times of crisis?

'Science and technology are perhaps the two fields which pose the question of the relation between citizens and the decision-making process best, because they have always been factors of economic and social development,' observed Philippe Busquin on closing the Science and Governance conference organised by the Commission last October.(1)

Debates and precautions

But how to initiate a debate on difficult subjects which genuinely involves the public without snapping one's fingers at parliamentary democracy? The solutions are many - from referendums to citizens' panels, including consensus conferences and public inquiries - and their pertinence varies depending on the questions asked. An ethical problem is not the same as a technological choice. In each case the objective should be to widen the debate and allow the decision-makers and scientists to take the people's views into account.

Then, in better knowledge of the facts, it is necessary to act - or not, as the case may be. In 1999 the European Commission undertook to integrate the precautionary principle in its policies and to make assessments prior to any decision-making. However, precaution is not the same as paralysis. On the contrary, it is a way of further defining the directions research can pursue - research which may perhaps in future render this principle obsolete by virtue of its advances. Moratoriums can also buy time during which research can continue while the public reflects.

What is precautionary research? Why this divide between science and society? How to act in a crisis? How to create a joint scientific and technical reference system? Just some of the questions on the agenda at the Science and Governance Conference held in Brussels last October.

Don't panic!

But time is of the essence in 'crisis situations'. These seem to destabilise both the decision-makers (required to take urgent measures) and their scientific advisers (required to rapidly appraise situations whose parameters may not fully be known). But apart from this - and the transparency of information required in the event of serious events - there must also be a rigorous approach of anticipation and prevention. Such anti-crisis monitoring is based on a series of 'weak signals' which, taken individually, may appear of little significance, but when correlated sound a clear warning.

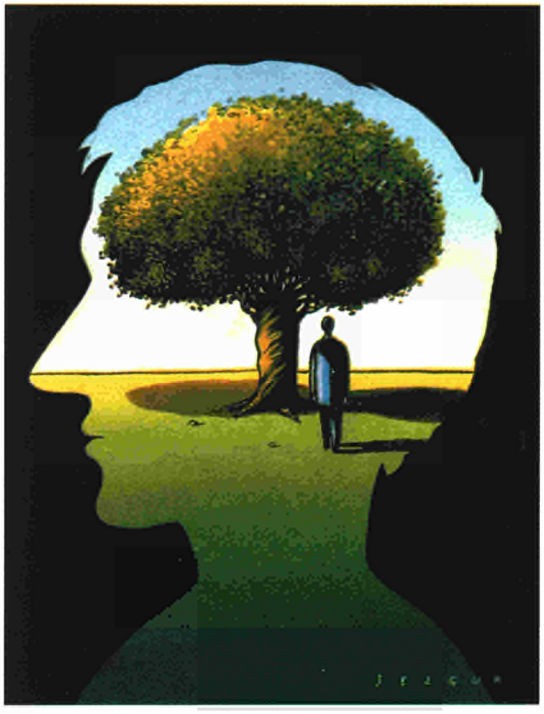
Standards and references

The creation of a common scientific and technological reference system is part of this same dynamic. Throughout the European Union, Community directives increasingly stipulate regulatory decision-making processes - on environmental protection, safety of citizens, international trade, etc. The scientific bodies controlling the implementation of these standards must therefore be based on common procedures. The Commission's Joint Research Centre, for example, is already an independent scientific reference centre, networking with national laboratories with the aim of developing the necessary harmonised know-how for implementing European policy. ■

(1) This meeting included four thematic sessions: decision-making process; anticipating risks; crisis situations; development of a European reference system.
To find out more, go to: http://www.jrc.es/sci-gov/

Billions of neurons

Consciousness, intelligence, language use, memory, emotions... The faculties which make man unique in the biosphere are the result of a very special system - the brain - which is without doubt the most complex organ evolution has produced. It is not surprising therefore to find that science has taken a long time to penetrate its mysteries. Understanding the organisation and activity of its several thousand billion cells - the neurons - and the billions of connections between them is a truly enormous task.



Of all areas of scientific research, present advances in the neurosciences offer perhaps the most fascinating prospects for the modern world. First of all, as a dynamic discipline in the crucial field of medicine, they are aimed at combating the often tragic diseases resulting from brain disorders. In Europe - paradoxically due to ever-increasing life expectancy - these disorders exact a heavy toll, for example due to the ravages of neurodegenerative diseases such as Alzheimer's or Parkinson's. At the other end of the age range, hereditary brain disorders - which still strike many babies at birth - are the cause of enormous suffering. There is also the possibility of reducing the suffering caused by behavioural or psychiatric diseases, which unfortunately are increasing in a world of accelerating social change.

The brain is an organ which holds much fascination for the researcher - not just when it malfunctions, but perhaps primarly when it is healthy. This fascination is shared by the general public.

European programmes reflect this importance, especially as Europe has traditionally been recognised worldwide as a centre of excellence in this field. Under the Fourth Framework Programme, 87 million euros (12% of the funding for biomedicine and 6% of that for the biotechnologies) was granted to 118 projects. These projects involved 736 research teams in 26 countries. The creation of a Neuroscience industrial platform, in which more than 20 of Europe's most dynamic pharmaceutical and biomedical companies are taking part, provided an effective forum for evaluating the results of research carried out in all these networks.

This priority is confirmed by the Fifth Framework Programme, within the Quality of Life and Management of Living Resources programme. In addition to projects initiated under *The cell factory* and *The ageing population and disabilities* key actions, the Neurosciences part of the programme's generic research activities is at present supporting the creation of 12 new research networks. These comprise 79 laboratories specialising in cellular communication, learning mechanisms and memory, neuroinformatics and theories of neuroscience. Other projects linked to the brain's development and the understanding and treatment of the principal mental or psychological disorders are currently being developed.(1) ■

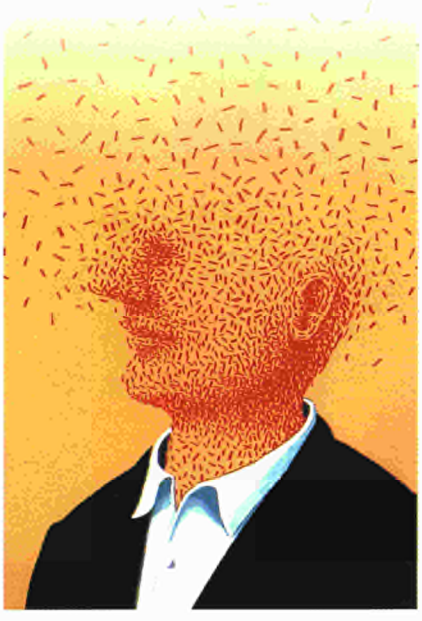
(1) In particular, European research was the subject of numerous presentations at the 22nd world congress of the Collegium Internationale Neuropsychopharmacologicum (CINP), held last July in Brussels.

The challenges of neuropharmacology

To communicate with each other, neurons exchange molecules, which create electric currents by binding themselves to the receptors on their membranes. Deceiving, blocking, and saturating some of these receptors are among the strategies used in research on new medicines to combat brain disease and pain.

Developing medicines is a long obstacle course. First you have to find a target, namely a molecule or group of molecules whose abnormal functioning is linked to the illness. Then you have to test millions of candidate molecules with the potential to attach themselves to the target and restore its normal function. As soon as some molecules have been selected, you have to start eliminating all those which cannot be used on man because of their toxicity or rapid breakdown by the body.

It is certainly a complex process - and even more so in the case of medicines for treating brain disease. First, because the brain is separated from the blood by a 'blood-brain barrier' which prevents the passage of many substances, with the result that many promising medicines fail to make the grade because they are unable to reach the brain. The problem of side effects also becomes much more delicate where man's grey matter is concerned, as they are not all detectable through animal experimentation.



The era of consortia

However, this does not mean progress is blocked. Despite these obstacles, neuropharmacology is advancing and today is effectively combating disorders which were previously untreatable, such as drug dependency (see box). One of the strategies which has permitted this progress is familiar to judo experts: turning your opponent's own strength against him. Many brain functions have been shown to involve a small group of receptors. By concentrating research efforts on one or other of these it is possible to open up new approaches to developing medicines of benefit to a wide range of illnesses. This is the strategy adopted by two consortia of European researchers currently supported by the Union.

The first, coordinated by Alvaro Villaroel (Instituto Cajal, Madrid), is focusing on a pathway which is permeable to potassium ions - known as the KCNQ channel - where a large protein inserted in the neuronal membrane allows potassium ions to pass through only under certain conditions. If these conditions are met, the passage of ions is accompanied by a specific electrical current, known as the M-current, whose modulation by medicines can improve cognitive capacities. Each KCNQ channel contains an 'alpha' protein chain which is the subject of much interest. As Thomas Jentsch, a partner on the project from Hamburg University, wrote in *Nature* magazine: 'We are now familiar with four types of alpha chains. Changes in any one of them is associated with a human ailment.' This is why an advanced multidisciplinary study of the KCNQ channel, ranging from its biochemical structure to the physiological properties of the M-current, is on the network's programme. This improved knowledge should make it possible to develop new medicines - a task which falls to the project's two industrial partners, Diver Drugs of Barcelona and Neurosearch of Ballerup (Denmark). Their efforts will focus mainly on neonatal epilepsy and Alzheimer's disease.

The second programme is interested in another key molecule of the neuronal membrane: the somatostatin receptors. Why somatostatin? The coordinator of this network of 12 laboratories, Wolfgang Meyerhof (Deutsches Institut für Ernährungsforschung, Potsdam, Germany) explains: 'Somatostatin is a model for the neuropeptides group - very small proteins whose role in intercellular communication is well known. But before we can use them we have to increase our knowledge of their specificity, pharmacology and limited *in vivo* half-life.' The main reason why such a vast research effort is concentrating on somatostatin is the wide range of illnesses in which it plays a part: Alzheimer's disease, Parkinson's disease, Huntington's chorea, and also depression, schizophrenia and anxiety. Finally, this molecule has unique anti-proliferative properties which make it

an interesting molecule in fighting brain tumours. This explains the interest shown in it by the giants of the European pharmaceutical industry, Novartis of Switzerland and Glaxo-Wellcome of the UK, both partners on the project.

Using endogenous morphines to combat pain

In addition to this research on brain disease, important work is also being carried out to meet one of the most tenacious challenges the central nervous system poses for contemporary medicine: combating pain. This branch of pharmacology has long been neglected and it was not so long ago that eminent clinicians considered it 'normal' for patients to suffer. Fortunately, those days are over and analgesics now represent a market estimated at 300 million euros a year in Europe - and with good reason when you consider that almost 50 million Europeans suffer from recurrent headaches. Chronic pain is now seen as a scourge which impairs the quality of life, and it remains a subject of continued fundamental and applied research.

'Morphine is probably the drug whose use can be traced back the furthest of any in Western medicine,' explains Ian Kitchen (University of Surrey, United Kingdom), who coordinated a European research network on the role of D opioids in controlling pain and dependence between 1996 and 1998. 'But while morphine is certainly an excellent analgesic, it produces many unwanted side effects. This is why clinicians have long been seeking new drugs.' Researchers in this network sought to improve their understanding of the molecular bases of morphine's effect as well as of the related opioid molecules known as endorphins, which circulate naturally in our brains. Their studies of the response to pain and its treatment with transgenically modified opioid functions in mice, which provide excellent laboratory models, gave rise to no fewer than 50 publications in specialist scientific journals. Following on from this fundamental research, since 1999 a programme coordinated by Andis Kreicbergs (Karolinska Hospital, Stockholm) has been trying to develop new opioid drugs which do not cause side effects and which are tailored to the inflammatory pain of the locomotor system. Tens of millions of Europeans who suffer from arthritis and back pain will certainly appreciate their effort. ■

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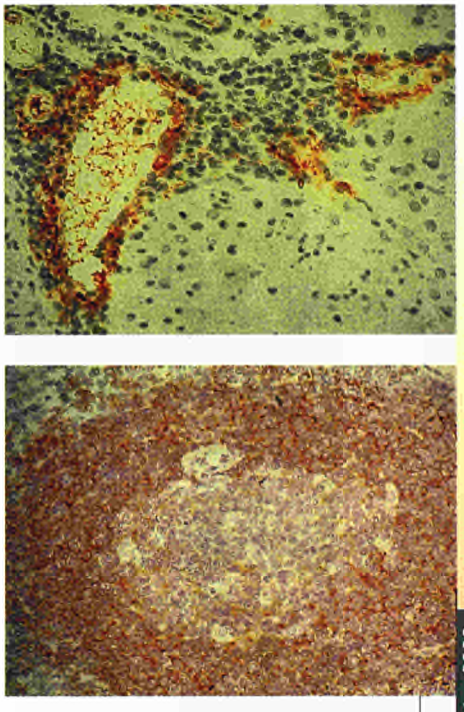


Multiple sclerosis is a degenerative disease of the nervous system caused by a disorder of the auto-immune system. A research project by Dutch, Swedish and Austrian teams has succeeded in demonstrating on animal models a promising treatment using a monoclonal antibody (shown in orange) which blocks the auto-immune dysfunction.

Coordinator: Jon Laman, Erasmus University of Rotterdam (NL) - laman@immu.fgg.eur.nl

A medicine against drug dependence

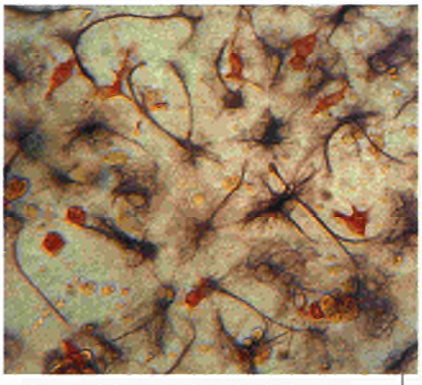
What is pleasure? For a neurobiologist, above all it is the release of a neurotransmitter, dopamine, in a region of the brain known as the mesolimbic system. This holds true whatever the source – food, sex, cocaine or nicotine – hence the idea of using molecules able to 'trick' the dopamine receptor, thereby providing relief for the addict needing drugs. The first molecule of this type, named BP897, was discovered by Pierre Sokoloff's group at Inserm, Unité 104, Paris. Dr Sokoloff, who since 1995 has coordinated two successive research networks supported by the European Union, believes that 'BP 897 is innovative in the sense that it does not interfere with the brain's primary mechanism of looking for drugs, and thus does not create new dependencies'. The first clinical trials are currently under way.

Contact **Pierre Sokoloff**, INSERM, Unité 104, Paris
sokol@broca.inserm.fr

Can cells repair the brain?

If neurons die, then why not replace them? This is simple idea which proved remarkably effective when transplanting fœtal neurons to sufferers from Parkinson's disease. Research is now turning its attention to finding new sources of neurons for transplantation, thereby making the treatment as widely available as possible.

