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Editorial

Climatic governance and political warming

Apparently, the 'Earth Summit' in Johannesburg will prove to be no exception to the rule which seems to apply to most events of this type, leaving in its wake a sense of disappointment mixed with a degree of satisfaction. While the absence of resolutions setting concrete and quantifiable objectives was widely condemned – especially by non-governmental organisations – this global meeting did produce two positive results.

First, there are the priority themes which finally dominated the Summit conclusions: water, health and poverty. Clearly identifying these three basic concerns to humanity as fundamental objectives is encouraging and shows that such major meetings are not totally removed from reality.

Secondly, there is the image of mobilisation and solidarity presented by the European Union. This certainly played a part in achieving most of the objectives the Commission had set itself.

At the same time, a note of disappointment must be sounded regarding the relative sidelining of science. The scientists may have been heard but they were not really listened to. Some of the political speeches ignored or even contradicted the 'facts' now supported by an accumulating mass of evidence. Hence the importance of good governance. It is simply not enough to support research financially; its results must also be communicated, discussed, shared and taken into account. Money alone is insufficient. There is a price to be paid for benefiting fully from the finance allocated to research and development.

We must recognise that the general context today is not the most favourable. Humanity is in great need of climatic governance and of a political warming to the cause.

DOSSIER

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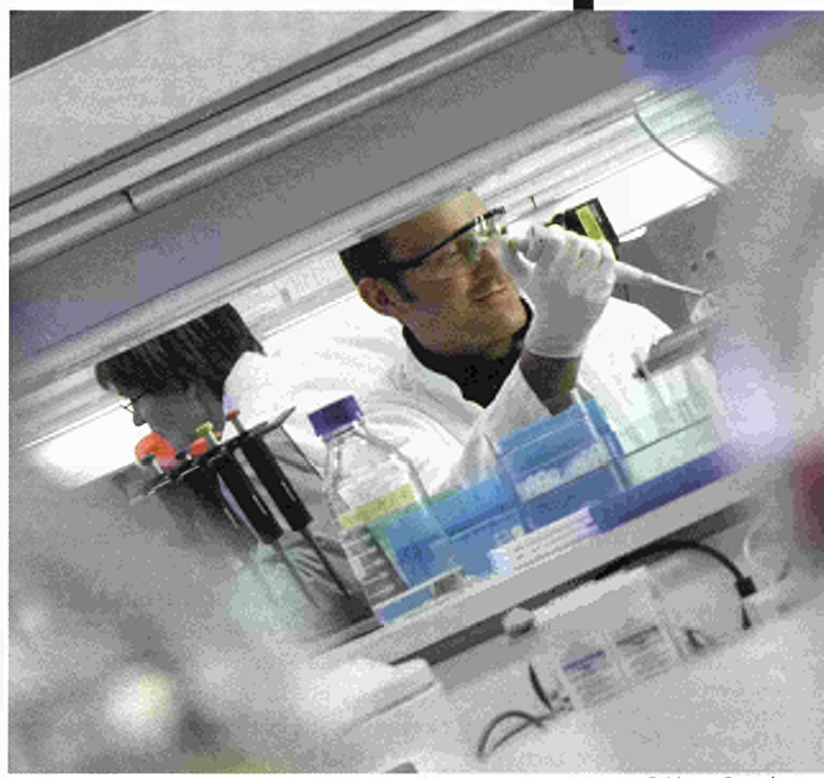
The revolution revs up

'Take increased investments, evolution in the legal framework and a new culture, and you have a so-called Old World able to compete with the United States.' It was in these terms that in May this year the American *Time* magazine painted a decidedly optimistic picture of the biotechnology sector in Europe. Although the United States has experienced an unrivalled boom in this field over the past decade, today there are unmistakable signs of a European awakening – among policy-makers, researchers and investors – based on the dynamics of rapprochement between the fundamental life sciences and their applications.



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An inseparable pairing of science and technology, a series of discoveries and a spirit of innovation have resulted in the biotechnologies providing a constant source of new applications in the fields of health, agriculture and the environment. They are enabling several traditional industrial sectors to regenerate and, more spectacularly, they are spawning new and innovative companies which already employ 87 000 people in the European Union. As stressed by European leaders at the Lisbon (2000) and Stockholm (2001) summits, as a result of their commitment to the acquisition of new knowledge, biotechnology companies are a vital element in Europe's accession to a knowledge-based economy.

This is a sector which reveals the true value of the European Research Area. 'European biotechnology can only compete with the rest of the world if we maximise research co-operation and minimise useless duplication. High-level researchers, whether working in the private, public or academic sector, must be the first to benefit from this quest for synergy,' stressed Philippe Busquin, European Commissioner for Research, at the major Biovision Forum held in Lyons (France) in February 2001. But the battle is not being fought in the scientific field alone. There is also a need to create an economic environment which encourages the creation of innovative companies or 'DNA start-ups', as they are sometimes called, which have doubled in number in Europe over the past five years.

The stakes are high with a European biotechnology market expected to be worth over €100 billion by 2005. Encouraging and training researcher-entrepreneurs, granting them access to financial resources through more open and abundant venture capital, and providing Europe with more coherent regulations on the marketing of biotechnological products are the main lines of the new strategy which the Commission – after wide-ranging consultation with scientists, economists and politicians – has proposed to the Member States and European Parliament (see *Decision time for the Union*).

In forging ahead in this way the greatest attention must also be paid to the heated public debate about this ongoing 'revolution'. How can progress in the life sciences be reconciled with the concerns of society? EU countries and the Commission have already taken initiatives to this effect, such as their commitment to giving clear priority to consumer protection and to considering the interests of the most vulnerable groups. New ethical questions have also caused the Commission to prohibit any funding of research on human reproductive cloning. These measures must be further strengthened as 'commitment to fundamental ethical values will be crucial in creating confidence and winning public support for the new biotechnologies', as Commission President Romano Prodi stated at the Lisbon Summit.

The announcement, in June 2000, that the human genome had been sequenced was a global event. It is symbolic of the life sciences entering the age of genomics and brings with it the promise of many new applications.

The crazy decade of sequencing

Arabidopsis thaliana, *the first plant to have its genome decoded, in 2001. Here, a collection of strains which have been generated at the plant improvement greenhouses at Versailles (France).* © Jean Weber

Over the past decade, biology has experienced one of the most radical transformations in its history: the decoding of genomes. Scientists had known since the 1950s that the genetic inheritance of all living creatures was desoxyribonucleique acide (DNA), a giant molecule in the form of a double helix, which is the main constituent of chromosomes. DNA carries the information needed for the synthesis of all proteins, which are the chemical building blocks of living creatures. Even when molecular biology was still in its infancy, biologists knew that each protein was coded by a gene: a long sequence of four chemical letters – the nucleotide sequence – which is the basic structural unit of DNA.

It remained a huge task, however, to decipher a text written in such a 'rudimentary' alphabet. It took the British scientist Frederic Sanger several years before he finally managed to decode the several thousand nucleotides which make up the genome of a small bacterial virus. Sequencing the human genome, with its 3 billion 'nucleotide letters', was a daunting prospect.

From genetics to genomics

Yet it was this sequence, decoded almost in full, which was published in 2000 by a world-wide consortium of laboratories, including the Sanger Centre in the United Kingdom which alone carried out one-third of the work. This remarkable international effort was the climax of the genome race in which Europe had been a forerunner. European research groups, supported by the Commission, had decoded the first genome of a nucleic cell (yeast) in 1997, followed by the bacteria *Bacillus subtilis*, which is very important in agri-foodstuffs, and finally, in 2000, the first plant, *Arabidopsis thaliana*. Today, the genomes of several dozen micro-organisms, including some model species for biologists, such as the *Caenorhabditis elegans* worm, the fruit fly (drosphila), the mouse – and, of course, man – have all been sequenced.

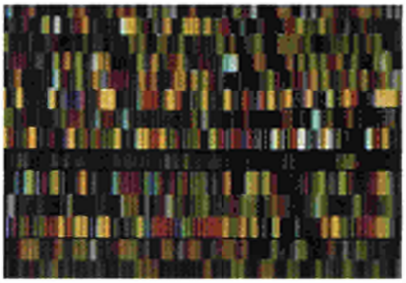
But the adventure is only just beginning. 'A concerted effort is now needed to exploit this vast medical, social and economic potential,' stressed Philippe Busquin in response to the announcement that the human genome had been successfully sequenced. Indeed, decoding the chain of nucleotides in a sequence is really only the beginning. The next steps are to seek potential genes, understand the variability between one individual and another, and to identify the mutations responsible for specific characteristics.

It is at this point that genetics gives way to genomics, or the study of the coordinated expression of the complete genome rather than just an isolated gene. Genomics – and its close relative proteomics which is concerned with the study of all the proteins in a living organism – are inextricably involved in the computer processing of sequences by *DNA chips*. The latter permit the automatic sequencing of nucleotide chains.

Key role for bio-informatics

To develop this booming discipline, the European Commission granted €9.4 million to the new European Bio-Informatics Institute in the United Kingdom, an offshoot of the prestigious European Molecular Biology Laboratory (EMBL) in Heidelberg (DE). The EMBL was at the origin of the *E-Biosci* project (which also received Commission funding, to the sum of €2.4 million) to create a huge databank of information and publications on genomics, to which there is free access.

This expansion of bio-informatics clearly illustrates one of the central characteristics of biotechnologies: their interdisciplinarity. The pioneers of genome studies were physicists. Chemists then took over to decode the genetic code, and now it is the turn of the computer scientists. 'Biotechnology would not assume such importance without the contribution of other sciences and technologies. Molecular biology would be unable to play a significant role in the global economy without chemistry, biochemistry, physics, electronics and informatics. Also, industrial and economic development necessarily involves human resources management, commercial law, intellectual property rights and finance,' explains Daniel Dupret, head of the Proteus company and an expert with the Research Directorate-General.



Coal, oil, and then silicon (with the arrival of electronics in the 1970s) each triggered an industrial revolution. For historians, DNA will no doubt be seen as the material behind the revolution we are experiencing today. Above, DNA sequences revealed to decode the human genome.
© INSERM: B.Jordan/M.Hunapiller

A thousand and one genome applications

Biotechnologies thus constitute a knowledge, tools and technology base with applications in a range of sectors, such as pharmacy, agri-foodstuffs, chemistry and environmental protection. The medicines production industry has already had recourse to technologies originating in the knowledge of genomes, for example. Insulin, obtained previously from pig livers, is now produced in bioreactors by bacteria or yeasts whose genetic make-up has been modified to add the coding gene for human insulin. This type of process, which makes it easier to satisfy quantitative requirements while at the same time providing a better guarantee of quality and safety, will soon be perfected for plants too which will then be able to produce therapeutic proteins under conditions of complete health safety. Over the next few years, progress in the life sciences will no longer give rise to new *processes* but rather to *entirely new products.*

In the field of health, genomics promises not just to treat previously incurable genetic diseases but also to develop treatment adapted to individual patients depending on their specific genetic heritage (see box). In agriculture, mastering genomes and the genetic modification of plant characteristics will permit a qualitative impact as well as an agronomic one. A good example of this is golden rice which is genetically modified to produce the beta-carotene molecule, a precursor of vitamin A that it does not contain naturally. Developed with EU support, this food could help fight blindness associated with a vitamin A deficiency which affects 200 million children worldwide every year.

Finally, new *services* could also be developed, thanks to the extraordinary power of the DNA chip which is able analyse the expression of an entire genome. It will be possible, for example, to define a sick cell at the genetic level or to measure the toxicity of new chemical substances without recourse to animal experimentation.

The enigma of methylation

The DNA sequence is a long chain of four chemical letters: the nucleotides. We know that these can exist in two forms: the traditional form and the so-called *methylated* form, which occurs when a certain hydrogen atom has been replaced by a methyl group (CH_3). The methylation of nucleotides does not change the nature of the coded protein. Rather it controls the level of expression by acting as a kind of 'off/on' switch for genes. In particular, different levels of DNA methylation, transmitted through the hereditary process, are associated with certain cancers.

The Human Epigenome Consortium, set up in 1999, aims to improve our understanding of the role of methylation in human diseases. The network, which the Commission supports as part of its 'infrastructure actions', includes the project co-ordinator Epigenomics of Germany as well as leading German sequencing centres (Berlin Technological University and the Max Planck Centre for Molecular Biology). 'Our principal objective is to construct a methylation map for the entire genome,' explains Alexander Olek of Epigenomics.(1) This is expected to have repercussions for cancer treatment, which is why the German Centre for Cancer Research in Berlin is also a member of the Consortium. Knowledge of a tumour's methylation profile – its *digital phenotype* – would make it possible to tailor treatment more specifically to the cancer cell characteristics.

To find out more
www.nature.com/genomics/

(1) Alexander Olek was named 'best entrepreneur of 2001' in the start-up category by Ernst and Young.

The time when universities and businesses regarded each other with mutual suspicion is well and truly over. In recent years the symbolic figure of the researcher-entrepreneur has become central to the organisation of research.

The age of the researcher-entrepreneur

Aware of the development of spin-offs and the desire of young researchers to give their work an entrepreneurial dimension, many European universities are now including a business creation component in their courses.
© NeuroSearch

'In the 1980s, most biologists who set up their own companies were scientists who had achieved a certain renown. Today, most of these budding entrepreneurs are younger researchers who are unable to fall back on their name or their contacts but who already have specialist knowledge and are attracted by the entrepreneurial adventure,' explains the Belgian researcher and specialist in immunology Donny Strosberg. As the co-founder of a number of biotechnology companies over the past 20 years, he was in at the beginning of this 'cultural revolution' which has given birth to a new kind of start-up.

Cultural change

Before taking the plunge, however, one must first have the training. Traditional academic culture – based on the widest possible dissemination of results within the international scientific community – is very different to private research which is guided primarily by the quest for a competitive edge. A researcher who plans to become an entrepreneur must therefore learn to keep things under wraps a little if he does not want to see his ideas stolen by his competitors, thereby robbing him of the rewards generated by their industrial application. He must also plan his company's activities over the years to come, raise investment capital, anticipate expenditure and revenue, draw up a business plan and enlist the help of genuine business managers. As European universities have grown increasingly aware of this trend – and of its benefits – so they have started to provide training on the many aspects of setting up a company.

For those who are already working and have limited time, the Eurobiobiz company (which received €193 000 from the Commission in 2002) holds workshops for future researcher-entrepreneurs on subjects including accounting, intellectual property, negotiation, human resources management and raising funds. These all feature in the programme during the three-day training courses held nearly every month in a different European capital. Twenty-five European biotechnology companies have already been set up by graduates from these courses.

Setting up a company is not, of course, the culmination of the efforts of the lone researcher-entrepreneur. It is the result of countless meetings, contacts and negotiations with financiers able to back what are often costly projects. This is why every year the 'Biotechnology and Finance', forums – initiated in 1998 by the Commission and the European Association of Security Dealers – bring new biotechnology companies and researchers with interesting ideas into contact with representatives from the world of industry and finance who are in a position to help them raise the funds they need.

Double flexibility

Once a company reaches a certain stage in its development, it becomes impossible for the researcher-entrepreneur to run the business single-handed. At this point a specialist must be brought in to take control of business and financial management. Some of these become *business angels*, stepping in when needed to make their experience available to young researcher-entrepreneurs, while others become serial business creators. As Donny Strosberg explains, 'When you notice you are becoming less useful in a company because the research has reached the development stage you then have to know how to step aside and make your skills available to another organisation.'

To find out more

- Eurobiobiz
  www.eurobiobiz.com
- Biotechnology and Finance forum
  http://europa.eu.int/comm/research/biotech/finance.html

Investors in the long term

Research is expensive. A young biotechnology company has to raise new capital at each stage of its development. The growth of venture capital in Europe and the development of new stock markets have facilitated access to this vital ingredient

When studying the feasibility of a project to create a biotech company, private investment and national subsidies are usually enough. But for the actual start-up, recourse to *venture capital* funds is needed. These specialised financial structures invest simultaneously in a number of high-tech companies, counting on the profits made by the fortunate few to offset the losses incurred by those who fail.

