

# RTDinfo



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## The promise of **superconductivity**



Portrait:  
J-P Changeux and H-O Henkel

Environment:  
Tracking down endocrine disruptors

# Editorial

## A clone too far

It was perhaps the clone that proved to be the final straw. The claim by the Raelian Movement in December of the birth of the first child by reproductive cloning sparked a wave of emotion and protest in Europe and elsewhere. Carrying out on human beings experiments which are continuing to give very mixed results on animals is contrary to all medical ethics. This use of a technique which gives human beings the ability to self-reproduce – a phenomenon which is common in the world of living organisms – was also condemned by many for its narcissistic overtones and the quest for immortality that it entertains.

On the other hand, others saw in this supposed advance no more than a logical extension of a type of biomedical progress which enables the treatment of previously untreatable human sterility and is even able to alter the actual concept of sterility. Reproductive cloning would make it possible for a single woman or a couple of homosexual women to produce a child without male intervention – marking a revolution in human biology.

The polarisation of this debate is reflected in the actions proposed. While politicians have called for the practice to be considered a criminal offence, many countries appear to oppose a ban. The Union has set an example as Article 3 of the "Charter of Fundamental Rights" explicitly lays down 'the prohibition of the reproductive cloning of human beings'. The Sixth Framework Programme will not finance any research activity on this subject, and Commissioner Busquin has pledged his full support for the Franco-German initiative to establish a global convention banning human reproductive cloning.

The fact remains that the quest for money and glory will no doubt sooner or later produce the world's first cloned baby. Why should reproductive cloning be an exception to the major trends in contemporary technological progress? After all, Gabor's famous law in essence states that 'everything that is possible will ultimately come about', and some have seized upon this to affirm that technology will advance to the very limits of what is possible. Similarly, when technological breakthroughs occur, we often hear that the law has been presented with a technological *fait accompli* – as if morality and ethics were the poor relations of reason.

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## DOSSIER

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[europa.eu.int/comm/research](http://europa.eu.int/comm/research)

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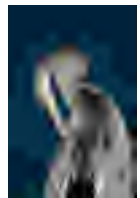
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Scientists are proposing new diagnostic approaches and concrete remedies to break the never-ending cycle of damage to historical buildings.

# Flashback

**Exceeding all the organisers' expectations, 9 600 people, from 65 countries, registered to the Sixth Framework Programme launch conference – an event which will surely go down in history as the biggest meeting ever organised by the European Commission. No fewer than 307 journalists were also in Brussels to report on these three days in November. People, atmosphere and centres of interest were there in abundance – sometimes creating bottlenecks in the most popular areas – as well as opportunities for fruitful contacts and exchanges of experience.**

Apart from the immediate impressions, how was the event received? One week after the conference, a questionnaire was sent out by e-mail to all participants. More than 10% replied within the very short time allowed.

Why had they come? Although two-thirds were primarily seeking information on FP6, more than half were also motivated by the opportunity to meet other researchers or industrialists and to discuss possible partnerships or networks.

## The favourites

So did they find what they were looking for? The event favourites were: the 'practical' sessions (*How to participate in the Sixth Framework Programme*), the thematic sessions – not only the 'official' programme but also the 80 presentations and debates organised as part of the *participants' forum* –, the exhibition stands and the opportunity to make new contacts. The system of making appointments through the Internet *Mingle Zone* was seen as a good thing by 40% of those who used it before the conference. But although it was appreciated in principle, only 17% of those who attended the conference actually used it. Finally, on the communication front, *The Sixth Sense* conference newspaper was a big hit.

More than 8 000 people were present throughout the three days. Some 60% of participants who completed the questionnaire considered this to be just about the right duration. What is more, two-thirds of them considered the financial contribution requested to be appropriate for a meeting of this kind.

Other 'details' also prompted a number of comments – especially from the organisers. Some of the rooms used for the *participants' forum* were considered as too small, the Commission teams not always easy to pick out among the crowds, the stands were sometimes rather dull, and the debates often too short. The absence of video links also made it impossible to follow conferences outside the halls where they were taking place.

## Back in 2004

The final verdict was generally positive, or even very positive. So much so that on closing the event, Commissioner Philippe Busquin suggested that this kind of event should be held more regularly, in the form of a *European Conference on Science and Technology* with the next meeting already set for 2004. This will not of course mark the launch of a new R&D Framework Programme. 'Holding such a conference would be useful for assessing progress made in creating the European Research Area, adjusting the objectives in line with rapid developments in knowledge, and generating new opportunities for partnerships and networking.'

## More precisely

- More than a thousand visitors from the candidate countries, or about one in ten.
- Three-quarters of those who completed the questionnaire (see article) liked the thematic sessions and participants' forums for their organisation and content.
- 2 100 messages were sent using the *Mingle Zone* system. 1 338 people registered on the site.
- 89% of people polled had a copy of the conference journal *The Sixth Sense* and 77% of them had read at least one article.
- 19% of interviewees thought the conference was too long while 5% considered it too short.





Registration

Philippe Busquin  
launching the Sixth  
Framework Programme



'During these three days I had the feeling that the Heysel had been transformed into a genuine *village*, fully representative of the European Research Area. The intensity of the debates and the contacts between researchers was extraordinarily rich and rewarding.'

*Philippe Busquin,  
European Commissioner responsible for research*



Closing session

Workshop debate



Participants' forum

Plenary session



'My colleagues and I were all very impressed by this conference. It was remarkably well organised and proved extremely useful in terms of information and, of course, establishing contacts.'

*Gergely Csonkareti  
Hungarian Science and Technology Foundation, Budapest*



Claudie Haigneré, French  
Minister for Research,  
and astronaut

Guy Verhofstadt,  
Belgian Prime Minister,  
and Philippe Busquin



Carmen Vela Olmo, member  
of the Strata-Etan research  
network



Marius-Joan Piso, director of  
the Romanian Space Agency



Concert given by the European  
Youth Orchestra



ESO Stand – Astrophysical Explanations



Reading break



Aeronautics and Space Stand

'On calm reflection on this vast conference – it was, in fact, just a foretaste, in the research field, of a Europe which is taking shape in all its other dimensions; a complex Europe rich in history and culture, with its wealth of languages and particularities, projects and ambitions – one is more inclined to understand its ambitions and admire its achievements, to pardon its failings and to persevere in what remains to be done, than to bemoan its insufficiencies from within the confines of one's own Member State.'

*Alain Videau  
Engineering consultant for R&D projects (France)*



Genomics and Biotechnology Stand



Yves Pietrasanta,  
Member of the  
European Parliament



Fusion road show

'As international relations manager representing my organisation, I spent three fascinating days. To be able to rub shoulders with more than 8 000 people from the European research world was a unique opportunity.'

*Karin Keyes Endemann  
National Research Council of Canada*



Sustainable  
Development Stand



Murli Manohar Joshi,  
physicist, Research  
Minister in the Indian  
Government



Press conference

'The programme presentations I attended were clear and very open to questions from participants. The subjects covered by the various forums were also very stimulating. The only problem was deciding which ones to attend, but that is the price of the overall excellence of the programming.'

*G. R. Fenwick  
Institute of Food Research (UK)*

Sandwich break



One of the many  
cyber accesses



Information Society  
Technologies Stand

*This selection of photos taken over a three-day event during which hundreds of speakers addressed their audiences, cannot be anything more than a snapshot. These pictures simply seek to portray something of the atmosphere at this historic event.  
<http://www.europa.eu.int/comm/research/conferences/2002/>*

# A dream about to

**Discovered in 1911 by the Dutch physicist Heike Kammerlingh Onnes, superconductivity – or the total elimination of resistance to the passage of an electric current in certain materials – is a truly exceptional phenomenon. In a sense, it is the realisation of the age-old human dream of perpetual motion. A current entering a closed superconductor circuit can travel indefinitely, free from the dissipating effect of the Universal Law of Energy Loss.**

Although lending an almost 'miraculous' property to materials, for many decades superconductivity was bound by what seemed to be an intransigent law. It only occurred at critical temperatures ( $T_c$ ) lying at the very extremes of the physics of matter, in a zone just a few degrees above the impassable barrier of the famous absolute zero (or zero kelvins – 0 K – equivalent to  $-273^\circ\text{C}$ ).

For more than seven decades following Kammerlingh Onnes' discovery, all observations, including the first *Theory of Superconductivity* published in 1957 (see box), confirmed this basic principle. What is more, the only way to descend to such extremely low temperatures was through the production of cold (or cryogenics) associated with the liquefaction of helium (at a temperature of 4 K). Finally, there were other constraints which applied to all elements likely to serve as superconductors: superconductivity disappeared almost instantly the moment the surrounding magnetic field or current exceeded certain values.

*Heike Kammerlingh Onnes discovered the phenomenon of superconductivity in 1911. He subsequently won the Nobel Prize for physics in 1913 for being the first person to liquify helium by lowering its temperature to 4 K ( $-279^\circ\text{C}$ ).*  
© Nobelstiftelsen



Remarkable applications based on superconductivity – such as medical imaging – were developed, nonetheless, during the closing decades of the last century (see article *The long and winding road*). Yet this cold constraint remained a seemingly insurmountable obstacle and, by the early 1980s, all the 'dreams' of a stream of new and revolutionary applications for this unique property of matter seemed to have melted away in the face of this harsh reality.

## The 1986 breakthrough

Then suddenly it all changed. In 1986, Alex Müller and Georg Bednorz, two Swiss physicists working at the IBM laboratory near Zurich, announced that they had developed a compound of the cuprate family (copper oxides), containing lanthanum and barium, which acted as a superconductor at 30 K. This sudden temperature rise – all the more surprising since it was obtained in a ceramic material, which shows all the characteristics of an insulator at normal temperatures – was greeted with astonishment in the world of physics.

## The stakes

*What would a world be like where superconductive applications were commonplace?*

Whether at work or at home, nearly all our everyday activities involve the consumption of electricity. For infrastructure used in transporting and converting energy – power lines, transformers and generators of all kinds – the mastering of superconductivity would result in a dramatic reduction in energy losses caused by conductor resistance. It would also bring about a substantial increase in machine performance.<sup>(1)</sup> That would mean significantly lower total energy consumption for our societies. In addition to this economic benefit, it would also contribute to reducing greenhouse gas emissions and help combat global warming in a wider context.

But there is more to superconductivity than the absence of electrical resistance. Research conducted over nearly a century (see *The long and winding road*) has shown that the magnetic effects of superconductive materials open the door to a vast field of potential applications which remain largely unexplored. The development of medical imaging is one major example. This has a very promising future when you consider the services such diagnostic tools could provide if they were available in every GP's surgery.

The development of *Maglev* trains – prototypes of which are already in operation in Europe and Japan – that 'levitate' above the rails, thereby virtually eliminating energy loss caused by friction between the train and its tracks, is literally a case of 'deinventing the wheel'.

# come true?



Alex Müller and Georg Bednorz were awarded the Nobel Prize for physics in 1987 for being the first to determine, in September 1986, the existence of copper oxide-based compounds able to act as superconductors at high temperatures.

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Researchers all over the globe set about making cuprates and, just a few months later, in February 1987, a team from the University of Alabama-Huntsville announced triumphantly that, by replacing lanthanum with yttrium in Müller and Bednorz's compound, they had increased the critical temperature to an incredible 92 K, almost ten times higher than all the elements classified to date! This giant step forward marked the beginning of the era of the HTS (High Temperature Superconductor) and a whole new ball game. By raising the temperature it was now possible to replace the costly and difficult technique of helium cryogenics with the much more commonplace industrial liquefaction of nitrogen (obtained at 77 K).

Other applications are also in the pipeline, particularly in the area of electrical energy storage. Then there are the environmental technologies, such as 'magnetic filtering' processes to purify the water or air in cities 100 times more efficiently than present methods.

The arrival of superconductive electronics is expected to have a huge impact on the increasingly important field of information and communication technologies. Apart from the explosion in the speed and power of computers, there would also be a macroeconomic impact in terms of the allocation of energy. In the United States, it is estimated that the energy consumption resulting from the huge increase in Internet use will soon represent 10% of the total electricity distributed by the networks.

(1) All electrotechnical equipment would also become lighter and less bulky, pushing down its derived cost.

## Back down to earth with a bump

This breakthrough in critical temperatures was immediately heralded as a huge advance and led to many research projects all over the world. But, after the initial enthusiasm, the world of research soon came back down to earth with a bump. As promising as it was, the discovery of HTS also marked the beginning of a complex and laborious chapter in the long saga of superconductivity. The reality was that converting these new materials into 'electricity superconductors' that could be used in practical applications posed enormous problems.

Europe saw major multidisciplinary efforts by the very best laboratories, both public and industrial, with Union support, make a significant contribution to scientific co-operation in this field. The long quest for superconductive applications was now well and truly under way, with the promise of radical changes to technology in the not-too-distant future.



Image of an electrical discharge in a 'superconducting fault current limiter'. This type of device is potentially able to absorb – without damage to the grid system or power cuts – extremely high currents (often caused by lightning) into electricity grids. This is one of the first electrotechnical innovations based on superconductivity, and one that several utility companies are taking up. It was developed in the framework of the European *Superpoli* project.

## Economic prospects for the applications of superconductivity at a worldwide level (in € millions)

Year	1997	2000	2003	2010
Scientific devices destined for use in research	355	415	550	840
Magnetic Resonance Imaging (MRI)	1400	1900	2100	2750
<b>Sub-total</b>	<b>1755</b>	<b>2315</b>	<b>2650</b>	<b>3590</b>
New electrotechnical applications	35	25	55	980
New electronics applications	20	30	75	680
<b>Sub-total</b>	<b>55</b>	<b>55</b>	<b>130</b>	<b>1660</b>
<b>Estimate of total worldwide market</b>	<b>1810</b>	<b>2370</b>	<b>2780</b>	<b>5250</b>
Market shares for LTS <sup>(1)</sup>	1805	2355	2730	3650
Market shares for HTS <sup>(1)</sup>	5	15	50	1600

This table was compiled in December 2001 by the *Consortium of European Companies Determined to Use Superconductivity (CONNECTUS)*  
[superconductors.org/connectus.pdf](http://superconductors.org/connectus.pdf)

(1) Low and High Temperature Superconductors



*Discovered in 1933, the diamagnetic properties of superconductors make it possible to obtain a levitation effect. A spectacular application of this is the development of Maglev trains. Shown here is the prototype developed in Germany, which can 'float' above a magnetic 'rail' without any contact and, therefore without friction. On 31 December 2002, the city of Shanghai in China inaugurated the first Transrapid line, on a 30-km link between the city and the airport, with a top speed of 430 km/hr.*

© Transrapid

# The long and winding road

**U**ntil the 1986 milestone discovery of High Temperature Superconductors (HTS), scientific and technological progress on 'low temperature' superconductivity had followed a long and winding road – one that can offer insights into the challenges facing today's researchers.



The slow and sometimes very intermittent progress of research during the last century, nevertheless, brought a number of advances in the fundamental knowledge of the superconductor phenomenon and its unique properties. It was in 1933 that the Germans Walter Meissner and Robert Ochsenfeld demonstrated the surprising diamagnetic effect (now known as the Meissner effect) by which a current passing through a superconductor exercises a strong repelling force on an external magnetic field. This property causes a magnet brought close to a material in a superconductive state to levitate spectacularly. The Meissner effect has consequently become the best way of testing whether a material superconducts or not. It is also the principle behind the current development of prototypes of the first *Maglev* (Magnetic Levitation) trains.

Scientists have been carrying out a wide range of full-scale experiments. These include attempts to discover all the elements that could become superconductors, identify their critical performances and investigate possible applications for them. Scientists have so far experimented on

a series of metals and natural metalloids (numbering about 30 at ambient pressure), alloys and combinations of materials of all kinds.