Neurons die, that is our sad fate. Unlike other types of cell, dead neurons are not replaced. This slow decline is part of the body's normal ageing process. But the premature death of neurons which occurs in patients suffering from neurogenerative diseases is much more difficult to accept. The degeneration can be diffuse, which is the case for Alzheimer's disease, or more localised as in Parkinson's disease. But in both instances the loss has tragic consequences: a cognitive deterioration leading to dementia in the former, and motor problems in the latter. Although some drugs manage to slow the progress of the symptoms, a real cure is not yet in sight. Hence the enthusiasm when it was shown that transplanting neurons was able to correct the symptoms of Parkinson's disease - and hopefully make them disappear altogether.



As part of the research on developing neuronal transplants to treat Parkinson's disease and Huntington's chorea, two Swedish and Spanish teams have produced stem cell cultures expressing a gene able to code for a protein necessary for dopamine production (orange cells).

Coordinator: Ernest Arenas, Karolinska Institutet (Sweden) - http://cajal.mbb.ki.se/

A Swedish saga

This new treatment was initiated at Lund University (SE), recognised worldwide for its work in neuronal grafting, where the team headed by Anders Björklund (see interview) first developed fœtal neuron grafts in animals and then applied the same techniques to sufferers from Parkinson's disease. A team of researchers coordinated by Olle Lindvall of the University Hospital of Lund recently produced positive results following a decade of clinical trials applying this treatment to man. Using brain imaging they were able to show that the grafted cells form new connections with the neurons in the diseased regions and produce the chemical which is deficient. This means that these cells are actually able to repair the brain!

Diversification

One drawback is the difficulty of practising such treatment on a large scale. It takes six foetuses, obtained from abortions, to acquire enough cells for a single patient, and it is therefore essential to find other sources of cell material for grafting.

European research is currently exploring a number of avenues. A group headed by Håkan Widner at the Wallenberg Neuroscience Centre in Lund has studied the possibility of grafting pig neurons and developed ways of preventing their rejection by the human immune system.

Another line of research is focusing on stem cells: immature cells present specifically in the bone marrow and the skin which are able to multiply indefinitely and differentiate into every cell type in the human body. Scientists are studying with great interest those which apparently exist in the brain. The network, which is coordinated by Urban Lendahl of Stockholm's Karolinska Institutet, has obtained extremely important data (published on two occasions in the journal *Science*), on identifying neuronal stem cells in adult mice. Their research also demonstrates that these cells can be a source of renewed neuron development - which brings hope for treating neurodegenerative diseases - and have the ability to differentiate into many new cell types. This multi-potency of neuronal stem cells opens up a whole new potential for reconstructing the human body by using its own elements.

New beginnings for stem cells

Regenerative medicine is stimulating interest among several new and flourishing European biotechnology companies. Two research networks devoted to cell treatment of the nervous system are currently receiving EU financing to couple the dy-

Three questions for Anders Björklund

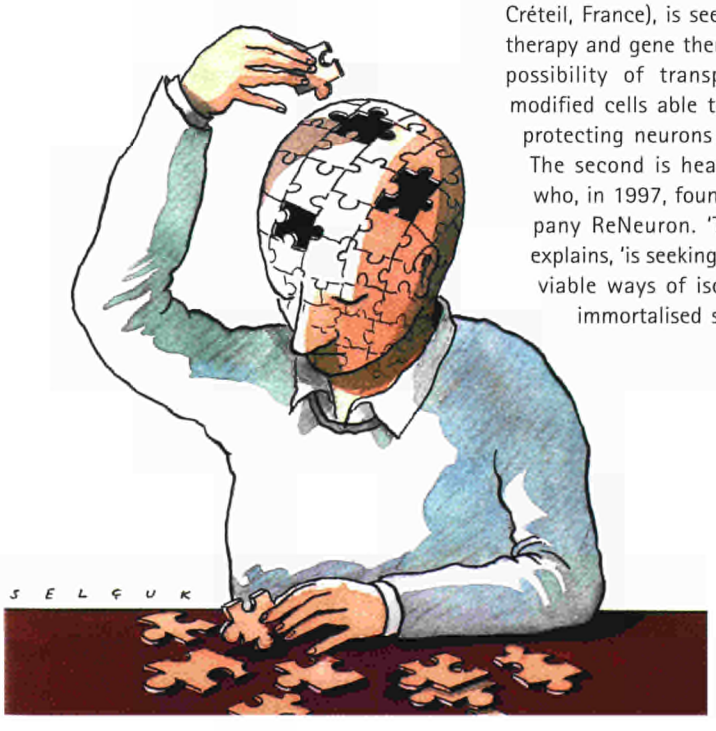
A professor of histology at Lund University (Sweden), Anders Björklund is one of the pioneers of neuronal transplantation.

How did you begin your research on neuronal transplants?
In the 1970s I was interested in the possibilities of brain regeneration following lesions. This was therefore fundamental biology. In 1975, together with my colleagues, I was able to show that, in rats, fœtal neurons transplanted to an adult brain could integrate and form new connections. This meant that the brain was capable of regeneration, contrary to what was believed at the time. As I had long been interested in Parkinson's disease and in dopamine, a neurotransmitter whose deficiency causes the disease, I had the idea of trying a therapeutic approach using this regenerative capacity offered by fœtal neuron transplantation. In 1979 we were able to show that fœtal neuron transplants were indeed able to correct the symptoms in an animal model of Parkinson's disease.

And the transition to man?
It was in1985, in cooperation with the university's department of neurology, that we first thought of transplants to patients suffering from Parkinson's disease. It took two years to consider the ethical implications, mainly focusing on the use of fœtal tissue. The first operation was then carried out in 1987. Thirteen years later, 11 patients have been operated on at our university hospital with very encouraging results. Some of them have even been able to come off medication.

What avenues of research are currently being explored?
The problem with transplanting fœtal neurons is access to the cells to be transplanted. Foetuses, which come from abortions, are available in a limited quantity and quality. High hopes are currently being placed in stem cells, which are capable of in vitro multiplication. Such stem cells are opening up many new prospects for cell treatment of the nervous system, even if a lot of research remains to be done before finding a treatment. I am thinking in particular of Huntington's chorea, for which we have started clinical trails, and also certain forms of epilepsy.

namism of these firms with the expertise of universities and hospitals. The first, coordinated by Marc Peschanski (Inserm U421, Créteil, France), is seeking to combine cell therapy and gene therapy by exploring the possibility of transplanting genetically modified cells able to produce molecules protecting neurons from cellular death. The second is headed by John Sinden who, in 1997, founded the British company ReNeuron. 'This consortium,' he explains, 'is seeking to find commercially viable ways of isolating conditionally immortalised stem cells and transplanting them to the diseased brain.' Central to this strategy is the use of suicide genes inserted into the stem cells. By activating these genes at will, it would be possible to kill the transplanted cells once the patient is cured, thereby eliminating any risk of these cells becoming tumorous - and provide what amounts to a personalised repair job. ■



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Brain imaging in the network age

Brain imaging techniques which provide us with a real-time picture of how the brain works represent one of the revolutionary techniques behind the progress in the neurosciences. By combining various techniques, complementary views of the same brain can now be obtained, thereby improving our understanding of the mechanisms operating in this vital organ.

What distinguishes the brain of an Italian dyslexic from a French or British dyslexic? This apparently incongruous question was asked by researchers in the Brain Imaging in Developmental Dyslexia network coordinated by Uta Frith (University College – London). They arrived at a surprising conclusion: the brain's response to reading is more rapid in the language of Dante than in the language of Molière or Shakespeare. From which Dr Frith concludes that: 'Italian writing has a structure which seems to provide protection against dyslexia. This would explain why under 2% of Italians are dyslexic compared to 5% of French and British.'

The study used Positron Emission Tomography, or PET, a nuclear medicine technique which measures the blood flow rate in the various regions of the brain: the more active the neurons, the higher the blood flow rate. Meanwhile, a team from the Erasmus Hospital in Brussels has developed a non-invasive procedure for eliminating brain tumours with extreme precision, using gamma radiation (Gamma Knife), made possible thanks to PET imaging in real time. Whereas an operation requires very invasive surgery, this treatment allows the patient to return to normal life after just two days.

Other techniques make it possible to measure electrical activity directly. Magneto-encephalography, for example, records variations in the magnetic field on the surface of the scalp. It was used to spectacular effect by the European project conducted by a group of laboratories coordinated by Risto Näätänen of Helsinki University. 'We identified the cerebral response to an auditory stimulus; this makes it possible to predict a patient's chances of coming out of a coma,' he explains.

But these various brain imaging techniques would benefit from being integrated. That is precisely the aim of the Neurogenerator project being coordinated by Per Roland (Karolinska University, Stockholm) who, between 1996 and 1999, had already set up a network designed to assemble various data on the anatomy of the human brain. 'We are trying to build a global model of the organisation of the human cerebral cortex,' he explains. 'This involves creating a database of brain activity recordings acquired by different methods, then developing computer tools to enable the recordings to be used in a standardised manner.' ■

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Reacquiring the power of speech

Strokes often result in disability, especially speech problems. Some patients lean to speak again, while for others the disability proves permanent. Why? Faced with this mystery, neurologists are extremely cautions in their forecasts. Improving our understanding of what is happening in a brain which is relearning certain processes following a stroke, and defining reliable criteria for assessing the ability to reacquire speech are the objectives of a new European research network coordinated by Cornelius Weiller (Hamburg University). The 12 laboratories participating in this study will be using numerous comparative imaging processes to assess the various methods used in the functional rehabilitation of stroke patients.

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At the source of diseases of the senses

If we can hear and speak, it is because our brain has specialised neurons in the inner ear and the eye. Two research projects are currently seeking to understand the causes of malfunction in these cells. One is focusing on congenital deafness and the other on blindness associated with ageing.

Innate or acquired? This constant conflict certainly applies to the major diseases of the central nervous system. Our brain is the product of evolution and composed of a set of genes which determine many properties. Although subject to the laws of genetic determinism, it is nevertheless exposed to the influence of the external environment (food, sensorial stimulation, emotions, etc.), and particularly so in the case of the inner ear's cochlea and the retina, nervous structures which gather sensory information. How then is it possible to distinguish genetic from environmental factors in seeking the source of the diseases of the senses?

Relieving deafness

Almost one child in every 1 000 is born deaf, and in 80% of cases the cause is of genetic origin. Around 100 genes appear to be involved. Coordinated by Christine Petit (Institut Pasteur, Paris), a network of French, Spanish, British and Israeli teams is trying to take full advantage of our knowledge of these genes. The first aim is to enable a molecular diagnosis to be made. 'We are trying to improve genetic advice to hearing parents who already have one deaf child and who want to know the risk of such an auditory deficiency being repeated if they have more children. But our main challenge remains the development of new forms of treatment,' explains Dr Petit. This is why the network plans, in particular, to pursue studies on the basis of research on transgenic mice. Another avenue being explored by the project is the possible role of the genes responsible for congenital deafness in hearing deficiencies in adults. On exposure to the same decibel level, our hearing can be impaired to a greater or lesser degree depending on our genetic heritage.

Macular degeneration

While these researchers are starting with a genetic study and then going on to consider environmental aspects, the 'Prevention of visual handicaps in the elderly European population' network, coordinated by epidemiologist Astrid Fletcher (London School of Hygiene and Tropical Medicine), is adopting the opposite approach. 'We are tracing the circumstantial factors which could contribute to macular degeneration, meaning the progressive lesion of the most sensitive region of the retina - the macula. Common after the age of 65, this deterioration makes reading a problem, which is a serious handicap for people for whom this is often their favourite pastime,' points out Professor Fletcher.

A study has been launched on a representative sample of elderly people living in Great Britain, Norway, France, Estonia, Greece, Italy, Spain and the Netherlands. Hopefully, this will produce a list of preventive recommendations including an eye test, a questionnaire on associated diseases (especially diabetes) and risk factors (such as exposure to ultraviolet rays).

But genetics is never far off: blood samples will also be taken from patients for subsequent research on genetic causalities. ■

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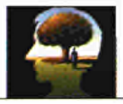

Understanding mental suffering

Are the genes or the environment to blame? And are drugs or psychotherapy the solution? The scientific approach to the causes of mental illness remains marked by uncertainty, which is why multidisciplinary European research is now attempting to identify the factors which can trigger these disorders.

What happens in the brain of a patient suffering from a psychiatric illness? There are as yet few answers to the question. It is not known exactly what region of a depressive, paranoid or schizophrenic patient's brain could be affected, or in what way or for what reason. But scientists are not about to be defeated by the complexity of diseases of the psyche. By studying large populations living in very different circumstances, psychiatrists, epidemiologists and biologists are trying to correlate observations carried out on a number of significant factors which could hold the key to mental and personality disorders.

A broad panorama

The study, which is coordinated by Professor Jordi Alonso of the Institut Municipal d'Investigació Mèdica, Barcelona, aims to provide an initial panorama of mental health in a number of countries. 'We want to gather data enabling us to estimate the prevalence of risk factors for mental illness, assess the handicaps which result, and, finally, better understand the different kinds of treatment adopted in Europe,' he explains. For the study, 24000 people from Germany, Spain, Italy and the Netherlands will be chosen at random. Standardised interviews will then enable the researchers to carry out a systematic evaluation of the frequency of mental problems and the responses to them. They hope that by taking stock of Europe's mental health in this way they will be able to 'better identify the needs of patients and provide indicators for reforming the organisation of health care in psychiatry'.

Depressive natures or depressing lives?

Two other studies financed by the European Union over the last few years have applied the same approach to 'mood problems'. In this case the symptoms can be monopolar - those described by the generic term of depression - or bipolar, alternating between depressive phases and a euphoric phase of excitement. A network coordinated by Julien Mendlewicz of Brussels' Erasmus Hospital set itself the task of tracing the genes making an individual susceptible to these disorders. The DNA of 3 081 patients from five EU countries, Bulgaria and Israel was collected to enable researchers to try to identify configurations of genetic polymorphism by means of the identification of candidate genes which are suspected of being involved in mood disorders.

However, within a given population, depression tends to strike differently depending on both living conditions and the emotional environment. The ODIN (Outcome of Depression In Europe) study coordinated by Christopher Dowrick at the University of Liverpool sought to define this phenomenon. By analysing the cases of 16 500 depressives in five countries, researchers realised that 'the prevalence of depression is remarkably stable in a rural environment, between 7% and 9%, whereas its prevalence in an urban environment can vary sharply from country to country, from 3% in Santander to 18% in Liverpool, for example.' So how should these results be interpreted? The ODIN researchers believe they show the importance of the existence of dense social interactions in preventing depression. A hypothesis they confirmed in the same study by analysing the effectiveness of protocols for psychological intervention when treating depressive patients. ■

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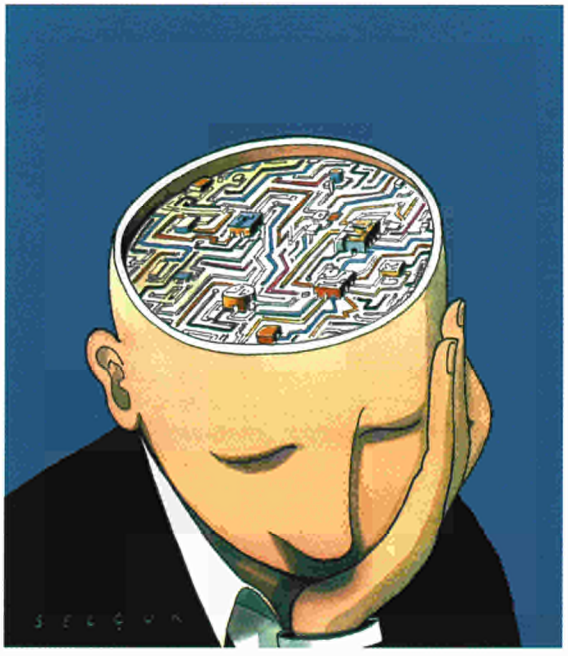
The brain *in silico*

Our accumulated knowledge of the workings of the human brain has become so complex that it can no longer be understood without recourse to computer modelling of the cerebral functioning.