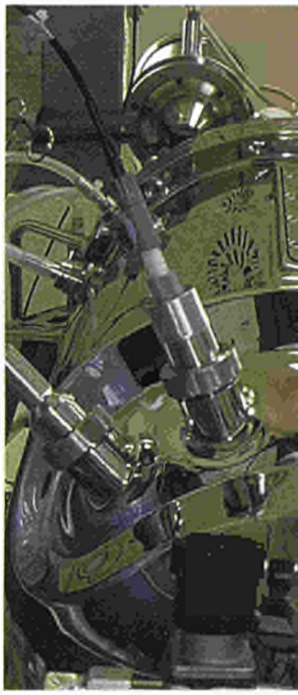
Europe's helping hand

For many years a lack of venture capital was a brake on the development of advanced technologies in Europe, especially in the life sciences. This was in marked contrast to the United States where this specialisation made its appearance back in the late 1970s. To correct the deficiency, the Commission turned to the European Investment Bank (EIB), which launched the *i2i* initiative, making a billion euro available to venture capital operations over the following 12 months, mainly in new information technologies and biotechs. The EIB also operates through the European Investment Fund (EIF) in which it has a 60% stake (30% being held by the Commission and 10% by major financial institutions). The EIF helps high-tech companies to start up by financing business incubators, and it is biotechnology which, in practice, benefits most from this mechanism. Most recently, the EIF has invested €20 million in Heidelberg Innovation in Germany, €29 million in MVM International Life Science (a subsidiary of the British Medical Research Council) and a further €10.5 million in Nordic Biotech K/S which incubates start-ups in the Scandinavian Medicon Valley.

The end result is that European biotechnology companies are now able to count to a growing extent on experienced venture capital funds with available capital. Consequently, viable projects which fail to get off the ground are becoming increasingly rare. In fact, venture capitalists who, two or three years ago, preferred to invest in new information and communication technologies are now turning their attention to life science companies which they see as having better long-term prospects. At a time of stock market unrest, the latest figures cited in the Ernst & Young report confirm this. Whereas venture capital investments in the high technologies fell by 31% between 2000 and 2001 – the bursting of the Internet bubble decimated the ICTs – investments in biotechnology companies fell by just 16% compared with 2000, a year which had broken all records. The only cause for concern was the low investment in biotech projects for agriculture. Venture capitalists fear the consequences of the public debate on GMOs and are reluctant to invest in agri-biotechs in Europe at a time when the sector is booming in the new emerging economies.

From venture to development capital

Nevertheless, raising the necessary venture capital is just one step in the long process which leads to the marketing of a biotechnological product. Clinical trials and securing authorisation require a fresh capital injection. This is what is known as development capital, and is usually provided by financial markets specialising in high technologies. There are two ways for a company to be launched on the stock market in Europe: through one of the five new markets (London, Frankfurt, Milan, Amsterdam, Paris), or directly at European level through the Nasdaq-Europe. 'These new financial markets have created a very beneficial new dynamic, but they remain too fragmented,' is the view of Philippe de Taxis du Poët of the Research Directorate-General. Hence the idea of further integrating them through the Financial Service Action Plan. The FSAP is a set of 40 measures adopted at the Stockholm Summit in March 2001 and due to enter into force by 2005. The successful transition to the euro has made this integration even more desirable.



Equipment at the Computer Cell Culture Centre in Seneffe (Belgium), which specialises in cell culture for the production of vaccines and other therapeutic proteins.

To find out more

- European Investment Bank www.eib.org
- European Investment Fund www.eif.org
- European Venture Capital Association www.evca.com

One of the Cellectis laboratories. This newly created biotechnology company is part of the Pasteur Bio Tope business incubator, set up in December 2000. © Institut Pasteur

The number of biotechnology companies in the EU more than doubled between 1997 and 2001. Today, 1 879 companies employ 87 182 workers. This record growth – the highest in the world during this period – reflects Europe's new biotech dynamic having been left behind by the Americans for a long time.

A wealth of

It is happening all over Europe. While it was UK start-ups which led the field until the mid-1990s – with one-quarter of the firms and one-third of the capitalisation – today's European biotech landscape is multipolar. Germany, the United Kingdom, France, Scandinavia, the Netherlands and Belgium each have more than 150 biotechnology companies.

Biotech and high tech

This 'biotech boom' has brought with it some major qualitative changes. Until the mid-1990s, the term biotechnology was applied to all companies working on living organisms, as distinct from the traditional pharmaceutical and chemical sector. Progress in research and technological transfer have now blurred that distinction. In addition to the 'traditional' specialities (such as enzyme production through bacterial fermentation) there are now new activities requiring advanced research and high-tech tools, such as genome research for therapeutic purposes.

Mirroring the trend in the information and communication technologies, this changed life science landscape, characterised by a wealth of high-tech start-ups, has radically altered the relationship between SMEs and major companies, in this case pharmaceutical, agricultural and chemical. The latter were the pioneers until the 1980s, developing biotechnologies within their own research departments. But the dynamism of the biotechnology SMEs – often provided by the cream of academic researchers – has convinced the 'giants' to pursue another strategy and to set up partnerships and networks with the most creative SMEs.

These partnerships are clearly mutually beneficial: the start-up gains access to research funds and the large company acquires new technologies which it does not have the means to develop itself. Will this

Rice research. © Crop Design

Cereals of the future

It was in Ghent, Belgium, that in the early 1980s Marc Van Montagu's pioneering team developed their first transgenic plants. The city has retained its agri-biotech tradition and is now home to Crop Design, one of the most important European start-ups in this sector. With its roots in the Flemish Inter-University Institute for Biotechnology, and founded in 1998, the company now employs more than 70 persons in its 1 400 m^2 of laboratory space. It has also managed to raise €30 million in a two-stage capital increase.

So how did Crop Design manage to convince the venture capitalists? By pressing home the environmental benefits of the new generation of GMOs on which it is currently working, obtained by modifying the gene expression within the plant rather than by adding new genes. Under the Nonema European programme – on which nine academic laboratories are cooperating – Crop Design is also carrying out research on the auto-stimulation of plant defence systems against nematodes.

These worms attack the plant roots causing damage to crops estimated at €80 billion a year worldwide. The only available means of combating them at present is with chemicals which are not biodegradable and thus build up in the environment. An interesting alternative would be to stimulate the expression of certain nematode-resistant genes in the roots only, and then only in the event of attack by this parasite.

The *Traitmill* technology developed by Crop Design, which makes it possible to predict the effect of various genetic modifications on the development and agronomic qualities of the plant, is the design tool of the 'greener' generation of GMOs of tomorrow.

www.cropdesign.com

www.nonema.uni-kiel.de/

trend ultimately lead biotech start-ups to opt for independence and to start competing with the large groups? Or, once the genetic revolution is over, will we see the big groups buying out the outsiders, the dynamics of the start-ups being a temporary though highly efficient form of research?

start-ups

All-purpose enzymes

Enzymes – proteins which act as a catalyst for chemical reactions by binding specifically to one or more molecules – are very much the 'all-purpose' tool. They are found in pathogen detection kits, the paper industry and biosensors, for example. The difficulty lies in purifying them while at the same time preserving their biological activity. This is the principal activity of the British company Applied Enzyme Technology (AET) based in Pontypool in South Wales. Its chemists, biologists and physicists are all dedicated to the same goal: to control the enzyme's molecular environment so as to stabilise it while retaining its catalytic properties. The approach has already been applied successfully to more than 50 proteins, in particular as part of the European Diamonds (Directly Interfaced And Micro Or Nanostructured Detection Systems) project which the AET coordinated between 1997 and 2000. As this established the feasibility of the nano-technological approach, the next step is to develop applications. AET has thus joined the Safeguard (Sensor Arrays For Environmental, Generic And Routine Detection of Pesticides), project which is seeking to use immobilised enzymes as ultrasensitive sensors to detect pollutants.

- www.aetltd.com
- On the Safeguard project: http://europa.eu.int/comm/research/quality-of-life/cell-factory/volume1/projects/qlk3-2000-00481_en.html

The Union: new aid

Whichever proves to be the case, following the very strong growth over the past five years in Europe, consolidation is now needed. In terms of start-up numbers, the gap opened up by the United States may have closed, but the companies are too new to create revenue which is in any way comparable with the sums being generated across the Atlantic: €9.87 billion in Europe compared with €13.73 billion in the United States. The sector is struggling to achieve economic stability due to the scale of the initial investments in research. In 2001, total losses recorded for the sector in Europe amounted to €1.52 billion. Meanwhile, new products developed by US companies are now winning market shares which are earning them considerable revenue.

To support European genome research and its applications in the field of health, under the Sixth Framework Programme 2002-2006, a budget of €2255 million will be allocated mainly to aid integrated projects and to set up networks of excellence. Of this, 15% – or €338 million – will be devoted to integration of SMEs.

Consolidation also involves strengthening links between the individual biotechnology companies, in particular through partnerships or mergers between firms developing complementary technologies. 'A working group is being set up which will bring together the European Investment Bank and venture capitalists,' confirms Waldemar Kütt of the Research Directorate-General. 'This will look at new financing models to consolidate the growth of Europe's biotech industry in the longer term.'

The virtuous circle of the 'biovalleys'

Any moves to strengthen European biotechnologies must also study the circumstances which gave rise to their creation in the first place. 'Clearly the vast majority of European start-ups originated in a local context in the immediate vicinity of research centres. In many regions this was encouraged by a committed

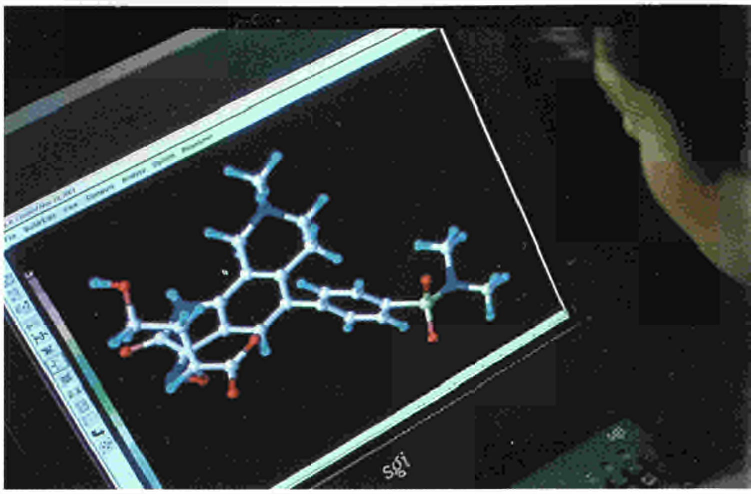
To find out more

- BioM AG
  www.bio-m.de
- Genopoles network
  www.genopole.org
- Manchester Bioscience Incubator
  www.bionow.co.uk
- The Rhine Biovalley
  www.biovalley.com

policy to create *biovalleys*,' explains Phlippe de Taxis du Poët. Biovalleys are a geographical concentration of high-tech companies around a local project for economic development, such as the BioM AG Munich Biotech development in Germany, the Manchester Bioscience Incubator in the United Kingdom, the Evry genopole in France, or the Biovalley – which has registered its name as a trademark – straddling the three countries of the Rhine Valley (Germany, France, Switzerland).

Why have companies concentrated in these areas? 'Because they not only find scientific excellence but also a stimulating environment offering them the means to evaluate the commercial potential of an idea or a technology, to conduct a market analysis, to create a managerial team and to seek finance, in particular start-up capital. These are all necessary to launch a business,' continues Philippe de Taxis du Poët. 'The biovalleys are therefore attracting innovative companies which in turn make the environment even more attractive, creating a virtuous circle which strengthens the link between the ability to discover and the ability to find commercial applications.'

It is a model which has proved its worth. It must now be disseminated and improved by networking and more generally facilitating exchanges of experience between biovalleys. 'The instruments of the new Framework Programme are open to any proposal to this effect,' confirms Waldemar Kütt.



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Medicon Valley

The densest concentration of biotechnology companies is found in the northern EU countries, between the Copenhagen (DK) area and Skania in Sweden. This *Medicon Valley* has 26 hospitals and 12 universities with 4 000 researchers and 135 000 students. It combines academic excellence with economic success, providing 30 000 jobs in more than 160 biotechnology companies, some of which, such as Denmark's Neurosearch – devoted to the quest for medicines to treat complaints of the central nervous system – have become genuine pharmaceutical 'strongholds'. The secret of such success clearly lies in the concentration in the same area of scientific excellence, a high-tech industrial fabric, a highly skilled workforce and a coherent strategy of government aid. But most important of all is the commitment to cross-border co-operation.

It all started at the end of the 1980s at a time when southern Sweden was being hit hard by the closure of its shipyards and textile mills. The Ideon Science Park opened alongside the University of Lund campus, its founders taking their inspiration from the US model of research centres and companies in close proximity, as in Silicon valley. At the same time, across the Øresund Straits, Danish researchers returned from a trip to the United States and founded the Medicon Valley Academy, a binational non-profit-making institution charged with the coordinated development of the dual site. Today the Medicon valley is attracting US companies, and Biogen of Cambridge, Massachusetts plans to set up its first European plant there – with the prospect of €350 million in investments and the hire of 400 employees by 2005.

- www.mediconvalley.com
- www.neurosearch.com

As the decade begins, biotechnology presents Europe with a strategic choice. It can follow – and be subject to – innovations developed elsewhere, or it can anticipate them for its maximum benefit, and to guide them in a way which Europeans would want. To face this challenge, the Union needs a shared and coherent vision and approach. This is exactly what the *Life sciences and biotechnology, a strategy for Europe* communication and action plan – prepared by the Commission and approved by the Barcelona European Council – aims to do.

Decision time for the Union

With sound know-how in the life sciences, Europe has not yet managed to draw maximum benefit from its scientific excellence, in particular as a result of the fragmentation of financial and human resources.
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At the Lisbon Summit in March 2000, European heads of state and government set the goal of 'making Europe the most competitive knowledge-based economy in the world by 2010'. The following year, the Stockholm Summit confirmed this ambition and stressed the importance of biotechnology in achieving it. The Commission was charged with developing the strategy. A first consultation paper was circulated in September 2001. That autumn, 320 contributions were received from governments, the European Group on Ethics (EGE), industrialists, researchers and individual citizens. These were all taken into account when drafting the final document, published in January 2002 and submitted in March to European leaders gathered in Barcelona.

This strategic vision is rooted in an inescapable fact: although Europe has a solid skills base in the life sciences, the use it makes of this scientific excellence falls far short of US performances in this sector. The Commission document states that one of Europe's major weaknesses is that 'total European investment in research and development lags behind that of the United States. Europe also suffers from the fragmented nature of aid to public research as well as the low level of inter-regional co-operation in research and development between companies and institutions in different regions of several Member States.' Thus, the lack of common goals and a shared vision of what is really at stake has meant that Europe has been slow to seize the challenges and opportunities of the new biotechnological age.

Strengthening the knowledge base

To correct the situation, Europe must first improve its capacity to use the potential advantages of these technologies by developing concrete research and development. 'When Europe works together, it is strong,' stated European Research Commissioner Philippe Busquin at the Biovision Forum (Lyon, February 2001), citing the example of European co-operation in genome sequencing. But he also added that 'aid to European coordination will also be important in the case of key emerging technologies, such as those promised by research on stem cells, xenotransplantation, nanobiotechnology and proteomics.

The Sixth Framework Programme (2002-2006), now finally adopted by the Union, is designed to be a key instrument in supporting this research. It includes two thematic priorities (*Life sciences, genomics and biotechnology for health* – with a budget of €2 255 million euros, and *Food quality and safety* – €685 million) which will be fully open to biotechnology while two others will have recourse to it (*Nanotechnologies and Sustainable development and global change*). This thematic concentration will be further strengthened by the very nature of the support which will be aimed above all at the implementation of integrated projects and the creation of networks of excellence able to generate co-operation throughout the European Research Area. Other programmes – such as support for SMEs and innovation, for the mobility of researchers, and for scientific infrastructures – will also encourage this mobilisation.