Since the 1940s, a number of alloys have been developed – in particular the family of niobium nitrides and niobium titanium – showing excellent superconductive properties, at critical temperatures between 15 and 22 K, while attaining higher critical magnetic fields. But it was not until 1962 that the US firm Westinghouse first developed long lengths of superconducting electric wire produced from NbTi alloys on an industrial scale.

## The super magnets

Meanwhile, liquid helium cryogenic technologies had made considerable progress and it became possible to use superconducting coils developed at temperatures close to absolute zero. This made it possible to pass currents of unprecedented intensities, in the region of a million amperes per square cm., which in turn generated uniquely intense magnetic fields.





**Brian Josephson, winner of the Nobel Prize for physics in 1972, demonstrated in 1962 the existence and very particular characteristics of the 'tunnel effect' that can be produced between two superconducting materials separated by a thin insulating layer. This scientific discovery has opened the door to the development of new applications, especially the superconductive electronics of the future which hold the promise of beating all records for processing speed and power.**

© Nobelstiftelsen

It is in the field of these 'super' magnets that most of today's superconductive applications have been perfected. In particular, it has given rise to a boom in medical diagnosis technologies employing magnetic resonance imaging (MRI). These devices are now widely used in hospitals and represent a global market of almost €2.5 billion annually.

Other high-tech applications in the field of high magnetic fields are also of interest to the scientific world. These include the particle accelerators used at the European Organisation for Nuclear Research, CERN, the experimental nuclear fusion installations at the Wendelstein Stellarator in Germany, and the various spectrometric technologies used in the molecular study of materials or living organisms.

## The Josephson junction

Another very interesting field of application for superconductivity was opened up in 1962 when a brilliant young doctorate student at Cambridge University, Brian Josephson, demonstrated the existence and very particular characteristics of a 'tunnel' effect that can be produced between two superconducting materials separated by a thin insulating layer. In such an interference device (also known as the *Josephson junction*), the flow of electrons – even in the absence of any external voltage – can pass from one material to another, crossing the insulating barrier. This provides the capacity to detect even the weakest magnetic field.

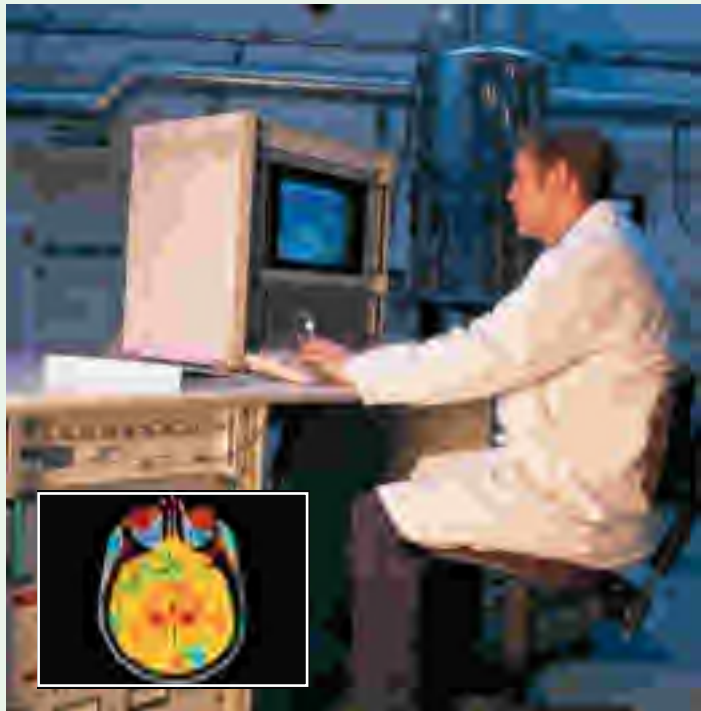
This discovery has since come to acquire considerable importance. It is at the core of a revolutionary technique known as SQUID (*Superconducting Quantum Interference Device*). SQUID works by placing in parallel two *Josephson junctions* connected in a loop by a superconducting link. It was discovered that even a very weak magnetic field, known as a magnetic quantum, produced at the centre of the superconducting loop causes the latter to generate an electrical signal.



## Where theory fears to tread

Why do some materials become superconductors when they approach absolute zero? It was 50 years before fundamental physics provided the first 'reasoned' explanation for this phenomenon. In 1957, a trio of US scientists – John Bardeen, Leon Cooper and Jon Schrieffer – proposed their *Theory of Superconductivity* (later known as the *BCS Theory* after their initials), which came to be universally recognised and accepted. They showed that, under the extremely cold conditions of very low critical temperatures, changes occur in the vibrations and energy levels of atoms within the crystalline structure. In this state, the usual repellent force between electrons ceases and they pair off, forming a flux that is able to move without encountering any resistance.

Bardeen, Cooper and Schrieffer were awarded the Nobel Prize in 1972. Unfortunately, since the discovery of new High Temperature Superconducting (HTS) materials in 1986, the BCS theory is no longer able to explain fully the phenomena with which today's physicists are working. Therefore, we have reached the limits of theory. Although empirical hypotheses have been put forward – for example, the notion that the superconductivity of HTS may be linked to a certain degree of alignment, of the 'grains' of matter that make up the material – they have not been demonstrated.



**One of today's most widespread applications of superconductivity is the creation of intense magnetic that are spearheading major advances in medical imaging and the life sciences.**



SQUID is the most 'sensitive' magnetic detection system available to scientists today. The technique is giving rise to highly advanced applications in medicine, particularly in the fields of neurological imaging by magnetoencephalography and cardiology. Important applications are also emerging in the field of metrology and the physico-chemical sciences.

### The chips of the future

The unique properties of Josephson junctions and the phenomena of quantum interference devices have also opened the door to a potential revolution in superconductive computing. They were used in designing what is known as the Single Flux Quantum (SFQ) device, which acts like a new generation of switches for binary logic with a reaction time in the area of one picosecond.

The absence of resistance in a superconductor circuit minimises energy loss, which is currently one of the major obstacles to boosting computer performance. Superconductive electronics would, therefore, make it

possible to produce processors 500 times faster than present semi-conductor components, while producing 200 times less heat.

### A whole new ball game

However, even if prototypes of these chips of the future have already been developed, the first generation of superconductive supercomputers has, to date, remained very much a promise rather than a reality. In the early 1980s, superconductivity seemed to have reached the limit of its potential as its applications were limited by the need to work at temperatures approaching absolute zero. The record, obtained from a niobium germanate alloy, was 23 K.

The cost and technological complexity of helium cryogenics closed the door to many 'dream' applications, whether in the field of electrotechnics or computing. It was against this backdrop that, in 1986, came a major breakthrough: the high temperature superconductors, which suddenly opened up a whole new world of possibilities.

#### To find out more

- A remarkably comprehensive site on all aspects of superconductivity: [superconductors.org/](http://superconductors.org/)
- A particularly valuable guide to web resources worldwide: [www.shahlimar.com/superconductor/](http://www.shahlimar.com/superconductor/)



This Nuclear Magnetic Resonance (NMR) spectrometer, developed by the US firm *Varian*, was installed at the Pacific North West National Laboratory (USA) in March 2002. It is fitted with the very latest device from *Oxford Instruments*, a Wide-Bore 900 MHz/21.14 Tesla super-diamond, which beats all records of magnetic power achieved in a commercial application.

#### To find out more

- [www.oxford-instruments.com](http://www.oxford-instruments.com)

## Magnet Valley, Oxfordshire

The green countryside near the prestigious Oxford University is home to one of Europe's – and, indeed, the world's – leading firms in super-magnetic, superconductive applications. Founded in 1959 by the research couple Martin and Audrey Wood, *Oxford Instruments* provides a genuine case study of the entrepreneurial appliance of science.

Its founders believed in their work and were ready to take a risk. The helium-cooled superconducting coils made at the time were still experimental machines, laboriously and expensively constructed in the laboratory. There were few applications for high magnetic fields and nobody would have banked on the importance they would assume in the future.

But the founders of *Oxford Instruments* were on to a good thing. Provided, that is, they could continue to invest in research and to innovate as soon as new applications were ready to find a market. Four decades later, of the more than 20 000 super magnets operating worldwide – in the field of medical imaging<sup>(1)</sup> or for scientific uses (especially the physics of matter and the life sciences) – 55% carry the *Oxford Instruments*' logo. Add to that the large number of cryogenic equipment and superconducting wires the company sells.

Apart from the three sites in Oxfordshire, the firm has also built up a vast international network of subsidiaries and dealerships in Europe (Germany, the Netherlands and France), the United States and Japan. This multinational structure employs some 2 300 highly skilled staff.

As the tried and trusted reference in 'low temperature' superconductivity, *Oxford Instruments* was clearly destined to embrace the new wave HTS when they hit the headlines 15 years ago. It is now very much involved in research in this field at European level.

(1) *Oxford Instruments is active in this field principally via its partnership with Siemens.*

# How to change powder into 'wire'



The image shows a classic demonstration of the 'diamagnetic levitation' of a superconducting disc made of an HTS compound when it approaches a magnet. (Photo from the Solid State Physics Group, KTH, Sweden)

**Changing powder into 'wire' is the simple yet infuriating puzzle that hundreds of high-tech laboratories worldwide have been grappling with for more than a decade. The non-metallic physical consistency of the new HTS (High Temperature Superconductor) compounds is altogether different from traditionally extruded copper wire. How, then, is it possible to convert them into 'resistance-free' conductors of electric current?**

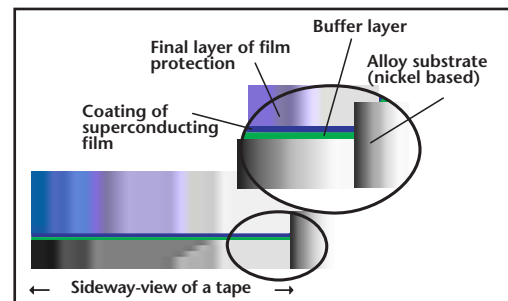
The feverish activities of chemists and physicists following the discovery of HTS produced a growing list of compounds with relatively high critical temperatures (the record set recently is 138K). However, they show very different performances in terms of magnetic field and the critical current they can carry.

## The BSCCO family

Although the list may well grow further – and some new surprises may be in store (see box: *Waiting in the wings*) – the other major problem concerns the technologies that will enable these compounds to be used. The ceramic nature of copper oxide-based HTS compounds means that they have to be deposited along a long support – in fact on tapes which are similar to those developed decades ago for audio or video cassettes. Over the past decade, the search for a solution to this problem of materials engineering has been a major scientific,

multidisciplinary and industrial challenge, in which European research is actively involved.

An initial avenue of research was opened up with the use of a family of materials jointly known as BSCCO (pronounced 'bisco'), which are copper oxides containing the elements bismuth, strontium and calcium. Their principal quality lies in their grain structure, which quite systematically shows a favourable alignment, a necessary precondition for allowing the passage of an electric current in the superconductive state. In the widely used 'powder in tube' technique, BSCCO precursors were successfully incorporated into silver tubes, from where it was possible to draw or extrude multifilament-long strands.



Cross-section of the superposed layers required to manufacture an HTS superconducting tape.

Despite the limited performance of this solution (cost of silver support, limits on intensity of current density carried through and relatively low magnetic fields tolerated), it has the merit of having given rise to instructive experiments that are useful in the electrotechnical sector.

## The promising but problematic case of YBCO

Today, there is general agreement on the potential of technological developments based on the HTS group known as YBCO (yttrium barium copper oxide).<sup>(1)</sup> YBCO is resistant to high critical magnetic fields and, at temperatures above those at which nitrogen liquefies, it can conduct electric currents estimated at one million amperes per cm<sup>2</sup> !

(1) YBCOs were at the core of the first HTS, in 1987, with critical temperatures above that at which nitrogen liquefies.

**Design for a prototype of an integrated device, combining superconducting magnet, a cryostat and complete refrigeration system, as developed by the industrial partners working on the European Ready project (Oxford Instruments, Air Liquide, Schneider), in close cooperation with the French CNRS (Centre National de la Recherche Scientifique).**  
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This is certainly a tempting prospect, but the headache comes when working with the compounds to prepare industrially useable quantities of the superconducting tapes capable of carrying the current. It is a genuine technological feat to deposit the compounds on the necessary supports. The process involves superposing extremely complex and perfectly dosed chemical elements – on the scale of the nanometre and with utmost precision – to obtain impeccable critical performances. At the same time, the processes must be workable on an industrial scale with competitive manufacturing costs.

Eamonn Maher, on behalf of the company Oxford Instruments (UK) and coordinator of the European Ready project, takes the view that: 'The options are so many that the final choices must be made by industrialists, even if they do need the expertise of university research laboratories to assist them. It is they who must ultimately evaluate the technological opportunities on the basis of their know-how and market conditions. In the Ready project, coated conductor tapes produced by thermal evaporation and chemical deposition techniques will be used in the secondary windings of a transformer integrated with a pulse tube refrigerator.'

## Waiting in the wings

Relaunched since the discovery of the High Temperature Superconductors (HTSs) in the late eighties, research into superconducting materials could well hold more surprises in store and totally overturn some accepted ideas. Scientific articles are constantly reporting on new atypical lines of inquiry, many of them linked to the accelerated development of nanotechnologies.

Among the most recent are studies carried out on the superconductive capacities of the fullerene and nanotube families, constructed on the basis of carbon atoms, or of the heavy fermions (belonging to the actinide or associated groups). More recently, there was the announcement in March 2001 of the remarkable performance obtained from magnesium boride alloys.

These 'outsiders' all have the failing of only being superconductive at low temperatures (at any rate lower than liquid nitrogen). But they do offer potential new ways forward – in particular in terms of development and economic viability – to rival the present approaches to HTS.

## The 'Sol Gel' method

Grenoble (FR), Octobre 2002. About 30 representatives from ten research partners working on the European *Solsulet* project (*Novel Sol Gel* technology for long-length superconducting coated tapes) were the guests of the Laboratoire des Matériaux et du Génie Physique, one of the jewels in the crown of Grenoble's Institut National Polytechnique. Over the two-day gathering, the researchers took stock of the progress made in the year since they had launched their joint project. Coming from Spain, Germany, the United Kingdom, Italy and, of course, France, the participants were pleased at the opportunity to discuss their work and initial results, as well as to refine their strategy for the months ahead. All in all, the meeting was a fine example of what the European Superconductivity Area represents, with a mix of nationalities, generations, academic excellence and industrial know-how.

*Solsulet* has an innovative ambition: to develop a radically new method of depositing YBCO HTS compounds on long thin tapes, representing a complete departure from the traditional vaporisation or heat chamber processes. They aim to achieve this by using *Sol-Gel* technology.

'This process is already well-known for its applications in the fields of glassmaking and optics to create anti-reflection films on windows or optical lenses', explains Xavier Obradors, the project's coordinator and an experienced researcher in the field of superconductivity at the Institut de Ciència de Materials de Barcelona. 'But this depositing method has been tried very little, if at all, in obtaining superconducting tapes.'

The principle is to pass the YBCO compounds through a transitional liquid and colloidal phase – when they are present in aerosol form (the 'Sol' phase) – to arrive at a solid 'gel' state forming a superconducting film on the support. 'We currently have all the conditions, and, in particular, the equipment needed for this approach', continues Obradors. He adds that early tests of the new method are under way but the challenge of enhancing its superconductive performance will continue until the project winds down in two years' time.

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An active participant in the *Solsulet* project, the Laboratoire des Matériaux et du Génie Physique in Grenoble has for many years been a major centre involved in European research on HTS superconductivity.