Internet revolution, new economy, start-ups... gene therapy, sequencing, GMOs... Scarcely a day passes without such concepts grabbing the headlines, concepts virtually unheard of just a decade ago that symbolise the increasingly frequent marriage of the new information technologies and biotechnologies. On the one hand, the spectacular progress in genetics would not have been possible without progress in computer technology; on the other, artificial intelligence is increasingly drawing on our knowledge of both the human and animal brain. Exploring the synergies between neurosciences and information technologies is one of the new key objectives of European research on neurosciences supported by the European Union.

The birth of neuroinformatics

This is a field in which European researchers are already very active and where a number of university laboratories have acquired a level of excellence. But they would benefit from pooling their resources and jointly undertaking certain research. That is the aim of the Computational and Neuroinformatic Neuroscience thematic network, coordinated by Erik de Schutter (Antwerp University, Belgium), a specialist in modelling the electrical activity of the cells in the cerebellum, a region of the brain involved in controlling the locomotive system and balance. The network consists of ten laboratories, from the United Kingdom, Sweden, Norway, Germany, Italy, the Netherlands and Switzerland. Dr de Schutter explains: 'By increasing the exchange of know-how and resources, and by promoting mobility between laboratories, the aim is to promote the growth of an internationally competitive European neuroinformatics "strike force".'



Modelling to the rescue

One of the fields of neuroscience where the need for interaction with the new information technologies is most strongly felt is the physiological study of complex functions - such as vision or motor functions. Scientists have built up a vast array of data over a long period on the organisation of the neurons involved in these functions, in particular through observations on monkeys. They are becoming increasingly aware of their anatomic structure, the number and nature of connections made with other neurons, and the intensity of the electrical activity involved. But how can all these data be incorporated within global models of these complex physiological functions? This is where computer modelling comes in. This allows formal neuron models to be constructed which imitate the brain's activity, and thus the *in silico* testing of the various hypotheses on how the human functions.

This approach is being applied to the study of vision by a Franco-British-Swiss research group coordinated by Henry Kennedy (Inserm U 371, Bron, France). Meanwhile, the network headed by Yves Burnod (Inserm U 483, Paris) is looking to model the way in which the cerebral cortex and spinal cord control movement. 'This research,' explains Yves Burnod, 'is attempting to develop new hypotheses on the voluntary control of arm movements. These have the potential both for clinical applications for assessing movement disorders and for technological applications, in robotics for example.' ■

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Open forum

This double-page forum aims to provide a flexible and informal platform for reports, thoughts, opinions and statistics which we believe warrant a wider audience. The forum is designed to be an invitation to discussion and debate, and a place for ideas - with which we trust our readers will keep us well supplied.

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Letters

The 'post-normal' science

In addition to advancing knowledge and improving practice, science is now being called on to assist in the protection of people and the environment, and to contribute to sustainability in industry and in lifestyles. In this, 'precaution' has become a new guiding principle.

When they are engaged on these tasks, researchers are now frequently in a situation where facts are uncertain, values in dispute, stakes high and decisions urgent. They must appreciate that their expertise is but one among several elements of a policy processes. Their contributions can help to define the range of possible outcomes, but they can not determine unique policy solutions. This context is so different from that of traditional research, that it is well described as 'post-normal'.

For the public, science is no longer a closed area of exclusive expertise. Rather, it is an endeavour which is open to comment, criticism and, some time, participation. In this way there develops an 'extended peer community', where those with different perspectives come to dialogue and to learn from each other.

This new post-normal style is coherent with the general movement towards greater public accountability and participation, which is now being articulated at many levels within the EU.

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What role for the universities?

Is Society willing to pay for the Core Business of Universities ?

In the last century, the universities have been tremendous knowledge factories, in creating new knowledge through research. This has given the material and basis for our modern society. As the second half of the

When it comes to numbers

■ **Climate: the beginnings of certainty**

In the latest report from the IPCC (Intergovernmental Panel on Climate Change), climatologists are increasingly categoric about the process of global warming. The 20th century saw an overall rise in the temperature of the earth's atmosphere of around 0.6°C - the biggest increase for a thousand years - and this was most marked during the last decade when 1998 beat all records. During the second half of the century, the area of snow cover in winter on land and of ice on seas in the Northern Hemisphere during spring and summer fell by approximately 10-15%, with a 40% reduction in the thickness of the Arctic ice field over recent years. Sea levels have risen by an average of 10-20 cm over the past 100 years. Climatologists predict an increase in the globe's average temperature of 1.5-6°C before the end of the century (as opposed to the 1.0-3.5°C announced in 1995) and a rise in sea levels of 0.15-0.80 metres.

■ **The latest S&T indicators**

The figures below are taken from a new booklet, 'Science, Technology and Innovation – Key Figures 2000', which summarises the results of analyses of comparative development indicators for the research and development performances of the European Union, its Member States, the United States and Japan.

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■ **Job creation.** In 1999, technology-intensive industrial and services activities represented just 20% of total employment in the Union, but experienced a job creation dynamic double that of the rest of the 'traditional' economy (1.7% compared to 0.9% in industry and 6.4% compared to 3% in the services).

■ **Investment in the knowledge-based society.** The percentage of GDP devoted to research by the EU remains low and sta-

last century also saw a vast increase in the number of students, we face a situation where almost half of future generations will take higher education in some form. Intellectual capital is considered to be the most important asset to secure a competitive national economy.

The core business of universities has become the core business of society. But this awareness also has its consequences. Politicians want visible return on the money spent. As a consequence, there are new demands on the universities. They are expected to contribute more directly to innovation and economic activity through contract research and in helping to establish new companies based on the research results obtained by their professors. At the same time, new actors are entering the educational market.

By demanding too much from universities, society weakens the core business of research and education. The key question now is whether society is willing to pay for the added value universities represent, namely a broad intellectual environment that provides a basis for the widest possible understanding and the healthy development of society.

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Social sciences and nuclear research

Extract from a letter from Erik Laes, researcher at the SCK-CEN (Studiecentrum voor Kernergie – Centre d'Etude de l'Energie Nucléaire) in Mol.

In 'the age of risk', people feel insecure about the future. In this social context of uncertainty, a new concept for policy making at the global and local level has emerged: Sustainable Development. At present, the nuclear expert is struggling with society, and he paradoxically lacks a scientific approach and insight in complex human behaviour and societal interaction.

SCK-CEN already had some experience with multidisciplinary projects (e.g. extending the research on nuclear complexity to economics and liability), but in 1998 the board of directors decided to integrate social sciences in a more co-ordinated way.

An original transdisciplinary approach was set up. A horizontal program manager is co-ordinating 4 projects, joining 4 senior project leaders, 7 young scientists in social sciences and humanities, and interested SCK-CEN experts. University professors and experts from different disciplines and backgrounds accompany the projects. All researchers involved meet monthly in two reflection groups, with active participation of SCK-CEN's top management. These working groups are discussing two broad items: ethical choices in radiation protection - focussing on ALARA[1] and the precautionary principle within the context of new trends in low dose effects, such as genetic susceptibility - and nuclear expert: role and culture - analysing expert attitudes, behaviour and dilemmas in nuclear problem solving and communication. The four projects are:

- legal aspects and liability – trying to bridge the gap between law and complex technology;
- sustainability and nuclear development – looking through Technology Assessment on criteria for Sustainable Development;
- transgenerational ethics related to the disposal of long-lived radwaste – exploring ethical aspects when dealing with the time scales under consideration;
- emergency communication and risk perception – studying risk perception in the situation of a nuclear incident or accident and its relation with communication and emergency management.

The restoration of trust will require the integration of humanities and social sciences in a transdisciplinary problem solving approach, far beyond the technical dimension. Members of the academic community who show interest in our projects can always contact us.

(1) Editor's note: general principle of radioprotection whereby exposure to these rays is As Low As Reasonably Achievable.

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tionary (1.8% since 1994), whereas - following a temporary dip - R&D investments by its competitors now show a clear increase (2.7% of GDP in the United States and 3.1% in Japan).

- **Human potential.** Just 5.1% of the EU's working population is employed in research, compared to 7.4% in the USA and 8.9% in Japan. The difference is even more marked if only research posts offered directly by industry are taken into account.
- **Scientific production.** In 1998, 37.8% of scientific works published worldwide came from Europeans (an increase of 1.7% on the previous year), with the Americans publishing 32.9% (down by 2.1%). But it was US publications that were the most frequently cited (51%), despite an increase in European citations (up by 2.1% to 38.2%). 53% of patents registered in Europe come from outside the EU, whereas the share of patents registered by EU countries on the US and Japanese markets remains very small.
- **Intensity of trans-European cooperation.** Indicators of cooperation between companies engaged in innovative activities give a clear lead to the Scandinavian countries.

News in brief

Rethinking relations between science and society

The attitude of Europeans to science is somewhat paradoxical: whereas they increasingly expect the new technologies to improve their quality of life, some of these technologies are viewed with mounting suspicion. This genuine unease among the public - made worse by events such as the BSE crisis - is creating a growing divide between the scientists, the policy-makers and the public.

Believing that it is essential to overcome this divide which is a serious obstacle to the dynamism of the European Research Area, on 16 November Commissioner Philippe Busquin submitted a discussion paper to the Research Council, entitled Science, society and the citizen in Europe, which proposes a double debate - within the European institutions and amongst the general public.

This questioning of science and society is a vital element in the Commission's more general reflection on European governance which is aimed at reviving the democratic debate between the politicians and the people. Here, science and technology take on a symbolic value due in particular to their impact on society, the complexity of the issues they raise and the relationship between policy-makers, experts and citizens.

There are three main fields of action and discussion:

- the structuring of research according to new aims for society, in particular the need to subscribe to the principle of sustainable development - environmental, economic and social;
- the responsible use of scientific and technological progress, in particular risk management which respects the precautionary principle, and managing expertise in a way which recognises the importance of ethical questions;
- the creation of a new dialogue between science and society, which involves more citizens in discussions on scientific and technological choices, improves public understanding of science and increases interest in scientific careers (especially among women).

http://europa.eu.int/comm/research
*PR 16/11/00**

The importance of human resources for research

How to organise mobility to bring together supply and demand on the European researcher market? How to remove the obstacles - especially administrative - to the movement of researchers within the European Research Area? How to award mobility a genuine role in transferring knowledge and technology? What European dimension should be given to scientific education?

These were the discussion topics during the conference-debate organised by the Human Potential programme in Crete (GR) in October. Young researchers and research officers exchanged their experiences and opinions and together considered a new dynamic for the mobility concept. Philippe Busquin was present in Heraklion, restating the point that the 'circulation' and training of researchers was a vital key for the European Research Area, whose policy is aimed at creating the practical conditions, both regulatory and psychological, for genuine mobility in Europe, in particular by increased and more diverse grants. The aim is also to develop genuine 'European careers', to encourage industry and the public authorities to create more research posts, and to make European research institutions more attractive.

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EU-US: 10 years of cooperation on the life sciences

The EU-US Task Force on research on biotechnology, a vehicle for cross-Atlantic consultation on biotechnology research programmes and activities, was set up 10 years ago, at a time when the life sciences perhaps did not suspect that they were destined to experience such rapid development and to spark such intense debates. Initially the consultation was mainly in the form of the exchange of information between scientists, before quickly widening to include support for discussion groups and seminars, the organisation of training, the exchange of scientific personnel, etc. It was one of the Task Force groups, centred on the issue of 'biotechnology and genetic resources', that initiated the famous GBIF (Global Biodiversity Information Facility) project, whose objective is to compile a global database including full details of all living species.

The discussion groups have covered a range of subjects affecting relations between science and society - such as bio-ethics, public perception of progress in biotechnology, the role of women in science, etc. 'The Task-Force has brought leading scientists together, from both sides of the Atlantic, to discuss future directions for front-line scientific research, enabling Europe to contribute as an equal partner,' stresses Bruno Hansen, who is co-chairman of the Task Force and Coordinating Director of Life Sciences Research at the Commission.

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*PR 12.10.00**

European mobilisation for post-genomic research

Last June, the complete sequencing of the human genome received extensive media coverage and heralded the beginning of the 'post-genomic' age (see RTD info 27). A vast field of research for the development of new diagnostic and treatment approaches has now opened up in the field of human health and this rapid development requires increased European support if it is to realise its potential. Since its launch in 1999, the Quality of Life programme has already supported a wide range of genomic research in some 400 laboratories at a cost of 120 million euros. The European Commission has now decided to commit an additional amount of around 100 million euros for 2001. Entitled Genome Research for Human Health, this new initiative will concentrate on two specific areas.

• Three quarters of the support will go to launch Integrated projects to provide sufficient critical mass - the equivalent of at least 150 researcher-years - for research topics with a high potential impact on health. Apart from their high-profile scientific objectives, the projects must support a dynamic networking of national centres of excellence and research programmes, and include a 'mobility and training' element allowing young researchers to develop their know-how in the vital field of genomic research.

• The remaining 25 million euros will be used to strengthen the new specific infrastructures required for European post-genomic research – particularly the development of bio-informatics data bases and animal model resources. A call for proposals was published on 15 November and will close on 9 February 2001. On the basis of the research themes presented, a targeted call for the selection of new integrated projects will be published during the summer with a closing date set for November 2001.

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*PR 16/11/00**

2000 Descartes Prize

'Scientific excellence, although a necessity of modern science, is not rewarded enough in Europe,' stated Philippe Busquin on awarding the Descartes Prize. A new European award has now helped make up for this deficiency by rewarding international teams whose very high quality research would not have been possible without this cross-border dimension. A hundred networks, consisting of teams from all Member States in various scientific fields, competed for the initial selection. Eight teams were chosen to participate in the final which was held in Brussels on 8 November. The jury, headed by Yves Michot, former head of Aérospatiale Matra, awarded the prize to three research projects in the fields of chemistry, electronics and genetics. The 11 researchers shared a total amount of 660,000 euros.