To find out more

- Document *A strategy for Europe* http://europa.eu.int/comm/biotechnology/introduction_en.html
- The European Group on Life Sciences http://europa.eu.int/comm/research/life-sciences/egls/index_en.html
- The European Group on Ethics http://europa.eu.int/comm/european_group_ethics/index_en.htm
- The European Research Area www.europa.eu.int./comm/research/era/index_en.html
- The Sixth Framework Programme www.europa.eu.int./comm/research/fp6/index_en.html
- European Organisation for Molecular Biology www.embo.org

GMOs: a social issue taken into account by one of the principles of European strategy: **responsible governance of the life sciences and biotechnology.** *Above, colza microplots for research on herbicide-resistant plants.* © *J.Gasquez*

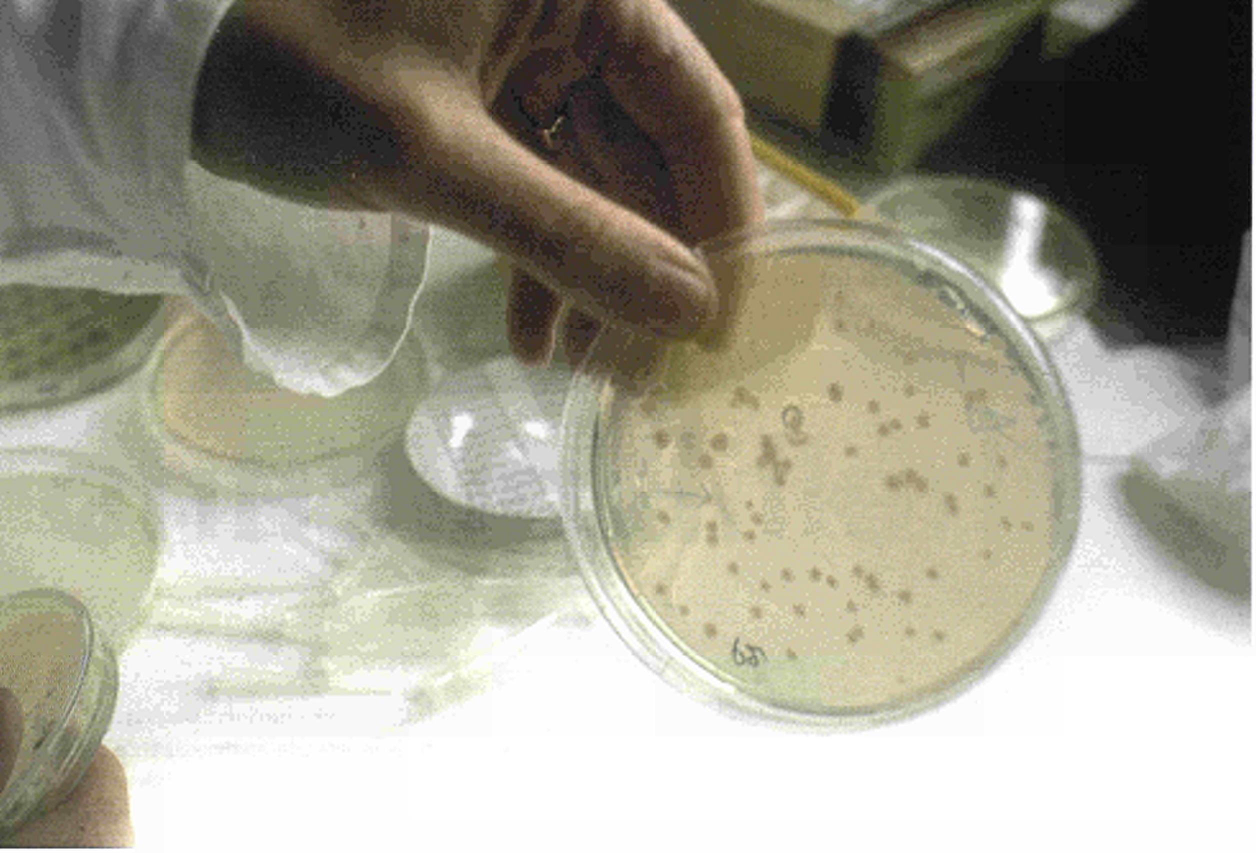
Ethical vigilance

This aid for research and innovation must not, however, conceal another key aspect of the biotechnological revolution: the need to exercise control over the ethical and social choices presented by the applications generated by this new knowledge. In Europe, as elsewhere, development must be clearly in line with the sensitivities of society. If not, the whole dynamic could be lost. Hence the importance of the second principle of European strategy: *responsible governance of the life sciences and biotechnology.*

The present subjects for public debate range from genetically modified foods to the use of embryonic human stem cells, these issues representing just some of the changes brought about by progress in the life sciences. The aim of forums for dialogue with society, such as those organised by the *European group for life sciences,* (1) is to broaden the discussion by presenting well-founded hopes in terms of combating diseases and hunger in the world. This group has already organised two open conferences on genetics, and stem cells. Its next forum will look at the contribution of the life sciences to sustainable agriculture in Developing countries. Other bodies will be asked to participate in the interests of impartial vigilance, such as the *European Group on Ethics.* Finally, the seventh priority axis of the Sixth Framework Programme, *Citizens and governance in a knowledge-based society,* will finance research on the socio-economic impact of biotechnology.

Rhythm and regulations

Encouraging society's support for biotechnology also means getting the products of biotechnology on to the market as quickly as possible. 'We must ensure that new products are safe for the consumer and the environment while at the same time providing the clarity and visibility which the societies which market them need so much,' explained Philippe Busquin at the Biovision Forum. New more coherent rules that are standardised at European level will therefore apply to the distribution of new medicines, such as conditional authorisation for one year and an accelerated examination of files on products of importance to public health. The regulations governing agri-biotechnology will also see some changes with the harmonisation of legislation on the use of GMOs in animal feedingstuffs, their detection, and the monitoring of any risks (or benefits) for the environment. In all cases the approach is the same: to reduce the margin of uncertainty surrounding the risks and benefits, and to provide objective facts as a basis for regulated monitoring with a view to international recognition.



'The life sciences and biotechnology are not a panacea and will not solve problems of distribution affecting the developing world. But they are one of the major instruments for so doing.'
© INSERM

An international vision

As the biotechnological revolution concerns the whole planet, there is a need to 'respond to this global challenge' – the third strand of European strategy – through international dialogue on regulatory matters, in particular within multilateral forums such as the World Trade Organisation (WTO), the Protocol on Biosecurity, or the various UN agencies. It is within these bodies that such issues must be debated if the Union is to play a leading role in setting a course, standards and recommendations on the basis of international scientific consensus.

The international approach must also take into account its special responsibility towards developing countries. The biotechnologies offer many new opportunities for providing global food security, combating Aids and preserving biodiversity. 'The life sciences and biotechnology are not a panacea and will not resolve the problems of distribution affecting the developing world. On the other hand, they will be one of the instruments in achieving this,' states the Commission's strategic document. Through increased scientific co-operation, Europe must help the developing countries to manage the risks, challenges and possibilities of these new technologies, in accordance with the choices made by each one of them. (2)

The adoption of this European strategy will serve as a reference for meeting the challenges presented by the explosion in the life sciences. It is nevertheless difficult today to say what will be the questions raised by developments in biotechnologies over the next five or ten years. This is why the Commission wants to receive regular reports on the coherence of EU policies and legislation. All those with a stake in European biotechnologies are already invited to participate in the refining and implementation of the initiatives proposed.

(1) See site in margin.
(2) See the article on the EDCTP initiative on clinical trials in Africa, page 34.

Five European laboratories have teamed up to work on a fascinating project to study the oceans' smallest inhabitants. We now know that these minute microcellular creatures play a key role in maintaining some of the world's major ecological balances.

The lilliputians

Sampling picoplankton in the coastal waters close to Roscoff (France).
© D. Doussal – Roscoff Biological Station

Picoplankton? We encounter them all the time. The tiniest drop of sea water is teeming with these organisms less than three microns in size. (1) Every time we take a dip, we are surrounded by billions of picoplanktonic cells.

These minute creatures – 25 years ago we did not even know they existed – remain an enigma. The European Picodiv project (*Exploring the picoplankton diversity*) aims to shed light on some of the mystery which surrounds this whole swathe of living creatures, concentrating in particular on phytosynthetic eucaryotes, (2) the picoplankton about which we know least of all.

Similar but different

'To date we have identified around 4 000 species of *traditional* phytoplankton. These are visible to the naked eye and commonly measure around 100 μm", as in the case of diatomea, for example, a very abundant species of unicellular algae,' explains Daniel Vaulot, a researcher at the Roscoff Biological Station in Roscoff, France and co-ordinator of the Picodiv project. 'But only about 30 species of picophytoplankton have been described. This is a derisory figure as we suspect there are a great many species of these truly minute organisms.' *Picophagus flagellatus* (described in 2000) measures around 2 μm, while the very abundant *Prochlorococcus marinus*, is among the smallest at just 0.5 μm.

To complicate matters, these oceanic lilliputians have the annoying tendency of resembling one another. Many are spherical in shape and green or brown in colour. This similarity does not, however, prevent them from displaying big differences in metabolism, environmental preferences, dynamism, pigments and other proteins. In short, they may look the same but they are in fact quite different.

'To describe a unicellular organism, in principle you have to be able to cultivate it,' continues Daniel Vaulot. 'The situation is further complicated with picoplankton because the usual nutritional environments always select the same species, which proliferate at the expense of those we are interested in. So we must take great pains to refine our culture mediums. We have achieved this with some success, but still have a long way to go.'

The latest molecular tools

Researchers are therefore using new techniques to try to penetrate the mysteries of picoplanktonic diversity, turning in particular to the latest advances in molecular biology. Carlos Pedros-Alio, of the *Instituto de Ciencies del Mar* in Barcelona, is one of the experts on these genetic tools with the Picodiv team. 'Even if a species is not described in the traditional sense, we can obtain a *genetic signature*,' he explains. 'We have succeeded in identifying very variable zones in the genome of these micro-organisms, more specifically in the sequence of the 18S ribosomal RNA gene. When two individuals show very different sequences in these zones, we can consider that they belong to different species, although it is not really very accurate to speak in terms of species for such minute creatures. When the differences exceed a certain limit, we consider they belong to distinct genres or classes.'

These signatures make it possible to detect changes in the composition of picoplanktonic communities. The so-called Denaturing Gradient Gel Electrophoresis (DGGE) technique is then applied. The 18S RNA gene is amplified in a seawater sample and deposited on a gel which is then subjected to an electric current causing the molecules to migrate. The result is a series of bands which form a *fingerprint* defining a given population. By using this tool, researchers are able to determine how, depending on the place and time of year, different picoplankton varieties succeed one another in the marine environment.

Also, it is now possible to count picoplankton, to define the density of a particular species. The method, known as Fish (Fluorescent In Situ Hybridisation) is quite simple.

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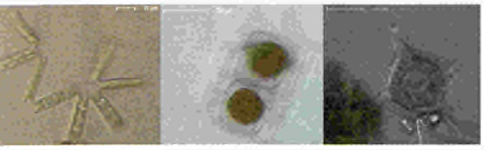
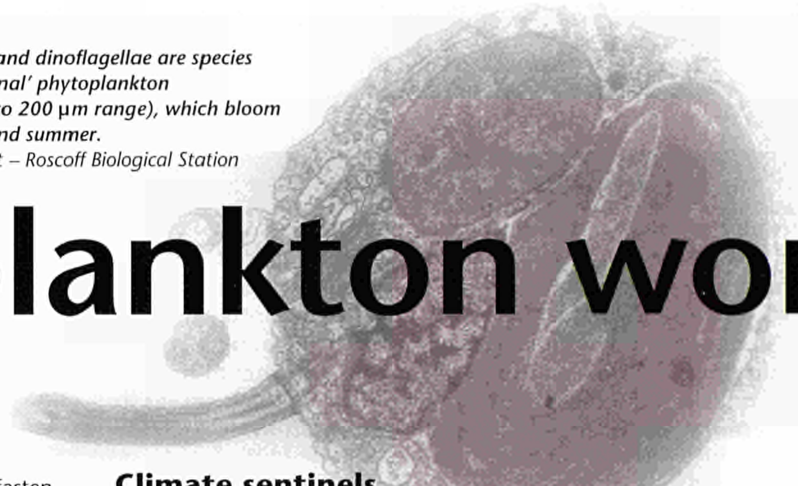
Internet site

www.sb-roscoff.fr/Phyto/PICODIV/



Diatomea and dinoflagellae are species of 'traditional' phytoplankton (in the 20 to 200 µm range), which bloom in spring and summer.
© D. Vaulot – Roscoff Biological Station



of the plankton world

'We prepare small quantities of DNA designed to fasten on to the *signature* of a given species,' continues Carlos Pedros-Alio. 'We then add a small fluorescent molecule. When this DNA solution is mixed with a sample taken from the ocean, a comparison between the proportion of fluorescent individuals and the total population (that can be counted under the microscope) gives us the proportion of the variety we are interested in.'

Bringing back the bounty

Finding out more about picoplankton could bring many benefits. There is certainly a fundamental aspect relating to knowledge of the life sciences. 'There are very complete catalogues of stars, some of which are millions of light years away,' stresses Carlos Pedros-Alio. 'It would be paradoxical not to know something about the populations of the water in which we bathe.'

Participants in the Picodiv project regularly work at three sampling sites, chosen as representative of the diversity of European coastal waters: Roscoff (Channel), Helgoland (North Sea) and the Bay of Blanes (Mediterranean). They also take part in a lot of marine expeditions, from the Arctic to the South Pacific. 'We sometimes have the impression we are working in the European tradition of the great 17th century naturalists who returned from every trip with new and extraordinary species and laid the foundations for the taxonomy of living organisms,' adds Carlos Pedros-Alio.

Climate sentinels

Important discoveries concerning the biology of this whole layer of life are already in prospect. According to Daniel Vaulot, ' heterotrophic eucaryotes (those without chlorophyll) used to be considered exclusively as predators. We now believe their role could be much more complex and varied, ranging from breaking down organic material to parasitism – none of which was suspected five years ago. In some waters, the picoplankton represent 80% of the biomass and play a determining ecological role at global level. Not only are they at the base of the food chain, but they are also involved in essential cycles of matter, especially of carbon or nitrogen. This means that a sound knowledge of the biology of picoplankton is essential for an accurate modelling of climate development.' When the associated species have been identified (in warmer waters or in waters rich in a given nutrient, for example), a simple sampling will tell us whether these indicator organisms are present.

Some species of picoplankton are also known to be toxic, so it is better to have tools with which to detect them.

'In this new field of research, co-operation between European laboratories gives us the critical mass needed to hold our own in the face of the US teams,' stresses Daniel Vaulot. 'In a sense, we are the pioneers of the study of small eucaryotes, a field that is proving very fruitful.' It is not for nothing that the work of the Picodiv researchers has been featured in the pages of *Nature* on a number of occasions.

(1) Three thousandths of a millimetre, or 3 µm.
(2) Eucaryotes are cells with a genuine nucleus, unlike bacteria.

SUSTAINABLE DEVELOPMENT RTD info N° 35 October 2002 | 17

Revealing the hidden costs of energy

Europe has made a determined choice towards a policy of sustainable development. To be effective, this must involve a review of economic calculations to include previously ignored costs. If these 'externalities' were to be taken into account in the energy field, the price per kWh of fuel of petroleum origin would double. The ExternE, NewExt and ExternePol projects have developed a remarkable methodology which serves as a reference for this new kind of cost calculation.

Known as *externalities*, these hidden costs relate mainly to health and environmental expectations. Burning one tonne of coal at a fossil-fuelled power station, for example, results in the emission of many substances into the atmosphere. These have various effects within the perimeter around the emission point, including an increase in respiratory diseases, deterioration of buildings and lower agricultural production.

The external costs of electricity production in Europe vary from one European country to another depending on technological and demographic differences. In Germany, for example, the external cost per kWh produced by a windmill is 0.05 cents compared with between 5 and 8 cents for electricity produced by an oil-fuelled power station.

For the community these negative effects are costs which are not included in the energy bill as such. Some feed through to quantifiable sums in other sectors, such as health care. Others are more 'virtual' in nature but can be estimated nevertheless in terms of the price citizens would be prepared to pay to avoid them. There is a growing urgency to make a rigorous evaluation of all these *externalities* as they are a valuable decision-making tool when making major political and economic choices in the field of energy policy.

The impact pathway

Although the principle may seem obvious, implementation is particularly complex. It began in the early 1990s at a time when the term *sustainable* was being used increasingly in political circles without anyone being able to lend it any real scientific substance based on sound principles of evaluation. The ExternE – *External Costs of Energy* – project was originally launched by a consortium of European and American researchers. (1) The aim was to define energy externalities – and more precisely electricity production externalities – for each of the available sources: wind, solar, nuclear, biomass, coal, oil, natural gas, and hydroelectric. 'The project required the co-operation of many specialists from different disciplines: economists, physicists, chemists, epidemiologists and ecologists,' explains Ari Rabl, one of the ExternE directors and a researcher with the Energy Centre at the Ecole des Mines in Paris. 'It was a fascinating exercise intellectually as everybody had to become something of an expert in everything to understand exactly what their colleagues expected of them.'

The method developed, known as the *impact pathway*, is a logical and systematic approach. It estimates the cost of each and every stage in electricity production, bar none. In the case of coal, for example, this involves evaluating the impact of building a new thermal power station, mining the raw material and quarrying the limestone (when used for flue gas desulphurisation), transporting the coal, wastes and other materials, the electricity generation itself, waste disposal and electricity transmission.

Variable geometry totals

'A sound evaluation of impact in monetary terms requires knowledge which has only been acquired over the past decade and without which ExternE would not have been possible,' stresses Ari Rabl. 'We have used recent epidemiological data to asses the impact on health – in terms of the number of persons affected and number of years of life lost – of certain pollutants. We have also used models for the dispersion of pollutants in the air, at local and European level.'