Takis P. A. Ageladarakis,  
Research DG, EC

# Europe in the race

**Dozens of European academic and industrial laboratories have been working together for more than a decade on the challenges of HTS superconductors. The EU actively supports these joint efforts. Takis P. A. Ageladarakis, who is responsible for superconductive materials at Research DG, explains the thinking behind this choice of priorities.**

**Searching for 'superconductivity' on the European research projects database on the Cordis server will return hundreds of results. Is this abundance of material due to a deliberately targeted policy?**

In the late 1980s, the rising potential of a new generation of HTS superconductors was arousing worldwide interest. Superconductivity constituted a priority field, necessitating the pooling of trans-disciplinary resources and efforts at a European level. This required the support of the EU's R&D programmes and, hence, the first 'Joint Community Action on Superconductivity' was launched in 1988. Its aim was to provide a strong impetus to and enhance the visibility of a scientific domain where multi-disciplinarity required a major boost. Throughout the last three Framework Programmes, a continuous series of European projects – concerned with the study of both fundamental and applied aspects of HTS in the fields of information technology, materials and energy – have been supported via a range of specific programmes.

**What are the main lines of research supported by the Union in the field of HTS materials – seen as potentially crucial to the future of superconductive applications?**

In recent years, some 22 specific projects, bringing together more than 80 public and private research laboratories, have sought to develop new HTS materials or improve the performances of existing ones. Efforts concentrated both on BSCCO compounds, which are 'riper' for applications, but also – particularly under the last Framework Programme – on the optimisation of the most potentially impressive YBCO compounds. In both cases, the improvement of materials went hand-in-hand

with the development of various high-tech and innovative processes ultimately geared towards manufacturing low-cost, high-performance HTS conductors. At the same time, continuity has been a key concern. We wish to make sure that every project benefits from the results obtained by others whenever possible, while respecting fully the boundaries of intellectual property rights. We also want to ensure that the know-how of laboratories and researchers is constantly enriched and exploited to the full.

**When will we see actually pertinent results and fully-fledged applications?**

Results are already available! Of course, we are still at the pilot-test stage in most cases. For the BSCCO family though, Europe and the rest of the world are now developing HTS tapes measured in kilometres that are beginning to find commercial applications. Take the example of the world's first trial, carried out by the Danish company *NKT Cables*, to use superconducting cables in a public electrical supply grid in Copenhagen. On the other hand, operational YBCO conductors – by far the most promising in terms of superconducting performance – are still being produced only at 'laboratory' lengths. Nevertheless, their industrial prospects are surely promising in the longer term. The Union has supported projects that included a demonstration application using YBCO materials. This demonstrative dimension is clearly a major attraction for industrial players, and they are, indeed, actively involved in nearly all the projects we support.

**But to return to the subject of 'conclusive applications', what kind of revolution are they likely to bring?**

Clearly, the day we have HTS superconductivity with fully-fledged applications at our fingertips, we will witness enormous technological and economic changes in widely differing fields. At that point – and this brings us to the heart of the increasingly important dialogue between 'Science and Society' – the research and hopes of scientists who are working on mastering the techniques of superconductivity will have to be explained and presented much more intensively to the citizen.





**Will Union-backed research on superconductivity continue throughout the Sixth Framework Programme and, if so, in what form?**

The new Framework Programme – with its two principal instruments: integrated projects and networks of excellence – no doubt calls for more imagination on the part of the scientific community and industrial players involved in research on superconductivity. Contrary to past practices, the R&D players will have to present more structured initiatives. They should be based on long-, medium- and short-term prospects in the fields in question, whether these are new knowledge-based materials, processes, or technologies for the information society, energy or sustainable development arenas. The new programme is, in fact, very open to the technologies of the future. But its aim is to create targeted co-operation on a larger scale by demonstrating the capacities that Europe can attain through increased investment in these fields.

## Contact

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An example of the operational use of HTS superconductivity at an electrical supply station in Copenhagen. NKT Cables installed three 30KV BSCCO superconducting cables. The new cables carry a current five times that of their traditional counterparts. For the first time, since May 2001, they have been supplying electricity to 50,000 homes in a reliable, economic and efficient manner.

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**A command of HTS superconductivity is a genuine global contest in which the United States and Japan are particularly active challengers. How is Europe placed – and how is it co-operating – in this race?**

Naturally, there is a competitive dimension to this race that requires a high level of multi- and inter-disciplinarity. With its high degree of excellence, Europe is, indeed, well positioned in this race.

As with all challenges linked to knowledge advancement, we should encourage relationships of exchange and open co-operation between competitors. This is even truer of superconductivity since it has been chosen as a pilot case for scientific and technological co-operation between the Union and Japan. To this end, the high level joint workshop held on this subject in 2001 at Tsukuba in the Japanese archipelago was a very rewarding meeting at which researchers from both sides were able to take stock of the 'state of the art'.

Another framework for international exchange is the SCENET-2 thematic network, set up with the Commission's support. This platform of pan-European excellence (see box) is a bridgehead that maintains on-going relations with the best research centres in this field, whether in the United States, Japan or Russia.

## SCENET, the European superconductivity area

The idea gained ground during the Fourth and Fifth Framework Programmes: How to establish a link between the many European research projects which, each in their own corner, are working on developments in superconductivity? The answer came, first in the field of information technologies, with the creation of a 'thematic network' known as SCENET (Superconductivity European Network) that started to serve as a platform for exchange and information between researchers active in this field, with the Commission's support. In 1998 the network was extended to include research on 'materials for energy'. 'Maintaining contacts between nearly 80 university laboratories, public research centres and high-tech companies located in the 15 Member States and six other countries – Bulgaria, Israel, Hungary, Norway, Slovakia and Switzerland – SCENET is the veritable backbone of the *European superconductivity area*', stresses Panagiotis Ageladarakis. 'The Union's support for this thematic network has been renewed until 2006. It plays an essential role as a forum enabling all the parties to exchange their experiences – in particular by organising training – as well as their visions of the strategy required for Europe to be a player in this field.'

## To find out more

• [www.orchidea.maspec.bo.cnr.it/working\\_groups/working\\_group\\_list.html](http://www.orchidea.maspec.bo.cnr.it/working_groups/working_group_list.html)

Children born in the host country; children who started school in their country of origin; children who are members of families that immigrated a long time ago or only recently... These are all relevant to 'second-generation' immigration.



# Getting to the core of migration

**Seventeen teams of Commission-backed researchers<sup>(1)</sup> have been investigating the issues surrounding immigration and integration. They have been exploring questions regarding the reality of daily life for immigrants, the integration of second-generation immigrants, inter-cultural dialogue and cross-border variations in integration policy. Their findings are both finely shaded and instructive.**

There are many types of migrants who flee diverse situations and face differing receptions depending on their country of destination. They include political and economic refugees, the victims of traffickers who hand over all they have to be smuggled across a border, people with tourist visas who hope to get by somehow when it expires, plus the many arranged and never-to-be-consummated marriages and attempts at family reunification. Yet their lives often have one thing in common – the kind of jobs they are 'offered': dirty, difficult and dangerous.

To find out more about the lives of migrants and to compare their situation in different countries, 17 European research projects focused on three major themes: the characteristics of the migratory phenomenon (routes, reasons, method, etc.); the living conditions of migrants; and the opportunities for, and obstacles to, integration, especially for young second generation immigrants.

Except for genuine political refugees, migration is the promise of a better life, or quite simply a 'life' and all that it implies in terms of work, income and a home. Over time, these migratory flows have shown changing trends. While family reunification is declining, an increasing number of single women are crossing borders to take up jobs as domestic help or in the tourism sector. There are also young people (see box: 'The dream and the reality') who may not have a particularly hard life in their home country, but are drawn by the lure of the 'land of opportunity'. Rather than landing in a dream world, many end up in a precarious economic wilderness on the fringes of society.

## Supply and demand

Speculation is rife over whether illegal immigration spawns a parallel economy. Researchers working on the Migrant Insertion in the Informal Economy project reject this widely held belief. They conclude that 'far from being an effect of illegal immigration, the underground economy is one of its causes'. Therefore, it is this parallel economy that must be curbed, if the flow of illegal migrants is to be stemmed. In Spain, for example, the strict and effective checks on undeclared work introduced in the mid-1990s led to a fall in the influx of illegal immigrants.

*(1) In the context of the TSER (Targeted Socio-Economic Research) supported by the Fourth Framework Programme.*





But whether legal or illegal, are immigrants competing with 'nationals' for scarce jobs? This is another widely held view which is not altogether borne out by the facts. In southern Europe, such competition applies only to certain types of unskilled and manual work. In countries with high unemployment, such as Italy or Spain, but other countries too, immigrants tend to take dirty, difficult and dangerous jobs which nationals refuse to do. So immigrants are not taking anybody's job, simply filling a vacuum.

Among the ranks of the unemployed, however, foreigners are very much in evidence. In Berlin, Germany, for example, 34% of immigrants were jobless at the end of the 1990s, double the figure for German citizens. In the country as a whole, 38% of unemployed Germans were without qualifications, compared with 78% for foreigners. The Fare (Family Reunification Evaluation) project stresses that the inability to speak the language is a major handicap for access to employment but that 'migrants, and particularly women, often fail to learn German because the

language courses are too expensive or they do not have the time.' Although most young second generation immigrants speak the language of their host country well, they do not write it well. Language, therefore, remains an obstacle to employment.

### Second generation, second class?

The situation of second-generation immigrants was the focus of the Chip (Child Immigration Project) partners who studied and compared the 'quality of life' for second generation immigrants in six countries (Belgium, Greece, Italy, France, Switzerland and the United Kingdom). The objective was to gauge the impact of education policies on integration. It also looked at the relationship between the attitudes of certain players (teachers, social workers, police, etc.) and the degree of integration achieved. Chip believes that the problems experienced by second-generation immigrants can vary significantly depending on whether, as children, they started school in their country of origin, were born in their host country or arrived there at a very young age. Other important factors were whether their families had lived in the host country for a long time or had only arrived recently.

However, regardless of his or her degree and ease of integration, young immigrants come up against the prevalent stereotypes of their 'group'. It is not unusual to find that ill-considered communication policies, sometimes emanating from well-

intentioned public authorities, ultimately have a negative effect on the desire of children of foreign origin to invest in the society in which they live.

It is, in a way, a question of recognising differences – and the best place to do that is at school (See box entitled 'The multicultural challenge').

### Teaching-Integration

A project entitled Effectiveness of National Integration Strategies Towards Second Generation Youth studied the impact of teaching on integration in France, Germany and the United Kingdom. France seems to provide an education system that is relatively

## The multicultural challenge

Working with multi-ethnic classrooms requires a special approach and sensitivity. This is why some schools employ the services of 'language mediators' who help foreign students or give core subjects in the immigrant child's mother tongue. In some countries, such as Belgium and Italy, teachers can take special courses on multiculturalism outside the mainstream school network.

More specifically, several European higher education institutions are training future teachers in this multicultural approach. Their work was studied by the Immigration as a Challenge for Settlement Policies and Education project in six countries (Finland, France, Germany, Greece, Israel and the United Kingdom). The aim of the project was to promote the exchange of ideas that would optimise a type of multicultural education designed to help immigrants or refugees, as well as the children of ethnic minorities, to acquire the necessary skills to take their place in the economic and social world around them. The researchers found that this 'open' method of teaching gives priority to human rights, equal opportunities and the values of diversity. It also involves questioning the traditional approaches prevalent in certain courses, in particular history and geography. A sub-project, Open Europe, should make it possible to develop multimedia teaching aids which incorporate the multicultural dimension.

Researchers also noted that the concept of a plural society has gained ground in the United Kingdom since 1997. Some schools embrace multi-ethnic cohabitation by developing a particularly open education system. Pupils at these schools are encouraged to be aware of their differences and the wealth of their respective cultural backgrounds. This initiative, which is quite difficult to apply on a general level because of the ethno-centred nature of school curricula, requires the full commitment of teachers if it is to work.



Too many foreigners?  
Most European governments are considering restricting migratory flows. This is seen as a necessary first step before immigrants already settled in the country can integrate.





### Contact

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### To find out more

● [www.cordis.lu/tser/home.html](http://www.cordis.lu/tser/home.html)  
 ● <http://improvingser.sti.jrc.it/default/>

Immigrant jobs. Dirty,  
difficult and dangerous  
just about sums them up.

successful at integrating young immigrants – the differences in university results between students of foreign origin and nationals being less there than in other countries. Yet youth unemployment in general remains high and is far above Germany's, for example. The reason behind this seems to be that the more academic French system is less suited to the reality of working life than German education, which focuses more on professional integration. However, it is in the United Kingdom that second-generation immigrants find the path to employment the hardest to negotiate: three-quarters of British youth have a job while the majority of British-born Indians and Pakistanis do not.

### Policies and practices

Apart from the school system, the opportunities and obstacles to integration vary from one country to another, but not always as one would imagine. The Case project shows that, although, in principle, Sweden favours integration, it finds it difficult to put into practice. This is mainly because hiring procedures require a command of the language that is beyond the level of most immigrants. In Italy, the integration of foreigners is facilitated by the parallel economy and there is greater tolerance than in other countries (such as Spain) where there are fewer immigrants. Nevertheless, most European governments are looking at the question of 'quotas' and believe that migratory flows must be limited before foreigners already present can be integrated.

This is why many countries apply the rule that nationality is

acquired by birth on the territory of the state concerned (*jus soli*), thereby incorporating naturalisation into the process of integration. For researchers on the Efnatis project, who studied the integration and socio-cultural recognition of foreigners, this is just one factor – albeit an important one – in integration, and not an end in itself.

## The dream and the reality

The Migrant Insertion in the Informal Economy project studied a certain 'élite' of young immigrants from the Maghreb and other parts of Africa, who tend to arrive in Europe on its southern shores (1 500 000 of them over the past 15 years). But it is also southern Europe that has the most jobs in the informal sector, such as domestic work, seasonal farm work, jobs on building sites, in small workshops or with service companies. These young migrants are ready to accept low-paid work that does not match their qualifications because they do not have the necessary papers to work in the formal sector. This causes a split between their personal and social identity. Many led decent lives with a favourable standing in their communities back home, whereas their fringe status in their host country brings with it poverty and stigma. Their dreams of a bright European future prove deceptive.



# An outsider

**'The strength and attraction of the Leibniz Association is that its institutes are relatively independent from the federal and regional authorities which finance it. This independence is a source of great creativity', believes Hans-Olaf Henkel, its president. This industrialist, who has a passionate interest in science is former head of IBM Europe, former president of the National Federation of German Industry (BDI) and last year was appointed head of the major network of 80 research institutes comprising the Wissenschaftsgemeinschaft Leibniz.**

**It is rather unexpected to find a non-scientist at the head of one of Germany's most important research networks, isn't it?**

I may not be an actual scientist, but I have always been interested in science. Also, before I became president, I was a member of the Leibniz network board of management and for more than a decade I have had a seat on the board at the Max Planck Institutes and the Helmholtz Gemeinschaft. Before that, as head of IBM Europe, I was responsible for a laboratory with 2 000 employees in Böblingen. What fascinated me at the time was that, in the space of just a few years, IBM had succeeded in 'producing' – if I may use the term – four Nobel prizewinners at its Rüschiikon research centre in Switzerland.

**One of the reasons IBM can turn out Nobel prizewinners like that is surely that its R&D budget worldwide is higher than that of all the Union countries put together.**

It would be wrong to say that the research effort is insufficient everywhere in Europe. Sweden and Finland have long allocated almost 3% of their GDP to R&D – the famous percentage set by the Union as the target for 2010. Switzerland too has a dynamic policy. If Europe were guided by these examples, it would certainly be able to achieve the objectives adopted in Barcelona.

**Do you believe the new priorities and instruments of the Union's Sixth Framework Programme are going to be able to create this European Research Area of which there is so much talk?**

It is a good programme and I support it. As to its implementation – the question is whether it will prove possible in practice to keep to the priorities set. Among other things, that means being prepared, after careful thought, to stop funding certain research projects.

As to the new instruments, I do have some questions. For example, how will it be possible for a research institute – excellent, no doubt, but relatively modest in scale – to participate in the Framework Programme without first having to come under the wing of a major and more powerful organisation.