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*PR 9/11/00**

**To consult press releases (PR), see the website: http://europa.eu.int/comm/research/press_en.html*

Key meetings during the Swedish presidency

www.cordis.lu/sweden/

- Cooperation between academia and industry in IT – 17-18/4/01 - Karlskrona
- Sustainability research and sector integration – 9-11/5/01 - Stockholm
- The role of Candidate Countries in EU research – 21-22/5/01 Linköping
- Bioethics in research – 11-12/6/01 – Umeå
- EU Enlargement: Research and Public Health as a lever for Economic Growth – 24-27/6/01 – Umeå – *www.vll.se/enlargehealth/*

Subject to confirmation:

- Social Sciences and the Humanities in the EU Framework Programmes: enlargement, governance, knowledge society and new development models – February 2001
- Technology Foresight – March 2001
- How to Raise Public Awareness of Science - March/April 2001
- Research Policy: Cooperation and Competition - March/April 2001 – Stockholm
- Space Forum - Spring
- Institutes for Advanced Study and Universities in Contemporary Europe - Spring - Uppsala

Other events

- Aeronautics Days –28-30/01 – Hamburg (DE) – *growth@cec.eu.int*
- Living knowledge, building partnerships for public access to research (an international conference on science shops) – 25-27/1/01 – Brussels – *www.bio.uu.nl/living-knowledge*
- Sustainable development and R&D policies – 1-2/2/01 – Karlsruhe (DE) – *www.itas.fzk.de/susdevpol*
- The contribution of European socio-economic research to the benchmarking of RTD policies in Europe – 15-16/3/01 – Brussels – *nikolaos.kastrinos@cec.eu.int*
- Biotechnology Ethics and Public Perceptions of Biotechnology (workshop) – 16-25/3/01 – Oxford (UK) – *efweb.org/ppb/*
- World Conference on Open Learning and Distance Education – 1-5/4/01- Dusseldorf (DE) – *d-2001@fernuni-hagen.de*
- 10th European Congress on Biotechnology – 8-11/7/01 – Madrid – *www.sebiot.es*

The diseases of the poor

AIDS kills more than 2 million people a year in Africa; in the south, life expectancy has fallen from 64 to 47 in three years. 700 000 children die of malaria every year. 95% of deaths from tuberculosis are in developing countries. The countries prone to these rampant and transmissible diseases are unable to manage them, while the rich countries remain indifferent to these diseases of the poor. Less than 2% of the world's medical research budget is devoted to them. Yet the misery they bring is not exclusively confined to the South: after beating the disease for 40 years, certain Central and Eastern European countries have seen new tuberculosis outbreaks in the past decade.

European programmes are already providing significant support for research efforts aimed at combating these diseases (the 28.6 million euros provided by the EU to the Eurovac project which is trying to develop an AIDS vaccine is just one example). But it is clearly becoming increasingly necessary to make a concerted effort, in terms of both financing and partnership, if any 'realistic' objectives are to be met in the face of such a large-scale problem. This implies extensive coordination of research efforts and the coming together of politicians and players worldwide. It was with this in view that the Commission, in cooperation with the WHO and UNAIDS, organised a strategic meeting with the principal partners in the developing countries last September in Brussels. Three main areas for action were identified: optimising access to existing aid infrastructures and care, reducing the cost of essential medicines in developing countries, and increasing investment in research to combat the three major transmissible diseases.

Contact : michel.pletschette@cec.eu.int

The response from the SMEs

The percentage of SMEs participating in European research projects is increasing. By April 2000, exactly one year after the Fifth Framework Programme issued its first calls for proposals, Community support of almost 450 million euros had been allocated to the some 4 000 SMEs participating in shared-cost research projects in the four thematic programmes. Compared with the previous four years, that represents a participation rate which is up from 28% to 37% of all participants in such projects.

Furthermore, the system of exploratory awards (allocated to companies to enable them to evaluate research beneficial to their development and to submit proposals with European partners) is also recording growing success: 674 grants were awarded for 1999 alone, which is more than half the total number of grants allocated during the four years of the previous framework programme.

giorgio.clarotti@cec.eu.int

Breast cancer: removing the risk of relapse

Would additional localised radiation (or 'overdosage') reduce the risk of a tumour recurring among women who have been operated on for breast cancer? A clinical trial on this treatment carried out on 5 569 European patients by the radiotherapy group and cancer group of the EORTC (European Organisation for Research and Treatment of Cancer) seems to indicate that it would. 'As a result of this study,' explained Professor Horiot, one of the coordinators, 'we succeeded in establishing the standards for an optimal treatment strategy. Furthermore, thanks to the quality control procedures, we have also defined and harmonised radiotherapy techniques and dosage prescription in the framework of a wide-ranging European cooperation.'

Information:
EORTC – Fax: +32-2-772 35 45.

Antonio Ruberti: 1927-2000

Antonio Ruberti, European Commissioner responsible for research and education in 1993-1994, died in September at the age of 73. An important figure on the Italian scientific and political scene, his career included being rector of 'La Sapienza' university in Rome, and then minister of scientific and technological research from 1987 to 1993. Passionately interested in the European challenge posed by the knowledge-based society, it was during his time as Commissioner that he launched the Socrates and Leonardo da Vinci education and training programmes. He was also the initiator of the European Week of Scientific Culture and the European Forum for Science and Technology. In recent years he devoted his energies to his responsibilities as an Italian Member of Parliament, chairing the Committee for European Policy.

Up-and-coming generations

Astronomy, medicine, the environment ... At the 12th Young Scientists Contest held in Amsterdam last September, the keen interest in science among up-and-coming generations was once again illustrated by the diversity of projects presented by the 85 student finalists aged under 20 coming from 35 countries. To quote Dr Pauline Stosse, president of the jury of 12 renowned scientists charged with selecting the winners: 'The quality of the projects is amazing, and I would not be surprised if some of these projects, as in previous years, ended up yielding patents or otherwise contributing to our quality of life.' This year the three first prizes went to projects on palaeontology (identification of different types of dinosaur fossils by a Polish student aged 20), biology (a system for extracting cells in a fermenter, developed by three 18-year-old British students) and the protection of biodiversity (in this case a rare type of Georgia bat).

In addition to the financial rewards for the nine prize-winners, the contest also gives some finalists the chance to join teams of researchers from the JRC (Ispra), the European Northern Observatories (Canary Isles), the Royal Geographical Society and - for the first time this year - the European Space Agency, as well as to visit the European Patents Office. The next competition will be held in Bergen (NO) in September 2001.

http://europa.eu.int/comm/research/young-scientists/
graham.blythe@cec.eu.int
PR 12/9/00

Publications from the programmes

Biotechnology

■ *The EC-US task force on biotechnology research* – The results of 10 years of cooperation (see p. 18) / 34 pp/ QoL

Agriculture and food

■ *Inventory of European food composition databases and tables* / PR / ISBN 92-828-9761-3 / 45 pp/ Eur-Op

■ *Eurofoods recommendations for food composition database management and data interchange* / PR / ISBN 92-828-9757-5 / 79 pp/ Eur-Op

■ *FAIR programme. Agriculture, forestry and rural development: research results* / Cat.P / ISBN 92-828-9722-2 / 697 pp/ QoL

■ *Functional food science in Europe* / PR / ISBN 92-828-4776-4 / QoL

Medicine and health

■ *Transmissible Spongiform Encephalopathies: the European initiative* / Cat.P / 129 pp/ QoL

■ *Odontogenesis* / PR / ISBN 92-828-9465-7 / 114 pp/ Eur-Op

Industrial research

■ *Soil / Structure interaction in urban civil engineering* / PR / ISBN 92-828-9533-5 / 169 pp/ Eur-Op

■ *Steel Research* / Four new project reports have also just been published / Contact: GWH

Environment

■ *EurOCEAN 2000: The European conference on marine science and ocean technology* (vol. I) / Cat.P / 377 pp/ EESD

■ *EurOCEAN 2000: The European conference on marine science and ocean technology* (vol. II) / Cat.P / 354 pp/ EESD

■ *Large-scale infrastructures and quality of urban shape* / PR / ISBN 92-828-8996-3 / 285 pp/ Eur-Op

■ *European network infrastructures for studying chemodynamics and water quality protection in natural porous media* / PR / ISBN 92-828-9343-X / 159 pp/ Eur-Op

■ *Terrestrial ecosystem research in Europe: successes, challenges and policy* / Cf.P / 208 pp/ EESD

■ *WEGA II: Large wind turbine scientific evaluation project* / PR / 305 pp/ EESD

■ *Underwater acoustics (ECUA 2000)* / vol. I / Cf.P / 746 pp/ EESD

■ *Underwater acoustics (ECUA 2000)* / vol. II / Cf.P / 804 pp/ EESD

■ *Catalogue of the EC-sponsored projects related to scientific drilling* / Cat.P / 418 pp/ EESD

■ *Stratospheric ozone 1999 (Air pollution research report 73)* / Cf.P / 778 pp/ EESD

Non-nuclear energy

■ *Wind energy production in cold climates (WECO)* / PR / ISBN 92-894-0033-1 / 301 pp/ Eur-Op

■ *ExternE: Externalities of energy (vol. 7)* / Study / 535 pp/ EESD

Nuclear energy

■ *RODOS: decision support system for off-site nuclear emergency management in Europe* / PR / 259 pp/ EESD

■ *The TRUSTNET framework: a new perspective on risk governance* / PR / 45 pp/ EESD

■ *Strategic issues related to a 6th Euratom Framework Programme* / Opinion / 18 pp/ EESD

■ *Project reports / 10 project reports have also just been published* / Contact: EESD

International cooperation

■ *Research and cooperation with developing countries* / Cat.P / 58 pp/ INCO

Socio-economic research

■ *Government-company relationships in the arms industry* / PR / ISBN 92-828-9572-6 / 68 pp/ Eur-Op

Fundamental research

■ *Ion beam study of art and archaeological objects* / PR / ISBN 92-828-7652-7 / 136 pp/ Eur-Op

Abbreviations
- PR: Project Report
- Cat.P: Catalogue of projects
- Cf.P: Conference Proceedings

Where to order ?
- RSH: research@cec.eu.int
- QoL: quality-of-life@cec.eu.int
- GWH: growth@cec.eu.int
- EESD: eesd@cec.eu.int
- INCO: inco@cec.eu.int
- IMP: improving@cec.eu.int
- Eur-Op: http://eur-op.eu.int/general/en/s-ad.htm

Presenting European research

Just published

■ *Science, Technology and Innovation: Key Figures 2000* / An update of figures on European science and technology compared with the rest of the world / 86 pp

■ *Heritage under threat* / New leaflet in the *European Research in Action?* series on European research to safeguard the heritage / 10 pp/ Available in 11 languages.

■ *Results and research for SMEs* / Success stories of research projects supported by specific measures in favour of SMEs : Available in EN, FR, DE / Two volumes of 25 sheets.

■ *Growth in action no 1* / New newsletter of the Competitive and Sustainable Growth Programme / *Contact: growth@cec.eu.int*

And among the publications available...

■ *Towards a European research area* / Complete text of the Communication of the European Commission / Available in 11 languages / 52 pp

■ *Brochures presenting the four thematic programmes and three horizontal programmes of the Fifth Framework Programme* / Available in EN, FR, DE / 16 pp

■ *Participating in European research programmes* / A practical guide to proposing research projects / Available in EN, FR, DE / 100 pp

■ *Research and technological development in Europe* - Examples of projects / Two volumes of 78 pp each presenting 36 research projects in diverse disciplines and fields / Available in EN, FR, DE.

■ *European Research in Action* series / 10-page leaflets on the responses of European research to major contemporary challenges/ Subjects: natural disasters, water resources, global change, employment, health, road safety / Available in 11 languages.

■ *Humankind, nature, technology* / The three leitmotivs of Hannover's Expo 2000 reflected in advances in European research / Supplement to RTD Info / 36 pp / Available in EN, FR, DE

■ *Europe: a research area* / A layman's guide to European research / 34 pp / Available in 11 languages.

■ *Knowledge-based Europe* / CD-Rom for the layman on European research, innovation and education / Distributed free of charge to students, teachers and journalists.

Contact: research@cec.eu.int

Calls for proposals: overview

Deadlines 2001

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

KEY ACTIONS	JAN	FEB	MAR[2]	APR	MAY	JUNE	SEPT	OCT[2]	NOV	DEC
Food, nutrition and health			15							
Control of infectious diseases								18		
The "cell factory"			15					18		
Environment and health			15							
Sustainable agriculture, fisheries and forestry								18		
The ageing population and disabilities			15							
Generic research		28[2]						18		
Genomics and human health initiative		9[3]								
OPEN CALLS [1]	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUNE**	**SEPT**	**OCT**	**NOV**	**DEC**
Training: Marie Curie individual fellowships				11				10		
Research training networks		1								
SME Measures (exploratory awards / cooperative research)	17			18			19[4]			
Accompanying measures		9				12		11		
Support for research infrastructure		9						18		

(1) Call published on 6/3/99. (2) Call published on 15/11/2000. (3) Call for expression of interest to be followed by a targeted call during the summer (see p 19). (4) CRAFT projects only (no exploratory awards).

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

KEY ACTIONS	JAN[1]	FEB	MAR	APR	MAY[2]	JUNE	SEPT	OCT	NOV	DEC
Systems and services for the citizen					X					
New methods of work and electronic commerce	15				X					
Multimedia content and tools	15				X					
Essential technologies and infrastructures	15				X					
Cross-programme themes	15				X					
Future and emerging technologies [3]					X					
OPEN CALLS	**JAN**	**FEB**	**MAR**	**APR**	**MAY[2]**	**JUNE**	**SEPT**	**OCT**	**NOV**	**DEC**
Future and emerging technologies [4] [5] [6]		15			X	15[8]				
Support measures [6]		15			X	15[8]				
SME Measures (exploratory awards / cooperative research) [7]	17			18			19[8]			

(1) Call published on 14/10/2000. (2) Closing in May of a call planned for January-February (subject to confirmation). (3) Proactive initiatives. (4) Open sector. (5) Evaluation at least every 3 months. (6) Call published on 10/2/2000. (7) Calls published on 16/3/99 (8) New call planned for 15/2/01 (9) CRAFT projects only (no exploratory awards).

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

KEY ACTIONS	JAN	FEB	MAR	APR	MAY	JUNE	SEPT	OCT	NOV	DEC
Innovative products, processes and organisation					15[2]					
Sustainable mobility and intermodality			15[2]							
Land transport and marine technologies			15[2]							
New perspectives for aeronautics			30[2]							
Generic research					15[2]					
Measurements and testing research			15[2][3]							
Support for research infrastructure			15[3]							
OPEN CALLS [1]	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUNE**	**SEPT**	**OCT**	**NOV**	**DEC**
Training: Marie Curie individual fellowships			21				19			
SME Measures (exploratory awards / cooperative research)	17			18			19[4]			
Accompanying measures			15				15			
Expressions of interest on research needs				30						
IMS (RTD projects)[5]				15			15			

(1) Reception deadlines for calls published on 16/3/99. (2) Periodical call planned for 15/12/2000. (3) Targeted call published on 13/10/2000. (4) CRAFT projects only (no exploratory awards). (5) Intelligent Manufacturing Systems (IMS – RTD projects) ; publication date not yet set.