The mass of data which the ExternE methodology took as a basis for its conclusions is impressive. They range from technical elements, such as emission levels for each pollutant (several dozen were taken into account), to meteorological models, which are essential for assessing dispersion, and include demographic data and surveys of individual value systems so as to quantify notions such as impaired health.

After eight years of study involving dozens of researchers throughout the Union, dating from 1998, ExternE has drawn up an inventory per country and per energy. The picture which emerges is a varied one. (2) In Germany, for example, the external cost per kWh produced by wind power is 0.05 cents, compared with 5-8 cents per kWh for electricity produced by an oil-burning power station.

ExternE Transport

Although ExternE focused on electricity production, some of the results obtained can be used for other evaluations. A group of researchers, led by Peter Bickel of Stuttgart University, decided to apply the impact pathway methodology to transport. A series of case studies were carried out on road transport (using various fuels), as well as on waterways and rail transport in a number of countries. 'The impact on health dominates the quantified damage in our study, in particular mortality due to primary and secondary particles such as nitrates and sulphates. We have also established that population density in the vicinity of roads is a determining parameter for the scale of the impact,' believes Peter Bickel. The researchers were rather surprised to find that carcinogenics emitted by vehicles are less harmful than particles, mainly emitted by diesel engines. A comparison of the externalities of freight transport by road and rail shows that the former amount to between €0.04 and €0.3 tonnes/kilometre and the latter between €0.001 and €0.009 tonnes/kilometre.

www.feem.it/gnee/terapap/bickel.html

The EcoSense software

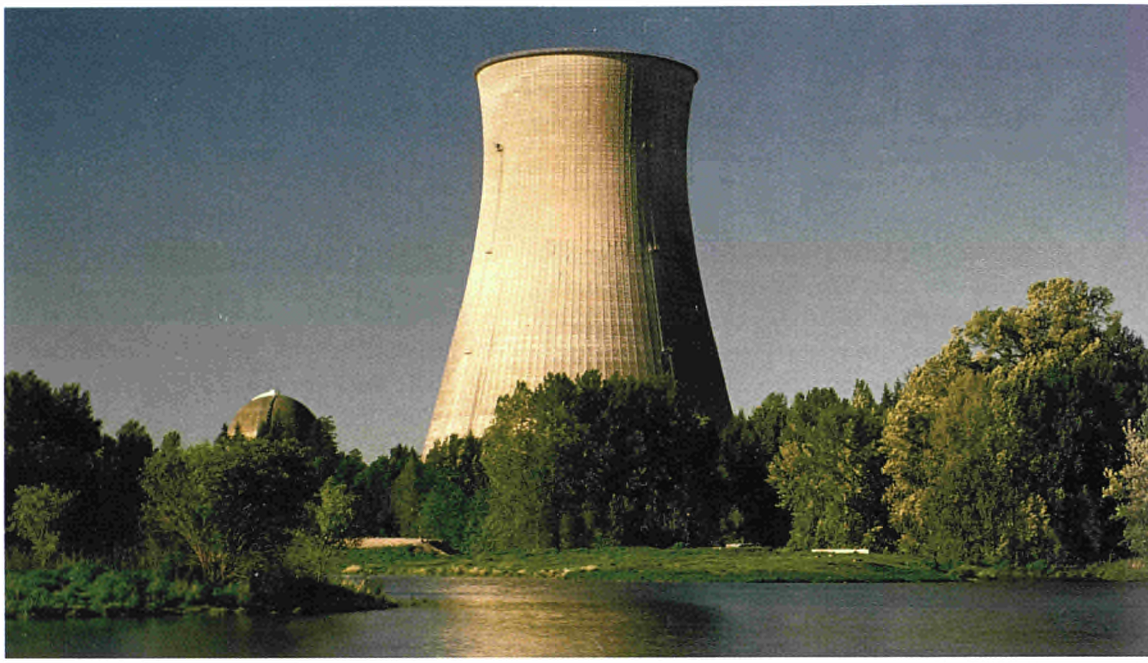
The ExternE team has developed EcoSense, an externalities evaluation software of potential interest to a number of users. The principle is simple: once the damage caused by one tonne of sulphur dioxide has been calculated, for example, this figure can then be used rapidly by relating it to the population exposed. Brazil and China are among the countries which have started studying their externalities using EcoSense. It has also been used by the electricity company EDF (Electricité de France). The researchers plan to update the software regularly and make it more readily available.

externe.jrc.es/Method+EcoSense.htm

➔

To find out more

- Official ExternE site with 1998 results: http://externe.jrc.es/
- Another site with a wealth of information: www.externe.info/
- The NewExt site, hosted by the University of Stuttgart: www.ier.unistuttgart.de/public/abt/tfu/projekte/newext/newxmenu.html



The risk of technological accident – oil spills, burst dams, etc. – is also included in these calculations. Primarily taken into account for nuclear power, these costs are low as a result of the existing safety measures.

Throughout Europe, the external costs of the nuclear kWh – ten times less than for coal – are low, ranging from 0.2 to 0.7 cents.

As a rule, the differences between countries are considerable, reflecting differences in the technology used as well as demographic differences. Researchers consider that the external costs of electricity production are equivalent to 1-2% of Europe's GDP. They also believe that if these costs were billed, the price per kWh of energy produced from oil or coal would double.

ExternE follow-up

These results, as well as the solid interdisciplinary and scientific methodology used to compile them, are the first of their kind to be published and have already been accepted as a reference for energy policy in the medium to long term. At the same time, work is continuing on further refining this methodology under an ExternE follow-up project known as NewExt or, to give its full name, *New Elements for the Assessment of External Costs from*

External costs of electricity production in the EU

Sub-totals of quantifiable externalities in terms of public health, occupational diseases, material damage, climate warming, etc. (in cents/kWh).

Country	Coal Lignite	Peat	Oil	Natural gas	Nuclear	Biomass	Hydro-electricity	Photovoltaic	Wind
AU				1-3		2-3	0.1		
BE	4-15			1-2	0.5				
DE	3-6		5-8	1-2	0.2	3		0.6	0.05
DK	4-7			2-3		1			0.1
ES	5-8			1-2		3-5*			0.2
FI	2-4	2-5				1			
FR	7-10		8-11	2-4	0.3	1	1		
GR	5-8		3-5	1		0-0.8	1		0.25
IE	6-8	3-4							
IT			3-6	2-3			0.3		
NL	3-4			1-2	0.7	0.5			
NO				1-2		0.2	0.2		0-0.25
PT	4-7			1-2		1-2	0.03		
SE	2-4					0.3	0-0.7		
UK	4-7		3-5	1-2	0.25	1			0.15

** mixed biomass-lignite combustion*
Source: ExternE

Energy Technologies. This aims to refine certain parameters, in particular the evaluation of the monetary costs of mortality due to atmospheric pollution. The externalities will also be extended to include areas not yet taken into account, such as damage to soil and water (acidification and eutrophication, dioxin emissions, influence of each energy on global warming, etc.).

Researchers are also busy exploring the externalities resulting from the risk of technological accident. Previously these were calculated principally for nuclear energy, but given the high level of safety and the high degree of 'improbability' of an accident at a European nuclear power station, they proved to be very low. To provide a balanced picture for all energies, however, the probability and costs of catastrophes such as oil spills or the bursting of dams should also be taken into account.

Will the NewExt results – available next year – change the picture presented by ExternE? 'It is still too early to say,' says Alexander Gressmann of Stuttgart University, one of the NewExt coordinators. 'In a sense, the more we try to quantify new and ever more complex externalities, the more we cause the hidden costs to rise. But on the other hand, by refining our calculation instruments (statistical tools for evaluating mortality, for example) we reduce other amounts.'

How does it translate into policy?

The study of externalities involves a continuous process of updating as progress is made in the various disciplines involved. This will be one of the tasks of ExternePol which, from autumn 2002, will also be building on the work begun by ExternE. 'We want to increase the reliability of results, such as by incorporating new and better models. We also want to extend the methodology so that it can be applied to new problems,' explains Ari Rabi, who will be the project coordinator. ExternePol (as its name suggests) will also try and improve the communication of the results obtained over the past decade to policy-makers and ensure that they can use them as a tool in the service of sustainable development.

One possible policy measure would be to tax the energy sources most damaging for society in accordance with the costs they create. However, this would mean a rise in energy prices producing damaging effects in other areas of the economy; it is also difficult to apply a homogenous tax throughout the EU. Another approach would be to subsidise energies which use clean technologies. A Community text adopted in February 2001, for example, authorises 'Member States to grant operating subsidies to new installations producing renewable energy, calculated on the basis of external costs'. These subsidies are currently limited to 5 cents per kWh.

'We are seeking to change mentalities,' stresses Ari Rabl. 'This process takes time. But a number of countries have expressed interest in our work, dozens of studies have adopted our method and our results have been taken into account when drawing up European directives. Personally, I have even been approached by several industrialists seeking an externalities calculation for their plant. These are all signs that our work is gaining recognition.'

(1) *The Americans pulled out of the project in 1995.*

(2) *The results are available at http://externe.jrc.es*

The value of years lost

In the field of health and the environment, the NewExt researchers have replaced the traditional concept of a calculation based on the *Value of Statistical Life* with an evaluation of the *Value of Life Year Lost*. 'We see this approach as very pertinent,' explains Alexander Gressmann. 'Atmospheric pollution usually has the effect of reducing average life expectancy by several months due to the appearance of certain chronic diseases.' These cannot be calculated in the same way as fatal accidents – such as road accidents – which on average shorten a life by several decades. 'These concepts may seem cynical for non-economists,' concludes the NewExt coordinator. 'In reality, they are simply tools designed to express the economic choices of society as accurately as possible.'

Miniaturisation, innovative materials, robotics, optics, software engineering... Despite what some people think, space research is at the origin of many technological advances. It is a particular source of inspiration for high-tech SMEs seeking to convert innovative technology into commercial applications in fields as diverse as medicine, mechanical engineering, transport and textiles. This is why the European Space Agency (ESA) has teamed up with the European Commission to create Esinet, the European network of 'space incubators'.

On Earth as in the

When he began his career as a researcher at Brunel University, to the west of London, Tony Arson probably never imagined that one day he would be running his own company. Today he heads Anson Medical, an SME and member of a group quoted on the Stock Exchange. It was while working on a space project in the field of microgravity that he realised that shape memory nickel-titanium alloys could have interesting applications in the medical sector. 'Their principal property is the ability to return to their original shape following heat deformation, as well as their super elasticity,' he explains. 'Thanks to the support of companies specialising in technology transfer, such as JPR in the United Kingdom and D'Appolonia in Italy, we have been able to develop products which are ideal for less invasive surgery, such as orthodontic springs, clips/staples and artificial hips. More recently we have developed stint grafts for the treatment of aneurysm. This is now our flagship product.'

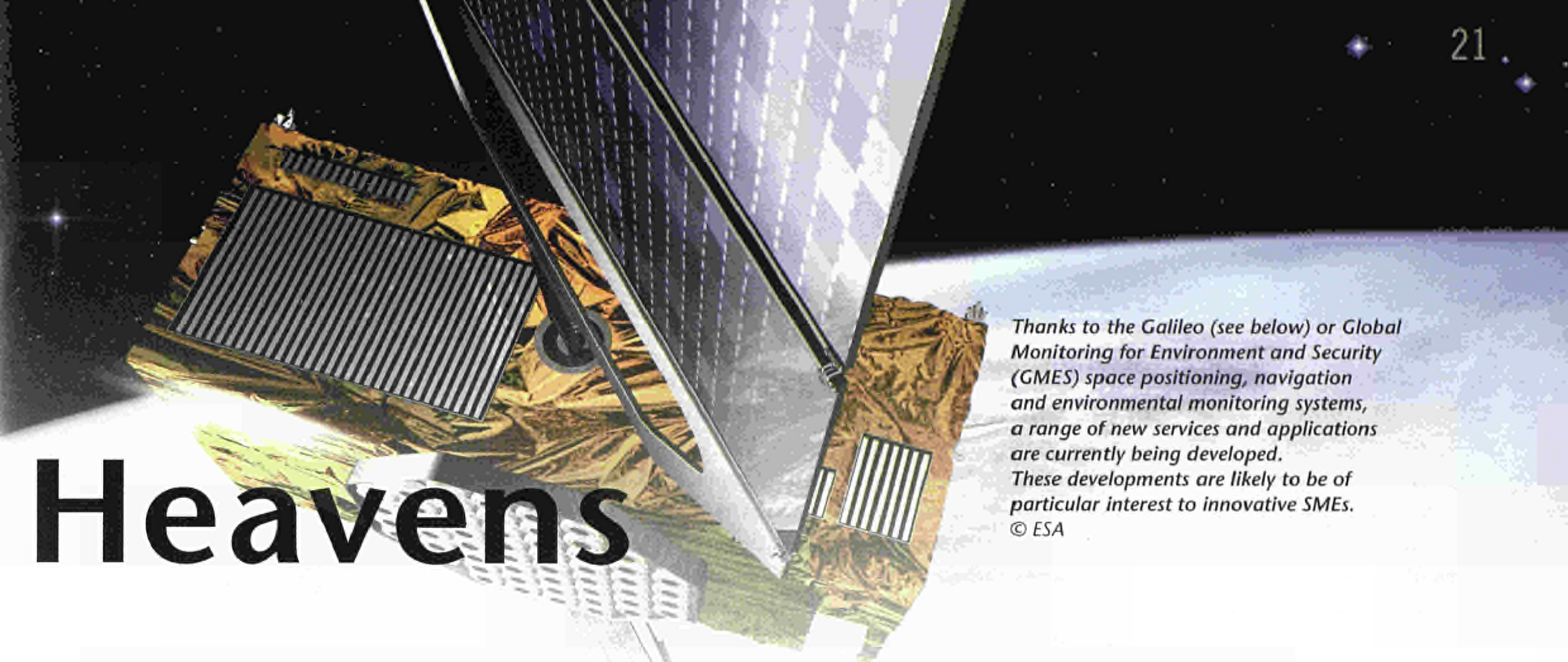
As a field of very advanced experimentation requiring innovative technological systems, space is a potential source of all kinds of applications. As early as 1991 the ESA launched its active technology transfer programme (TTP) charged with promoting space technologies in other industrial sectors. Today, more than 150 technologies with their origin in space have found the most diverse applications, generating a turnover estimated at €200 million. By 2004 this could have grown to a billion euros.

The ESA's Technology Transfer programme is promoting the SpaceHouse concept in the construction sector. This is an invitation to use the exceptional architectural possibilities offered by the development – initially for space applications – of carbon fibre reinforced plastics or CFRPs.
© ESA

SME aptitude

The size and flexibility of SMEs means that they are often the best suited to capitalising on these innovations. Many technology consultancy and brokering companies are active on the 'space transfer' market and several of them are participating in the Aero-Space Link (Aslink) project. This is supported by the European Commission as part of its 'Economic intelligence' initiative which is specifically targeted at SMEs. Under the Aslink leadership, about 40 proposals involving more than 80 aerospace companies and 180 companies active in other sectors have been selected by various European research programmes.

Lostesc (Leveraging on Space Technologies to Enhance SME Competitiveness), another programme promoted jointly by the ESA and the Commission, has a similar objective.



Heavens

Thanks to the Galileo (see below) or Global Monitoring for Environment and Security (GMES) space positioning, navigation and environmental monitoring systems, a range of new services and applications are currently being developed. These developments are likely to be of particular interest to innovative SMEs.
© ESA

Coordinated by the French company Technofi, six consultancy firms – from Austria, Belgium, France, Italy, Spain and Portugal – have identified technologies likely to find applications outside the space industry with a view to promoting them in industrial circles and proposing them for finance as co-operative research under the Craft programme. About 30 projects were submitted in this way during the Fifth Framework Programme and six or seven will be submitted under its successor. The Artec Aerospace company of Toulouse, for example, has successfully drawn on a new technology for vibration absorption used during satellite launches to develop applications in shipbuilding (such as the Corsica-Continental ferry), high-speed train wheels, helicopters and Formula 1 rear-view mirrors.

Need for protection

In a field as specialised as space technology transfer, the creation of spin-offs or start-ups requires a specific infrastructure for technical assistance and managerial support. These are the needs which the 'space incubators' are designed to meet. The ESA has set up one of these incubators in the Netherlands, at the heart of its Estec research and technology centre in Noordwijk. There are almost 20 centres of this kind throughout Europe – in Belgium, Germany, France, Italy, the United Kingdom, Portugal, Finland, Bulgaria, and Ukraine – located in regions with a concentration of space-related activities. Since July 2001, these SME 'guardians' have worked together within the European Space Innovation Network (Esinet) exchange and co-operation network.

This initiative, which benefits from Union support, was launched by the ESA, the T4Tech Centre of Genoa (IT), the European Business Network (EBN), and Wallonia Space Logistics (WSL).