Also, to create this new European Research Area, national egos will have to take a back seat to excellence. At the same time, of course, the potential role of research policy in Europe's structural policy must be taken into account. This aspect must be looked at, for example, when deciding on exactly where major research projects should be carried out.

In this respect, as long ago as under De Gaulle, France pursued a successful policy of decentralisation, creating centres of excellence far from Paris, in southern France in particular. In Germany we have not yet been able to follow such an example in our new *Länder*. In the former RDA, there is one scientist per thousand inhabitants, compared with four in West Germany and eight in Japan.

**In 1999, in Helsinki, the Union set itself the ambitious goal of making Europe the 'most competitive and innovative region in the world' by 2010. Can we really overtake the United States and Japan?**

No, based on progress to date we are not in a position to achieve this. To reach such an objective there are a number of decisions that needed to be taken right away and which were not. It is an illusion to think that we can become the most competitive region in the world simply by pooling our efforts and giving more muscle to common European research. It also requires the necessary reforms in the individual Member States. When I look at the present situation in France, Germany or Italy, I am anything but optimistic. That applies to the liberalisation of the labour market as well as balanced budgets and budgetary discipline.

**What can Europe learn from the United States?**

A lot. For example, governments can encourage the private sector to invest more in research by means of specific tax incentives. The United Kingdom has already taken this path, with a positive impact on the creation of research posts. But this is not true of the Union as a whole, and especially not in Germany. Many scientists have left this country because the general conditions are not conducive to flourishing scientific activity. By seeking to offer researchers the very best working conditions, the institutes

# speaks out

of the Leibniz Association, for example, have managed to convince many scientists from the former USSR to come to them rather than going to the United States.

## **What do you think of the last of the new Framework Programme's priorities, namely 'Citizens and governance in the knowledge-based society'?**

I believe it is particularly welcome as I am very concerned, at least with regard to Germany, by the rejection of technology that is openly being advocated by a certain élite minority. We have the safest nuclear reactors in the world, but are abandoning nuclear energy. And our coalition government of 'greens' and socialists is coming up with more and more reservations about GMOs. When you look at what has become of the pharmaceutical industry in Germany – formerly the 'world's pharmacy', but which now carries out most of its research in Switzerland, the United States or the United Kingdom – you can see the consequences of a policy which is hostile to technology.

## **But surveys show that two-thirds of the Union's population share this distrust of GMOs.**

Nevertheless, we cannot on the one hand say that we want to overtake the United States in technology by 2010 and at the same time demonise genetic engineering in Europe. In the United States, two-thirds of foods contain GMOs and the Americans are none the worse for it. What is more, genetic engineering is essential for developing countries. The idea of a fortress Europe which bans the access of GMOs from the United States is an aberration which compromises the future development of an autonomous European capacity in this sector. To my mind, the farmers and the ecologists have entered into a fatal alliance.

## **What do you think then of research on stem cells? The moratorium on this, which runs until the end of 2003, excludes them temporarily from any form of financial support from the Union.**

This ban means that Europe's research ministers are unable to take a decision. Europe clearly risks lasting exclusion from this research field. That said, President Bush's decision is also very ambiguous and has disappointed many US scientists. I find it paradoxical that in Germany a mass of cells in a test tube has greater legal protection than an embryo. Let us hope that Europe quickly arrives at an intelligent decision in favour of responsible research on stem cells – for the benefit of both medicine and humanity.

● **The Wissenschaftsgemeinschaft Gottfried Wilhelm Leibniz** comprises 80 research institutes employing 12 000 people, including 5 200 scientists. Its work – co-funded by the German Government and the federal states – covers a wide range of fields (economics, environment, social sciences, natural sciences, engineering, etc.). In 2001, the global budget was €820 million.  
[www.wgl.de/](http://www.wgl.de/)

● **The challenges of research in the 21<sup>st</sup> century**  
This is the title of the communication presented by Hans-Olaf Henkel at the Heysel Conference to mark the launch of the Sixth Framework Programme.  
This text can be downloaded at:  
[http://europa.eu.int/comm/research/conferences/2002/resources/speeches/1-henkel\\_en.pdf](http://europa.eu.int/comm/research/conferences/2002/resources/speeches/1-henkel_en.pdf)

## News in brief... News in brief...

## Investing in knowledge is Europe's number one priority

Is Europe on the road to achieving the ambitious objectives for 2010 of competitiveness, economic dynamism, social cohesion and sustainable development which it set itself three years ago when it adopted what was known as the Lisbon Strategy?

The Commission report addressed to senior European politicians – to be discussed at the spring Summit of heads of state and government under the Greek presidency – expresses serious concerns at the delays and sluggishness of Member States in implementing the pledged reforms.

The Commission believes – and this is a central aspect, stressed with unusual insistence, in this message on the 'state of the Union' – that a much more vigorous effort to invest in knowledge and innovation must be a key priority. 'At a time of change and difficulty, it is all too easy to yield to the temptation to reduce or postpone this investment so as to respond to what appear to be more pressing concerns',



**'The research divide between Europe and the United States is costly in terms of missed opportunities for innovation, growth and jobs.'**

stated Commission President Romano Prodi when he presented this 'spring report' to the European Parliament on 14 January 2003.

'We must not make this mistake. Knowledge and innovation are at the

heart of sustainable development. They are the preconditions for growth, competition, the creation of new jobs and a better environment. Without investment and without innovation, not only can we not develop, but we also risk seeing our living standards fall.'

There is a very specific reason why the Commission is stressing this priority to such an unusual extent. The latest indicators show that – with the exception of the Nordic countries (Finland, Sweden, Denmark) and their admirable dynamism in R&D – overall Union investment in R&D is stagnant. 'The gap in R&D expenditure between Europe and the United States is more than € 20 billion a year, plus the cost in terms of missed opportunities in innovation, growth and jobs', notes Philippe Busquin, European Commissioner responsible for research. More firmly committed than ever to achieving the goal of '3% of GDP for European R&D by 2010',<sup>(1)</sup> he is preparing

an action plan for April which will provide a coherent and ambitious roadmap of common measures and recommendations for the Member States.

*(1) An increase of more than 50% compared with the present 1.9% of GDP.*

*"Spring Report"*

*[europa.eu.int/comm/lisbon\\_strategy/pdf/5\\_en.pdf](http://europa.eu.int/comm/lisbon_strategy/pdf/5_en.pdf)*

## epoline®: Patent Europe goes on-line

The Union still lacks genuine legislation on the concept of the *Community patent*. A failure to agree – on language matters in particular – has caused discussions to fail yet again, to the great disappointment of the Danish presidency, which ended on 31 December 2002.

The European Patent Office, based in Munich, is nevertheless a reality. For almost three decades now, it has been compensating for this legal vacuum by providing de facto protection for intellectual property rights and inventions in the 24 European member countries.

The EPO, which handles some 150 000 patent applications a year, recently acquired a remarkable new tool which has brought it well and truly into the electronics age.



The *epoline*® access system – whose operational validity was confirmed at the Nice (FR) conference in early December 2002 – is a new dual-use

electronic tool. Firstly, users can consult on-line an impressive database of patents registered at the EPO (about three million documentary sources). Secondly, applicants for an EPO

patent can now directly submit their own proposals for the rights to be granted.

*[www.isc-europe.com/epoline/](http://www.isc-europe.com/epoline/)*



## News in brief... News in brief...

## EU space policy

On 21 January, the European Commission adopted the Green Paper on EU Space Policy. The Paper, prepared in co-operation with the European Space Agency (ESA), tackles key issues such as the EU's independent access to space, scientific excellence in this field, the industrial and technological base, relevant markets, human resources, the legal and institutional framework, international co-operation, and environmental and security aspects.

It aims to launch a debate with all players — national and international organisations, the EU space industry and users, the scientific community and citizens. The consultation will help shape an EU response to competitiveness and security challenges related to space, to be detailed in a forthcoming White Paper.

For the full text of the Green Paper (available in English, German or French) or to participate in the on-line discussion forum, go to: <http://europa.eu.int/comm/space/>

## EIROforum: harnessing excellence

There is no mistaking some signs. At the exhibition on the occasion of the FP6 launch, Europe's seven most important intergovernmental research infrastructures — CERN (particle physics), the ESRF (synchrotron radiation), the ILL (neutron resources), the EMBL (molecular biology), the EAS (space activities), the ESO (astronomy and astrophysics) and the EFDA (nuclear fission) — presented their respective activities on a single platform. This gathering of organisations that are internationally recognised centres of excellence in their own fields is a sure sign of the European Research Area dynamic at work.

The significance of this joint stand was also reflected in the announcement that a new EIROforum coordination body is to be set up for the further development of co-operation on points of common interest.

The EIROforum is particularly interested in creating new synergies and shared experiences. One of the most important is the role of its members in terms of employment opportunities in research and the attractions of European science at an international level. Another key area is the promotion of joint strategies for the development of the GRID and GEANT scientific networks. Finally, as each of these organisations is a 'showcase' for big science in its own field, they will also have a major role to play in enhancing communication between science and society.

[www.eiroforum.org/](http://www.eiroforum.org/)



This exceptional image, published in January 2003 by ESO (a member of the EIROforum), marks an impressive 'first' and has sparked immense interest among astronomers across the globe. The result of three years' work, which enabled some 450 telescopic images to be combined — representing almost 50 hours of exposure at the la Silla Observatory in Chile — it is the best source ever of observations made of the 'Chandra Deep Field South'. The knowledge acquired of this distant corner of the cosmos should make it possible to study the early history of our Universe.

## Call for experts

Implementing Framework Programmes requires a great deal of independent expertise to study and select the projects submitted in response to calls for proposals.

In December 2002, the Commission launched a double call, which will remain open until the end of 2006. It is addressed to the international technological and scientific community as a whole (also outside Europe) for help in the processing of replies to calls for proposals — and possibly the monitoring of projects and networks selected. Applications can be made by individuals or — and this is new — research organisations can put forward lists of their team members.

[www.cordis.lu/experts/ip6\\_candidature.htm](http://www.cordis.lu/experts/ip6_candidature.htm)

## Nano: the Next Dimension

The distance from the Earth to the Moon measures billions of metres. The nanodimension is the same thing but in the opposite direction: taking our immediate environment as the starting point, in which the metre is the standard unit of measurement, you enter a world where the perception of phenomena is measured in billionths of a metre.

This striking image opens the fascinating science documentary film made by the French production company *Ex-Nihilo*. This surprising 26-minute film is a mix of gripping visual images and remarkably clear and informative commentaries from such learned

European figures as Nobel Prize winners Jean-Marie Lehn and Harry Kroto. At the Sixth Framework Programme's launch conference last November in Brussels, this documentary was a resounding success among the audience of journalists who attended the screening. Commissioned by the Research DG, this short film can be shown by any TV station without having to pay any royalties. Copies can be requested from the distributor, DDB Focus Europe.

[gerald.alary@ddb.be](mailto:gerald.alary@ddb.be)

Twisted nanotubes  
© @CERCA



Structure of a sometimes multiwalled nanotube  
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## News in brief . . . News in brief . . .

## European prizes, the pick of 2002

## Descartes Prize



Inaugurated in 2000, the Descartes Prize rewards projects combining excellence and European co-operation. Last December in Munich, the 2002 prizes went to two research projects, one in the field of medicine and the other in astrophysics.

Headed by Professor Lars Fugger of Aarhus Hospital (Denmark), the first of these projects greatly advanced our understanding of Multiple Sclerosis (with an estimated 350 000 sufferers in Europe) and identified a number of promising new leads for drug development. The principal factors at work in the autoimmune attack were also identified and new light was shed on how

the disease is triggered by a virus. Danish, Swedish, British and US teams worked together on this project.

The second prize was awarded to research on the origin of Gamma Ray Bursts (GRBs), huge explosions which contribute to the formation of stars and planets. Under the supervision of Dr Van den Heuvel of Amsterdam University, researchers used data supplied by the Italian-Dutch BeppoSax satellite. This project sheds light on questions that have been baffling astronomers for decades and confirms that these GRBs are the most powerful explosions in the Universe after the Big Bang. Dutch, Italian, Danish, Spanish, British and German scientists worked together on this project.

The two prize-winning teams, each of which receives prize money of € 500 000, were selected from the 10 finalists of a particularly rich 2002

crop. There were 108 entries for the Descartes Prize, with an average of nine countries co-operating on each project. About one-third of these included partners from the candidate countries.

**To find out more:** [www.cordis.lu/descartes](http://www.cordis.lu/descartes)

**Contacts:**

- Georges Vlandas – [georges.vlandas@cec.eu.int](mailto:georges.vlandas@cec.eu.int)

## Archimedes Prize



The Archimedes Prize seeks to support young scientists, who are the future of research, by awarding a money

prize to projects conducted by undergraduates. The judges look for originality and interdisciplinarity in projects within a number of fields proposed by the Commission (biology, energy, demographic change, disability, etc.). This enables them to reward projects of very different kinds. At a ceremony for the 2001 and 2002 prize-winners, held on 5 December last year at the European Patent Office (EPO) in Munich, 20 projects involving 25 students received their prizes – a grant worth between € 34 000 and € 44 000 for each prize-winner to help them pursue a scientific career.

**To find out more:** [www.cordis.lu/improving/awards/archimedes.htm](http://www.cordis.lu/improving/awards/archimedes.htm)

**Contacts:**

- Georges Vlandas – [georges.vlandas@cec.eu.int](mailto:georges.vlandas@cec.eu.int)
- Manuel Carmona – [manuel.carmona-yebra@cec.eu.int](mailto:manuel.carmona-yebra@cec.eu.int)

## Opinion

## Beyond public understanding

Two important new themes were highlighted at the recent international meeting in Cape Town on Public Communication of Science and Technology. One was that the traditional mantra of public *understanding* of science should be replaced with the more appropriate concept of public *engagement* in science. If our societies are going to flourish in this age when science and technology are imbedded in every aspect of modern life, we need a more open and honest dialogue between the scientific community and the broader public that recognises both groups' needs, potential contributions, and legitimate concerns.

Second, an important new task was added to the agenda of science communicators: helping the public better understand the nature of research and its products. I am repeatedly struck by how many people have

no idea about the "what" or "how" of research. In my own experience, these often are people looking for help with dire health problems. They want to know what the latest research is showing, and what has or has not been scientifically tested. But, too often, they do not know what research actually is, and to understand and benefit from science, its products and its limitations, one must know how scientists do their work and come to their conclusions.

One outcome of public education in research will be a far greater understanding of what does and does not constitute evidence. From my perspective, the nature of scientific evidence is one of the most important things for people to understand in modern life. We want people to use research-based evidence to make critical life decisions, so we need to help them know the difference between real scientific evidence and unsubstantiated claims.

AAAS will be expanding efforts on both these issues. We welcome the involvement of the entire global science and technology community.

Alan I. Leshner

Chief Executive Officer, American Association for the Advancement of Science and Executive Publisher, Science.

(1) *The seventh International Conference on Public Communication of Science and Technology was held in Cape Town (South Africa) from 5 to 7 December 2002. See: [www.sciencein africa.co.za/2001/september/pcst.htm](http://www.sciencein africa.co.za/2001/september/pcst.htm)*

## News in brief...



## Letters

About 'Talking Science'<sup>(1)</sup>

I regret that these difficult issues were covered so superficially and that there was no reference to the many high quality research projects which have been or are being conducted on the subject [of the relationship between science and the media]. As far as I can judge, you mainly provide a platform for the 'actors' (scientists and/or popularisers), as if the subject did not really deserve to be taken seriously, that is treated as a research topic in the field of the human and social sciences, and not approached from the point of view of the actors themselves (...). The incantatory litany of 'there must be more science on television' presented in *Talking Science*, together with the 'scientist-layman divide', is exactly the kind of thing that has been repeated endlessly by politicians over the past 20 years. It is a litany which ultimately comes back to the same old banality: it is all very simple, there must be 'more science on TV'.