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

KEY ACTIONS	JAN	FEB	MAR	APR	MAY	JUNE	SEPT	OCT	NOV	DEC
Sustainable management and quality of water		15[1]						15[1]		
Global change, climate and biodiversity		15[1]						15[1]		
Sustainable marine ecosystems		15[1]						15[1]		
The city of tomorrow and cultural heritage		15[1]						15[1]		
Cleaner energy systems, including renewables		9[2][3]	15[2][4]							14[2]
Economic and efficient energy for a competitive Europe		9[2][3]	15[2][4]							14[2]
Support for research infrastructure		15[1]						15[1]		

(1) Environment and sustainable development call only, published on 15/11/2000. (2) Energy call only, published on 24/10/2000. (3) Medium and long-term Energy projects. (4) Short-term Energy projects

Key

Submission deadlines (for specific research actions)

Batch evaluation dates (for open calls)

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

Deadlines 2001

OPEN CALLS[1]	JAN	FEB	MAR	APR	MAY	JUNE	SEPT	OCT	NOV	DEC
Generic research		9[1] 15[2]						15[2]		14[1]
Training: Marie Curie individual fellowships		9[1]	21[2][3]							14[1]
SME Measures (exploratory awards / cooperative research)	17[7]			18[7]			19[6][7]			
Accompanying measures[7]		9[1][5] 15[2]	15[4]			15[2]	19[2]			14[1]

(1) Energy (E) only - call published on 24/10/2000. (2) Environment and sustainable development (ESD) only - Call published on 15/11/2000 (3) ESD - Closing date for individual fellowships only. For reception fellowships: open until 20/3/02 (4) ESD - Advanced study courses. (5) E - Including the OPET (6) CRAFT projects only (no exploratory awards) (7) Call published on 1/4/99.

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

KEY ACTIONS	JAN	FEB	MAR	APR	MAY	JUNE	SEPT	OCT	NOV	DEC
Nuclear Fission	22[1]									
OPEN CALLS[2]	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUNE**	**SEPT**	**OCT**	**NOV**	**DEC**
Generic research	22[1]									
Support for research infrastructures	22[1]									
Training: Marie Curie individual fellowships	10[1][3]					13[1][3]				
Other training actions			26[1][4]							
Accompanying measures			26[1]				24[1]			

(1) Call published on 17/10/2000. (2) Call published on 20/3/99. (3) Including fission programme. (4) Special courses, research-training networks, cooperation with third countries.

INTERNATIONAL COOPERATION (www.cordis.lu/inco2/)

CALLS BY COUNTRY GROUPS	JAN	FEB	MAR	APR	MAY	JUNE	JULY	SEPT	OCT	NOV
States in pre-accession phase[1]			16[1]				16[1]			16[1]
NIS & other CEEC[1]			16			15[5]	16			16[1]
Mediterranean partners (INCO-MED)			16[2]				16[2]	17[3]		16[2]
Developing countries (INCO-DEV)			16[2]				16[2]	17[3]		16[2]
Emerging economies and industrialised countries[2]		16[2]				18[2]		17[6]	16[2]	
Coordination						15[7]				
Fellowships for Japan			1							
INTAS[4]		28								

(1) "Support for participation in conferences" calls opened. (2) "Accompanying measures" calls opened. (3) Research projects, concerted actions and thematic networks calls. Envisaged publication date: 15/4/2001. (4) Call published on 30/10/2000 : research linked to the Aral Sea Basin - www.intas.be. (5) Copernicus 2 - reintegration of the Balkans (RTD projects, concerted actions, thematic networks). (6) Accompanying measures for the coordination of multilateral research - Diseases linked to poverty. (7) Accompanying measures: Diseases linked to poverty

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

OPEN CALLS[1]	JAN	FEB	MAR	APR	MAY	JUNE	SEPT	OCT	NOV	DEC
SME Measures (exploratory awards / cooperative research)[2]	17			18			19[3]			
Awareness and assistance actions in the fields of Intellectual Property Rights and Linking Innovation, Finance and Technology			15[4]							

(1) See also on Cordis calls for tenders and calls for specific promotion and encouragement actions. (2) Call published on 1/4/99. (3) CRAFT projects only (no exploratory awards). (4) Indicative closing date for a call planned for 15/12/2000 (subject to confirmation).

HUMAN POTENTIAL (www.cordis.lu/improving/)*

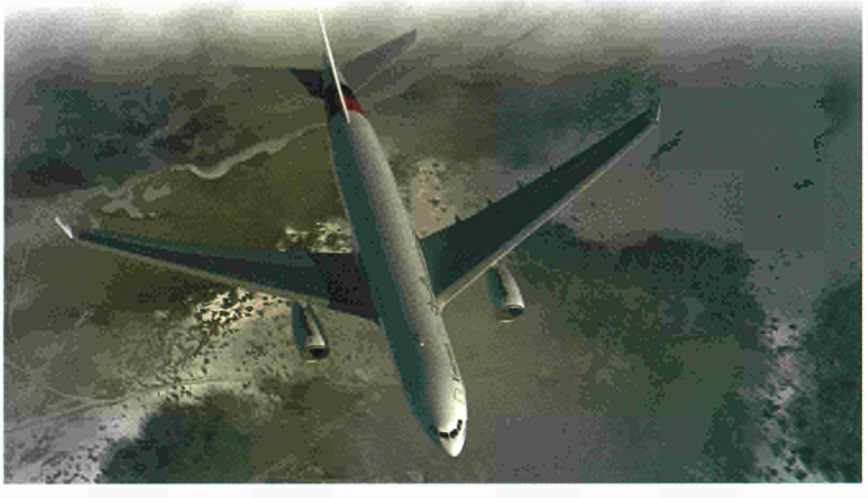
OPEN CALLS	JAN	FEB	MAR	APR	MAY	JUNE	SEPT	OCT	NOV	DEC
Research training network						4[1]				
Marie Curie individual fellowships			14[2][3]				12[2][3]			
Marie Curie industry host fellowships							13[4]			
Marie Curie development host fellowships and training sites						16[5]				
Research infrastructure cooperative networks and exploratory workshops	15[6]									
High-level scientific conferences		1[2]								
Awards for first-class research						1[7][8]				
Raising public awareness of science and technology				15[9]						
S&T policy strategy: Groups of experts (Strata)	Open until 30/09/2002									
S&T policy strategy: Thematic networks (Strata)						29[10]				
S&T policy strategy: Accompanying measures (Strata)[11]	Open until 15/6/2002				1					
Accompanying measures for the programme[12]	8	Open until 28/6/2002								
KEY ACTIONS	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUNE**	**SEPT**	**OCT**	**NOV**	**DEC**
Improvement of socio-economic knowledge base	Call scheduled for 01/09/2001									

(1) Call planned for 15/12/2000. (2) Calls published on 16/3/1999. (3) Individual fellowships, return fellowships, experienced researcher fellowships. (4) Call planned for 15/02/2001. (5) Call planned for 15/02/2001. (6) Call published on 15/11/2000. (7) Descartes Prize: Call scheduled for 30/09/2001. (8) Archimedes Prize. (9) Call planned for 15/1/2001. (10) Call planned for 15/03/2001. (11) Call published on 01/03/2000. (12) Call published on 16/05/2000.

(*) Reference: 3rd edition of the Work Programme. 4th edition planned for December 2000

Preparing for the Global Challenges of 2020

Hamburg - one of the major centres of the Airbus industrial complex - will be hosting Aeronautics Days 2001, from 29 to 31 January. This red-letter event will be the occasion to present the main lines of a new ambitious strategy within the European Research Area and to chart the future of European aeronautics. The objective over the next two decades is to equip the European Union with a global air transport system able to meet the challenges of the projected growth in the world market while strengthening the remarkable position currently enjoyed by European aeronautics. We summarise the issues at stake in this priority European field.



European aviation is experiencing a golden age which shows no sign of slowing. The continuous growth in world air transport - passengers and freight - experienced since the 1960s is set to continue at a rate of at least 5% a year over the next two decades. The latest Airbus forecasts indicate that this will mean a demand for 7600 new aircraft every decade - or a market estimated at 1300 billion euros by 2019. As a vital sector in the European - and American - industrial dynamic, aircraft manufacture must therefore continue to innovate if it is to win these large markets.

Consensus among the players

The technological race which will underlie the competition looks like being intense and increasingly demanding. The traditional battle between the commercial competitiveness of aircraft - their value for money - is today more relevant than ever. But at the same time, continuous market growth is bringing into play an unremitting stream of new parameters for the future of European and global aviation.

Aircraft manufacturers are thus perfectly aware of the major problem of the impact of increased traffic on the global environment. There is also a broad consensus that future improvements in aircraft performance must go hand-in-hand with a major drive for innovation in the air transport system as a whole. European research must meet the urgent need for progress in air traffic management and control (ATM and ATC), airport infrastructures, airline infor-

Three questions for Marc Vincendon (Research director Airbus - Toulouse)

In what ways is the European Union taking into account the expectations of Airbus researchers?

Increased research coordination in all the vital areas of aeronautics development is genuinely seen as a vital necessity by all the players in the European sector. As early as 1997, the sector's industrialists - the aircraft, equipment, and engine manufacturers - took stock of their strategic needs under EIAP (European Integrated Aeronautics Programme) and our expectations were generally taken into account in the architecture of the Aeronautics key action under the Fifth Framework Programme, which provided greatly increased resources. The programme's architecture - with research projects in critical areas on the one hand, and major technological platforms on the other - effectively contributes to the objectives of the European industry.

How does this added value translate in the field?

Airbus is by nature a completely trans-European company and we see the European research programmes as being of very significant value. The EU initiatives provide an ideal support framework, making it possible to involve aircraft manufacturers and suppliers in all the Member States. This produces a vertical integration of the equipment manufacturers' chain, where there are many SMEs which can consequently also be involved in research. For example, I coordinate the TANGO[1] technological platform - 34 participants in 12 European countries - which coordinates the validation of European technologies aimed at reducing the

The main objectives of the Aeronautics key action

The development of new generations of aircraft	• 35% reduction in production costs • 20% reduction in development time
Gains in aircraft efficiency	• 20% reduction in fuel consumption • Increased reliability
Respect for the environment	• 10 dB reduction in sound level • 20% reduction in CO_2 emissions • 80% reduction in NO_x
Operational capacity and safety	• Optimisation of airspace use • 25% reduction in maintenance costs • Reduced rate of accidents

mation systems, etc. It is this new global approach covering the whole of the aviation sector which is on the agenda at *Aeronautics Days* 2001.

The culmination of a development

The launching pad for a European aeronautics research area over the next two decades, the *Aeronautics Days* are the result of a process brought to fruition over a number of years by the efforts of the Commission in association with all the air transport players. It was the creation of an *Aeronautics Task Force* in 1995 that triggered the initial initiatives aimed at increasing the coordination of European research projects in the field of aircraft manufacture (aircraft, equipment and engine manufacturers) and within the global management of the air transport system (ATM, ATC, ground infrastructures).

The impetus created by the Task Force led to the creation under the current Fifth Framework Programme (1999-2002) of the major key action dedicated to *New perspectives for aeronautics*. The research strategy focuses on two priorities of relevance to the whole issue of air transport: the development of technologies seen as critical in the medium or long term, and the implementation of the new concept of major technological platforms aimed at validating innovations before they reach the market.

This key action has a budget of 700 million euros for a four-year period - nearly three times the resources devoted to European aeronautics research between 1995 and 1998.

The European aviation area

Community funding - which now represents 30% of the public research funds allocated to the sector in the European Union - has thus become vital to the future of the aviation sector. As such it is an excellent example of the *European Research Area* in practice, a political objective already supported by all the manufacturers concerned.

In April 2000, their representatives within the *External Advisory Group*, which is charged with advising the Commission on implementing research under the present key action, published the *Aeronautics for Europe* memorandum which lays the foundations for a new vision of the European system up to 2020. Following this 'charter' in favour of a new industrial partnership under EU auspices, last October Commissioner Philippe Busquin charged a group of 14 key figures from Europe's air transport sector with acting on the priorities to achieve tangible results within this timeframe.

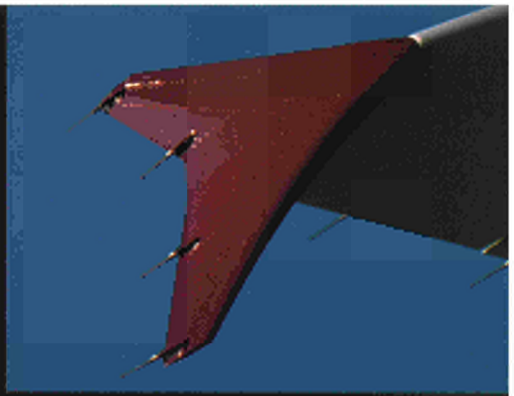
The results of this strategic consultation will be on the agenda at the Hamburg *Aeronautics Days*. ■

http://europa.eu.int/comm/research/growth/aeronautics-days/index.html

weight and manufacturing costs of aircraft cell structures. The ambitious objective of this vast operation is to achieve about a 20% reduction in both.

What does a group such as yours see as being the most pressing research priorities?

Safety, respect for the environment, and passenger comfort must all be improved. And of course aircraft design, construction and operating costs must be reduced. A number of projects and platforms in which we or our associates are involved are focusing on these aspects. But more radical responses to these essential concerns to the aircraft manufacturer can be found by studying the advanced configurations that will define the aviation of the future. These studies must be given every encouragement. All these priorities are fully integrated in our approaches.



(1) Technology Application to Near-Term Business Goals and Objectives of the Aerospace Industry.

Aviation and the environment

Aviation has two Achilles heels: noise and air pollution. Despite the enormous progress in reducing these major nuisances, the prospect of sustained growth in global air transport presents aeronautics research with a major environmental challenge.

The aeronautics industry has not rested on its laurels where the environment is concerned. The noise level of an Airbus 320 is around 20 dB less than that of a Caravelle or Boeing 727 40 years ago. And when it comes to aviation fuel consumption - and thus the volume of greenhouse gas emissions - the reduction is around 70%.

'Cleanliness' is paramount

Although the modern aircraft is increasingly 'clean', the life of an aircraft - between 20 and 25 years on average - nevertheless means that it takes time before the technological advances which can reduce pollution are able to produce their effect. Another problem is the rapid growth in air traffic. In the past, complaints from people living close to airports were limited, and far and few between - rather like the aircraft themselves. Today the daily - and often nocturnal - comings and goings at large and medium-sized airports pose, and will increasingly pose, many problems, with an environmental impact (noise and air pollution in residential areas) which borders on the intolerable. Almost everywhere there is a growing demand for regulating action and the ICAO (International Civil Aviation Organisation) is drawing up stricter standards.

The other concern is for areas far from human habitation, in the cold expanses of the upper atmosphere where the planet's global ecosystem is engaged in a precarious balancing act in the face of the action of solar radiation. Unlike ground-based sources of pollution, aircraft, despite the strenuous efforts to limit their emissions, are in part active in a particularly sensitive region of the Earth's environment. To date, little account has been taken of the impact of air traffic on these high-altitude chemical processes, but the increased research efforts of recent years have significantly improved our understanding of the effect of aircraft emissions on the atmosphere.