Why such a network? 'Apart from the traditional managerial and infrastructure assistance, space incubators have a very specific vocation. Exploring and implementing the technological potential in this field requires a particularly specific expertise, in terms of intellectual property for example,' explains Franco Malerba. A biophysicist and the first Italian to be launched into space, Franco Malerba is an active member of the Italian Space Agency and head of the new network's Liaison Advisory Committee.

Galileo and GMES

'Esinet meets a need for openness and cross-fertilisation which is felt by all these European incubating centres,' stresses Florence Ghiron, director of WSL, an incubator set up in 2001 in Liège (BE). 'We are working on technology niche markets where you have to go beyond the regional level before you can really do business,' she explains.

Esinet is a very timely development as European space activity is set to develop a great deal with the opening of the Galileo and Global Monitoring for Environment and Security (GMES) sites. 'New services and applications will be designed to exploit these future space systems in the field of positioning, navigation and environmental monitoring,' stresses Florence Ghiron. 'Many of these developments could be of direct interest to SMEs. We are also ready to welcome at our centres any terrestrial applications in terms of transfers generated by the implementation of these systems at European level. These large systems will certainly require increased exchanges.'

To find out more

- www.ansommedical.com/
- www.jratech.co.uk/
- www.esa.int/export/esaCP/ESATHSUM5JC_Benefits_0.html
- www.artec-aerospace.fr
- www.estec.esa.nl/
- www.t4tech.com/

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

DNA: an excess of patents

Several thousand patents have been awarded to public and private sector researchers in the field of DNA sequencing alone. In many cases these provide protection for all sequence use. The Nuffield Council on Bioethics (UK) believes that such rights should be an exception rather than the rule and that too often these patents have been awarded without respecting the three-pronged rule that traditionally governs the notion of a discovery, namely that it must be new, inventive and also, as it is a patent, utilisable. The association has just published *The ethics of patenting DNA*, a report in which it shows that many patented sequences should not have been patented at all because they do not satisfy these criteria. This study identifies four possible uses of DNA sequences (diagnostic tests, research, gene therapy and the production of therapeutic proteins), in each case stating the criteria on which a patent application should be based. If taken into account these criteria would considerably reduce the royalties which are easily amassed.

To find out more:
www.nuffieldbioethics.org/
www.nuffieldbioethics.org/publications/pp_0000000014.asp
www.nuffieldbioethics.org/filelibrary/pdf/theeticsofpatentingdna.pdf

Scientific culture in the United States…

Seventy per cent of Americans admit they understand little about research and – in contrast to the Europeans – a growing number believe in 'pseudo-sciences'. 30% of them believe that certain unidentified flying objects prove the existence of extraterrestrial civilisations, but only just over half (54%) know that it takes the Earth 24 hours to rotate on its axis. Yet they retain their faith in scientific research, which 44% of those interviewed see as generating progress (33% believe the opposite).

These are the latest findings of the US National Science Foundation which every two years carries out a survey on US scientific culture. The report also notes that a growing number of foreign researchers are working in the United States (45% in the field of engineering) and identifies trends in federal aid for research, up by 50% for the life sciences and down by 25% for physics.

To find out more:
www.nsf.gov

…and in Japan

Carried out in 15 countries, a mini test of ten questions on science puts the Danish in the lead (64% of correct answers) and the Portuguese last (43%), with the Japanese just two places ahead, in 13th position. The Japanese tend not to be very cultured about science, are generally poorly informed – with the exception of environmental issues – prefer television and the general press to more specialised journals, and do not go to exhibitions or other educational events to do with science. Nevertheless, they see the scientific approach and its results as positive (the cynical would say this is logical given their ignorance of it!) and a large majority believe that research should be government funded. A majority would also like more effort to be made to promote public understanding of science.

These data are taken from a study* published in January 2002 by the National Institute of Science and Technology Policy, attached to the Japanese Ministry of Education.

*** The 2001 Survey of Public Attitudes Toward and Understanding of Science & Technology in Japan.**

European R&D expenditure: a warning light

Last June, European Commissioner Philippe Busquin repeated his concern following the publication of the latest global indicators revealing that Europe is falling further behind in its investments in research. European investment in R&D in 2000 was just €164 billion compared with €288 billion in the United States. This deficit is largely due to lower participation by the private sector in the total research effort, representing 56% in Europe compared with nearly two-thirds in the United States and Japan.

But the public authorities share responsibility for this private sector reluctance as government support for company research represents 12.3% in the United States compared with 8.5% for the Union as a whole. Philippe Busquin thus repeated the ambitious 2010 target for the European Research Area – as ratified at the Barcelona Summit in March of this year – of having the EU (and its industry in particular) invest 3% of GDP in research (as do the Americans and Japanese) as opposed to the present 1.8%

To find out more:
Science and technology indicators for the ERA
europa.eu.int/comm/research/era/sti_en.html

EUREKA, a market-oriented network

At the annual EUREKA ministerial conference, held in Thessaloniki (GR) on 28 June, 171 new projects were announced for a provisional total budget of €490 million and 33 thematic sub-projects were launched for an amount of €930 million. This brings the total number of ongoing EUREKA projects to 713 with a total investment of €1.3 billion. The Lillehammer Award for the Environment was awarded to the Care partnership (recycling and disposal of computer components which are no longer used) and the Lynx Award for SMEs went to the Dutch firm Contronics Engineering.

EUREKA – which plans to situate its action within the dynamic of the European Research Area – also welcomed two new members, the Federal Republic of Yugoslavia and Cyprus, bringing total membership to 33 European countries. Morocco was welcomed as an associate country. In regard to synergy with the Union, the highlight of the conference was the announcement of increased co-operation with the Innovation Relay Centres network, supported by the Commission.

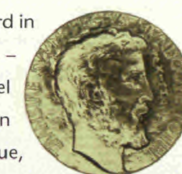
To find out more:
www.eureka.be/ifs/files/ifs/jsp-bin/eureka/ifs/jsps/publicHome.jsp

USA: scientific integrity in the firing line

In 2001, the US Office for Scientific Integrity (ORI) investigated 127 cases of 'misconduct' by researchers: 46 falsifications of results, 37 fraudulent scientific productions, 17 cases of plagiarism and 27 other cases of unacceptable behaviour of various kinds. These are the highest 'scientific crime' figures recorded for five years. The ORI therefore decided to set up a committee consisting of members of the National Research Council and US Institute of Medicine to be charged with proposing strategic recommendations to promote the concept of scientific integrity. In particular, the committee must draw the attention of the various research-funding institutions and agencies to their responsibilities in encouraging a sense of ethics among researchers. When will we see a European ORI?

To find out more:
stills.nap.edu/books/0309084792/html/

Excellence: The French Fields Medal



The most prestigious award in the field of mathematics – the equivalent of the Nobel Prize – was awarded in 2002 to Laurent Lafforgue, 36, a professor at the Institut des hautes études scientifiques, an institution which boasts five winners of the Fields Medal since 1958. Quoted in the French daily *Le Monde*, Lafforgue described Langlands Conjecture, the subject of his award-winning work, as 'one of the most wonderful things ever proposed by mathematics. The statements are very simple and often run to no more than three lines. The fact that they can be true is simply staggering! But it takes several hundred pages to demonstrate a number of very specific cases.'

To find out more:
Type 'Fields Medal' on the search engine www.google.com

Erratum
The article *What is a university 'worth'?* – RTD *info* n° 34
We mistakenly stated that the ALmaLaurea Consortium consisted of 19 universities. In fact it included 19 at the time of going to press and now numbers 30.

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To find out more:
Science and technology indicators for the ERA
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Diary

European notebook

▸ Inauguration of the Sixth Framework Programme of the European Union –
Organised by The Polish State Committee for Scientific Research for the EU candidate countries –
25-26/11/2002 – Warsaw (PL)
www.npk.gov.pl/konf-6PR/index_en.html

▸ Towards sustainable agriculture for developing countries: options for life sciences and biotechnologies –
Organised by the European Group of Life Sciences – 30-31/01/ 2003 –
Brussels (BE)
europa.eu.int/comm/research/conferences/2003/sadc/index_fr.html

Other events

▸ PV for Europe – Conference and Exhibition on Photovoltaics Science – Technology and Application –
Organised jointly by
ETA-Florence and WIP-Munich –
7-11/10/2002 – Rome (IT)
www.wip-munich.de/conferences/pv/rome_02/index.html

▸ 25th World Energy Engineering Congress –
9-11/10/2002 – Atlanta (USA)
www.aeecenter.org/weec/

▸ EPIDOS Annual Conference 2002 – The European Patent Office –
–17/10/2002 – Copenhagen (DK)
www.european-patent-office.org/epidos/conf/eac2002/home.htm

▸ 2002 EVCA Technology Investment Conference –
16-18/10/2002 – Barcelona (ES)
www.evca.com/html/events/conferences_03.asp

▸ SITEF 2002 –
International advanced technologies fair –
23-26/10/2002 – Toulouse (FR)
www.toulouse.cci.fr/

▸ European Conference on Aquatic Microbial Ecology (SAME 8) –
25-30/10/2002 – Messina, Taormina (IT)
www.same-8.it/

▸ Tenth ECMWF Workshop on the Use of High Performance Computing in Meteorology –
4-8/11/2002 – Reading (UK)
www.ecmwf.int/newsevents/workshops/parallel2002/

▸ Rothamsted Biomarket Bioproduct from plants and Microbes –
5-7/11/2002 (UK)
Biomarket@bbsrc.ac.uk

▸ Baltic Biotech –
8-10/11/2002 – Greifswald (DE)
www.baltic-biotech.net

▸ Ecsite Annual Conference 2002 –
14-16/11/2002 – London (UK)
ecsite.ballou.be/net/beta.asp

▸ International Chemical Information Conference & Exhibition –
20-23/10/2002 – Nîmes (FR)
www.infonortics.com/chemical/index.html

▸ Regards croisés sur les changements globaux
Organised by the CNES and CNFCG –
25-29/11/2002 –
Arles (FR)
dag.distinguezvous.com/cnes/regards/

▸ EUREKA [meets] ASIA 2002 –
25-29/11/2002 – Macau (China)
www.adi.pt/adi/default.asp

▸ Colour of Ocean Data –
Organised by the Flanders Marine Institute – 25-27/11/2002 –
Brussels (BE)
www.vliz.be/en/acruv/cod/

▸ Genomics and Forest Tree Stress Tolerance Short Course –
11/2002 – Chania (GR)
adoulis@maich.gr

▸ Dynamics and Conservation of Genetic Diversity in Forest Ecosystems –
2-5/12/2002 – Strasbourg (FR)
www.pierroton.inra.fr/genetics/Dygen/index.html

▸ Annual Conference of the European Patent Office –
3/5/12/2002 – Nice (FR)
www.epoline.org/epoline/nice/intro_en.htm

▸ Awarding of the 2002 Descartes Prize –
5/12/2002 – Munich (DE)
www.cordis.lu/descartes

▸ 7th international conference on public communication of science and technology (PCST) network –
5-7/12/2002 – Cape Town (SA)
www.pcstnetwork.org/

▸ Un pas vers l'Europe des chercheurs – Launch of the EU's Sixth Framework Programme for Research and Development –
Organised by the Swiss Federal Office for Education and Science – 6/12/2002 –
Berne (CH)
www.konferenz6frp.ch/

▸ Biotech Helsinki –
24-26/3/2003 – (FI)
finnexpo.fi/biotechhelsinki

▸ Nanotechnology Meets Business –
8-9/4/2003 – Frankfort (DE)
www.nano.org.uk/nanomeets.htm

▸ Telemedicine and Telecare International Trade Fair –
9-11/4/2003 – Luxembourg (LU)
www.telemedicine.lu/

▸ The Biobiz workshops
3-5/12/2002 – Prague (CZ)
21-23/1/2003 – Berlin (DE)
18-20/2/2003 – Paris (FR)
18-20/3/2003 – Warsaw (PL)
15-17/4/2003 – Hamburg (D)
20-22/5/2003 – Vienna (AU)
www.eurobiobiz.com

Publications

Project reports

- **Atlas historique des cadastres d'Europe (II) (*Historical atlas of land use in Europe*)** – EUR-OP
- **Optical infrared coordination network for astronomy** – anna-maria.johansson@cec.eu.int
- **Surface energy balance in urban areas** – EUR-OP
- **Bioactive compounds in plant foods** – EUR-OP
- **Biogenically active amines in food** – EUR-OP
- **Apoptosis and programmed cell death: molecular mechanisms and applications in biotechnology and agriculture** – EUR-OP
- **Plant biotechnology for the removal of organic pollutants and toxi metals from wastewaters and contaminated sites** – EUR-OP
- **Brucellosis in animals and farm** – EUR-OP

rtd-euratom@cec.eu.int
- **CLUSTER: Club of underground storage, testing and research facilities for radioactive waste disposal**

rtd-euratom@cec.eu.int
- **EU co-sponsored research on containment integrity**

rtd-euratom@cec.eu.int

Conference reports

- **Stem cells: therapies for the future?** quality-of-life@cec.eu.int
- **Urban forest and trees** – http://eur-op.eu.int/general/en/s-ad.htm
- **8th and 11th Workshop of Marie Curie fellows: research training in progress** – wolfgang.kerner@cec.eu.int
- **FISA 2001: EU research in reactor safety** – rtd-euratom@cec.eu.int

Project catalogues

- **Measurements and testing & support for research infrastructures** – growth@cec.eu.int
- **Decision support for emergency management and environmental restoration** – ernst-hermann.schulte@cec.eu.int
- **Nuclear fission and radiation protection projects selected for funding 1999-2001** – rtd-euratom@cec.eu.int

Brochures and reports

- **Talking science – A special edition of RTD *info* on relations between science and the media** – research@cec.eu.int
- **National policies on women and science in Europe** – (see article p. 38) brigitte.degen@cec.eu.int
- **10 years of EC scientific cooperation for the transition towards sustainability** – (4 brochures)
  - Capitalising on people and institutions
  - Managed land ecosystems
  - Aquatic ecosystems
  - Healthy societies

inco@cec.eu.int
- **European aeronautics: a vision for 2020 – Meeting society's needs and winning global leadership** – research@cec.eu.int

Leaflets

- **A research environment for an enlarged European Union**
- **Targeting sustainable development around the Mediterranean Sea**
- **Creating sustainable solutions in developing countries**
- **Targeting sustainable development in Eastern and Central Europe**

inco@cec.eu.int

Newsletters

- **Growth in action** – June & July 2002 growth@cec.eu.int
- **SME Update** – July 2002 research-sme@cec.eu.int

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

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

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Useful Web addresses

Atlas of Oceans
http://www.oceansatlas.com/index.jsp
On the occasion of last June's Environment Day, the FAO launched this site which provides a remarkable document base – and which will continue to be enriched with all the latest knowledge in the field of the cartography, physics and ecology of all the world's oceans.

Antarctica on line
http://www.antdiv.gov.au/
A valuable source of knowledge on the South Pole which is of the greatest interest to its closest neighbours, the Australians.

The eContent Village
http://www.content-village.org/default.asp
The Platform for information, communication and the sharing of knowledge on the latest developments in the eContent programme for the promotion of digital technologies and linguistic diversity in the information society.