In the meantime, the human and social science theses and research projects accumulate on the subject, trying in vain to de-simplify the reason-

ing of the politicians and the actors... but which clearly remain unread. This is a pity, because before recommending that Europe should commit itself to popularising science, one must have a very precise understanding of the mechanisms at work at the very local level and make the effort to read or consult with the people who have long been working on the subject! (...)

I hope that these words of criticism will cause you to dig a little deeper into the social circulation of knowledge, a subject widely covered by the human and social sciences, and by the communication sciences in particular.

Igor Babou

'Information and Communication Sciences' Education Section, 'Communication, Culture and Society' research team, Ecole Normale Supérieure Lettres et Sciences Humaines, Lyons (FR)

(1) This letter was addressed to us following the publication, last autumn, of the special edition *Talking Science*, devoted to the relationship between science and media.

## Observation

## E-mailo, ergo sum

I was about to send my New Year greetings to 150 business relations. I had chosen to do it by e-mail, using a short diaporama of my own composition: pretty shades of blue, an elegant apostrophe, a personal message that would be worth far more than the usual holly branches and standard formulas.

It was then that a no doubt well-intentioned correspondent sent me a copy of a press release from the British Computer Society on the information overload from which managers in the computer sector suffer. They receive an average of 52 e-mails a day! They spend two hours reading, deleting, storing or replying to them. That rather dampened my enthusiasm for electronic greetings. Did I really want to add a few more futile drops to this deluge of information?

I had myself received several greeting cards by e-mail, some personal, some professional, and I had not been displeased. So, I set to thinking about my real motivation, apart from simple tradition. I understood (of course, this may be obvious to the *RTD info* reader) that in mass communication it is the sender who is indebted to the recipient, as it is the latter who allows him to exist through his message, even if he doesn't read it. Keeping one's address available is like allowing a friend to have the pleasure of giving a present.

I also noticed that very few of the recipients of my greetings were computer experts in the United Kingdom (none to be honest) and that, as is often the case with statistics, the general validity of this survey was directly proportional to its irrelevance to myself (have you not also observed this phenomenon?).

So why, then, deny myself this satisfaction: I send e-mails, therefore I am? With a complex-free click, I increased by 150 X 100 kilobytes the deluge of information coursing across the World Wide Web and inundating mailboxes.

Candide

## Request for free subscription to RTD info

You can subscribe free of charge to the magazine at <http://europa.eu.int/comm/research/rtdinfo/rtd-adrf.html>

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(\* If you would like to receive several copies of one language version, please make your request, giving your full name and a brief justification:  
- by e-mail ([rtd-info@cec.eu.int](mailto:rtd-info@cec.eu.int))  
- by fax (+32-2-295 82 20).

If you would like to receive a copy of any recent issues of *RTD info*, please send a brief message by e-mail or fax.



## Sixth Framework Programme

## Calls for proposals (2003)

On 17 December 2002, the Commission issued an initial batch of 49 calls for proposals with closing dates from March 2003. These calls cover nearly all the research projects to be supported under the Sixth Framework Programme, with estimated Community funding of € 5 billion. The table below provides a summary (simplified – and thus necessarily simplifying) of this initial stage.

An essential distinction was made, in terms of thematic priorities, between budgets dedicated to the 'new instruments': Integrated Projects (IP) and Networks of Excellence (NoE). These amount to an estimated 70% of commitments.

The term *Others* refers to traditional support granted previously.

The reference site to be consulted for all official information is on the CORDIS server: [www.cordis.lu/fp6](http://www.cordis.lu/fp6)  
General e-mail address: [ec-fp6@cec.eu.int](mailto:ec-fp6@cec.eu.int)

CALL IDENTIFIER	RESEARCH FIELDS OR ACTIONS TARGETED	DEADLINE	BUDGET (MILLIONS €)
<b>INTEGRATING AND STRENGTHENING THE EUROPEAN RESEARCH AREA</b>			
<b>Life sciences, genomics and biotechnologies for health</b>		<b>rtd-genomics-biotec@cec.eu.int rtd-diseases@cec.eu.int</b>	
LIFESCIHEALTH	Thematic call: priority fields of advanced genomics and their applications for health, as well as combating major disease, especially cancer	25.03.03	513 <sup>(1)</sup>
<i>(1) Of which IP + NoE: € 385-410 M</i>			
<b>Information Society Technologies</b>		<b>ist@cec.eu.int</b>	
IST-1	Thematic call: applied research in connection with social and economic aspects (especially e-security, e-learning, e-business)	24.04.03	1 070 <sup>(1)</sup>
IST-C	Future and emerging technologies (FET) – Open field (continuous submission)	Open until 31.12.04	60
IST-NMP	Manufacturing, products and services engineering in 2010 <sup>(2)</sup>	• 24.04.03 <sup>(3)</sup> • 16.09.03 <sup>(4)</sup>	60
<i>(1) Of which IP + NoE: € 700 M – (2) Joint call by IST and NMP programmes – (3) IP/NoE and others – (4) Others</i>			
<b>Nanotechnologies and nanosciences, multifunctional materials and new production processes</b>		<b>rtd-nmp@cec.eu.int</b>	
NMP-1	Thematic call covering many fields in the three thematic strands of this priority	• 06.03.03 <sup>(1)</sup> • 10.04.03 <sup>(3)</sup>	400 <sup>(2)</sup>
NMP-2-SMEs	Targeted call for SMEs: products and services with a high added value based on new knowledge in traditional, less RTD-intensive industries	10.04.03	40 <sup>(4)</sup>
<i>(1) For IP + NoE – (2) Of which IP + NoE: € 260 M – (3) Others – (4) For inclusion in IP</i>			
<b>Aeronautics and space</b>		<b>rtd-aerospace@cec.eu.int</b>	
Aero-1	Thematic call: research in the aeronautics sector (aimed in particular at industrial competitiveness, environmental impact, safety, and the global operational capacity of the air transport system)	20.03.03	240 <sup>(1)</sup>
Aero-2	Specific support actions in the aeronautics field	• 20.03.03 • 19.09.03	7
TREN-1	Research piloted by the Transport-Energy DG on the global operational capacity of the air transport system	20.03.03	19 <sup>(2)</sup>
Space-1	GMES and telecommunication satellites	20.03.03	60 <sup>(3)</sup>
<i>(1) Of which IP + NoE: € 149 M – (2) See also note in the Sustainable Development priority – (3) Of which IP+ NoE: € 52 M</i>			
<b>Food quality and safety</b>		<b>rtd-food@cec.eu.int</b>	
Food-1	Thematic call covering a wide spectrum: nutrition and health, epidemiology of illnesses of nutritional origin, traceability, methods of analysis, detection and control in the animal and agri-foodstuffs chain, etc.	15.04.03	187 <sup>(1)</sup>
<i>(1) Of which IP + NoE: € 128 M</i>			
<b>Sustainable development, global change and ecosystems</b>		<b>rtd-energy@cec.eu.int</b>	<b>rtd-sustainable@cec.eu.int rtd-transport@cec.eu.int</b>
TREN-1	Research piloted by the Transport-Energy DG on sustainable energy systems	18.03.03	82 <sup>(1)</sup>
TREN-1	Research piloted by the Transport-Energy DG on surface transport systems	15.04.03	39 <sup>(1)</sup>
Energy-1	Thematic call on sustainable energy systems (with impact in the medium and long term)	18.03.03	198 <sup>(2)</sup>



CALL IDENTIFIER	RESEARCH FIELDS OR ACTIONS TARGETED	DEADLINE	BUDGET (MILLIONS €)
Transport-1	Thematic call on sustainable transport systems	15.04.03	170
Transport-2	Specific support actions in the field of sustainable transport systems	• 03.04.03 • 19.09.03	5
Global-1	Thematic call covering a very wide spectrum in the field of 'Global change and ecosystems' (especially greenhouse gases and carbon sinks, ozone holes, water cycles, biodiversity, desertification, and natural risks, etc.)	08.04.03	170 <sup>(3)</sup>

(1) The total of budgets corresponding to the TREN-1 identifiers (including the Aeronautics priority) is €140 million (of which €91 M is allocated to IP + NoE) –

(2) Of which IP + NoE: € 129 M – (3) Of which IP+ NoE: € 120 M

Citizens and governance in a knowledge-based society		rtd-citizens@cec.eu.int	
Citizens-1	The knowledge-based society (in particular the role of science and technology, impact on quality of life, dynamic of integration of migratory movements)	15.04.03	20 <sup>(1)</sup>
Citizens-2	Call concerning all research themes for targeted projects and coordination actions	15.04.03	33 <sup>(2)</sup>
Citizens-3	In particular: dynamic of the knowledge-based society and its economic and social impact, social cohesion, changes in working methods, enlargement and governance	10.12.03	48 <sup>(1)</sup>

(1) For IP + NoE – (2) Others

Support for policies and anticipation of scientific and technological needs		rtd-nest@cec.eu.int	
SSP-1	In particular: sustainable management of natural resources, problems of public health, etc.	13.03.03	149
NEST-A	New and emerging science and technology (NEST) <sup>(1)</sup>	• 14.05.03 • 22.10.03	28

(1) Call due to be published during the latter half of February 2003

Horizontal research activities of interest to SMEs		rtd-sme@cec.eu.int	
SME-1	Specific call for SMEs: co-operative research projects	• 13.03.03 • 27.11.03	95 60
SME-2	Specific call for SMEs: collective research projects	• 06.03.03 • 10.09.03	60

Specific measures to support international co-operation		rtd-inco@cec.eu.int	
INCO-DEV-1	Developing countries (DEV): projects in the field of health, resource management and food safety	11.09.03	60
INCO-MPC-1	Mediterranean partner countries (MPC): projects in the field of the environment, cultural heritage and health	07.05.03	25
INCO-WBC-1	West Balkan countries (WBC): projects in the field of environment and health	07.05.03	13.5
INCO-DEV/SSA-1	Specific support actions (DEV) <sup>(1)</sup>	• 11.03.03 • 04.09.03	1
INCO-MPC/SSA-2	Specific support actions (MPC) <sup>(1)</sup>	• 11.03.03 • 04.09.03	0.6
INCO-WBC/SSA-3	Specific support actions (WBC) <sup>(1)</sup>	• 11.03.03 • 04.09.03	0.6
INCO-Russia+NIS/SSA-4	Specific support actions for Russia and other countries of the former USSR <sup>(1)</sup>	• 11.03.03 • 04.09.03	0.6
INCO-COMultilatRTD/SSA-5	Specific support actions for the multilateral coordination of RTD policies and activities <sup>(1)</sup>	• 11.03.03 • 04.09.03	0.6

(1) Calls open until 2006

Support for the coordination of activities		rtd-coordination@cec.eu.int	
ERA-NET/1/CA-SSA	Supporting the co-operation and coordination of research activities at national or regional level (ERA-NET) <sup>(1)</sup>	03.06.03	24

(1) Calls open until 2005

## STRUCTURING THE EUROPEAN RESEARCH AREA

Human resources and mobility (Marie Curie actions)		rtd-mariecurie-actions@cec.eu.int	
Mobility-1	Host networks for training experienced researchers <sup>(1)</sup>	• 03.04.03 • 19.11.03	115 115
Mobility-2	Host fellowships for training researchers at the start of their careers <sup>(1)</sup>	• 02.04.03 • 11.02.04	60 70

CALL IDENTIFIER	RESEARCH FIELDS OR ACTIONS TARGETED	DEADLINE	BUDGET (MILLIONS €)
Mobility-3	Host fellowships for the transfer of knowledge <sup>(1)</sup>	• 22.05.03	40
		• 19.05.04	45
Mobility-4	Support for conferences and training courses	• 01.04.03	10
		• 20.04.04	10
Mobility-5	Intra-European fellowships <sup>(2)</sup>	• 12.03.03	55
		• 18.02.04	55
Mobility-6	International expatriation fellowships <sup>(2)</sup>	• 21.05.03	10
		• 12.02.04	18
Mobility-7	International host fellowships for foreign researchers <sup>(2)</sup>	• 21.05.03	9
		• 12.04.04	11
Mobility-8	Support for the creation of networks of excellence <sup>(2)</sup>	• 20.05.03	25
		• 18.05.04	30
Mobility-9	Excellence award (in the framework of mobility) <sup>(2)</sup>	• 20.05.03	0.25
		• 18.05.04	0.25
Mobility-10	Marie Curie Chairs	• 20.05.03	5
		• 20.01.04	5
Mobility-11	Reintegration grants (in the framework of European mobility) <sup>(2)</sup>	Open from 15.04.03 to 31.10.04	39
Mobility-12	International reintegration grants (for researchers based outside Europe) <sup>(2)</sup>	Open from 15.04.03 to 31.10.04	17

(1) Allocation to host bodies

(2) Allocation to researchers

Research infrastructures		rtd-infrastructure@cec.eu.int	
Infrastructures-1	Transnational hosting of researchers and integration of activities	15.04.03	190
Infrastructures-2	Development of communication infrastructures (Grids)	06.05.03	50

Science and Society		rtd-sciencesociety@cec.eu.int	
Science and society-1	Support for the Science and Society approach	Open from 09.12.03	4
Science and society-2	Support for European Science Week (2004)	13.05.03	3
Science and society-3	"Descartes" Prize (2004)	13.05.03	1

RESEARCH AND TRAINING IN THE NUCLEAR FIELD (EURATOM TREATY)		rtd-euratom@cec.eu.int	
Euratom Call 03 – Fixed deadline	Research on the management of nuclear waste, protection against radiation, security of installations, and training aspects	06.05.03	67
Euratom Call Open	Specific support actions, especially in the fields of training, mobility and access to infrastructures	• 06.05.03 • 14.10.03	2

## Sixth Framework Programme special

Two "special editions" of RTD info were published in November 2002 (also available in French and German)

► **The priorities of the Sixth Framework Programme 2002-2006** – (32 p.)

research@cec.eu.int

► **EU enlargement: the new borders of European research** (16 p.)

research@cec.eu.int

► Four summary leaflets are also available on the following subjects:

- **Integrated projects**
- **Networks of excellence**
- **The 'ERA-NET' scheme**
- **Support for research infrastructures**

► **Global change and ecosystems** (16 p., also available in French and German)

rtd-sustainable@cec.eu.int

► **Science and technology for sustainable energy** (16 p.)

rtd-energy-rtd@cec.eu.int



## Diary

## What's new on the Web?


**Meetings under the Greek presidency**

[www.cordis.lu/greece/events.htm](http://www.cordis.lu/greece/events.htm)  
[www.cordis.lu/greece/rd\\_events.htm](http://www.cordis.lu/greece/rd_events.htm)

- ▶ **Science meets Policy: New Experiences – Future Perspectives** – Workshop – 29-30/04/03 – Heraklion (Crete)
- ▶ **Foresight in the Enlarged European Research & Innovation Area** – 16-18/05/03 – Ioannina (Epirus Technological Park)
- ▶ **Sustainable Development Indicators in the Mineral Industries (SDIMI/03)** – 21-23/05/03 – Milos
- ▶ **European Platform for Biodiversity Research Strategy (EPBRS)** – 22-27/05/03 – Lesbos
- ▶ **Sustainable Development of the Mediterranean Sea and of the Black Sea** – 28-31/05/03 – Thessaloniki
- ▶ **Scientific and Technological Development cooperation between the European Union and the Balkan Countries** – Ministerial Meeting – 26-27/06/03 – Thessaloniki

**European notebook**

- ▶ **Nanotechnology Meets Business** – Conference on the commercial potential of nanotechnologies in Europe – 8-9/04/03 – Frankfurt (DE)  
[www.nano.org.uk/web\\_announcement.pdf](http://www.nano.org.uk/web_announcement.pdf)
- ▶ **Green Week** – Conference, exhibition and competition for schools – 2-6/06/03 – Brussels (BE)  
<http://europa.eu.int/comm/environment/greenweek/index.htm>

**Other events**

- ▶ **Biotech Helsinki** – 24-26/3/2003 – (FI)  
[finnexpo.fi/biotechhelsinki](http://finnexpo.fi/biotechhelsinki)
- ▶ **Maritime Heritage/03** – 24-26/03/03 – Malta  
[www.wessex.ac.uk/conferences/2003/heritage03/index.html](http://www.wessex.ac.uk/conferences/2003/heritage03/index.html)
- ▶ **Stem Cells – Hopes and Ethical Conflicts** – 26-28/03/03 – Engelberg (CH)  
[www.forumengelberg.ch](http://www.forumengelberg.ch)

**The Sixth Framework Programme on the Internet**

The *Europa>Research* site is at present launching a series of new pages to provide information on the Sixth Framework Programme.