Even if increasingly important progress has been made in limiting emissions, the impact of aviation on the environment is a cause of concern as it takes place in a particularly sensitive part of the Earth's ecosystem.

The climatologists' concern

Although the contribution of aviation to the production of CO_2, the principal greenhouse gas, remains moderate (around 12% of the total pollution attributed to the transport sector), the forecast increase in traffic is changing the picture. Present generations of aircraft engines are also a source of two other types of emission of particular concern: oxides of nitrogen (NO_x) and water vapour.

In a report dated October 1999, the IPCC[1] - the global organisation whose role is to assess the scientific, technical and socio-economic information relevant for understanding the risk of human-induced climate change - estimated that NO_x emissions cause a significant increase in ozone formation at the boundary between the troposphere and stratosphere, the altitude at which this gas causes a greenhouse effect. What is more, in the air corridors the increasing number of contrails (familiar white streaks caused by the emission of water vapour into a very cold atmosphere) could be contributing to the formation of additional high-altitude cirrus clouds, although the mechanisms for this are not well understood. About 30% of the earth's surface is covered with cirrus clouds and any increase will tend to add to global warming.

X-Noise: chasing the noise

The real progress made in combating noise is largely thanks to the efforts of the engine manufacturers. European research is aimed at an integrated approach involving all parts of the aircraft. 'As we make improvements reducing the overall noise level, further reduction requires increasingly complex innovations involving all the aircraft's structures. It's not just the engines but also aerodynamic noise from the wings, high lift devices, fuselage and landing gear,' stresses Per Kruppa, who coordinates the Noise projects at the Research DG.

It was to embrace all these aspects that, in 1998, the EU's X-Noise initiative was launched. X-Noise is a cluster of projects concerning all aspects of aircraft noise and with multiple objectives. It involves research centres, university laboratories and industry - 32 partners in all - and has a

Noise reduction requires increasingly complex innovation involving all an aircraft's structures - not just the engines, but also the wings, high lift devices, fuselage and landing gear.

budget close to 30 million euros (60% funded by the EU, 40% by industry). Its stated aim is a global reduction of 8 dB. Research themes include the propagation of noise from jet turbines (the Ducat and Resound projects), the integration of the nacelles supporting the engines in the aircraft structure (Ranntac) and the reduction of noise produced by the aircraft structures (wings and landing-gear). In addition, the Sourdine project is not only bringing technical improvements to aircraft but is also looking at how to optimise landing and take-off procedures to make them less noisy for people around airports.

Under the current key action, the technological validation platform known as *Low external noise aircraft* is building on the work of X-Noise - and with increased resources at its disposal.

100 million euros for the clean engine

Launched in March 2000, the *Efficient and Environmentally Friendly Aircraft Engine* (EEFAE) technological platform is an ambitious action with a substantial budget (100 million euros) aimed at meeting the challenge of emissions reduction. Its aim is to validate, and integrate into engine design and development, a bundle of innovative, emission-reducing technologies (in terms of engine aero-thermodynamics, combustion, cooling, materials and manufacturing processes) which have already been studied and developed under European or national research programmes. Fifteen industrial partners, three research centres, two universities and several SMEs in 10 countries are involved in the EEFAE's two distinct research concepts. 'These two concepts have quite different missions. One, the Affordable Near Term Low Emissions Engine (ANTLE), conducted by Rolls-Royce, is aimed at introducing the best technologies possible for reducing polluting emissions in the next generation of engines,' explains Reiner Dunker, a scientific officer at the Commission. 'The other concept, the Component vaLidation for Environmentally-friendly Aero-eNgine (CLEAN), conducted by engine manufacturers SNECMA and MTU, is endeavouring to develop a new engine cycle using an intercooler and a heat exchanger with a view to drastically reducing CO_2 and NO_x emissions.' ■

(1) Intergovernmental Panel on Climate Change

Skywatch

Apart from the unflagging commitment to reducing emissions at source, i.e. in the engines, the only way to combat air pollution caused by air traffic effectively - and in particular to legislate on the subject - is by acquiring an in-depth knowledge of its real impact on the environment. Thus, in 1993, at the initiative of Airbus, four airlines (Air France, Sabena, Austrian Airlines and Lufthansa) agreed to equip five Airbus A340s operating on scheduled flights with sophisticated equipment to measure ozone and water vapour concentrations. Known as Mozaic, this project, funded by the EU on a cost sharing basis, gathered data from some 95 000 flying hours on routes virtually worldwide, providing essential material for assessing the composition of the air on air traffic routes. The evaluation itself was carried out by the Aeronet (Identification of Aircraft Emissions for Reduction Technologies) network, a research platform launched in 1997 involving all the scientific players in the aeronautics field - from industry to air traffic officials, and including specialists in measurement, database management and development of models.

Europe under a single sky

Whereas Europe's market may now be 'single', its sky still has a long way to go. The prospect of growing congestion on air routes and at airports - with the underlying threat to safety - is making it essential to develop the technology and regulations to provide an efficient and reliable system, offering increased capacity and incorporating all aspects of air traffic management. This is a top priority at the heart of Europe's aeronautics research.

The increase in air traffic has been dramatic. At the end of 2000 the total number of aircraft movements (take-offs and landings) is 18% up on 1997. But according to AEA (Association of European Airlines) statistics, 22% of flights recorded delays of more than 15 minutes in 1998[1] compared to 13% in 1993. Apart from the indirect cost to passengers, these delays are estimated to cost the airlines the equivalent of 10 billion euros a year in terms of less efficient use of equipment and personnel, fuel wastage and passenger compensation.

Traffic jams in the sky

'There are a variety of reasons for these delays,' explains Patrick Bernard, a scientific officer at the Energy and Transport DG. 'Half of them can be attributed to organisational problems at increasingly congested airports, and to the internal problems of the airlines. But it is estimated that at least 50% of delays are caused by increasingly critical problems with air traffic control, involving aircraft in the air and on the ground.'

The challenge facing the development of what the experts refer to as the EATMS (European Air Traffic Management System) is a measure of the complexity of the European sky, a jig-saw of national air spaces coordinated by 68 national and local control centres. The ATM 2000+ Strategy plan, managed by the trans-European air traffic control body Eurocontrol, is the response to this challenge.

More research for increased safety

The strategy involves a three-stage implementation process, culminating in 2015 in the Single European Sky. It also involves a major research effort on new technological systems able to manage constantly growing air traffic and progressively integrate it into a pan-European control system. This is a highly sensitive field in which every innovation must be validated to ensure maximum reliability in terms of safety.

'Safety,' stresses Alain Joselzon, a scientific officer at the Research DG, 'is certainly a constant and ever present concern running vertically and horizontally through the whole aeronautics sector. It culminates, in particular, in air traffic control, the point at which all the factors relating to man, machine and the external environment permanently intersect.'

Air traffic congestion - more than one in five flights has an average delay of 15 minutes - must be resolved by means of a radical technological reform integrating air traffic flow management at airports and in the sky.

Almost two-thirds of current European aeronautics research projects are looking at various aspects of ATM, including ground traffic flow management. They address, for example, the transmission and processing of increasingly large volumes of data enabling control centres and towers to model traffic flows in the air or in the environment of airports, new tools for aircraft positioning, new avionics instruments and man-machine interfaces installed in the cockpits. Much of the research is also linked to validating the safety of these new technologies, their combined use and their dissemination.

The 'development of critical technologies' under the present Aeronautics key action is actively supporting research on EATMS, encompassing all aspects linked to accident prevention and the reliability - at minimum cost - of aircraft maintenance operations. A specific technological platform is also aimed at validating advanced on-board navigation technologies and their integration in the global architecture of the future EATMS on which Eurocontrol is working. ■

(1) With a record 31% in 1999, partly explained by the air space disturbances caused by military intervention in the former Yugoslavia.

The educational value of Twin-Objects

Working with the real and assessing in the virtual. Twin-Objects, for use in technological education, represent major progress compared to traditional simulation programs. They were developed by a group of teachers, educationalists, psychologists and computer experts working on the Brevie project.

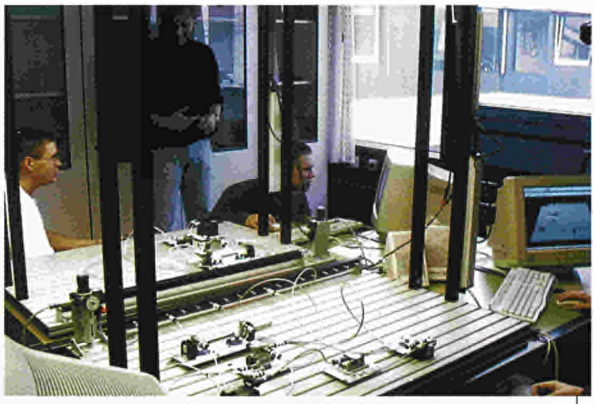
How can you get your students to understand the complex structure and functioning of the components which make up a pneumatic circuit? When faced with such complex problems, teachers increasingly use computer simulation. The construction of 'imaginary' circuits makes it possible, for example, to make virtual cross-sections or to visualise the air pressure in the tubes and flow directions in the system.

'However, with traditional teaching methods, simulation requires students to make a major conceptual effort and does not allow them to familiarise themselves with the material reality of the system they are analysing,' believes Wilhelm Bruns, a professor at Bremen University's Artec (Arbeit Umwelt Technik) Research Centre and the coordinator of the Brevie project.(1) 'The direct handling of objects is a fundamental aspect of the learning process. It is necessary to understanding and helps in developing the mental representations required to master complex technical systems.'

Virtual reality in real time

In response to this concern, computer experts, teachers, and researchers in education and psychology joined forces to develop a teaching aid allowing students to make the connection between the experience of material structures and their virtual counterparts. In the Brevie project, they developed a system allowing students to alternate freely between the material and the abstract. The Universal Graspable User Interface (UGUI) enables the computer to recognise what a student is doing when he is building a pneumatic circuit and to recreate it in real time, by computer.

'In this way the student sees the result of his work on the screen. He can visualise the movement of air flows inside the circuit he has created and identify any malfunctions and make the necessary changes. He can also carry out experiments on this model. We have called this real construction and its virtual counterpart Twin-Objects,' continues Professor Bruns.



Student-teacher relations are crucial to the success of a methodology which requires experiments to be carried out autonomously.

Not just for the students

An initial educational prototype was assessed at training establishments of various kinds in Portugal, the Netherlands, the United Kingdom and Germany. Their comments and suggestions led to the development of a second tool, tested at ETH Zurich's Institute for Work Psychology. The effectiveness of these systems seems to be very dependent on the teaching methods of the establishments where they were tested. The way in which students are encouraged to carry out autonomous experiments is, for example, crucial to the method's success.

The researchers are continuing their studies within the *Distributed environment for real and virtual learning* project, also supported by the Union, which is designed to incorporate other learning experiences (in particular those involving practical experiments with hybrid processes, such as systems combining mechanics, electronics, electricity and information technology).

'The applications of this learning environment are not, however, limited to teaching,' concludes Professor Bruns. 'This system can also serve as a communications aid for specialised technicians and engineers. This would enable technical problems to be solved remotely, for example.' ■

(1) Bridging reality and virtuality with a graspable user interface

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Artificial intelligence with the strength of steel

The optimisation of modern blast furnace operations involves the real-time analysis of a quantity of data which is quite simply beyond the capacity of human beings. With that in mind, and with the support of the European Union, France's Usinor has developed a knowledge-based system in which a unified approach to data collection and interpretation, and operating strategy has yielded significant improvements in a centuries-old technology.

European industrial strength has been linked to iron and steel production since the Industrial Revolution around 200 years ago. It comes as no surprise then that the first step towards a European Single Market was the formation of the European Coal and Steel Community (ECSC). Since its inception in 1952, and through its Europe-wide steel research programme, the ECSC has provided an estimated one billion euros for steel research, including a large portion for work in the important area of blast furnace operation. Now, thanks in part to ECSC support, France's Usinor Group has developed a new and highly advanced blast furnace monitoring and control system, with input from over a dozen of its country's leading experts in blast furnace diagnostics.

An awesome sight: modern steel production is the culmination of centuries of highly rational technological development, but the rumble of molten metal being poured from a blast furnace can still elicit a primitive thrill.

A process that's here to stay

According to Claude-Charles Thirion of Usinor's Advanced Data Processing division, 'Important and well-established traditional casting processes will almost certainly continue to be used for many years to come. But while major advances have been made through cooperative research, the basic mechanics of production technology have now been nearly completely optimised. For further significant breakthroughs we are going to have to look in new directions.'

Mr Thirion was among the researchers presenting results of ECSC-supported projects to an assembly which included Research Commissioner Philippe Busquin at the Sollac Atlantique steelworks in Dunkirk on 31 October 2000. In his address, Mr Busquin stressed the role of the ECSC in stimulating cooperative research. 'The ECSC has been a marvellous adventure,' he said, 'a prime example of successful scientific and technological cooperation in the European Research Area. It has worked!'

True artificial intelligence

'The blast furnace lies at the heart of the integrated steelworks,' notes Mr Thirion. 'Designed to produce a continuous flow of liquid metal at a temperature of around 1500°C, its regular and efficient operation is an essential element in reducing production costs.' Usinor's new system, Sachem - part acronym, and part reference to the North American Indian chief whose wisdom combines knowledge and experience - is designed to detect irregularities in blast furnace functioning, thereby ensuring stability and efficiency of operation. But the apparent simplicity of this task is misleading; the operation of a blast furnace is among the most complex processes in the world. Sachem is designed to acquire physical and chemical data from some 1000 sensors - temperature, pressure, gas etc. - which provide the system with around 5000 data items per minute.

The system takes the raw data, like temperature and time, and calculates variables such as rate of temperature change, which cannot be measured directly but which represent significant operating parameters. The Sachem system calculates and monitors thousands of these higher-level variables, checking consistency and validity, and this is where artificial intelligence comes into play. Combining empirical and scientific knowledge, Sachem uses specially organised and weighted connections between processing elements, the computer equivalent of neurons. Such 'neural networks' are particularly effective at predicting events when they have a database of prior examples to draw upon, essentially allowing the system to 'learn' from past experience.

Thus, Sachem detects anomalies based on what it knows from previous problems. It then immediately analyses and categorises them in terms of severity. The system can detect more than 160 different anomalies and produces about 40 alarms or warnings every day. It then provides diagnostic information and recommendations to operators on clearly and efficiently organised computer screens.

The new AI system means no surprises for plant operators. Sachem provides real-time monitoring, signalling and diagnosing problems and recommending corrective actions.

Serving but not replacing human operators

'It is important to note,' says Mr Thirion, 'that far from replacing human expertise, the new system has led to an increase in know-how among technicians at Usinor. In replacing the old-style system of ringing alarms and blasting hooters which used to send us scurrying to locate the problem, Sachem provides detailed real-time information about plant operation, allowing our people to understand, as never before, the factors underlying efficient blast furnace functioning. Sachem detects problems and suggests actions, yes, but only the human operator can actually take that action. Human beings are still in control.'