Final text of the adoption of the Sixth Framework Programme
http://europa.eu.int/comm/research/fp6/documents_en.html#fpdecisions

Reference addresses for the latest information on the Sixth Framework Programme
http://europa.eu.int/comm/research/fp6/index_en.html
http://www.cordis.lu/fp6

Sites on the development of the European Research Area
http://europa.eu.int/comm/research/era/index_en.html
http://www.cordis.lu/rtd2002/

Recent news on the EUROPA RESEARCH server

Women & Science: Statistics and Indicators – All the figures on 'research and gender'
http://europa.eu.int/comm/research/science-society/women/wssi/index_en.html

EU-funded TSE research in Europe
Research on BSE or mad cow disease
http://europa.eu.int/comm/research/quality-of-life/tse/index_en.html

EU-funded Agricultural Research Portal
http://europa.eu.int/comm/research/agriculture/index_en.html

Animal Welfare – Alternatives to animal experimentation
http://europa.eu.int/comm/research/quality-of-life/animal-welfare/seminars/index_en.html

Communicating science
Research and citizens
http://europa.eu.int/comm/research/science-society/sciencecommunication/links_en.html

Science and technology indicators for the ERA
The performances of European Research
http://europa.eu.int/comm/research/era/sti_en.html

Recent news on the CORDIS site

Quality of Life Bulletin, July 2002 – Newsletter of European research in the life sciences
http://www.cordis.lu/life/src/news0800.htm

Nanotechnology –
A new priority of the Sixth Framework Programme
http://www.cordis.lu/nanotechnology/

Research in Finland sur Cordis –
In the European Research Area series of sites
http://www.cordis.lu/finland

Cordis library –
New access service to documents and publications on research and innovation published in the context of European programmes
http://www.cordis.lu/library

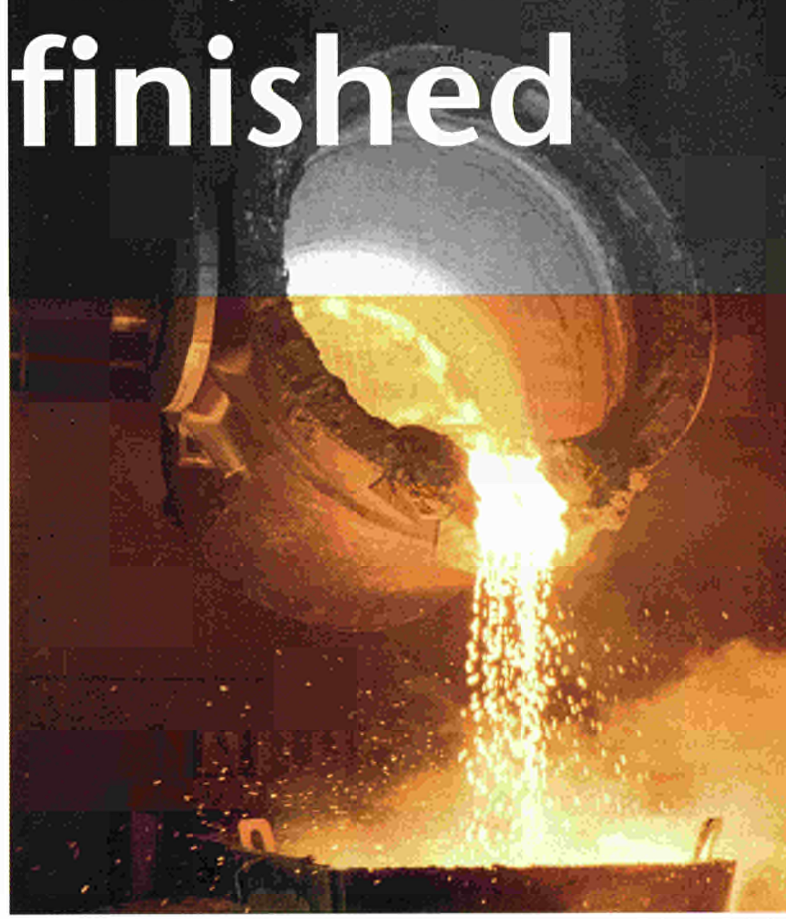
Cordis NCP Network –
Access to all national contact points able to inform you on RTD in the EU Member States and associate and candidate countries.
http://www.cordis.lu/fp5/src/ncps.htm

CORDIS Regional Research and Innovation –
the portal of the regions of the European Research Area
http://www.cordis.lu/regions/

Access to all issues of RTD *info* at the Europa/Research site/ (html or PDF version)
French: http://europa.eu.int/comm/research/rtdinfo_fr.html
English: http://europa.eu.int/comm/research/rtdinfo_en.html
German: http://europa.eu.int/comm/research/rtdinfo_de.html
Spanish*: http://europa.eu.int/comm/research/rtdinfo_es.html
*from n° 33

Far from finished

The end of the European Coal and Steel Community (ECSC) Treaty does not signify that a technological era is over either at the European or global level. Coal and steel will continue to play major roles in the areas of energy and basic materials for many years to come. Keen to conserve the dynamic role of Community innovation, which had kept European know-how at the forefront of both sectors, the Member States decided to use all the residual funds from the treaty to continue specific research in these key areas.



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Belgium, Germany, France, Italy, Luxembourg and the Netherlands signed the treaty establishing the ECSC in Paris on 18 April 1951. It was the practical follow-up to the declaration (1) by French Foreign Minister Robert Schumann on 9 May 1950 that proposed placing Franco-German production of coal and steel under a common High Authority within the framework of an organisation open to participation by other European countries. This first European Community set out to put an end to a century of national rivalries by a peaceful reconstruction based on shared interests. It was also an institutional test bed from which several years later developed the more ambitious Treaty of Rome establishing the Common Market.

Research-based strategy

Over the next five decades, the ECSC played a major economic role which extended far beyond these two industries. Coal and steel were important elements in rebuilding Europe immediately after the war and through the 1950s and 1960s, but the subsequent major decline in demand for both could have plunged Western Europe into a dangerous economic recession. The ECSC functioned smoothly in striking the right balance by improving productivity and by developing products to support new industries. An essential characteristic of the ECSC was the considerable means dedicated to research.

Subsequently, the ECSC helped to develop an organised response when the coal and steel industries went into deep crisis in the 1970s and 1980s. This made it possible to carry out the necessary industrial restructuring and conversion while placing particular emphasis on the protection of workers' rights, in keeping with the European social model.

A key component of the ERA

The 23 July 2002 marked a definitive step in EU history as the 50-year-old treaty expired. After that date, all remaining available ECSC funds – some €1.6 billion – would normally have reverted to the Member States. However, the innovative spirit that helped develop the ECSC research programme as a very strong element of the European Research Area led to the Council agreeing to continue common funding of RTD in these two sectors. Under the management of the European Commission, that decision will provide some €45 million a year which will cover activities not included in the Sixth Framework Programme. The funding will be split into 27.2% for coal-related research and 72.8% for steel-related research.

Coal offers an indispensable source of energy in the context of the overall European strategy for the security of its energy supply. But, even if research has enabled considerable progress, the challenge still remains to make it cleaner and to reduce emissions of CO_2 that contribute to the greenhouse effect.

The production of steel is closely linked to coal and shares the challenges. However, it has now established itself as a flexible, high-technology material adding value to a wide range of applications. The Commission will manage future research in both areas with even greater emphasis on the environmental objectives.

(1) http://europa.eu.int/abc/symbols/9-may/decl_en.htm

The quest for clean

Safety, energy efficiency, the fight against pollution... Decades of research under the auspices of the ECSC have resulted in a European know-how in the coal industry unequalled anywhere in the world. In the Union's strategy for energy independence over the coming decades, 'clean coal' is set to be a valuable asset.

The ECSC Treaty is ending on a paradox. Over the last three decades its – successful – mission has been to manage the decline in the Union's coal production, linked to the depletion of resources and growing difficulties of access to the European subsoil.

EU coal production fell from 200 million to 85 million tonnes between 1989 and 2000. Today, just four producing countries remain: Germany and the United Kingdom, and to a lesser degree Spain and France. Lignite production is also down, with Germany the biggest remaining producer, followed by Greece and, some way behind, Spain. With 240 million tonnes produced in 2000, lignite represents about 50 million tonnes of coal equivalent or 'tce'.[1]

Timely excellence

At the same time, by virtue of its research programmes, the ECSC Treaty has brought continuous technological improvements in mining safety and yield, energy efficiency and clean combustion. 'Europe leads the world when it comes to coal industry know-how,' stresses Christian Cleutinx, director of conventional energy at the Commission's Energy and Transport Directorate-General.

This high level of excellence is a major advantage in the 21st century economy. First of all, because coal remains an energy source of primary importance, not only at the global level – coal meets one-quarter of world's energy needs – but for Europe too. Although the Union is producing less and less coal, it continues to consume a great deal. In 2000 it imported almost 160 000 million tonnes of coal, mainly to meet its thermal electricity production needs.

Also, the Union of 15 Member States is about to enlarge to include countries which are major coal producers and consumers – countries which are also facing problems of modernising, restructuring and scaling down their mining industries as well as improving their combustion plants. As stressed in the Green Paper *Towards a European strategy for the security of energy supplies*, published by the Commission in 2000, far from being an energy source of the past, coal is set to be of great strategic importance in electricity production over the coming decades.

'It is a fuel which is in abundant supply in many regions of the world,' stresses Christian Cleutinx. 'The OECD estimates there are reserves of around 1 000 million tonnes, representing 200 years of world consumption at present rates. Unlike hydrocarbons, the many supply sites in themselves constitute a guarantee of stable prices and secure supplies.' In technical and economic terms, coal is particularly interesting when used as a combined fuel with other solid fuels of less value (such as lignite and peat), heavy hydrocarbon derivates and biomass.

The use of these inexpensive energy sources must, however, respect one fundamental condition: respect for the environment. As a major source of SO_2, NO_x and CO_2 – emissions, and thus seen as a major factor in climate warming, coal – and other solid fuels with which it may be combined – must be the subject of a major research and innovation effort if it is to qualify as a clean fuel.

ECSC achievements

This is a challenge which can be met and ECSC researchers have already laid down the foundations for doing so. Major technological advances have been made in two areas: PFBC or pressurised fluidised bed combined cycles and, most recently, integrated gasification combined cycle or IGCC.[2]

Solid fuels

The Carnot Programme, launched in December 1998 and set to terminate at the end of this year, has been mainly concerned with the development of clean and efficient technologies for the combined combustion of coal with other solid fuels, such as lignite, peat, oil shale, the heavy derivates of petroleum products, and biomass.

As well as environmental issues and questions of efficiency, the Carnot Programme has also looked at the related technical and economic aspects of solid fuels, such as preparatory processing, storage, transport and waste disposal.

An enlarged European coal area

Union enlargement will bring a considerable increase in coal reserves and its use as a European energy source. It will also bring an added environmental burden which requires urgent action. In 1998, when Union production was estimated at 158 million tce, the six candidate countries with coal reserves – principally Poland and the Czech Republic, and to a lesser degree Hungary, Bulgaria, Romania and Slovakia – produced a total of 167 million tce. Coal provides 65% of the electricity produced in the future Union members as a whole, compared with just 27% in the present 15 Member States.

The Gardanne power station in France uses the clean technology of combined cycle combustion on fluidised beds.
© EDF

coal

Other research projects are also concerned with the concept of 'clean coal', in particular in the area of filtering and recycling systems for harmful atmospheric emissions, the 'sequestration' of CO_2 emissions, and the co-combustion of solid fuels.

'If we want this fuel to play its strategic role in terms of energy security, then it must meet the increasingly demanding environmental challenges posed by climate warming,' stresses Andrew Minchener, member of the ECSC's committee of experts on combustion and gasification. 'If it is to retain its present leadership role in this technological sector, research on advanced combustion cycles must continue, in particular on the particularly efficient option of gasification.'

(1) Tonne of coal equivalent is one tonne of high-quality coal possessing a standard calorific value of 7 000 Kcal/kg.
(2) PFBC: Pressurised fluidised bed combined cycle – IGCC: Integrated gasification combined cycle.

Two advanced technologies

The PFBC process involves feeding a current of air under pressure (12-16 bars) into a combustion chamber heated to 850°C, thereby creating turbulence in a bed of inert particles and cinders which starts to behave like a fluid. The coal is introduced into this fluidised bed, where it is burned with a calcium-based sorbent (such as lime). About 80% of the electrical energy generated by this combustion is obtained by circulating water through tubes located in the fluidised bed which fuel a conventional steam turbine. The gases emitted by the combustion are then cleaned and sent to a gas turbine which generates additional electricity, permitting a high thermal yield of around 44%.

In the IGCC process, the gasified coal fuels a Brayton cycle gas turbine, which is a particularly efficient system of electricity generation with low emission levels. Gasification provides up to 90% enhancement of the coal's calorific capacity. This process also includes added electricity production through heat recovery by means of steam production fuelling a second turbine.

Contact

- Christian Cleutinx
  Transport and Energy DG
  christian.cleutinx@cec.eu.int

To find out more

- Coal research at the Transport and Energy DG
  europa.eu.int/comm/energy/en/fa_13_en.html
- Carnot Programme
  europa.eu.int/comm/energy/en/pfs_carnot_en.html
- Conclusions of the Commission's Green Paper on Energy
  http://europa.eu.int/comm/energy_transport/livrevert/final/report_en.pdf

Steel has a tough life

Despite competition from new materials, steel – or perhaps more accurately 'steels', given the many forms developed to meet different requirements – is and will remain an essential component of our technological environment. Thanks to constant efforts to adapt and innovate within the ECSC, Europe is a world leader on today's steel market. This enviable position requires a continuation of the research effort made over past decades.

The Union produces more than 60 million tonnes of raw steel every year, or 20% of world production. Faced with increasingly keen international competition, over the past three decades this key sector has experienced a wave of restructuring and concentration, coupled with technological modernisation on a large scale.

New jobs and technology

The European steel industry currently employs 277 000 workers. In 1952, when the ECSC was created, the six Common Market countries employed half a million steelworkers, producing 40 million tonnes of steel. In 1973, when the sector began to experience a crisis, the steel industry employed 774 000 workers producing 10 million tonnes below the present figure.

The ECSC played a vital role in the essential process of change in the steel industry, in two respects. At the social level, Community efforts to provide retraining meant little unemployment among former steelworkers. At the technological level, support for research was a key catalyst in permitting the modernisation of the whole production line and satisfying environmental demands.

Pioneering

'The ECSC played a pioneering role that foreshadowed the concept of the European Research Area by opting for integration, which enabled three generations of scientists and engineers to learn to work and innovate together,' stressed European Commissioner Philippe Busquin last June at a conference which took stock of progress in the steel sector to date and looked ahead to future steel research.

The ECSC programmes enabled the steel industry to increase the essential joint effort for technological innovation in areas such as product diversification, process automation, improvement in working conditions, reduction of pollution and energy savings.

This continuous research drive, costing almost a billion euro (funded by a minimal charge on each tonne produced) produced results which all those involved agree were beneficial. A 1995 study showed that every euro the ECSC invested in research projects generated about a dozen euro in return.

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To find out more

- Site of the new Steel programme
  www.cordis.lu/coal-steel-rtd/steel/home.html
- Site of the Growth programme
  europa.eu.int/comm/research/growth/gcc/ga02.html#top

'Post-ECSC' research

Adopted last February, the Union's new 2002-2006 'steel' programme will continue the European drive for technological innovation in parallel with the start of the Sixth Framework Programme. (1) The shared research priorities lie in two main areas:

- continued innovation at every stage of the production line with a view to sustainable growth (reduced emissions, energy savings, recycling and rational use of primary resources), increased competitiveness and improved product quality;
- the development of new market opportunities by producing special steels with very high-level performances in terms of their properties (at extreme temperatures, corrosion resistance, antiseismic characteristics, etc.).

(1) Details of the organisation of this new programme can be consulted on the CORDIS server (www.cordis.lu/coal-steel-rtd/steel/home.html).

A marriage of increased productivity and environmental improvements

Images of the large steel-making centres of the last century, shrouded in a thick black pall of toxic smoke, probably remain as the strongest symbol of industrial pollution. The accumulated technological progress of many years of research and innovation has since made such scenes obsolete.

This radical change was not, however, the result of a dramatic 'revolution' in the basic thermodynamic principles used in the process of transforming iron into steel. For 50 years the ECSC's policy was to support research bringing many 'small' innovations. This patient policy of advancing in measured steps, comprising projects addressing both productivity and purely environmental aspects, produced very significant global results.

CO_2 cut by half

Progress made in controlling the quality of the blast furnace charge, the use of combined fuels and equipment improvements means that today one tonne of steel can be produced using 450 kg of coke equivalent compared with 900 kg in the 1960s. Although the initial aim of such energy savings was to reduce production costs, it has also resulted in a 50% reduction in CO_2 emissions.

Another recent example is the spectacular progress made in the development of continuous smelting processes for stainless steel and thin strip carbon steel which drastically reduces the traditional steel-rolling activities and the associated energy and equipment costs.

The optimal operation of modern blast furnaces involves a real-time analysis of a variety of data which goes far beyond what man could do. Cognitive information systems now permit a unified approach to collecting and interpreting data within the alloy production unit, and bring decisive improvements to a centuries-old technology. Pictured here is the steel control room at the Avesta Polarit plant in Sweden. ©*Avesta Polarit*

The zero waste objective

Since the late 1980s, at the same time as continuing efforts to boost productivity and reduce energy consumption, the ESCE's Steel research programme has concentrated increasingly on projects directly related to strictly environmental concerns. Many projects have been financed in the field of the agglomerating process which is responsible for one-third of the dust emissions and two-thirds of the SO_2 emissions of the steel industry as a whole. This research has focused on innovations to provide filtering systems that are more effective than the conventional electrostatic processes, the reduction of emissions at source, and the modelling of parameters involved in the manufacturing processes which are the cause of harmful emissions.

Another key field is the processing and recycling of all the toxic waste and by-products of the steel industry, as well as waste water treatment.

The durability of steel

Steel is not only the world's most used metal material, it is also the most recyclable and recycled. In terms of natural resources this economy is also an economy in itself: production by recycling is less expensive and consumes less energy than smelting steel from minerals. About 45% of steel products in current use are made from recycled ferrous waste, a percentage that is growing all the time.