- ▶ Principal access site  
[http://europa.eu.int/comm/research/fp6/index\\_en.html](http://europa.eu.int/comm/research/fp6/index_en.html)  
 Several pages devoted specifically to various themes and 'horizontal' aspects of the programme are to be launched. Here are some to be going on with:
- ▶ Industrial technologies  
[http://europa.eu.int/comm/research/industrial\\_technologies/index\\_en.html](http://europa.eu.int/comm/research/industrial_technologies/index_en.html)
- ▶ Marie Curie actions  
[http://europa.eu.int/comm/research/fp6/mariecurie-actions/home\\_en.html](http://europa.eu.int/comm/research/fp6/mariecurie-actions/home_en.html)
- ▶ Science and Society  
[http://europa.eu.int/comm/research/science-society/index\\_en.html](http://europa.eu.int/comm/research/science-society/index_en.html)
- ▶ Co-operation and co-ordination of research activities carried out at national and regional levels (ERA-Net initiative)  
<http://europa.eu.int/comm/research/fp6/era-net.html>
- ▶ The policy of international co-operation  
[http://europa.eu.int/comm/research/iscp/index\\_en.html](http://europa.eu.int/comm/research/iscp/index_en.html)

The *CORDIS* server is also a very complete portal, designed especially to help research organisations to participate in the new Framework Programme. Among other things, the site has full details of calls for proposals.

- ▶ Principal access site <http://www.cordis.lu/fp6/>

**Publications**

Printed publications accompanied by the mention of an e-mail address are free and can be obtained by sending a message to the address given.

EUR-OP (Office for Official Publications of the European Communities) means that the printed versions must be purchased. To order copies please visit the website at:  
[eur-op.eu.int/general/en/s-ad.htm](http://eur-op.eu.int/general/en/s-ad.htm)

The publications mentioned are a selection. A complete list of new scientific publications from the RTD programmes is placed on the research website every two months: [europa.eu.int/comm/research/pub\\_rtd.html](http://europa.eu.int/comm/research/pub_rtd.html)

**Brochures**

- ▶ **Towards a European Research Area – Science, Technology and Innovation – Key Figures 2002** (84 p.)  
[research@cec.eu.int](mailto:research@cec.eu.int)
- ▶ **Wonders of life – Stories from European Life Science Research** (27 p.)  
[bernhard.zechendorf@cec.eu.int](mailto:bernhard.zechendorf@cec.eu.int)
- ▶ **The international dimension of the European Research Area**  
[inco@cec.eu.int](mailto:inco@cec.eu.int)

**Project reports**

- ▶ **A city for pedestrians: policy-making and implementation** (296 p.) OPOCE  
[rtd-euratom@cec.eu.int](mailto:rtd-euratom@cec.eu.int)
- ▶ **EU co-sponsored research on structural materials ageing** (285 p.)

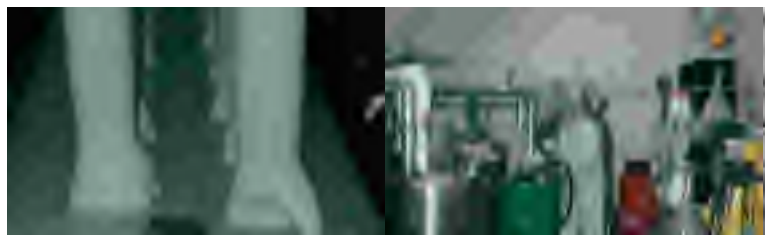
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- ▶ **Research infrastructures 2002** – volume A (231p.) et B (221 p.)  
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# How one idea can lead to another



**This is the story of how a seemingly unrealistic idea for Aids prevention finally led to the development of a new kind of surgical glove which protects healthcare staff from the risks of viral contamination.**

In 1987, the ravages of Aids were being taken increasingly seriously. Gilles Argy, head of R&D at Hutchinson in France, visited a group factory making condoms, accompanied by René-Guy Busnel, director of a research laboratory on animal physiology (CNRS). 'Wouldn't it be possible to develop a double sheath, the two layers sealing in a disinfectant able to destroy the Aids virus if the condom tears?' suggested Professor Busnel. But it soon became clear that given the actual conditions under which a condom is used – not to mention the possible harmful effects of virucides on female sexual organs – this type of prevention would be unworkable in practice. Replacing the double layer with a single layer incorporating crushable microcapsules containing the disinfectant seemed equally complex.

## Changing target

'The condom was not the right target, but an idea had been sown', explains Gilles Argy, who subsequently thought of a way of applying the same principle to latex gloves used by surgeons and healthcare staff. At the time, the medical world was growing increasingly concerned at the risk of transmission of the HIV or hepatitis C viruses through contact with the blood of contaminated patients. Injuries to the hands caused by needles or bistoury blades soiled with blood are not, in fact, rare. What's more, latex does not provide 100% protection as it becomes porous when stretched for long periods. After a lengthy operation surgeons can find that their hands are stained with blood even if their gloves appear intact.

However, crushable microcapsules were not seen as the ideal system. It was not until 1995 that a better solution was found, when Andre Cheymol, project leader at Hutchinson, and Gérard Riess, a lecturer at the Mulhouse School of Chemistry, came up with the idea of using an emulsion.<sup>(1)</sup> The final concept was born: a kind of 'sandwich' glove consisting of two external layers made from an elastic material with an intermediate layer containing the emulsified disinfecting agent, in the form of uniformly distributed droplets. When a dirty needle punctures the glove, the active agent mixes with the biological liquid on the needle and the blood from the wound.

## Delicate problems

There were two problems. First of all, a non-toxic, non-allergenic disinfectant was needed which would be compatible with the latex and destroy the virus very quickly. This product also had to encounter every viral particle introduced. The choice was made by a process of elimination. Among the known molecules, the best candidates were quaternary ammoniums – tensioactive compounds widely used for their disinfecting and detergent properties. They are remarkably effective in dealing with enveloped viruses such as HIV or hepatitis C, especially in the very particular conditions of an accidental scratch or pricking involving very brief contact. 'We now use a more all-purpose mixture with a wider spectrum of activity', explains Gilles Argy.

The second problem was more delicate. An emulsion had to be found which was sufficiently fluid for the virucide to be released during the few milliseconds it takes the needle to puncture the glove. It was calculated that the droplets needed to be an optimal average of 30 micrometres diameter to be sure they would be perforated by a needle. 'It was a student at Mulhouse, Pierre Hoerner – now a project leader with us – who developed the emulsion, and the equally difficult matter of how to incorporate it in the glove, while working on his thesis', says Gilles Argy.



The pilot plant at Liancourt (FR), able to produce 400 000 pairs of virucide gloves a year, has a pre-industrial area (with steeping machine) and control laboratory with a dedicated virology zone. From left to right: ceramic moulds, mixture preparation, production machine depositing several layers in succession on ceramic moulds, glove control unit, and packaging in sealed bags.

## Industrial-scale production

Ordinary surgical gloves are made by plunging moulds – in the form of porcelain ‘hands’ – into an aqueous latex solution. As water cannot be used in combination with ammoniums, organic solvents had to be used in this case, with all the associated constraints. A German chemicals company, Goldschmidt of Essen, produced the stabilising product, in accordance with Professor Reiss’ specifications.

The latex was also replaced by a thermoplastic elastomer, a synthetic material which avoids the allergic reactions natural rubber seems to be causing increasingly among healthcare staff. Once laboratory studies had shown the project to be feasible, in 1996 Hutchinson turned to the European Commission which agreed to finance wider cross-border co-operation helping to launch a pilot production plant under the Biomed 2 programme. Based at the production site of the Hutchinson subsidiary Mapa in Liancourt, France, this unit can produce 400 000 pairs of gloves a year. If this innovation proves as successful as is hoped, the next stage will be to move to genuine industrial-scale production, with continuously automated production lines.

## Conclusive trials

In the meantime, the glove has become a reality – thicker, admittedly, than ordinary gloves, but made of a more supple material. The first tests – for mechanical resistance, ergonomics, user tolerance – took place in 2001. They were managed by Biomatech, a company specialising in the preclinical and clinical evaluation of medical devices, in co-operation with the Lyon Sud hospitals in France where clinical trials were conducted in the autumn of 2002.

Jean-Louis Caillot, the surgeon who supervised these trials, reports that ‘the dozen specialists who tried them believe that freedom of movement is no longer affected after just a few minutes adaptation. The surgery took place in conditions close to those with a traditional double-gloving.’ Orthopaedic surgeons, who are familiar with this system, ‘got used to them a little quicker than some of their colleagues who still only use a single pair of gloves’. Another advantage is that during ‘normal’ use, that is without perforation, the protection is perfectly impervious to bacteria and even viruses. More interesting still, the layer of emulsion is a barrier which destroys or blocks viruses which would try to penetrate if the glove were accidentally punctured. As a result, however long the surgery lasts, the surgeon’s hands never come into contact with the pathogenic agents which may be present in the patient’s blood.

The next step? Before they can be made commercially available, the gloves need the recognised EC mark required for all medical devices – the procedure for this is already in progress. Also, early in 2003, Professors Stanley Plotkin and Fernand Bricourt will publish an article on the purely scientific aspect of the project in the *Journal of Medical Virology*. ‘This is essential to ensure product credibility’, explains Gilles Argy. Apart from hospital staff, Hutchinson believes that NGOs, emergency services and military personnel operating in regions with a high viral risk could be potential users of the glove.

Finally, it should be made clear that although this glove greatly reduces the viral charge (by about a factor of 15), and thus the likelihood of the transmission of a disease, it does not eliminate it altogether in the event of an accident involving contact with blood. Healthcare staff must, therefore, continue to remain vigilant at all times.

(1) Dispersion of one liquid into a second with which it is not miscible, such as vinegar in oil when they form vinaigrette.

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## To find out more

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## Biocide Medical Gloves

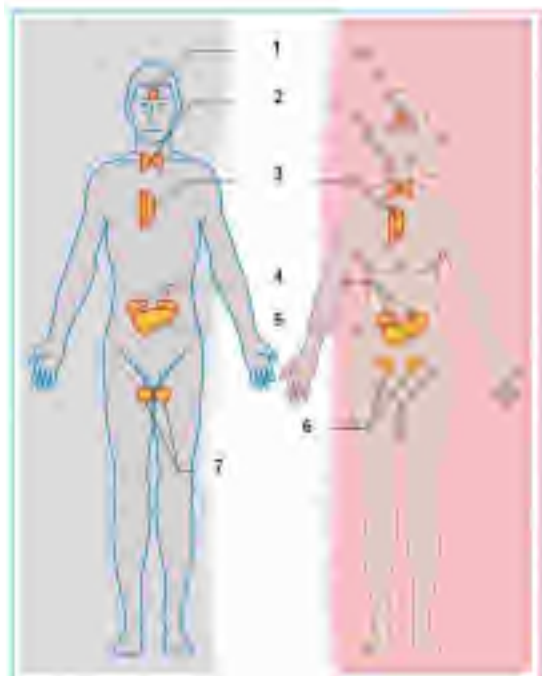
With European support of €1 785 000 (50% of the cost of the pilot production unit) under the Biomed 2 programme, the *Biocide Medical Gloves* project started in 1997. The partners came from the public and private sector in France and Germany: Assistance Publique/Hôpitaux de Paris; Institut national de la recherche médicale (Marseilles and Lyons); Institut national de la recherche agronomique (Maison-Alfort); Institute of hygiene (Hamburg); Biomatec (Lyons); Mapa SNC (FR); Goldschmidt SA (DE); and the University of Essen (DE).

# Tracking down endocrine disruptors

While many research projects are interested in oestrogens which could have a disturbing effect on the male species, the *Compendo* project is studying the androgenic factors threatening female elements. These electron microscope images show the effects produced by chemical compounds such as *tributyltin* and *triphenyltin* – used in paints for boats and agricultural fungicides. They produce abnormal penis and sperm canal phenomena (PP and Vd, right-hand picture) in female *Hydrobia* snails living in marine sediments. The cellular proliferation which results contributes to blocking the oviduct, a sterilisation of female subjects (OvL, normal in top picture, blocked in right-hand picture) and, finally, to the increasing disappearance of these molluscs along the coasts.



Concerns were first expressed more than a decade ago when a growing number of strange phenomena involving hormone changes and 'sexual mutations' were observed in natural environments. The possible cause was an insidious – and previously unsuspected – form of pollution caused by the ever more sophisticated nature of waste chemical and organic ingredients entering the environment. Their potential impact on human health is now taken very seriously indeed. True to the precautionary principle, a number of European research projects have been set up to track down and evaluate this creeping threat.



The main points sensitive to possible endocrinal changes in humans.

1. Pituitary gland
2. Thyroid and parathyroids
3. Thymus
4. Suprarenal gland
5. Pancreas
6. Ovaries
7. Testes

Diagram reproduced with the permission of the Institut National de Recherche et de Sécurité (INRS) – France

They can feminise males and lend male characteristics to females in species as diverse as molluscs, fish, frogs and birds, seriously reducing their fertility. They may also harm their development, undermine their immune systems and make them prone to tumours. They are even suspected of having an effect on human health, possibly being responsible for – statistically observed – lower sperm counts or the increase in testicular, breast and prostate cancer. So what exactly are these malevolent forces? They are known as *endocrine disruptors*, a vast and varied range of substances whose common characteristic is to interfere with the proper hormone functioning of living organisms and therefore – why not? – of humans.

## Mobilising scientists

European Union officials decided not to underestimate the dangers of this new kind of threat and, most notably, increased support for the research effort in this field (see box *A serious European warning*). As well as increasing efforts to monitor and study the disruptions observed in

ecosystems, and in man, closely, scientists also set about identifying the potentially guilty materials. The list is growing all the time.

In May 2002, the Research DG demonstrated its commitment to stepping up the European effort, in no uncertain terms, when it decided to allocate €20 million to a cluster of four projects. Known as *Credo* (*Cluster of Research on Endocrine Disruption in Europe*), the group includes 64 research teams dedicated solely to these disturbing molecules. 'In addition to the significant resources, one of *Credo's* strong points is our integrated approach to human health and environmental problems, which were previously the subject of separate European research actions', stresses project coordinator Andreas Kortenkamp of London University's School of Pharmacy. 'Bringing the projects together in this way is a positive step. We are finally going to see experts on human endocrinology, naturalists and chemists all working together. That is a very exciting prospect.'

### A complex affair

The complex nature of the problem demanded nothing less than such a concentrated research effort. First of all, there is the sheer diversity of the substances involved. Pesticides, flame retardants, cosmetics, medicines, paints and combustion products are all seen as potential endocrine disrupters. The way they act is also worrying. As their structure resembles a particular hormone, some of these molecules are able to act by triggering the same reaction in the organism which the hormone would produce naturally. Others, on the contrary, attach themselves to the hormone receptors to subsequently block its action. A third category disrupts hormone synthesis, transport, metabolism or excretion, thereby changing natural concentrations in living organisms.