The new system has now been installed and is up and running in six blast furnaces at three different sites in France. Among the observed results are improved productivity, fuel savings, reduction of CO_2 emissions, improved product quality, improved safety and extended operating life of plant machinery. Overall savings amount to nearly €20 million each year. Work is now going on at Usinor to apply similar knowledge-based systems to other steel production processes, as well as to other sectors, including transportation.

'One thing is for sure,' concludes Mr Thirion. 'Casting is with us to stay, and making it a more efficient and environmentally friendly process is in everyone's interest.' ■

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Steel, a permanent source of innovation

While steel may have lost some of its old prestige, it remains an important product for the European economy. In conjunction with the Sachem demonstration at Dunkirk on October 31, the results of three other ECSC-supported research projects were presented, demonstrating the vitality and innovation which still characterise the sector.

Galvannealed steel for the automobile industry

S. Wilmotte from Belgium's CRM presented a new thermal treatment technique for galvannealed steel for the automotive industry. Zinc-coated strips are reheated very rapidly, maintained at a constant temperature for a period, and then rapidly cooled. This 'square cycle' is achieved using new techniques for heating and cooling. Industrial tests have demonstrated increased productivity, improved quality and resistance to chipping.
Contact: Stephan Wilmotte - wilmotte@rdmetal.ulg.ac.be

Recovery of iron oxides from pickling solutions

One of the hazardous by-products of steel casting is iron oxide sludge, produced when steel strips are 'pickled' in hydrochloric acid. A new project, presented by H. J. Hartmann of EKO Stahl GmbH, results in an improved iron oxide recovery process. Dried iron oxides are roasted as they freefall down a vertical 'flash furnace', an extremely rapid operation lasting only 3 seconds as compared to 45 minutes under conventional methods. The resulting powder is of superior quality, ideal for the production of high-grade magnets.
Contact: H.J. Hartmann - Hartmann@fqz-brandenburg.de

Direct casting of steel strips

J. Kroos of Salzgitter AG presented an original process for direct strip casting with in-line rolling. Molten steel flows directly into a feeding system and is conveyed via an iron or copper belt subject to intense cooling by water jets. It then passes through a secondary cooling zone and subsequent rolling processes. The new installation is very compact, comprising a total length of only about 100 metres, and represents a major step forward in terms of production costs, product quality and environmental impact.
Contact: Joachim Kroos - Fax: +49.5341.213.488

For more information on Sachem and other steel research projects (see box) visit http://europa.eu.int/comm/research/press/2000/pr1310en.html

(Re)thinking flexibility

Flexibility at work takes various forms - variable working hours, telework, sub-contracting, atypical statuses - and is affecting a growing number of sectors. Although for some Europeans this offers new freedoms and autonomy, for others it means reduced job security. In particular, the absence of any legal framework is a worrying vacuum. This is why researchers on the Flexcot project are suggesting a number of avenues which the public authorities and social partners could usefully explore.

The new flexibility brought by the information society takes many forms, in terms of time and space. It is changing contractual relations and production methods. It has repercussions for social dialogue and corporate culture. Managers brandish it as an essential management tool, vital for competitiveness and essential to satisfying increasingly demanding customers seeking rapid and continuous services. But for the trade unions, flexibility is usually seen as an instrument of social repression and a way for employers to skirt round collective agreements, negotiated benefits and even legal minima.

So is it a solution or a problem? What different forms does this flexibility take depending on the field of activity, the national and regulatory context, and the individual company? What lessons should be drawn? For two years, partners on the Flexcot[1] project studied the combined effects of technologies and flexible work practices in four representative sectors: banking, construction and civil engineering, the press and health. 24 case studies were carried out in six countries (Belgium, Denmark, France, Italy, Spain, United Kingdom).

'We looked at trends in work practices and contractual relations between employers and workers in these different areas, identifying certain key issues for the future of labour,' explains Patricia Vendramin of the Fondation Travail-Université (BE), the project coordinator.

Dividing to rule

The Flexcot researchers see the growth of flexible work practices - which in most cases are dictated by purely economic considerations - as being based on the (real or supposed) requirements of an increasingly coveted clientele. This explains all the restructuring. The obsession is to achieve just-in-time production and delivery, which increases reliance on sub-contracting and continuously accessible services (round-the-clock maintenance, breakdown, delivery, etc.). Services for private individuals are following the same pattern and round-the-clock suppliers are engaged in ever fiercer competition.

They may revolutionise work practices and the corporate culture, but communication technologies are simply tools. The question is to know how to use them and to what end.

Work is therefore freeing itself from the constraints of time and distance while entrepreneurial strategies are drawing on new technologies to depart from the monolithic company model. The whole is being broken down into smaller units and all manner of contracts and unregulated statuses are being adopted.

'This trend leads to an implacable logic of company fragmentation. Firms sub-contract, work in networks and create small subsidiaries. The same is found in highly regulated sectors, such as banking. By opting for franchised branches and contracting out online services - some call centres operate round the clock - they can bypass collective agreements and hire people from outside the parent company on short-term contracts with a less secure status.'[2]

Using technologies effectively

In the countries studied, differences were found to be primarily sector-based. In construction and civil engineering, flexibility is often a two-edged sword: positive for those working in design offices, who decide their own working hours, but negative and imposed for on-site workers. In the daily press, the need to work to last-minute deadlines and sometimes to cover a very large area means employing the services of more freelance journalists located at various strategic points, with the limited editorial team concentrating on management and coordination.

'Technology is a tool. The question is to know how to use it.' The Flexcot coordinator cites the example of a British medical call centre. A rotating staff of nurses works three days a week, 12 hours a day, answering

Breaks are tending to disappear. All the slack has been taken up, and working time is today worked in full.

questions over the telephone. They are highly motivated and work in a climate of trust and responsibility, without any productivity norms or constant supervision. And 36 hours a week is full-time status. 'This particularly positive experience is illuminating. In other fields, five hours a day is considered a physical maximum at a remote information centre and those who work there do not last long.' Comparisons in completed case studies between a financial call centre and a medical help line show that different kinds of human resource management are possible using the same technology.

Another finding of these field studies is that technology enables human resource needs to be assessed more precisely. 'Work situations are becoming increasingly intense. All working time is time actually worked, and there is no longer any slack. Staff numbers are set at a minimum and the pace is getting faster.'

Avenues to be explored

Economic management is changing and, in Europe as a whole, labour legislation - and thus social protection - is now out of step with the reality of working life. A growing number of people are following an 'atypical' route and the 'new flexibility' continues to take little account of individual aspirations.

This is why Flexcot researchers are suggesting a number of avenues which public authorities and social partners could usefully explore. They stress the need to bring social legislation (such as regulation of subcontracting and distance working, or new forms of employment contract) up to date at a time when career paths are becoming increasingly complex, with career breaks, changes of status, time spent working abroad, etc. They are suggesting to trade unions that they should take the initiative in terms of cooperation on flexible work practices and better correlate the protection of collective and individual interests. They also want to increase employers' awareness of - among other things - the loss of the identifying and social dimensions which form the basis for the corporate culture and a company's self-image. ■

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(1) Flexible Work Practices and Communication Technology, a project supported by the European Union under the Targeted Socio-Economic Research programme (TSER). The partners are the Fondation Travail-Université (BE), Newcastle University (UK), the Université de Paris Nord (FR) and the Fondazione Pietro Seveso of Milan (IT). The Tele-Information Centre in Aarhus (DK) and Valencia's Foundation for Social Studies on Labour (ES) participated in the project as associate partners, supplying additional case studies.
(2) All quotations are from Patricia Vendramin.

The message from the mountain lakes

The symbols of unspoilt nature seemingly beyond the reach of modern ills, remote mountain regions are in fact hypersensitive ecosystems, both victims and excellent indicators of environmental and climatic changes caused by man. Over recent years, multidisciplinary teams of European researchers with the AL:PE and MOLAR projects have been studying these remote expanses of azure skies and lakes.

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Starolesnianske Pleso (Slovakia) - 'Central and Eastern Europe is particularly badly affected, primarily as a result of toxic pollutants. This damage gradually diminishes as you travel towards northern or southern Europe.'

Far above or beyond the tree line, remote mountain lakes are strongholds of secluded nature, where there is virtually no direct contact with man, save perhaps for the occasional summer hiker. In their splendid isolation, their ecosystems are subject only to the wind that blows, the rain and snow that falls from the sky, and daily and seasonal temperature fluctuations. Yet there is not a mountain lake anywhere which escapes the effects of distant civilisation.

'High altitude and upper latitude lakes are like sentinels at the furthest outpost of environmental and climatic change. Beneath their appearance of immutable solitude, they are in fact hypersensitive to the slightest pollution. Any atmospheric deposit of acids, heavy metals, chlorinated hydrocarbons or other volatile organic compounds with a high toxic content has an immediate impact on the structure and functioning of their ecosystems,' explains Hartmut Barth, the scientific officer responsible for the AL:PE and Molar[1] projects at the Commission's Research Directorate-General.

These lakes also retain a vast 'memory' of onslaughts they have suffered across the centuries. Their sediments are archives of the effects of the industrial revolution, of acid rain, and of major volcanic eruptions. 'All these episodes, sometimes visible to the naked eye, provide us with a precise and detailed picture allowing us to trace developments as far back as 700 to 800 hundred years,' notes Bente Wathne, the Norwegian scientific coordinator of the Molar project with its 23 scientific institutions from 13 countries.[2]

Building on success

'This broad partnership has worked very well. At the scientific level, it has allowed us to adopt a continent-wide approach. This is essential when considering pollutants which obviously take no account of national borders,' stresses Vera Straskrabová, the Czech partner.

Molar is picking up where the EU's AL:PE1 and AL:PE2 projects left off. These made detailed studies of lake ecosystems at the European level. 'These two projects enabled us to obtain an initial overall picture based on sediment analyses, and chemical and biological studies,' explains the project's administrative coordinator, Simon Patrick of the Environmental Change Research Centre (University College London). 'Building on this success, Molar subsequently concentrated on a number of key sites, providing detailed data on the time dynamic of these ecosystems and the way they behave when faced with various disturbances.'

The threats currently facing these sites have been identified. Acidifying deposits, toxic atmospheric pollutants and the impact of climate change are the trio causing most concern. Remote mountain lakes are particularly sensitive to these hazards for a number of reasons. Their very soft waters are unable to neutralise the acids they absorb through their catchment basin effectively; the nitrate levels are high as there is no surrounding vegetation to fix these molecules; and some pollutants, such as mercury and volatile organic compounds, are particularly prone to accumulation in cold regions. Finally, as climate change in Europe is likely to be most marked in Alpine and Arctic regions, this could result in a destabilising increase in the lakes' water temperature resulting from longer periods of thawing.


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Etang d'Aubé (France) and Lochnagar (Scotland) - 'A peculiarity of remote mountain lakes is the speed at which they react. Immediately there is a temperature increase, for example, the pH level of the water changes, and this quickly has an effect on all the aquatic ecosystems.'


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Lago Lungo (Italy) - The trio of dangers: acidifying deposits, toxic atmospheric pollutants and the threat of climate change.

Charting change

By virtue of their sensitivity, these ecosystems are excellent indicators of change. That is why they are studied very closely to find out more about the scale, pattern and biological impact of changes in air quality and climate.

Researchers have confirmed that all the lakes studied - including those that are very remote from inhabited and industrial areas - suffer the effects of atmospheric pollutants to some degree. Acidity, for example, influences the fauna, flora and complete food chain. Organic pollutants such as PCBs and DDT build up in living organisms, and become concentrated in the tissues and organs of fish, to the point where in some places they become unfit for consumption. 'From whatever angle these lakes are studied - whether one analyses their fauna, their acidity or their heavy metal content - a similar overall picture emerges,' explains Dr Wathne. 'Central and Eastern Europe is particularly badly affected, primarily as a result of toxic pollutants. This damage gradually diminishes as you travel towards northern or southern Europe. But one positive point deserves mention. Some forms of nitrogenous and sulphurous pollution have tended to diminish over recent years.'

European scientists hope that, in seeking to understand the links between these disturbances and physical, chemical and biological observations, they will be able to develop forecasting models for all these environmental changes: acidification, pollution and climate change. 'The successive projects studying mountain lakes have provided us with precise data to calibrate such models,' explains Rick Batterbee, a researcher at University College London. 'Our aim is to test the various scenarios once we have obtained a more global view of all the mountain lakes.'

'A peculiarity of remote mountain lakes is the speed at which they react. Immediately there is a temperature increase, for example, the pH level of the water changes, and this quickly has an effect on all the aquatic ecosystems. They raise the alarm which can help us take the necessary measures in terms of environmental management policy. This is what makes these research projects so interesting,' concludes Dr Barth. The successor to the Molar project, named Emerge, is already under way. ■

(1) AL:PE1 (Acidification of Remote Mountain Lakes: Palaeolimnology and Ecology) ; AL:PE 2 (Remote Mountain Lakes as Indicators of Air Pollution and Climate Change); MOLAR (Measuring and modelling the dynamic response of remote mountain lake ecosystems to environmental change: A Mountain Lake Research programme); these projects benefited from Union support under the Environment and International Cooperation programmes.
(2) United Kingdom, Norway, Finland, Austria, Spain, France, Italy, Switzerland, Czech Republic, Slovak Republic, Poland, Slovenia, Russia.

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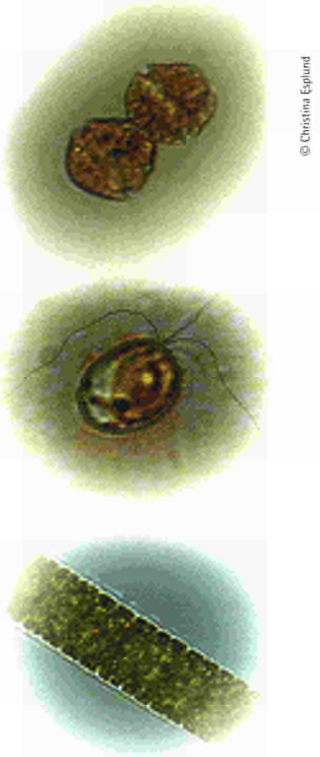
Prolific - and deadly - algae

The sea is wreaking revenge for man's negligence. From north to south, Europe's coastal waters are periodically invaded by toxin-producing micro-algae which pose a threat to human health. What is going wrong? Researchers on the Nutox project and Eurohab initiative are gradually coming to understand the physico-chemical and biological mechanisms which are producing this worrying phenomenon.

All around Europe's coasts - as well as at many other locations worldwide - the health authorities regularly have to issue warnings not to go fishing, swim in the sea or eat seafood. Anyone who ignores the warning runs the risk of suffering from paralysis, diarrhoea or neurological disease - or even death. The culprit is a mass of various kinds of phytoplanktonic microflora which scientists group together under the generic name of Harmful Algal Blooms or HABs. Although we have long known that such algae exist, in recent years that they have started to appear with increasing frequency and in considerably greater quantities. One of the principal explanations offered is a disturbance in the ecological balance caused by human activities - in particular, the production of excessive waste with high nitrate and phosphate content. Swedish, Norwegian, German, Spanish and French scientists joined forces on the Nutox[1] project to undertake a quantitative and qualitative analysis of the process.

