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A priority for Europe

MULTIDIMENSIONAL SPACE

Editorial

Communicating in the European dimension

On 30 June, following an initiative by the Research Directorate-General's Information and Communication Unit, some 50 European journalists gathered in Brussels to exchange experiences and impressions of their profession, as well as the difficulties experienced by the scientific press. The aim was not to give vent to their woes but to see how they could jointly organise effective communication between journalists from all the Member States.

Strange as it may seem, this was the first time such a meeting had been held in Europe! The participants were pleased to learn of the many initiatives aimed at improving the quality of scientific journalism to be found all over Europe. One of these deserves particular mention. A number of countries have launched schemes which enable journalists and scientists to swap roles. A scientist is invited to write an article while a journalist tries his or her hand at scientific research. As one programme organiser explains, after such an experience researchers cease to fear journalists. We believe that such initiatives should be encouraged at European level.

As the European Research Area becomes a reality, Europe is sorely lacking a mechanism enabling it to draw full benefit from its 'home grown' research activities. For example, an EU-backed project coordinated by a German research team that may, at a given moment, make a global breakthrough is likely to be covered in the national press but may well fail to make any media impact in other Member States. At present, there is no structured mechanism for informing the media in one Member State of scientific activities going on in another and giving the highest possible profile to European research.

A press service such as AlphaGalileo (www.alphagalileo.org) provides access to pertinent national information across an increasing area of Europe. But why not create a genuine European scientific press agency whose mission would be to ensure cross-border media coverage of European Research Area activities?

In this respect, the Brussels meeting was perhaps a first step towards the creation of a 'European scientific communication area' as a natural corollary of the European Research Area.

This meeting also shows the Commission's ability to act as a catalyst for the process, stimulate initiatives and develop European networks. It also reminds us that, despite their facility and power, virtual exchanges have neither the charm nor the effectiveness of 'flesh and blood meetings'. But had we ever believed otherwise?

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Europe's troubled seas

The Mediterranean's delicate health has long been at the centre of European environmental research. The Black Sea has not been ignored either and has been the subject of a number of studies and remedial measures. Now, with the approaching accession of Romania and Bulgaria (planned for 2007), the European Union will land itself an extensive shoreline along this landlocked sea, which is in a particularly critical state. The IASON initiative, launched in the spring of 2003 at a major scientific conference under the Greek presidency, aims to set up transnational and multidisciplinary co-operation networks to treat and protect these two crucially important maritime basins.

View of the point where the Eastern Mediterranean joins the Black Sea, captured by the Envisat satellite. At the top of the picture, south of the Carpathian Mountains, green patches can be seen which indicate suspended sediment in the marine waters off the Danube delta. To the south is Greece and the Aegean Islands, and at the bottom the desert coasts of Africa. © ESA

Thessaloniki is in Greece and is, therefore, still in Europe. Yet there is something in the atmosphere that evokes the proximity of the Orient, the Balkans and the Carpathians. An industrial port and university town in the Eastern Mediterranean, Thessaloniki stands at a crossroads of civilisations where Christians, Muslims and Jews have rubbed shoulders for centuries. It is this city, symbolic of an enlarged Union, which hosted IASON (International Conference on the Sustainable Development of the Mediterranean and Black Sea Environment). The gathering aimed to find ways of ensuring the sustainable development of these two important maritime regions.

A fast-growing population

Time is short. These two seas which form Europe's southern border are currently undergoing radical change. In addition to their relatively small size, they also have the common characteristic of being virtually landlocked, with the Straits of Gibraltar, the Dardanelles and the Bosphoros considerably impeding water circulation.

This is exacerbating the effects of a rapidly expanding population. 'In the 1960s, the population of the countries bordering the Mediterranean was 246 million. Today it is over 450 million,' points out Michael Scoullos of Athens University, who is also secretary of the Office for Information on the Mediterranean (MOI-ECDSE). 'Then there is the seasonal influx of tourists to be taken into account, totalling some 150 million. All the forecasts indicate that these figures are set to increase further.'

Half of the 25 000 km Mediterranean coastline is already heavily urbanised. The water treatment stations built in response to this population increase are often too old and too small, and not all coastal inhabitants are connected to them. Moreover, the impact of humanity on the marine environment is growing all the time – partly due to technological progress.

Wide-ranging impact

'The transnational and multidisciplinary environmental problems of the Black Sea and Eastern Mediterranean have not yet been assessed in an integrated way, one taking advantage of all the existing data and liaising with existing efforts,' says Achilleas Mitsos, director-general of research at the European Commission. 'Such an integrated approach could lead to solutions, policy actions and proposals for long-term strategies for sustainable development.'