## Focus on flame retardants

*Fire*, one of the projects in the *Credo* cluster, is interested in an important group of organo-halogenic compounds: Brominated Flame Retardants (BFRs). These are used extensively by industry in polymers and textiles and are often applied to construction materials, furniture and electronic devices. The group includes polybrominated biphenyl ethers (PBDEs) and tetrabromo bisphenol A (TBBPAs) which are the subject of particular attention. In 1999, the world market in these molecules was estimated to be 67 000 tonnes.

'We are going to study the distribution and development of the level of exposure to BFRs in wild coastal fauna, in particular among predators which are at the top of the food chain – such as terns, seals and bears – but we are also interested in human diet', explains Joseph Vos of the National Institute for the Environment and Public Health in the Netherlands and FIRE coordinator. 'With the aid of *in vitro* cell cultures, studies of the toxicity of various BFRs on the endocrine and immune systems of rodents or fish should enable us to determine in more detail which compounds are the most significant.' The aim is to provide an estimate of the risks to man and the environment, on the basis of exposure levels and effects, that will enable us to 'say whether or not we have a sufficient safety margin'.

## A serious European warning

In a Communication to the Council and Parliament, dated December 1999, the Commission stressed that studies on fish – in particular roach in the United Kingdom – showed an alarming proportion of males (13% on average, almost half in some rivers) with testes containing ovocytes – the cells destined to form eggs. On the other hand, female sea molluscs (oysters and winkles in particular) were found to be developing male characteristics associated with TBT, a compound previously used in paints for ships and which has a very serious impact on the reproduction of these species which, in some cases, have become extinct locally. There are also indications that the reproduction of birds is being threatened by these endocrine disrupters and researchers have reported cases of hermaphrodite gulls.

The growing number of cases of this kind caused the Commission to affirm that 'impaired reproduction and development causally linked to endocrine disrupting substances are well-documented in a number of wildlife species and have caused local population changes'

Commission Communication, Community Strategy, December 1999  
[http://europa.eu.int/eur-lex/fr/com/cnc/1999/com1999\\_0706fr01.pdf](http://europa.eu.int/eur-lex/fr/com/cnc/1999/com1999_0706fr01.pdf)

### Contact at the European Commission

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- Tuomo Karjalainen  
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### To find out more

- Press release on *Credo*  
<http://europa.eu.int/comm/research/press/2002/pr1505en.html>
- Report of the Working Group on Endocrine Disrupters of the Scientific Committee on Toxicity, Ecotoxicity and the Environment (CSTEE), Consumer Policy and Consumer Health Protection – 1999 – (96 pages)  
[http://europa.eu.int/comm/food/fs/sc/sct/out37\\_en.pdf](http://europa.eu.int/comm/food/fs/sc/sct/out37_en.pdf)
- Research under the Fifth Framework Programme  
[http://europa.eu.int/comm/research/quality-of-life/ka4/ka4\\_endocrine\\_en.html](http://europa.eu.int/comm/research/quality-of-life/ka4/ka4_endocrine_en.html)



## Credo Contact

● **EDEN:** *Endocrine Disrupters: exploring novel end-points, exposure, low-dose and mixture-effects in humans, aquatic wildlife and laboratory animals (22 partners in 10 countries, €8.7 million EC contribution).*

Andreas Kortenkamp (overall coordination of Credo) – University of London – School of Pharmacy (UK)

andreas.kortenkamp@ulsop.ac.uk  
<http://www.ulsop.ac.uk/depts/pharmacology/kortenkamp.html>

● **COMPRENDO:** *Comparative research on endocrine disrupters – Phylogenetic approach and common principles focusing on androgenic/antiandrogenic compounds (13 partners in 9 countries, €3.3 million EC contribution).*

Ulrike Schulte-Oehlmann – University of Frankfurt – Institute of Zoology- DE

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<http://www.bio.uni-frankfurt.de/ee/ecotox/research/index.html>

● **EURISKED:** *Multi-organic risk assessment of selected endocrine disrupters (10 partners in 8 countries, €3.1 million EC contribution).*

Wolfgang Wuttke – University of Goettingen – Faculty of Medicine – DE

ufkendo@med.uni-goettingen.de

● **FIRE:** *Risk assessment of brominated flame retardants as suspected endocrine disrupters for human and wildlife health (19 partners in 7 countries, €4.9 million EC contribution).*

Joseph Vos, National Institute of Public Health and the Environment (NL)

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'The mix of potential culprits is another problem', explains Andreas Kortenkamp. 'A single endocrine disrupter is not generally found in any given environment, but rather many different ones of different origin. It is not easy to study how they interact, although it is essential for evaluating the risk. We showed in previous projects that a dozen elements, all present in quantities below their observable activity threshold, had a major impact due to the synergy effect. It is this aspect in particular that the *Eden* project is seeking to investigate further.'

## Untangling the similarities

Finally, it is particularly difficult to untangle the biochemical web as vertebrates alone possess around 50 known hormones.<sup>(1)</sup> One of the most exciting questions will be to discover to what extent invertebrates, about whose hormone systems very little is known, 'resemble' vertebrates in terms of endocrine systems.

This is one of the aims of the *Comprendo* project which is studying androgenic and antiandrogenic compounds, in particular. 'We know', explains project coordinator Jörg Oehlmann of Frankfurt University's Institute of Zoology, 'that some hormones are particular to invertebrates – such as the very specific hormones which control metamorphosis in insects. But we also have reason to believe that, in the course of the long evolution of life, areas of endocrine systems have been able to remain virtually intact. Tributyltin (TBT), for example, is known for acting on the same enzyme as that which converts androgens into oestrogens in molluscs and mammals, despite the fact that these are very different groups. We want to check this hypothesis as it would make it possible to construct animal models from which we could extrapolate the effects on man.'

## Identifying the sentries

If primitive aquatic organisms, such as echinoderms (sea urchins, starfish, etc.) or molluscs, were shown to carry the same hormone receptors as man, this similarity would bring many benefits. We could use these species in their natural environments as 'sentries' able to indicate when contamination levels give cause for alarm. But most importantly, these organisms could provide the basis for developing test systems with which to evaluate the harmlessness to human health of a given chemical compound.

'Aquatic invertebrates or amphibians are themselves of interest to us as they are a part of ecosystems and warrant our protection. But they also interest us with a view to constructing protocols – recognised by scientists in general – with which to test the action of a given chem-

ical compound on the endocrine system', explains Jörg Oehlmann. Indeed, one of the current problems is the absence of recognised tests with which to quantify the harmfulness of a molecule for the hormone system.

## An urgent need for tests

In fact, there are many tests, but controversy continues over the interpretation of their results. Some of them (such as those involving rodents) are also seen as insufficiently sensitive. Developing universally recognised protocols, and which could be validated by the OECD and then used in laboratories worldwide, would mark major progress, to which the scientists working on the *Credo* project certainly intend to contribute. However, it is not known how many protocols are needed to verify that a product is totally harmless. At present, interest is focused almost exclusively on oestrogenic or androgenic effects. It is likely that new tests will be required when we have more advanced knowledge of other hormones (especially those produced by the thyroid gland).







The variety of species (especially those in the aquatic food chain) among which hormonal or sexual aberrations have been observed constitutes a genuine warning signal.



'It is a question of providing pertinent and usable scientific data to permit a Community strategy on endocrine disrupters. We are not doing research out of curiosity alone, but want to provide decision-making tools and are beginning to reflect on how our data on the mixtures of substances could be used for regulation purposes', is how Andreas

Kortenkamp sums up the situation.

### 553 'candidate' substances

In this respect, the most difficult aspect will certainly be to shed light on the relationships between these substances and human health. The drop in male fertility noted in several Northern European countries, as well as the general increase in certain types of cancer, are generally believed to be multifactor phenomena. Smoking, alcohol consumption, changes in diet, and a more sedentary lifestyle are among the factors which probably play a part. Given these conditions, it is a formidable challenge to estimate the degree of responsibility of a given chemical compound or group of compounds.

## Virility and oestrogens

According to Jörg Oehlmann (Institute of Zoology – Frankfurt University), '95% of funds for research on endocrine disrupters, whether in Europe or the United States, are allocated to compounds with oestrogenic effects, although such well-documented examples as those of TBT clearly prove that androgenic effects are of equal concern.' To explain the paradox, the researcher ventures this hypothesis: 'my women colleagues believe that as research is male dominated, they have chosen to spend most money on compounds that could present a risk to their own capacities...'

A shortcoming – whether real or imagined – which *Credo* has been able to guard against as the *Comprendo* project in which Jörg Oehlmann is participating is devoted exclusively to androgenic compounds.

Even if this is just an initial empirical sample, the Commission has already identified no fewer than 553 candidate substances for a more in-depth study of their endocrine effects. These products are now awaiting the necessary data and tests to evaluate them effectively. However, the list remains provisional. ●

(1) The most well-known are adrenaline (secreted by the adrenal glands), testosterone (produced by the testes), insulin (produced by the pancreas), thyroxin (produced by the thyroid gland) and oestrogens (secreted by the ovaries).



Jean-Pierre Changeux – 'There will always be a margin of uncertainty, a certain calling into question, in connection with any advance in scientific knowledge. Is this a reason not to try and know more?'

# A man of dialogue

Jean-Pierre Changeux is a man of spirit and surprises. It was exactly 20 years ago that this neurobiologist and humanist first sparked controversy when he published his *Neuronal Man*. Can we ever again be satisfied with the idea that the human brain simply operates like a machine, governed by electrical and chemical impulses? Since that publication, while continuing to progress in his research on neuroscience, Jean-Pierre Changeux has further pursued his investigations into the superior functions of the brain and the 'big questions' – such as those concerning truth, beauty and good – with are peculiar to our species.

'Following the decoding of the human genome, scientific research now allows us to hope for a better understanding of the brain and its functions, at the level of the individual and of society. Everything which previously lay in the realms of the spiritual, the transcendental and the intangible, is now becoming tangible, naturalised and, dare I say it, quite simply humanised', writes Jean-Pierre Changeux in his most recent book, *The Man of Truth* (see box). This is a statement which will not come as any surprise to those familiar with the author of *Neuronal Man*. Is Changeux an iconoclast? Perhaps, but in overturning beliefs, he is not short of arguments.



Diagram of the acetylcholine receptors, the first neurotransmitters (biomolecules ensuring the passage of influxes between neurones via synapses). In the brain, acetylcholine plays a key role in mental stimulation and memory functions. Its discovery, in 1972, is due to research by Jean-Pierre Changeux.

© Institut Pasteur

He has been working on the brain for the past 40 years. It all began while he was writing a thesis under the direction of one of the fathers of molecular biology, Jacques Monod. 'I learned from him the need to look for the elementary causes – that is the molecular mechanisms – of the phenomena of life, from simple bacteria to the reflective consciousness of the human being.' It was at this time

that the young Changeux helped to shed light on the concept of allosteric interaction (the property of certain proteins to be able to change form and function under the influence of signals from their environment). He became enthralled by the prospect of extending this model to synaptic transmission (sending a nervous signal from a neuron to another cell by a neuromediator).

## Neurons and synapses

This tireless scientific enquiry – he is currently engaged in innovative research on the nicotinic receptors in the central nervous system and the mechanisms of nicotine dependency – has taken on an increasingly multi-disciplinary approach. The Molecular Neurobiology Unit he has headed for many years at the Institut Pasteur includes researchers from many fields, including cellular biology, biochemistry, molecular genetics, electrophysiology and behaviour.

But Jean-Pierre Changeux is anything but a scientist holed up in his 'ivory tower'. He is also a professor at the Collège de France, where he turns his attention to a different subject every year, always carefully prepared. *Neuronal Man* (1983) summarises the content of his first seven courses and has proved a considerable success at the bookshops. This is not a work designed for the hermetic world of the specialist, but one in which the author tries to spread the message of the remarkable progress in our knowledge of the human brain by providing his thoughts on the radical changes which could result. But not without raising a frank and challenging question:

'The possible combinations linked to the number and diversity of connections in the human brain seem to be sufficient to explain human capacities. The divide between mental and neuronal activities is not justified.'

With this declaration, Jean-Pierre Changeux opens up a scientific debate with fundamental philosophical and

humanist implications. For him, an investigation of neurone and synapses must be accompanied by an enquiry into the major questions (such as conscience, thought, knowledge, truth, beauty) which constitute the very humanity of our species.

### From aesthetics to ethics

This cultured neurobiologist (he believes that science and its history belongs alongside art in our museums in illustrating the progress of civilisation) is familiar with the work of many of the psychologists, anthropologists, sociologists, philosophers and other experts on the human sciences who are abundantly cited in his works. As an art collector (especially French classicism) and amateur organist, he is naturally inclined to delve into the concept of beauty, and in his work *Reason and Pleasure* he forges a new research discipline: neuroaesthetics. ('Science does not identify with reason, nor art with pleasure, but there is no science without pleasure nor art without reason.')

His current interest is ethics. He had already broached the subject in *Conversations on Mind, Matter and Mathematics*, a book of conversations with the mathematician Alain Connes, devoted mainly to relations between the brain and mathematics. A few years later, in 1992, President François Mitterrand asked Jean-Pierre Changeux to chair the French Committee of Ethics for Life Sciences and Health. He was confronted by many 'practical' questions (drug addiction, cloning, gene therapy, etc.) during this experience which involved contacts with many different personalities – including the philosopher Paul Ricoeur.

He worked with this moralist, who does not deny the existence of either the 'soul' or of transcendence, in a further work, entitled *What makes us think?* 'We often found ourselves taking opposing views on scientific questions such as the origins of human thought. But, surprisingly, on matters of ethics and how to debate them in contemporary societies, we based human specificity on common values. That leaves the question of where these values come from.'

### Science as an instrument for truth

Jean-Pierre Changeux believes that we must look for the answer in our brain and its epigenetic structuring in relation to the history of morals and of society.

'The mistake is that, very often, there is insufficient distinction between common fundamental ethical dispos-

## A passionate humanist

In his latest book, *The Man of Truth*, Jean-Pierre Changeux endeavours to establish a 'fresco' of the answers which the immense field of research opened up by neuroscience, genetics and the cognitive sciences could provide to the question of what constitutes the originality of the human species. In his approach, Changeux awards particular importance to the epigenetic hypothesis, according to which the development of the brain involves, in addition to the action of genes, an intrinsic development coordinated by the learning and experience particular to each individual. Our capacities for thought and reflection, our ability to produce, communicate and accumulate knowledge, as well as our constant aspirations to find a common truth or ethics, at the individual and collective level, are all viewed with the scientist's eye. 'Does this lead us to the death of Man? On the contrary. I see in this a prodigious "brew" of vitality', writes Changeux. Because more than anything else, this researcher – inspired by progress in scientific knowledge but unfailingly lucid about possible illusions – is a passionate humanist.

itions (the representation of the self as another within the social group, the strengthening of the social link through co-operation, the non-acceptance of murder, lies, etc.) and social conventions, myths and sacred texts. The latter vary depending on culture, history and geography. It is important for diverse human societies to come together and to unite around what they have in common rather than concentrating on the differences, while at the same time accepting both the existence and the value of these differences.'

Why is it that the ability to tell the truth is a trait peculiar to the human species? Is this not an activity which can bring our societies together in their quest for truth, namely through progress and science? The reflection and dialogue which can produce authentic agreements must therefore be conducted at global level. Utopian perhaps, but the Fundamental Charter for Human Rights is nevertheless a reality. Why not seek 'universal ethics', perhaps by starting with the creation of a World Committee on Bio-Ethics, acting in a consultative capacity and within the UN framework?