Reasons for the proliferation

'The balance between phytoplankton species in coastal waters is closely linked to the mineral and organic matter carried by river water, coastal run-off and possibly acid rain,' explains Serge Maestrini of the Research Centre for Marine Ecology and Aquaculture (CREMA L'Houmeau - a joint institute of CNRS and Ifremer). Over recent decades, large quantities of nitrates and phosphates with assorted origins - agricultural, domestic detergents, etc. - have entered these waters. Their eutrophication has resulted in the overproduction of one of the principal species of planktonic algae, diatoms, which are major consumers of silicon. 'This has resulted in coastal waters being poorer in silicon and relatively richer in nitrogen and phosphorus. These conditions are thus favourable to the development of algae with little taste for silicon, and in particular three species of toxic algae - dinoflagellates, prymnesiophyceae and cyanobacteria - which pose serious problems of proliferation just about everywhere in the world, and in the coastal waters of northern and southern Europe in particular.'



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Algal varieties under the microscope - from the top:
Alexandrium fundyense *(dinoflagellate producing a paralysing toxin).*
Chrysochromulina polylepsis *(haptophyte harmful to fish).*
Nodularia spumigena *(cyanobacteria).*

Six complementary teams

Researchers from northern Europe joined forces on the Nutox project to carry out large-scale experiments in the Norwegian Sea, the Skagerrak strait and the Baltic Sea. Edna Granéli's team from the Kalmar Institute of Natural Sciences (SE), the project coordinator, focused in particular on ways of controlling toxin production by means of nutrients. Experts from the Department of Applied Nuclear Physics at the University of Lund (SE) analysed the chemical composition of the algae using nuclear microprobes (PIXE, Particle-Induced X-ray Emission), while scientists from the Trondheim biological station (NO) made interspecific comparisons between toxic species from different European regions.

The other three groups worked on the material gathered. Researchers from the Institute of Nutrition and Environment (Jena University, DE) looked at the toxicological aspects. The French team from CREMA L'Houmeau concentrated on studying the effects of nitrogen and phosphorous content on toxin production. A Spanish laboratory, attached to the Department of Aquatic and Environmental Sciences and Techniques (Santander), was charged with comparing the populations of the same species of different origin (from northern and southern Europe) using molecular-genetics techniques. The species chosen was *Alexandrium tamarense*, a dinoflagellate that produces a toxin which can cause paralysis (Paralytic Shellfish Poisoning, or PSP).

Phosphorous and nitrogen are the enemies

'One of the merits of this European cooperative project is the way in which expertise in a number of disciplines is focused on a common theme,' believes Catherine Legrand, who works with Professor Granéli. 'Experts in marine ecophysiology and marine biology, chemists and physicists have all come together. This is the first time, for example, that we have had access to the carbon, nitrogen and phosphorous composition of a dinoflagellate (*Dinophysis* spp.), whose toxin produces diarrhoea (Diarrhoeic Shellfish Poisoning, or DSP), and we owe this result to the use of nuclear microprobes.'

The research has shown that toxin production is at its lowest when there is a balance between nitrogen and phosphorous content. However, there is one exception: algae containing saxitoxin, a toxin rich in nitrogen, which has a paralysing effect. More saxitoxin is produced if the phosphorous supply is reduced, while it decreases significantly if the nitrogen supply is limited.

'It is possible to inhibit toxin production very quickly - in just one or two days,' says Professor Granéli. 'It is simply a matter of supplying the environment with those elements in which it is deficient. But this is a stopgap solution, which is not without its dangers. In a sense it amounts to pouring oil on the fire, as there is a danger of accelerating biomass production. The only long-term solution, therefore, is to reduce the supply of phosphorous and nitrogen.'

This is a warning which Europe certainly intends to heed. Nutox is part of Eurohab, an ambitious initiative to combat these algae (see box). Algae which continue to pose a problem for scientists. ■

(1) Effect of nutrient ratios on harmful phytoplankton and their toxin production. A project supported by the European Union under the MAST programme.

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Eurohab in brief

Faced with the spread of 'toxic algal tides', Europe decided that radical action was needed. At an international meeting in Kalmar (Sweden) in November 1998, it launched Eurohab (European Initiative on Harmful Algal Blooms), an umbrella project with financial support from the Fifth Framework Programme.

Four major priorities were set:

- to understand the mechanisms by which certain species of harmful micro-algae are able to invade the planktonic environment;
- to assess the causes - both natural and human - of this proliferation;
- to study the methods of interaction between HABs and fishery resources likely to promote the development of the toxic algae;
- to compile databases to monitor the development of phenomena in time and space.

A report detailing the current state of knowledge of harmful algal blooms[1] and the remaining uncertainties surrounding their development processes was published following the Kalmar meeting. This analyses the chemical and biological mechanisms which speed up their formation and proliferation as well as the toxins they contain and their impact. The document also presents the technologies already implemented or to be developed, in the field of biology (taxonomy, molecular biology, physiology, etc.) and the study of ecosystems (detection, modelling, etc.).

(1) Eurohab, Science Initiative, Harmful Algal Blooms in European marine and brackish waters, Proceedings, European Communities, 1999.

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Harmful algal bloom in a Norwegian fjord.

Spotlight on the Sun

Renewable energy resources meet 6% of Europe's energy needs. The aim is to double this share within the next decade. Of the sustainable technologies available, industry has traditionally been reluctant to exploit photovoltaic solar energy because of the high production cost of the cells and their low output. But major research efforts are now making photovoltaic solar energy a far more attractive prospect. Of particular interest is the innovative new concentrator developed by the Hercules project.

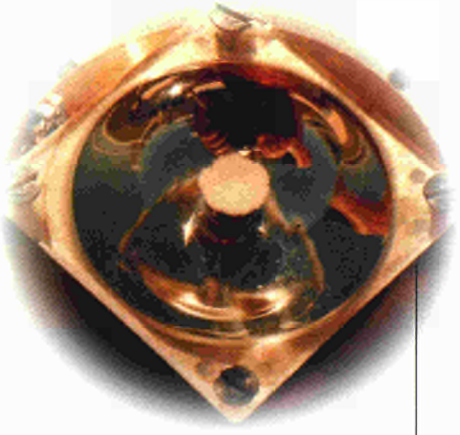
An inexhaustible source of energy coupled with prohibitive production costs: that is the contradiction of solar energy. The Hercules[1] project, one of a number of research projects in this field, has sought to resolve this through the efforts of an international and multidisciplinary partnership bringing together materials, photovoltaic and optoelectronics specialists from the worlds of industry and research.

It was the Institute of Solar Energy in Madrid that came up with the basic technological concept and developed the optical system. The institute worked to produce the solar cells with OFFE in St Petersburg - known for its excellence in producing high-performance photovoltaic cells for use in space - and a Belgian company, Energies nouvelles et environnement (ENE). A German company, Vishay, produced the feasibility study for the various elements and their integration, while a Russian company, Protechn, worked on the prototype moulds for the concentrator.

First, the partners had to decide on the materials for the photovoltaic cells. Gallium arsenide (GaAs) was chosen for its high output, despite being more expensive than the alternative, silicon. To offset the cost problem, the researchers focused their attention on a second parameter: concentrating the solar radiation. Using special optics, whose effectiveness is measured in terms of a concentration factor, the electricity production of the cells can be increased considerably and the surface area of the photovoltaic panels reduced accordingly.

Mini-cells

The aim was to develop a device with a concentration factor of around 1000. For this, very small (1mm²) cells, which are much easier to cool, were used. 'On the other hand, we had to be sure that this high density of cells per square metre did not result in an excessive increase in the assembly cost,' explains Antonio Luque of Madrid's Institute of Solar Energy, the project coordinator. The solution was provided by the Light-Emitting Diode (LED) industry[2]. 'Our German partner, Vishay, transferred LED technology to the photovoltaic cells and, due to the similar problems associated with cooling powerful LEDs, this helped solve the problem of cooling the cells.'



By increasing the concentration factor of solar radiation it is possible to increase electricity production per cell considerably and thus reduce the surface area of the photovoltaic panels. As a result of incorporating these innovative devices, the concentrator developed by the Hercules project marks significant progress.

Concentration by reflection

The concentrator uses a totally new concept. Conventional devices, usually consisting of lenses, require extremely precise optical settings and sun tracking systems to achieve a high radiation concentration. The device designed under the Hercules project is considerably less demanding in this respect. The concentrator can be off target by as much as 1.5 degrees, but the system will still continue to function. This means a significant reduction in the production constraints and thus lower production costs.

This new device also includes a plastic lens, whose back surface, which is not directly exposed to the sun, is covered with a reflective layer. The incident radiation is therefore refracted to the front surface of the lens (which is aimed at the sun), then reflected to the back surface before returning once more to the front surface. This reflecting back and forth is a mechanism known as 'total internal reflection' and is the result of the difference between the refractive indices of the media through which the radiation passes. The radiation then strikes the photovoltaic cell, whose position inside the concentrator has been calculated for optimal performance.

On track for industrial production

'On completion of the project, the output of systems consisting of cells and their concentrator was as high as 26% with a concentration factor of 1 000,' explains Mr Luque. 'That is the highest output ever achieved with photovoltaic cells for such high concentrations.'

A new European consortium coordinated by the Spanish company Isofoton (which markets photovoltaic cells in about 50 countries) is now beginning to manufacture complete solar panels. What is more, Madrid's Institute of Solar Energy has been contacted by a US manufacturer of very efficient silicon cells to develop a concentrator tailored to this technology. The cost of solar kilowatts is thus becoming competitive. ■

(1) Ultra-compact, high-flux, GaAs-cell PV concentrator - a project launched under the non-nuclear energy programme (JOULE)
(2) LED (Light-Emitting Diode) technology is widely used for indicator lamps on common electronic appliances.

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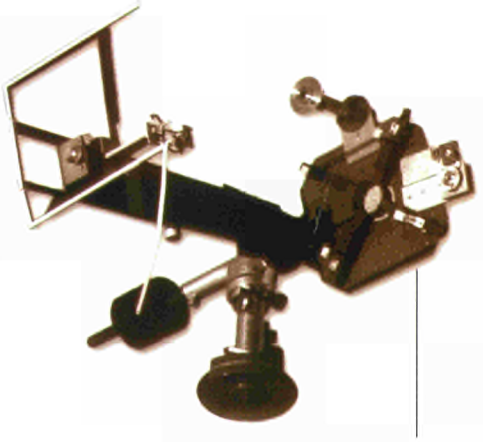

The concentrator remains efficient even if it is not pointed precisely at the sun. A deviation of up to 1.5 degrees is acceptable.

Energies in synergy

How can the use of renewable energy resources be optimised? How can wind and solar resources, which are naturally intermittent, be used to meet the needs of consumers at a given moment? How can the use of various energy supplies - both renewable and traditional - be planned to guarantee security of supply?

In 1999, an integrated management unit prototype, developed by the Care[1] project, was set up on Crete. This Greek island has 18 traditional electricity production centres plus eight wind farms. The Care system combines modules for wind force and direction forecasting, electricity demand forecasting, and dynamic safety evaluation. Through real-time optimisation of the use of resources, this management unit provides network operating officials with a reliable set of decision-making tools.

'The development of each system component was a challenge in itself,' emphasises Nikos Hatziargyriou, project coordinator. 'But all these individual elements also had to be integrated into a common environment and the final system designed in a way to make it easy to use for the operators.' One of the keys to Care's success was to involve the users at every stage in the development process. The screen can continuously display the current or historic network status in terms of electricity demand, share of wind power, etc., as well as forecasts for the hours to come. On this basis Care then proposes strategies to assist the operator.

The initial evaluations are encouraging with a margin of error of just 5% for electricity demand forecasts and savings of around 3% in the quantity of fuel used on Crete every day.

(1) Advanced control advice for power systems with large scale integration of renewable energy sources (Care) - a project launched under the non-nuclear energy programme (JOULE).

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New opportunities for lucerne

The nutritional and functional benefits of rubisco, a protein found in the forage crop lucerne (also known as alfalfa), are attracting great interest from experts on human diet. Researchers on the EU-funded Fralupro project have now developed an efficient process for extracting rubisco on an industrial scale, which could also be used for other proteins of interest to the pharmaceutical or cosmetics industries.

The world's most cultivated fodder crop, lucerne (or alfalfa), is now benefiting from an innovative technology to extract a protein - rubisco - for human consumption. The system developed should also enable other vegetable proteins of particular interest to the pharmaceutical and cosmetics industries to be extracted.

Lucerne biscuits.

Around 32 million hectares worldwide are used to grow lucerne for dehydrated fodder or use in animal feedstuffs. But apart from this basic application, scientists are becoming increasingly interested in the benefits of one of its constituents in particular: a protein called rubisco that could usefully replace soya protein in the human diet as it is much richer in essential amino acids and closer to dairy proteins. Given the present debate on GMOs, rubisco is all the more attractive as it has a well specified composition and clearly identified vegetable origin - which cannot be said of all the soya imported into Europe. It also possesses emulsifying and swelling properties which interest the cosmetics and detergent industries as well as the agri-foodstuffs sector.

From extraction to industrialisation

These beneficial properties offer the prospect of market diversification for an industry facing competition from other products, such as oil seed cakes, and hit by a reduction in European subsidies. "In addition to our core activity, which still focuses on animal feedstuffs, we have developed a pilot technique for the thorough fractionation of lucerne that enables us to extract the rubisco," explains Bernard Petin, the manager of France Luzerne and coordinator of the Fralupro project.(1)

The project, which is supported by the European Union, began in 1997 when France Luzerne and its five partners set out to test the technical and economic viability of the pilot process for large-scale production.

The new technique extracts the rubisco protein from fresh lucerne juice rather than from protein meal. This means working quickly and continuously to avoid any metabolic reaction. While it is relatively easy to produce a juice containing less than 0.5% insoluble matter on a small scale, it is much more difficult to keep to this level when volumes increase, and to produce a protein which is both colourless and tasteless. The new scale of operations also presents problems related to temperature control and managing the pH level, as well as the installation's ability to cope with a raw material whose dry matter content varies significantly depending on the season and climatic conditions.

Not just food

The demonstration unit developed by the Fralupro project is able to produce between 35 kg and 50 kg of protein an hour, compared to 6 kg to 7 kg for the initial pilot process. "Our aim is to produce 1 200 tonnes of rubisco a year, at virtually the same cost as soya. The lucerne extraction process is totally new in that it is the first time we have managed to go directly from the plant to a protein powder for human consumption," explains Mr Petin.

The technology developed by the Fralupro partners could also be used to extract other vegetable proteins with potentially high added value applications, especially in the pharmaceuticals and cosmetics fields. ■

(1) Fractionation of lucerne juice to create nutritional and functional protein ingredients for the food and non-food industry

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