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Example of surface waste collected following a trawling operation in the Mediterranean.

The uncontrolled discharge of waste from the 17 countries bordering the Black Sea over many decades has resulted in critical marine pollution in this closed basin.

A number of major rivers in this region (the Rhone, Po, Danube and the Nile) drain across vast areas where industrial agriculture dominates. Farm inputs also enter the sea through numerous smaller rivers and streams. French, Italian, and Spanish regions bordering these seas each consume more than 100 000 tonnes of pesticides a year while pesticide use is also increasing in other regions: Turkey recently reached the 35 000-tonne level and Egypt is going the same way.

There is also the question of air pollution – which is often under-estimated when speaking of the sea – generated by cars, household waste incinerators, industry, and so on. '[The] impact is, however, concentrated in the air masses of coastal areas and exchanges between these and surface waters. This phenomenon is exacerbated by the absence of tides, which greatly reduces the mixing effect,' notes Alexandros Theoharis of the Greek National Center for Marine Research. 'The concentration gradients, as well as pH gradients, for various molecules are, therefore, very intense, with marked consequences on marine biocenoses.'

Marine environments

Despite their relatively small size, the Mediterranean and the Black Sea have many marine environments each of which functions in a different way. There are the huge river deltas (the Danube, Rhone, Po and the Nile), steep fjords (Dalmatia), underwater thermal springs, deep sea beds (the Ionian and Levant Seas), island chains (Cyclades) and vast areas without oxygen (Black Sea). This diversity complicates the task of researchers.

The *Europe*, fitted out by IFREMER, on a Mediterranean mission – European research is today providing a considerable mass of data with a view to enabling the sustainable management of endangered marine ecosystems. © IFREMER

The sea itself is now being used more intensively than ever before. There has been a major increase in sea transport, especially of hydrocarbons, which can cause such devastating and lasting pollution. Every year 100 000 tonnes of hydrocarbons pass through the Black Sea alone. Fishing fleets are having a greater impact too, even if the number of vessels has remained virtually stable. Fish farming has also expanded considerably, and this too will have major ecological repercussions.

Disrupted ecosystems

The combined effect of this environmental pressure is that a number of sustainability indicators are now on maximum alert. A high and increasing mortality rate among marine animals in the Black Sea, for which there is as yet no clear explanation, has been observed over the past three decades, with losses estimated at tens of millions of tonnes.

Fish catches have plummeted by 80% in recent years and, of the 26 species previously fished commercially, only six remain in sufficient numbers. At the same time, populations of jellyfish and other gelatinous animal species have increased significantly, probably due to eutrophication and/or the accidental introduction by ships of foreign species.

Reduced catches have also been recorded in the Mediterranean for more than a decade. 'What is more, the overfishing of large carnivorous species has upset the structure and functioning of the ecosystem. At many locations, fisheries are now obliged to make do with smaller varieties which are more sensitive to environmental variations,' points out Jacques Bertrand of the French Institute for Marine Research (IFREMER).

These major changes to the Mediterranean ecosystem are all the more worrying as it is a sea with a high level of endemism (the presence of exclusively local and, hence, irreplaceable species). The Mediterranean represents just 1% of the world's seas but contains 7.5% of all aquatic species. Among the various indicators of disturbed ecological balances, there is a clear trend towards 'tropicalisation' as many species from warmer waters are proliferating to the point where they are threatening their indigenous cousins, whether plants (such as the famous predatory seaweed *Caulerpa taxifolia*), molluscs, shellfish or other types of fish. This worrying and complex phenomenon is probably due to the combined effect of

***Caulerpa taxifolia*, sometimes known as the 'predatory alga', is disrupting the balance of several marine ecosystems. Its excessive proliferation is the result of eutrophication caused by agricultural, industrial, urban or aquicultural waste.**

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inflows of water and increased shipping traffic through the Suez Canal and the Straits of Gibraltar, and may be further exacerbated by global warming.

Solutions without frontiers

Most of the processes at work – and consequently the possible solutions – are transnational and require multidisciplinary approaches. This explains the range of expertise represented at the IASON conference, where oceanologists and climatologists rubbed shoulders with specialists in biology, marine genetics, fishing, economics and modelling. The gathering drew scientists from throughout the Union, as well as delegates from Albania, Croatia, Russia, Turkey, Georgia, Bulgaria, Egypt, Cyprus, Romania, Ukraine, Israel and the United States. It is only through such a spirit of co-operation that a sustainable future for these two precious seas can be achieved.