The beauty of theory

Gerard 't Hooft: 'Most of the ills of the world do not come from knowledge but from human behaviour. And it is only through knowledge that this behaviour can evolve.'

The lineage of this learned Dutchman reveals a quite remarkable concentration of scientific excellence. His great uncle on his mother's side, Frits Zernike (1988-1966), received the Nobel Prize in Physics in 1953 – when Gerard was seven – for inventing the phase-contrast microscope, a revolutionary tool for the study of biology. His grandmother had married Pieter Nicolaas van Kempen, the eminent zoologist and professor at the University of Leiden, and one of their sons (thus Gerard's maternal uncle), Nicolaas Godfried, taught theoretical physics at the University of Utrecht.

It was hardly surprising therefore that Gerard dreamed of becoming 'a great man who knew everything', and from a very early age he showed a fascination for observing the world and nature around him. A world-renowned physicist now, he continues to add to his collection of seashells which he began as a boy when walking the beaches of the Netherlands – because 'a seashell expresses the inexhaustible beauty of matter worked by life'.

A fascination with discovery

His father, a brilliant naval engineer, had for a while thought of interesting his son in the very palpable world of technological innovation. But that failed to allow for the inheritance from his mother's side of the family. What really fascinated the schoolboy – and later the student – were not 'things already invented but the mystery of those to be discovered'. At secondary school, Gerard 't Hooft was good at most subjects, but he excelled in mathematics. At the age of 16 he won second prize in the national 'Maths Olympiad'. When the time came to go to university, this talent for dealing with the abstract caused him to opt for physics. He enrolled at the University of Utrecht where his uncle was a lecturer.

It was there, in 1969, that he started working under the direction of Martinus Veltman, his mentor and elder by 15 years with whom, 30 years later in 1999, he would share his Nobel Prize. It was Veltman who introduced him to the fascinating challenges of quantum physics. 'This was a very exciting time as we were starting to use the first large particle accelerators, at CERN for example, which had been developed in the 1950s. These instruments of experimentation radically changed existing theories formulated to describe the co-existence of forces of strong and weak interaction between the particles of the atomic nucleus. The results observed rendered obsolete the methods of calculation proposed by the theories. At the same time, calculating capacity increased enormously with the first big computers.'

Electroweak interactions

Veltman, who believed in the possibility of a new theory on what physicists call *electroweak interactions* (see box), set about pioneering a software program able to handle the previously indigestible mass of quantum calculations required by this new approach. He suggested to the young Gerard 't Hooft that this theoretical research should be the subject of his doctoral thesis. His confidence in his assistant proved to be well placed. In 1971, at the age of 26, 't Hooft published two articles in quick succession which constituted a new and decisive theoretical approach to *electroweak interactions*. With the aid of Veltman's software program the two researchers proceeded to verify the partial results and then jointly developed a complete functional calculation whose validity as a theoretical edifice has since been increasingly confirmed.

Their work was used extensively, for example, in the controlled experiments on the production and identification of W and Z subatomic particles by CERN's LEP accelerator. The Veltman-'t Hooft model is also at the origin of predictions of the existence of an as yet unidentified particle, the famous 'Higgs boson', something of a 'Holy Grail' for contemporary physicists.

The secret of matter

Electroweak interactions – which physicists have been racking their brains trying to explain for decades and which were elucidated mathematically by the 't Hooft-Veltman theoretical model – are essential to an understanding of matter and, what is more, to the chemistry of a star such as the Sun. If it were not for electromagnetic interactions, electrons would not revolve around the nucleus and there would be no atoms. It is weak interactions which convert protons into neutrons and cause the fusion of hydrogen atoms to form a helium nucleus in the great solar cauldron without which our planet Earth would be no more than an uninhabited ball of ice.

Internet site

- http://www.phys.uu.nl/~thooft/

See also

- www.nobel.se/physics/laureates/1999/illpres/index.html

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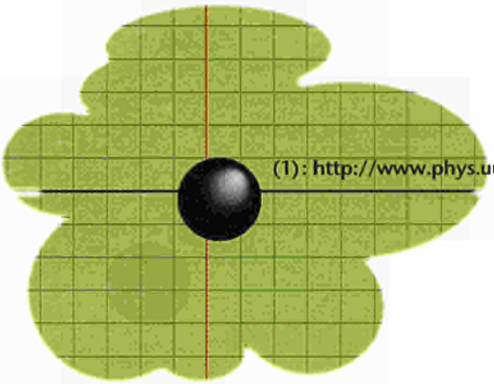
'Is it the environment I grew up in or my genes which determined my vocation as a physicist?' That is the question Gerard 't Hooft asks in an autobiographical paper written when he was nominated for the Nobel Prize in Physics in 1999. RTD info profiles a man of science with a distinct sense of humour.



Communicating curiosity

Gerard 't Hooft does not, however, share the passion of some scientific experimenters who scrutinise the 'soup' of particles turning in the accelerator. 'I have of course spent many working visits at CERN, but my passion is the beauty of theory. I am at present studying the absolutely fascinating concept of quantum black holes in the field of astrophysics.'

Remaining loyal to his old university in Utrecht, this 1999 Nobel prizewinner divides his time between pure research and lecturing on theoretical physics. 'For me it is very important not so much to transmit knowledge as such but to have a passion for curiosity.' As we speak, a new generation of doctorate students are hard at work in the neighbouring rooms, the blackboards full of equations. In fact, 't Hooft was a member of the jury for the last Young Scientists Competition organised by the Commission.

Has the study of science retained the image it had during his young days? 'No. Relations between science and society – and young people in particular – have become problematic. As a boy and then adolescent growing up in the 1950s, I knew a world in which the researcher and his work, in all its arduousness, had a genuine aura. Today we are living in a world where the importance of comfort leaves less room for effort. There is a danger of real scientific illiteracy, which is also the reason for a deplorable and absurd tendency to mistrust science. Most of the ills of the world do not come from knowledge but from human behaviour. And it is only through knowledge that this behaviour can evolve.'

Humour and the web

A physicist sensitive to communication matters, Gerard 't Hooft is also a man with a sense of humour – that much is clear from his website. (1) Naturally he speaks of his interest in black holes – and directs you to a US site where you can find the answers to all your questions on a subject which never fails to fascinate. An African lion sprawled in the shade of a tree then invites you to discover some remarkable photos taken by Gerard in Zimbabwe during the eclipse of the sun in June 2001.

He is also passionately interested in space and the many promises it holds. There is in fact an asteroid named 9491 Thooft, discovered in 1971 by a couple of Dutch astronomers working at the Palomar Observatory in California. Visitors to the NASA website can study its spatial orbit which takes it between Mars and Jupiter. Thooft, which even has a draft constitution comprising 13 articles, is also the neighbour of the asteroid B 162 inhabited it seems by a certain Little Prince...

Other links take you to a plan to build a hotel on the Moon and a campaign for a permanent human presence on our satellite which has been abandoned for the past 30 years. 'I believe that sooner or later the adventure of manned flights will resume and that we will ultimately explore our solar system.' But make no mistake – there is no straying from the strictly scientific, and 't Hooft has no time for the charlatans who try to distort the principles of physical rationality to justify paranormal fantasies.

Finally, the 't Hooft site pays homage to the peculiarity of names which strangely begin with a back-to-front apostrophe followed by a small t. A letter which, in their wisdom, word processing programs are incapable of respecting when it comes to drawing up an alphabetical list. 'My name often appears right at the beginning, or right at the end, before Mr Aaron or after Mr Zzzwylitski, who thought their place was assured.'

(1): http://www.phys.uu.nl/~thooft/black_h.html

Aids, malaria, tuberculosis:

Sub-Saharan Africa is plunging ever deeper into a deadly spiral. Poverty engenders disease which in turn generates more poverty. In partnership with scientists and health officials in the countries affected, the European Union is launching a major clinical research project to halt the progress of the three transmissible diseases which are draining this sub-continent of its lifeblood.

Health threats to the world's poorest countries, which lock them into a vicious circle of underdevelopment, are reaching the limits of endurance. The international community officially recognised the seriousness of the situation three years ago. Meeting in Okinawa in July 2000, the G8 countries agreed on the need 'to step up the fight against poverty in the developing countries' and to implement 'urgent measures to combat infectious and parasitic diseases'.

Field trials

In September of the same year, the European Commission proposed a new political framework to 'accelerate the fight against the principal transmissible diseases in the context of poverty reduction' and, in partnership with the WHO and the UNAIDS programme, organised broader consultation with many of the countries concerned, international development agencies, the world of research and the pharmaceutical industry. In April 2001, the first HAD (Health, Aids, Demography) action took practical shape, aimed in particular at strengthening pharmaceutical policies, stepping up the research effort and boosting international partnerships.

Last April, this new commitment gave rise to the launch in Barcelona of the European and Developing Countries Clinical Trials Partnership on Poverty-related diseases (EDCTP). This aims to develop clinical trials for new treatments and vaccines against Aids, tuberculosis and malaria in sub-Saharan Africa.

'Increased and more effectively coordinated clinical research is a prerequisite for pushing back the tide of destruction caused by these diseases,' stresses Antoni Trilla of Barcelona University's Hospital Clinic, coordinator of the project's start-up phase. 'Each of them takes a different form and poses its own problems of diagnosis, treatment and prevention which are also linked to specific local conditions, both geographic and social.'

➔

An increasingly alarming health situation

Poverty-related diseases are not exclusive to sub-Saharan Africa. But the death toll in this region is assuming catastrophic proportions, currently estimated at nearly 5 million a year.

The latest UNAIDS(1) figures show that, of an estimated 40 million people carrying the HIV virus worldwide, 28.5 million inhabit this subcontinent. Every year in Africa, Aids kills 2 million people, a sixth of them children. There are also 14 million orphans in Africa whose young parents have died of Aids.

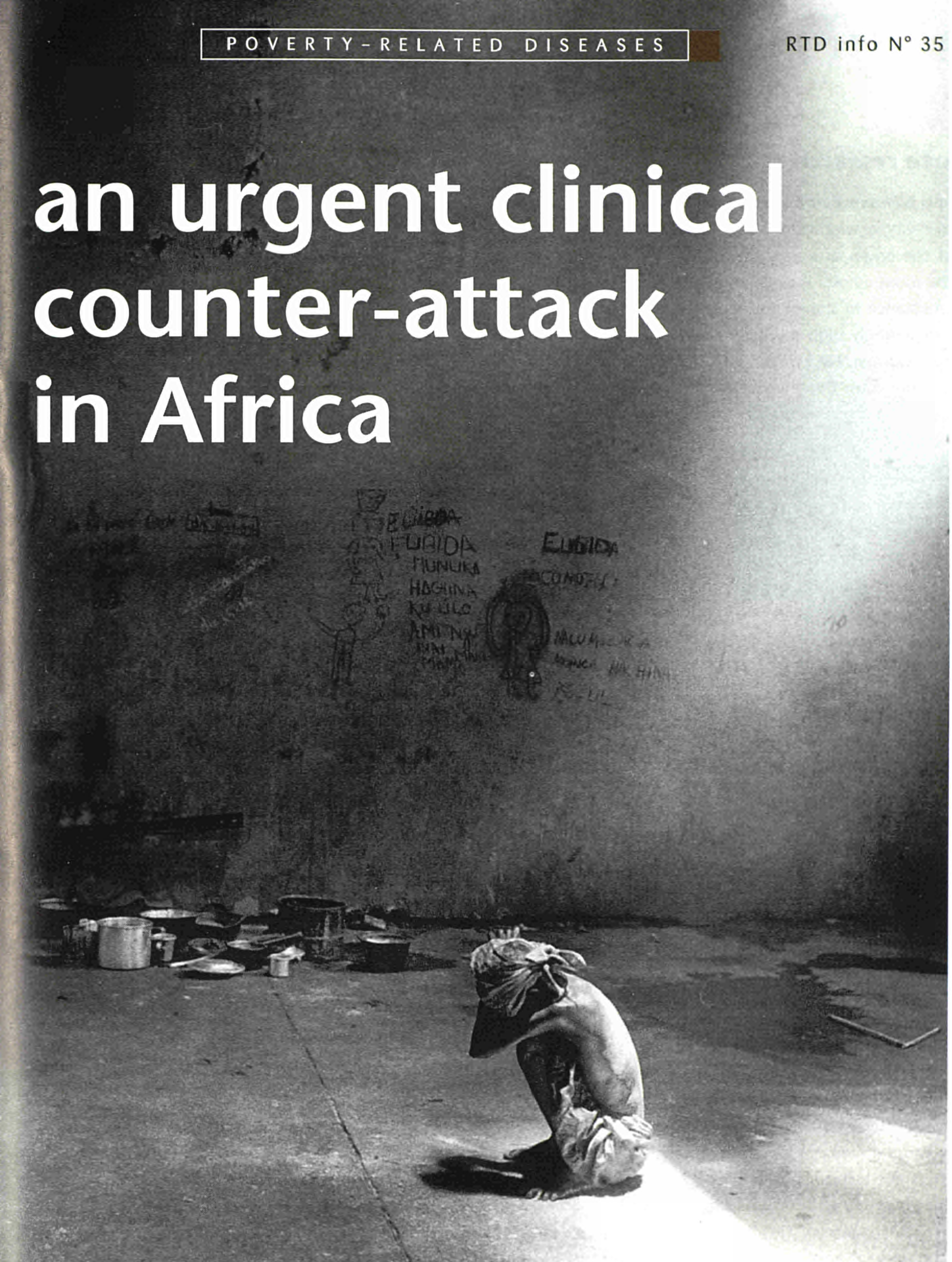
Tuberculosis affects 1.5 million people in sub-Saharan Africa and its spread is clearly closely linked to the spread of HIV/Aids. This contagious disease, of global dimensions and now on the increase, causes 2 million deaths a year.

Finally, the return of malaria is mainly affecting Black Africa, with more than 400 million suffering from the disease and almost a million deaths a year.

This devastation of the population – and its cost in terms of health care and the loss of individuals able to contribute to society – constitutes a genuine brake on development. The growing cost of disease is to the detriment of resources available for education. The circle is all the more vicious as it is education more than anything else which holds the key to ending the misery and improving health. In its alarming report, the United Nations stated that the overwhelming majority of young people are unaware of how Aids is transmitted and how to protect themselves against it.

(1) Highlighted at the HIV/AIIDS conference in Barcelona last July.

an urgent clinical counter-attack in Africa



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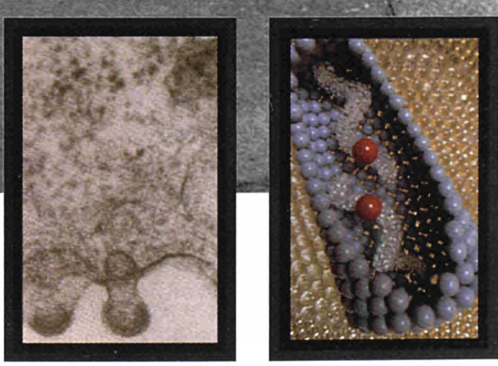

The genetic diversity of the HIV virus in Africa poses a major problem and requires solutions adapted to the continent. On the left, the HIV-1 virus which is responsible for Aids and on the right the nucleocapsid containing the genome and enzymes.
© INSERM

To find out more

- **Presentation of the EDCTP project**
  europa.eu.int/comm/research/info/conferences/edctp/edctp_en.html
- **Commission action programme**
  Accelerated action in the fight against HIV/AIDS, malaria and tuberculosis in the context of poverty reduction
  europa.eu.int/comm/development/document/com_en.htm
- **Information on Aids**
  www.unaids.org/
- **Information on tuberculosis**
  www.who.int/tdr/diseases/tb/default.htm
  www.hopkins-tb.org
- **Information on malaria**
  www.who.int/tdr/diseases/malaria/default.htm
  www.who.int/inf-fs/en/am203.html
  www.malaria.org/whatismalaria.html

A la carte research

One example is *Plasmodium falciparum*, which is wreaking havoc across whole swathes of sub-Saharan Africa. This agent is at the origin of a very severe form of malaria made all the more serious as populations are showing an increased resistance to known anti-malaria drugs, resulting in an increasingly high mortality among new-borns and pregnant women. New treatment combinations and possible vaccines must therefore be tested, while at the same time developing new preventive measures based on insecticides.

In the case of Aids, the genetic diversity of the HIV virus found in Africa poses a major problem. The use of complex forms of preventive or therapeutic vaccines which are the subject of intense research in developed countries is not a realistic prospect in the African context. There must be research and clinical trials on forms of prevention/treatment/vaccination adapted to the capacities for the supply and consumption of health care in the poor countries.