### To find out more

- For details of all publications by Jean-Pierre Changeux see the Institut Pasteur website (click on scientific information – publications) [www.pasteur.fr](http://www.pasteur.fr)





Tropical rainforests covered approximately 1 116 million hectares in 1997. This photo shows Counami Forest in French Guyana, photographed in 2002 by researchers from the JRC, and CIRAD, a French scientific body specialising in agronomic research in hot regions.  
© Valery Bond

Why have we been unaware for so long of the real state of our tropical forests? At the United Nations, the Food and Agriculture Organisation (FAO) has the job of assessing forest areas and the rate of deforestation. However, its regular global reports are based solely on national statistics supplied by Member States as it does not have a mandate to undertake any direct monitoring itself.

Although some countries lying in tropical regions have reliable data, largely due to a lack of resources, others only provide a very vague picture of the situation. Therefore, the FAO must arrive at estimates as best it can by comparing statements from various national forestry services – which are not always available or accurate – with information gleaned from, sometimes out-of-date, maps and the opinions of experts. The situation is further complicated by the fact that each country has its own methods of calculation and criteria – sometimes not even agreeing on what qualifies as forest!

The Intergovernmental Panel on Climate Change<sup>(1)</sup> recently condemned the fact that, 'for tropical countries, estimates of deforestation are subject to great uncertainty and could include margins of error of around 50%'.

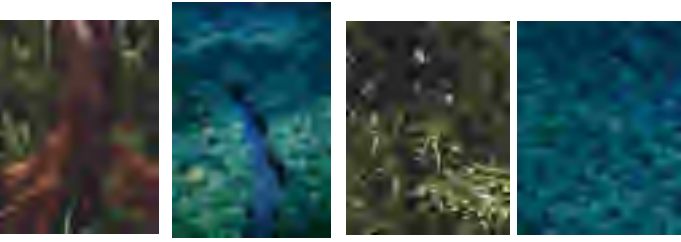
# Tropical forests:

**Reduced biodiversity, increased soil sterility, erosion, fires and desertification all pose a threat to our tropical forests. But how do we measure the true extent of these dangers facing the 'Earth's lungs'? After several years of floundering in the dark, the painstaking efforts of researchers on the Trees project promise to shed new light on the issue. The meticulous study of satellite images over the past decade is now permitting the first reliable diagnosis of the health of our rainforests.**

## Removing the uncertainty

A study by a team from the Joint Research Centre (JRC) in Ispra (IT) has greatly reduced this uncertainty. Its findings were published in the August 2002 issue of the US magazine *Science*. Working together on the European Trees project, financed by DG Environment, these researchers have produced figures based on satellite pictures with a 95% level of reliability. Results now being published by other teams would seem to confirm the validity of their approach.

'We were not trying to come up with a complete inventory of the humid tropical forest belt as a whole, as that would have involved processing a huge volume of data. We wanted to concentrate our efforts on sensitive locations where we knew something was happening', explains Frédéric Achard, a researcher at the JRC's Institute for the Environment and Sustainable Development. 'Deforestation is a fragmented phenomenon, concentrated in very specific areas. The first task for Trees was, therefore, to carefully select the best sample sites.'



# measuring the damage

## Comparing the images with reality

The observation sites were selected by generating a map of the world's deforestation hotspots.<sup>(2)</sup> Around 100 samples were selected, each with a surface area of 90 x 90 km or 180 x 180 km, covering in total 6.5% of the Earth's humid tropical landmass. 'Local institutions and European experts, making 27 partners in all, then studied the images obtained by two Earth observation satellites: the US *Landsat* and the French *Spot*, which the Trees project had selected from dates closest to the years 1990 and 1997 – photos from well-stocked and well-referenced collections', says Hans-Jürgen Stibig, South Asia coordinator for the Trees project. 'This made it possible to compare these images with the reality on the ground.'

Interpreting satellite images to produce forestry maps requires an excellent knowledge of the situation in the field. It is not always easy to distinguish between the original forest and very dense regrowth –especially if the terrain is hilly or mixed– when looking at photos of plots measuring several hundred square kilometres. The high resolution of the images (between 20 and 30 metres for the most precise) supplied by the *Spot HRV* and *Landsat TM* sensors meant repeatedly checking and rechecking the image against the situation on the ground until reliable maps could be generated and a sound diagnosis made. Next came the statistical phase which made it possible to deduce a global picture of the humid tropical zone as a whole on the basis of the sample sites.

## Not as good as it sounds

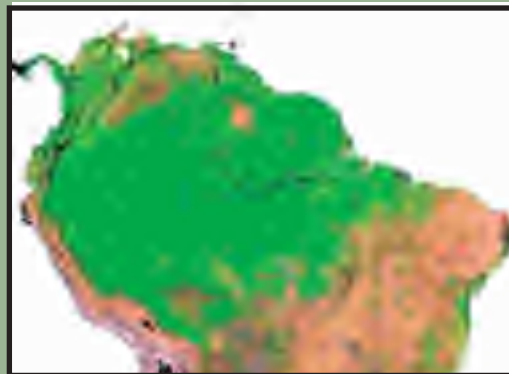
The results were the fruit of four years of concerted effort and their publication by *Science* magazine is a mark of approval for the quality of the research. So what do they say? Between 1990 (the reference year adopted by the Kyoto Protocol) and 1997, 5.8 million hectares of humid tropical forest –an area twice the size of Belgium– were lost every year. Another 2.3 million hectares are 'visibly degraded', indicating, for example, low-intensity



## Envisat's all-seeing eye

One of the latest developments to come out of the European Space Agency, the *Envisat* satellite, could prove a very valuable instrument in monitoring global vegetation cover, especially deforestation hotspots. By combining the information supplied by different sensors (ASAR, AATSR and MERIS), it should be possible to distinguish forested areas, felling areas and agricultural land, thereby monitoring trends in land use.

The AATSR sensor is also able to detect the heat emitted by forest fires, while two other instruments (MIPAS and SCHIAMACHY) are sensitive to the gases and aerosols associated with these fires. This could provide valuable additional information on the start of fires and thus aid rapid-response operations by firefighters.



Lacking the 'single eye' now provided by *Envisat*, the Trees project used a mosaic of images provided by a number of satellites (in this case provided in 1999 by the ERS-2 / ATRIS-2 sensors) to build up the most comprehensive global maps possible of the distribution of the ecosystems of continental tropical forests in South America.

Working with high-resolution satellite images, the first task of the Trees project was to generate a map of the Subcontinental distribution of forest cover on the basis of the data available for the early 1990s. This image shows the forestry map for Central Africa on a scale of 1:5 000 000. Map generated under the direction of Philippe Mayaux (JRC).



forestry, where the exact extent of the damage is not detectable by the method used.

These figures came as a surprise to the scientific community as they are, in fact, 23% below the FAO figures, which many had thought underestimated the situation. 'But having to somewhat downwardly revise the figures is no reason to speak of *good news*', Hugh Eva, co-author of the article, is quick to point out. 'It does not, in any way, alter the fact that deforestation is continuing at an impressive rate. But we have considerably reduced the uncertainty, which is positive. We have also identified the zones where deforestation rates have been and remain the highest, which is very important.'

The regional and local information contained in the Trees survey sound a timely warning. Of the 100 samples studied, 16 suffered an annual deforestation rate above 2.5%. The most seriously affected continent is South-East Asia (0.91%), followed by Africa (0.43%), and Latin America (0.38%). The rates attained in some zones are very alarming: between 3% and 4% loss per year in some areas of the Amazon, as much as 4.7% in Madagascar and between 3.2% and 5.9% in the interior of the island of Sumatra.

### Downward revision of carbon sinks

The results obtained by the JRC researchers at Ispra are also valuable in another respect. They provide details of the quantity of carbon released by deforestation – vital information for scientists who are trying to model the climate of the future. After examining the cleared surfaces and estimating the amount of carbon released per surface unit, Frédéric Achard and his colleagues concluded that deforestation in tropical regions had the effect of releasing approximately 1 Gt (one giga tonne, or a billion tonnes) of carbon every year from 1990-1997.

Adopting an approach based on global CO<sub>2</sub> flows, the IPCC estimated this annual amount, for the past decade, at 1.6Gt. This significant difference suggests that many



A clearing in the Amazon forest in the Mato Grosso of Brazil. Aerial photograph taken by Eva Hugh (JCR) in 1999.

## Pockets of biodiversity

Tropical rainforests house an unusually wide range of species. Although figures differ, they are generally considered to be home to between 50% and 60% of the world's biodiversity, while occupying just 7% of the surface area of continents and 2% of the Earth's surface. A study carried out in the Panamanian forest counted 1 200 species of Coleopterae (80% of them previously unknown) on just 19 trees.

The fragmentation and shrinking of forests is clearly reducing the number of species this environment can support. Some animals need large habitats to survive and their disappearance has a knock-on effect on other species. Conservationists believe that a *mixed* policy that both reduces virgin forests and protects a portion (say 10%) in the form of reserves or sanctuaries would result in the loss of one half of all species.



Location of global hot spots in the humid tropical belt, generated on the basis of a sample of 100 observation sites studied as part of the Trees project.



Amazon forest – Brazil, 1999 – Aerial photograph taken by Eva Hugh (JRC).

uncertainties remain regarding our knowledge of the carbon cycle. That could mean that the capacity of forests to act as carbon sinks is less than was originally thought. This is not without implications at a time when some countries invoke the extent of their forested areas as justification for their reluctance to reduce their emissions.

### What next?

The question of follow-up work is already receiving attention. The JRC researchers showed that it is possible to monitor precisely the rate of deforestation with relatively modest resources. 'When we launched the project we had to buy the satellite images', explains Philippe Mayaux, Trees coordinator for Africa. 'But today many images are available at a very low cost or even free of charge and can be consulted on the Internet.'

By supporting this research, the Union has clearly served the cause of sustainable development. However, the role of unilateral monitor of tropical deforestation is outside its field of competence. Now that the procedures have been developed, the statistical methods tried and tested, and many of the hotspots identified, it is to be hoped that the international community will continue the monitoring work with a view to arriving at global conservation policies. ●

(1) This group is the official assembly of thousands of experts from across the globe and was set up in 1988 by the World Meteorological Organisation and the UN Environment Programme.

(2) This map is available at the Trees site: [www.gvm.ies.jrc.it/Forest/defaultForest.htm](http://www.gvm.ies.jrc.it/Forest/defaultForest.htm)

### Contact

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### To find out more

- Site of the TREES project  
[www.gvm.ies.jrc.it/Forest/defaultForest.htm](http://www.gvm.ies.jrc.it/Forest/defaultForest.htm)
- The Commission's 'tropical forests' site:  
<http://europa.eu.int/comm/development/lex/en/forests.htm>

## The fires of deforestation

The deforestation and selective extraction of timber is making tropical regions increasingly vulnerable to fires. The phenomenon can be easily explained. The holes created in the forest cover by fields, roads or felling are zones which enable light to penetrate, leading to a dryer environment.

Combined with an increased human presence, this creates a greater risk of fire. Of the 5 million hectares destroyed by fire in Indonesia in 1998, just 400 000 was genuinely virgin forest. The rest was situated in plantations, mining areas or areas with several years of regrowth after felling. Deforestation also presents a particular risk of fire in areas with a peaty subsoil. Dried peat is an excellent fuel and is sometimes used as such in Indonesia, where it can be up to 20 metres thick.

# A monumental task

The façades of historical buildings concealed by tarpaulins are a familiar sight in our towns and cities. After being cleaned and repaired, they are unveiled again. Restored almost to their original splendour, they quickly become coated once more in the 'soot' caused by atmospheric pollution. European researchers are now studying this recurrent problem.

We must face reality. Even if we have sharply reduced urban industrial pollution caused, this has been largely offset by the polluting gas and particle emissions of cars. And it is these that are the major cause of the dirt that becomes encrusted on the facades of historical buildings and monuments', stresses H el ene Cachier, a researcher at the France's Centre National de la Recherche Scientifique (CNRS). Cachier, a chemist specialising in climate and environmental sciences, is coordinator of the **Caramel** project.<sup>(1)</sup> The project aims to correct our present lack of knowledge of the quantitative mechanisms by which particles of soot present in the atmosphere interact with stone materials.

'Although we understand the chemical nature of the damage, we still have to look at the causes. The mix of carbon soot found in the black crust which coats the stone is very complex. It contains carbon particles from motor vehicles, traces of interactions with atmospheric gases, and the effects of the wearing away of the material itself. Therefore, the carbon needs to be separated out from the other components and then really come under the microscope.'

The most difficult problem is to understand the various ways in which a monument reacts to a given concentration of pollutants. Launched in 2001, the Caramel project first focused on four test sites: the church of St. Eustache in Paris, Seville Cathedral, the Duomo in Milan and Florence Cathedral.<sup>(2)</sup> Samples were taken of the air and of the patina blackened by carbon particles.

Saint Eustache (Paris): the test was conducted on a turret, at a height of about 40 m, to guarantee a representative sample. Two funnels protect the two sampling lines (samples collected using a filter and an aethalometer, an automatic device for analysing carbon soot) from rain.



Milan Duomo: twin cherubs, one of which shows a very clearly defined area of black crust.

## A complex cocktail

A whole battery of instruments is used to capture and analyse the atmospheric pollutants and understand the variability factors. At specific moments, the mass, number and size of the carbon particles are determined precisely. Samples are collected by filters which are replaced weekly to assess seasonal variations. Initial findings have confirmed the importance of the presence of carbon particles in aerosols in urban areas. These are generated mainly by motor vehicles and vary according to peak traffic times, while also showing high sensitivity to meteorological conditions (air acidity or dampness). One of the most revealing findings was the degree to which readings taken at a single site can vary. The same measuring device can record, in real time, concentrations ranging from 0.5 to 35  $\mu\text{g}$  of carbon per  $\text{m}^3$ , depending on traffic levels.

One example is Seville Cathedral, which is situated in a predominantly pedestrian area. However, the Avenida de la Constitution, which is open to diesel buses, runs alongside it. This has meant that concentrations between the two facades of the cathedral vary by a factor of 10. Widely reported in the Spanish press, this attack on the city's heritage has prompted residents' committees and shopkeepers' associations to act. The transport authorities are now promising to phase out the diesel buses and replace them with electric ones.

(1) *Carbon Content and Origin of Damage Layers in European Monuments.*

(2) *Tests are now also being carried out on other buildings, such as the Florence Baptistery, the Louvre Museum, Trajan's Column (Rome), the Corner-Spinelli Palace in Venice, York Cathedral (UK) and Mechelen Cathedral (Belgium).*

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### To find out more

- [www.caramel.cnrs-gif.fr](http://www.caramel.cnrs-gif.fr)





## Letters

### About 'Talking Science' (1)

I regret that these difficult issues were covered so superficially and that there was no reference to the many high quality research projects which have been or are being conducted on the subject [of the relationship between science and the media]. As far as I can judge, you mainly provide a platform for the 'actors' (scientists and/or popularisers), as if the subject did not really deserve to be taken seriously, that is treated as a research topic in the field of the human and social sciences, and not approached from the point of view of the actors themselves (...). The incantatory litany of 'there must be more science on television' presented in *Talking Science*, together with the 'scientist-layman divide', is exactly the kind of thing that has been repeated endlessly by politicians over the past 20 years. It is a litany which ultimately comes back to the same old banality: it is all very simple, there must be 'more science on TV'.

In the meantime, the human and social science theses and research projects accumulate on the subject, trying in vain to de-simplify the reason-

ing of the politicians and the actors... but which clearly remain unread. This is a pity, because before recommending that Europe should commit itself to popularising science, one must have a very precise understanding of the mechanisms at work at the very local level and make the effort to read or consult with the people who have long been working on the subject! (...)

I hope that these words of criticism will cause you to dig a little deeper into the social circulation of knowledge, a subject widely covered by the human and social sciences, and by the communication sciences in particular.

Igor Babou

'Information and Communication Sciences' Education Section, 'Communication, Culture and Society' research team, Ecole Normale Supérieure Lettres et Sciences Humaines, Lyons (FR)

(1) This letter was addressed to us following the publication, last autumn, of the special edition *Talking Science*, devoted to the relationship between science and media.

## Observation

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