Making data accessible

A mass of oceanographical data has been gathered over the years by scientists working on the Mediterranean and Black Sea. A recent project (MEDAR/MEDATLAS) – supported by institutions in 20 countries, the European Commission and UNESCO – has now made readily available a large proportion of this data in the form of an easy-to-use database, available through the Internet or in the form of four CD-ROMS. This usefully supplements the multidisciplinary database previously compiled by the MTP/MATER, an EU-backed project studying the Mediterranean. MEDAR /MEDATLAS provides high quality data sets, based on extensive sampling of parameters such as temperature, salinity, dissolved oxygen, pH, as well as ion concentrations.

This impressive information source includes maps, graphs and diagrams, all accessible free of charge. The database is updated continuously and extended regularly to include new factors and parameters.

Eutrophication and algal efflorescence

The waters of the Mediterranean are naturally poor in nutrients and, thus, in algae, which is why they are so blue and transparent. But the results of the EU-backed Interpol project suggest that this equilibrium is now being seriously upset in certain places by human waste with its high density of phosphate, nitrate and other nutrients. This waste – originating in the leaching of agricultural fertilisers and the inflow of urban or industrial waste water – is causing eutrophication reflected in the intense development of unicellular algae and the micro-organisms which feed off them. In deeper waters, it is causing disoxygenation.

These changes are impacting on the ecosystem as a whole, sometimes resulting in the virulent proliferation of certain species of planktonic algae which produce 'red tides' (or tides of other colours depending on the species of plankton). These proliferations can be viscous and foul smelling, with disastrous effects for regions where beach tourism is a source of vital revenues. They can even be toxic, causing high mortality among marine species. Several European research projects, such as FATE, are trying to understand the mechanism at work in these proliferations and, in particular, the nutrient thresholds at which they are triggered.

Eutrophication is even more of a problem in the Black Sea than in the Mediterranean, especially in the north-west corner into which water flows from the 'four Ds': the Danube, Dnieper, Dniester and Don. For its size, the Black Sea is the final destination for a very large volume of human, agricultural and industrial waste. Algal blooms are frequent, intense and extensive, resulting in acute disoxygenation, which causes high mortality among shellfish and benthic molluscs. A number of marine species have disappeared, while the proliferation of jellyfish and *Noctiluca scintillans* (a type of plankton) has worsened what is already a seriously disrupted ecosystem. Fortunately, some easing of the effects of eutrophication has been observed recently.

To find out more

- MEDAR/MEDATLAS
  www.ifremer.fr/sismer/program/medar/
- MTP/MATER
  www.ifremer.fr/sismer/program/mater/

Control sample of fish catches taken on board the *Thalassa*. © IFREMER

The biodiversity capital

It is difficult to put a monetary value on marine biodiversity, although research is looking into possible ways of doing so. One example of the economic importance of this natural 'capital' is the vast numbers of species of bacteria, known as thermophilic or hyperthermophilic, which are able to live at temperatures of over 100°C and which are now the subject of close study. These bacteria live in hydrothermal springs and the molecules found in their metabolism can withstand temperatures which are incompatible with the functioning of ordinary biological processes.

Some of these molecules – enzymes, sugars, antiseptic or antifungal agents – are thermostable which makes them of great interest to industry, especially the paper, detergent, agri-foodstuffs and textile industries. Research into these fields has resulted in many products which are already commercially available.

Fishing and aquaculture

The sustainable management of marine resources is a delicate art. Fish farming – often presented as an alternative to overfishing – requires vast quantities of fish meal. In addition, uneaten food debris and excrement build up around the breeding enclosures and can place a considerable burden on the surrounding ecosystems.

The sustainable management of fishing means defining exactly what catches a given stock can support. This must be based on a complex series of demographic indicators –population size, age pyramid, number of reproducers, etc. This requires a major scientific monitoring exercise. The creation of fishing reserves as a tool of stock management involves a judicious choice of location, geographical limits and the implementation of precise rules.

These are all challenging tasks for researchers whose opinions are often questioned by professionals.

The gills of the giant Riftia worm which lives at a depth of over 2 000 metres. © IFREMER

By focusing on the environmental destinies of both the Black Sea and the Mediterranean, European research is responding to the new reality of the enlarged Union – and its future coastline. The IASON conference marks the point of departure for this integrated approach. Christian Patermann, director of environmental research at the European Commission, discusses the issues at stake.

IASON sets sail

European research has traditionally concentrated on the threat to the Mediterranean. Does this mean that the very critical situation of the Black Sea had previously been seen as not crucial?