Finally, new medicines – and the research to develop them – are needed to combat the resurgence of tuberculosis, now present in a particularly acute and resistant form.

Public aid

Vital clinical research is most certainly the heaviest initial item of investment in developing new vaccines and treatments adapted to the socio-economic context of the Southern Hemisphere. 'It is essential for the public authorities to initiate this process as at this stage the pharmaceutical industry is clearly reluctant to commit itself alone given the lack of a guaranteed return on the investment,' stressed Commissioner Philippe Busquin in Barcelona.

This public commitment has largely taken shape already. 'The EDCTP is not being set up *in abstracto*,' points out Michèle Boccoz of the Institut Pasteur (FR), member of the initiative's Management Group. The project aims to federate the various approaches already adopted by clinical research in sub-Saharan Africa. These are being pursued by the WHO and UNAIDS as part of bilateral or multilateral initiatives supported by various countries or foundations, or by European programmes.

The EDCTP's aim is to provide a coherent response which draws on Community and national efforts. Such an open and concrete approach reflects the philosophy of the European Research Area. This project can in fact be seen as a kind of advance 'pilot test' of the 'new instrument of Article 169' which will enter into force under the 2002-2006 Framework Programme.

This provision enables the Commission to fund research and development projects carried out by Member States and associated countries (15 EU countries plus Norway in this specific case). The Community is contributing €200 million to implementing the EDCTP initiative. Additional resources will come from funds invested in national programmes and from international organisations, whether public or private, which decide to help finance clinical trials.

Creating a translational dynamic

'In addition to networking all those involved in the project, which from the outset plans to actively involve the biopharmaceutical industry, the EDCTP wants to encourage new avenues of research, in particular through progress in genomics and proteomics. It is a matter of accelerating the "translational" dynamic between the most recent knowledge and its applications,' explains Antoni Trilla.

The financial resources provided by the Union will make it possible to support pilot test sites which may be proposed at European level or by African health officials. Within a vast co-operative network, these sites will ensure the synergy and convergence of research – which, at present, is too disseminated or isolated – with the aim of joint enhancement and emulation. The aim is to develop new and appropriate treatments which are easy to use and inexpensive. The project also wants to encourage the coherency of initiatives in the field, by providing a reference for the validation of the results of clinical trials which is applicable to the medical samples and the patients treated.

Essential North-South partnership

Finally, a crucial foundation for the EDCTP is to create a long-term and clearly affirmed partnership with African scientists and health officials who are currently in the front line of the fight against the three pandemic diseases. Antoni Trilla believes that 'the know-how, knowledge and experience of the Africans working in the field is indispensable. It would be unthinkable – and impossible – to conduct clinical trials without recourse to these able local players who are in direct contact with the affected populations. This partnership is, moreover, central to the current task of identifying the geographical and social sites of a size and nature to be validly used for clinical trials.'

'It is very significant that the African representatives were involved in the very conception of the EDCPT initiative,' adds Fred Binka, lecturer at Ghana University's School of

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African delegation

The EDCTP met with a very favourable response in Africa, as illustrated by the presence of key political figures at the conference to launch the project, last April in Barcelona. The African delegation included Mozambique's Prime Minister Pascoal Mocumbi together with the country's senior public health official Richard Thompson, Cameroon Health Minister Awa Coll-Seck, and many leading scientific experts recognised by international organisations, such as Fred Binka and Francis Nkrumah (School of Public Health, University of Ghana), Wen Kilama and Hassan Mshinda (African Malaria Network Trust and Ifakara Research Centre, Tanzania), Solomon Benatar (University of Cape Town, South Africa), Omou Y Sow (Conakry, Guinea), Souleymane M'Boup (Hôpital Le Dantec, Senegal) and Leopold Zekeng (Cameroon).

These leading scientists, together with Francine N'Toumi (Gabon), and Voahangy Rasolofo (Madagascar), constitute the 'coordinating group of Southern countries' within the EDCTP which is working in partnership with European scientists.

Public Health. 'This is a first as the other programmes we knew about were prepared without us and we were simply invited to participate. In the present case, we are bringing in our African knowledge and experience and have the assurance that the programme will consider our real needs and expectations.'

'In this context, one of the tasks during the project's preparatory stage is to provide the necessary training in terms of *good laboratory and clinical practices* at every level of health policy implementation. The EDCTP can also be the means by which African specialists can find opportunities to use their skills in their own countries, therefore putting a brake on the brain drain which is robbing Africa of valuable skills,' concludes Antoni Trilla.

Ethics and clinical trials

The Helsinki Declaration (1964), adopted by the World Medical Association, is the principal ethical code governing clinical trials on human beings. It lays down three major principles: the well-being of the subject must take precedence over the interests of science; subjects must give their consent freely and in full knowledge of the facts; and subjects must be assured of benefiting from the best treatment on conclusion of the trials.

Although the first of these rules is clearly respected in the case of clinical research in southern countries, the matter of informing the populations in question and obtaining their consent must always be borne in mind in cultural contexts which are ill-prepared for this kind of approach. The third principle is currently the subject of debate. Many clinical trials carried out on Aids in developing countries during recent years related to treatments more likely to be applied in rich countries and beyond the reach of local socio-economic resources.

The EDCTP should not stand accused of this as its goal is the development of treatment of direct use by these countries. 'But the time it takes before they become available and the way local health authorities make them available are also very important parameters when evaluating the ethical aspects linked to the carrying out of trials,' stresses Antoni Trilla. 'In any event, the criteria applied will be those habitually applied in developed countries, but the reality of the situation facing Africa must also be taken into account.'


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Malaria: decisive clinical trial in Mozambique

At the beginning of July, under the direction of Dr Ricardo Thompson, specialist in research on malaria and director of public health, Mozambique carried out further clinical trials on a promising potential vaccine developed by GlaxoSmithKline (GSK). These phase I trials follow previous trials in Gambia and are intended to confirm the harmlessness of vaccines, established in Gambia, on a limited group of children. Once this is confirmed, the specialists will launch phase II to determine the likely initial treatment benefits of the tested molecule among a wider population. These trials are being carried out in partnership with the Malaria Vaccine Initiative network and the International Health Centre at the Hospital Clinic of Barcelona, under the direction of Dr Pedro Alonso. Negotiations have also been initiated with the Bill and Melinda Gates foundation to reduce the production costs of treatment developed by GSK.

Charged by the Commission, the Helsinki Group has just published the results of a painstaking task: an evaluation of the situation of men and women scientists throughout Europe. It involved compiling comparable statistics as well as observing legislation and specific initiatives in over 30 countries designed to create a gender balance.

Equal skills for an equal career?

In the EU, 70% of university researchers are men. Trailing the field are Belgium, the Netherlands and Germany, with under 20% of women researchers. In Ireland, Greece and Portugal more than 40% of higher education teaching staff are women.
© NeuroSearch

'No statistics, no problem, no policy. Statistics help to identify problems and make it possible to measure the effectiveness of remedies,' believes the British sociologist Hilary Rose. This is the task which the Commission entrusted to the Helsinki Group on Women and Science. ([1]) The results are presented in the report entitled *National Policies on Women and Science in Europe*, published last June, which as well as a wealth of statistics also sets out the principles of policy and good practices to promote an increased role for women in science and research.

The balance of the sexes

'There is considerable diversity from one country to another in terms of scientific infrastructures and the climate permitting women to pursue their career,' notes Teresa Rees, lecturer at Cardiff University's School of Social Sciences. 'But there are also common factors, such as the lack of a balance between the sexes in more senior positions – at the level where scientific policy is decided.'

A number of attempts are being made to correct this gender imbalance. The Commission supports a policy of 'gender mainstreaming' which involves taking the gender dimension systematically into account in all research programmes and policies. This approach is most in evidence in northern Europe.

One example of this is the Equality Plan 2001-2003 implemented by the Finnish Academy which states that, given equal skills, preference should be given to either men or women depending on which of the genders is less represented. In this very egalitarian country – which has the highest standard of education in the world – 58% of university degrees and 45% of doctorates were awarded to women in 2001. But just 20% – an EU record low – of teaching staff in higher education are women.

This figure is indicative of the remaining imbalance when it comes to exercising positions of responsibility in the scientific hierarchy (see graph). In Europe's universities as a whole, 89% of those in the most senior posts are men. It is to remedy this situation that the French Research Ministry set up the *Mission pour la parité en sciences et en technologies*, one of the principal objectives of which is to 'achieve a balance between the sexes on deliberative and consultative bodies'. The order is to go out for women to make up one-third of staff in bodies on which the public authorities are represented, compared with 10% at present.

Setting the example

European Research Commissioner Philippe Busquin believes that the absence of women in positions of responsibility 'is not of an emotional nature, but the manifestation of discrimination which is the result of several factors'. These factors include lack of interest in science, the difficulty of returning to a job with the same status after a career break, a traditional confinement to certain tasks and a reluctance to accept certain posts which is more cultural than natural. This is why the Commission has decided to set the example by helping women to overcome this obstacle course.

Under the Fifth Framework Programme, the target was for 40% of the EU-funded Marie Curie research fellowships to be awarded to women – the figure was 38.9% in 1999 and 37.3% in 2000 – and for members of groups of experts appointed by the Commission to include 40% women, irrespective of field. The progress made was very real, women sometimes exceeding 50%. The same desire to correct the imbalance was evident in the research projects submitted to the Commission in which the more active participation of women was explicitly desired. The result is that 18% of women scientists were project coordinators under the Fifth Framework Programme compared with 10% in the previous one.

'Gender' research

This strategy is progressively enabling women to increase their presence. The Sixth Framework Programme is similarly committed to correcting the gender balance and has introduced new measures to this end. Particular attention will be paid to compiling statistics on the participation and role of women in European research and to gender studies.

The latter have developed considerably over recent years, mainly in northern Europe. In Norway, for example, a section of the Research Council of Norway is mainly concerned with analysing and planning a research policy to promote equality between the sexes, based on existing national and international experiences. The Netherlands too has taken this question very seriously since the 1980s. The Netherlands Association for Women's Studies publishes the *Tijdschrift voor genderstudies*, special chairs have been created and a 'gender' approach is applied systematically in fields ranging from literature to medicine.

About 10% of research posts in engineering and technology are held by women. Relatively more women are active in agronomical science, where they account for 28% of researchers, as a European Union average. Most women researchers are active in the social and human sciences. There is also a high percentage of women in the medical sciences, with Ireland (72%) and Portugal (65%) leading the field.
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(1) Comprising civil servants and experts on gender issues from the Member States and associated countries, this group is charged with promoting debates and exchanges of experience on measures to promote the participation of women in research.

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To find out more

- **The Helsinki Group**
  www.cordis.lu/improving/women/helsinki.htm
- **Statistics and indicators**
  http://europa.eu.int/comm/research/sciencesociety/women/wssi/index_en.html
- **'Gender and Research' information at European level**
  www.cordis.lu/improving/women/home.htm
- **Report of the Helsinki Group – National policies on 'women and science'**
  www.cordis.lu/improving/women/policies.htm
  www.cordis.lu/improving/women/reports.htm

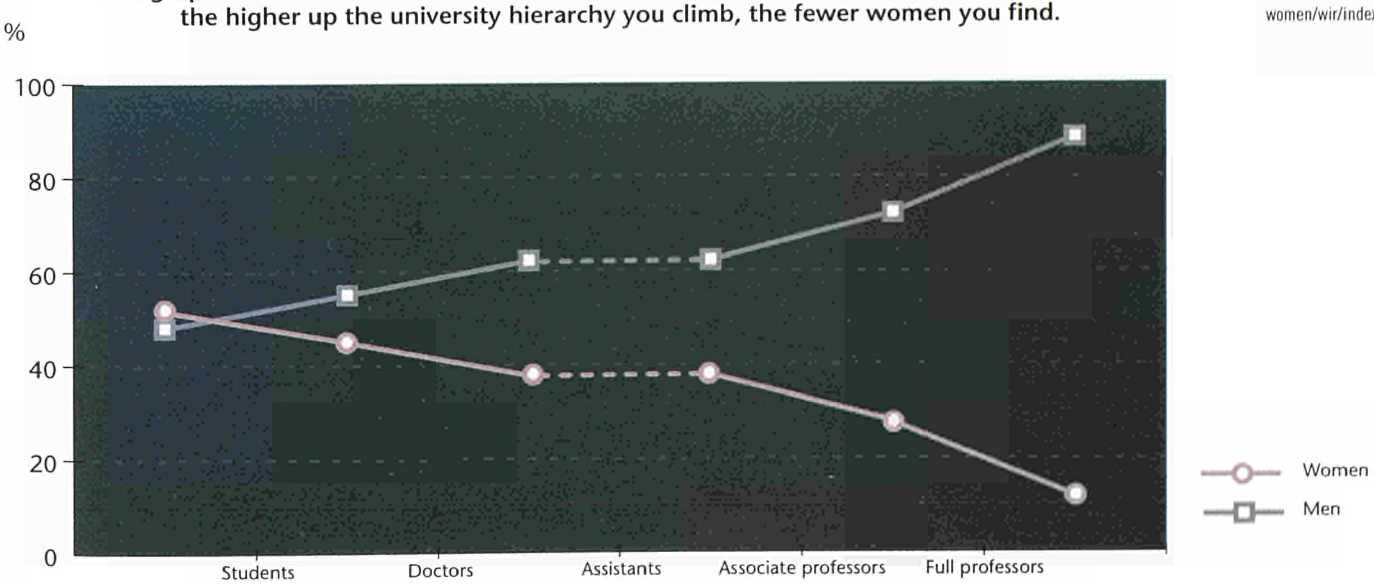
Heysel Conference

- A number of thematic workshops on women and research will be held during the Heysel Conference in Brussels from 11 to 13 November, on the occasion of the launch of the Sixth Framework Programme.
  http://europa.eu.int/comm/research/conferences/2002/index_en.html>Women

Women and industrial research

- The STRATA-ETAN high-level group of experts is currently studying the situation of researchers in the private sector. An international conference will be held on this subject in Berlin in the spring of 2003.
  http://europa.eu.int/comm/research/sciencesociety/women/wir/index_en.html

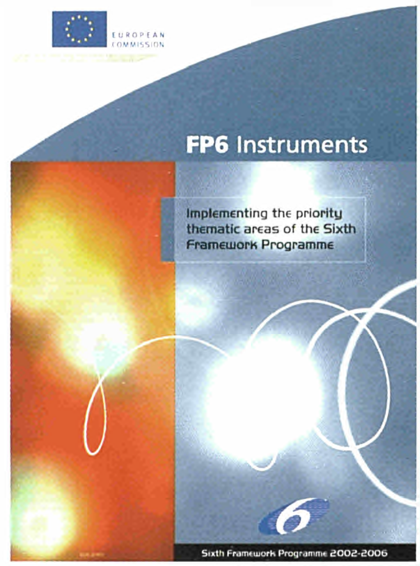
The typical development of a scientific career, per gender.
This graph of the situation in Austria (1998) is representative of all the European countries: the higher up the university hierarchy you climb, the fewer women you find.



Introduction to the Sixth Framework Programme

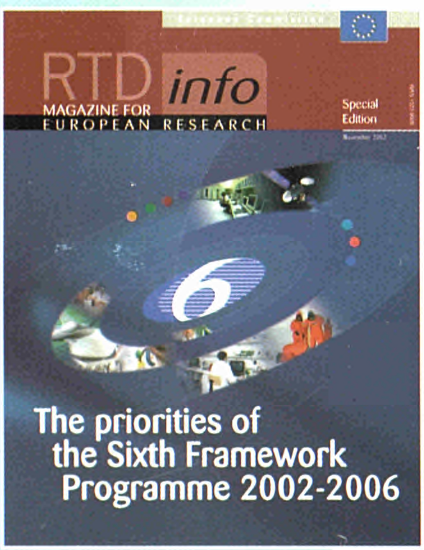
Participating in European research

This 88-page guide provides useful background information, tips and a general overview of FP6 for potential project participants.



FP6 instruments

This brochure (16 pages) gives an introduction to the instruments, new and traditional, available for implementing the priority thematic areas of FP6.



RTD info: The priorities of the Sixth Framework Programme 2002-2006

This special issue of RTD info magazine (32 pages) proposes a systematic overview of the seven thematic priorities of FP6:

- Life sciences, genomics and biotechnology for health
- Information society technologies
- Nanotechnologies and nanosciences, knowledge-based multifunctional materials and new production processes and devices
- Aeronautics and Space
- Food quality and safety
- Sustainable development, global change and ecosystems
- Citizens and governance in a knowledge-based society.

Another special issue of **RTD info** has been published recently on the opportunities for European research resulting from **EU enlargement** (Special Edition October 2002, 16 pages).

All these publications can be obtained by sending a request to research@cec.eu.int

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