Christian Patermann: Certainly not. And, just as it is actively involved at many sensitive points in the global environment, the Union has not waited until now to concern itself with the very serious problems in the Black Sea basin. It has provided support under the Phare and Tacis programmes – in particular for UN Environment Agency and World Bank initiatives. And then there are the actions carried out by the Environment DG and those in the framework of European research projects. These include EROS 21[(1)] which studied the effects of the Danube on coastal waters. This project also measured the Black Sea's high concentration of methane, one of the greenhouse gases responsible for global climate change.

The Black Sea basin clearly plays a considerable eco-strategic role. It is a major sea route for oil transport and it is the outlet for 20% of Russian exports. It is simply not possible to envisage managing its coasts and protecting its biodiversity at anything but the common European level, especially in the light of enlargement. Take the Danube, for example, Europe's second longest river whose immense delta is an exceptional ecosystem with a rich biodiversity. The environmental health of this delta is affected by everything happening in the immense drainage basin, which covers some 8 million km^2 and stretches from Poland to Germany, Austria and Romania.

Are candidate countries most concerned by these environmental questions able to participate in Union research actions?

The candidate countries from the former communist bloc are reaching the end of a process which has brought their infrastructures and research systems almost to the point of destruction. They are facing a number of pressing problems, sometimes related to questions of simple economic survival. As a result, research and environmental issues are not necessarily priorities for them at present.

But, in the longer term, it remains imperative for these countries to be involved in protecting their natural capital and resources. Apart from purely ecological considerations, economic resources, such as tourism and fishing, depend on the health of the rivers and seas.

These countries also have some excellent scientists. It is essential to create and sustain links with them and to help them become a part of the European Research Area. The concept of sustainable development is a basic tool in this respect, one which takes into account the economy, the environment and social aspects. Implementing it in this part of Europe is a vital opportunity and also a challenge for the continent as a whole.

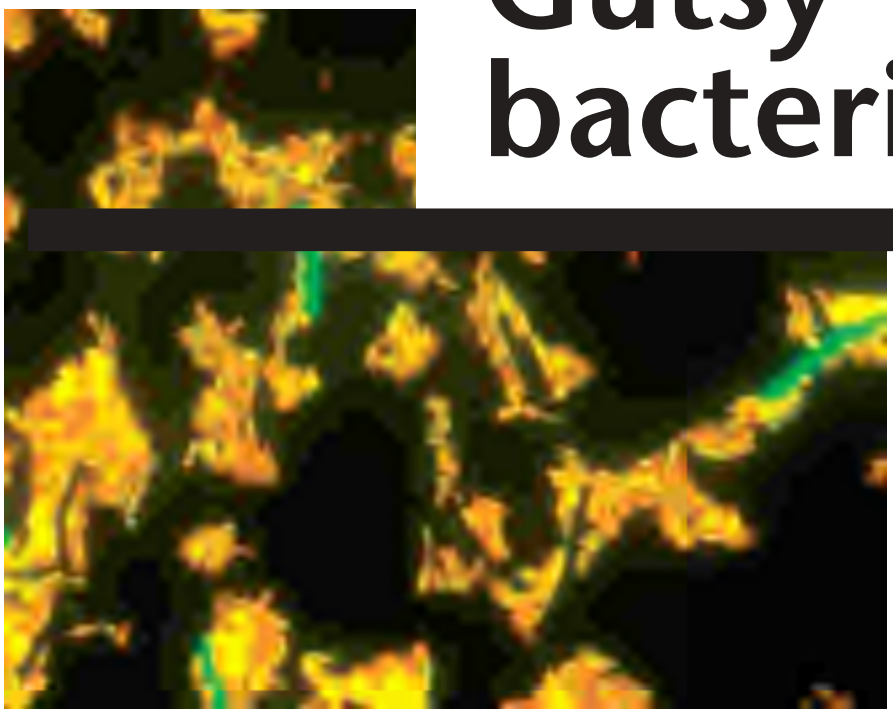
Did the Thessaloniki conference meet your expectations?

We wanted to take stock of this region in all the scientific fields linked to sustainable development: climate change, biodiversity, management of coastal areas, fisheries, aid in decision-making, and so on. The aim was to bring together scientists specalising in these fields to form a core team able to determine the priorities for improving the situation of these two maritime basins and to submit proposals for their sustainable management.

I was impressed by the quality of the contributions made by the participants and by the fact that more than 20 nationalities, from regions directly concerned as well as from northern Europe, turned up. We are going to continue this dialogue by setting up a permanent platform, initially supported by an Internet portal, so as to maintain these links, continue the evaluation, organise new initiatives and remain open to new contacts. Greece has undertaken to coordinate this effort and to define the operational instruments with which to put this dynamic to work.

(1) European River Ocean System
www.transboundarywaters.orst.edu/projects/casestudies/danube.html

Gutsy bacteria



The image shows a mixture of two pure cultures of *Lactobacillus intestinalis* (the green elongated elements) and *Bifidobacterium longum* (pinkish 'grains') as seen through a microscope. In some cases, an increased presence of these microorganisms in the intestinal flora can have probiotic effects which help strengthen immunity against many pathologies of bacterial origin.
Image: Ralph Thiel, DISE (DE)

The role of the many and varied bacteria which inhabit the digestive system is coming to be seen as a major factor in human health – despite the relatively little we know about them. It is also giving rise to so-called 'probiotic foods' with their potentially beneficial effects on the immune system.

They are present in their billions, belonging to some 500 different species. They exist in a very intimate relationship with our bodies, yet we never see them. The bacteria which inhabit our digestive tract form a vast community of uninvited guests whose influence on our health is confirmed regularly by scientific studies.

In addition to regulating the efficiency of intestinal activity – the intake of nutrients and the elimination of waste, they also seem to influence the workings of our immune system. The bacterial fauna in our intestines can also cause serious problems by promoting the development of virulent or even deadly pathogens. Conversely, a bacterial population in which these aggressors are unable to grow is a sign of good health.

What lies beneath

Despite its importance, we know very little about this intestinal fauna. To fill this gap, *Proeuhealth* – a cluster of European projects bringing together 64 research teams from 16 countries – was set up to investigate them.

Tiina Mattila-Sandholm of the Finnish Institute *VTT Biotechnology*, which coordinates *Proeuhealth*, describes the digestive tract as a 'black box'. 'Even today, in 2003, nobody can say exactly what the microbial ecosystem in our intestines really consists of,' she stresses.

What species are found there? How do they affect our health? What exactly are the 'good bacteria' – also known as probiotic bacteria – and how do they function? How can we develop foods which use them to optimal effect? These are just some of the questions into which researchers on the Proeuhealth project are looking. Launched two years ago, it plans to submit its findings by 2005.

Controlling the claim game

Probiotics are of just as much interest to health authorities as they are to food producers and consumers. We know that the ingestion of certain microbial strains (*Lactobacillus* and *Bifidobacterium* most notably) can have a particularly beneficial effect on health.

However, these benefits have only been demonstrated under very specific conditions. A number of tests have shown, for example, that certain strains of *Lactobacillus* can protect an infant against viral diarrhoea. Such results cannot be attributed to all

A division of *Escherichia coli*, a bacteria commonly found in the human intestines and other warm-blooded animals, magnified 200 000 times. Some varieties of *E. coli* produce toxins which can cause serious enterohaemorrhagic diseases transmitted by food.
© Institut Pasteur (FR)

***Lactobacillus* seen in cross-section, magnified 66 000 times. © Institut Pasteur (FR)**

probiotics of course – two strains of the same species can have almost the opposite effect – and even less so to the total bacterial population.

Despite this, a number of decidedly dubious extrapolations are made. Some food producers try to create an image of a 'healthy food' by making claims that too often go far beyond the scientific reality: 'stimulates the immune system' or 'restores balance to the intestinal flora'.

'I sincerely hope that our results will make it possible not just to improve the health of the population, but also to restore some order to this marketing jungle,' continues Mattila-Sandholm. 'But for that we need precise results, particularly on the mechanisms."

Digesting bacteria

Rigorous progress in this multifaceted investigation requires a thorough understanding of the exact nature of the intestinal bacteria and finding the means to differentiate between them. The *Microbe Diagnostics* project aims to do just that.

Headed by Michael Blaut, a young and enthusiastic researcher from the German Institute of Nutrition (DIFE – Potsdam), the research team is trying to draw on the latest results in molecular biology to make the most precise possible analysis of the composition of the intestinal ecosystem.

A number of techniques (flow cytometry, in situ fluorescence, RNA measurements) are used to detect significant sequences – or signatures – of the organisms present.

'We knew very little at the outset,' explains Michael Blaut. 'This is because science was, for a long time, only interested in organisms we knew how to grow, which is just a very small proportion of those we are now studying. Also, there was a tendency to concentrate on pathogens rather than the 'normal' intestinal flora – if such a word has any meaning as the variations between one individual and another, and even for the same person at different ages, are so great. Finally, the molecular tools have not been available for very long. We have, nevertheless, made major progress in recent years and we now have an inventory with which it is possible to work.'

The team from *Microbe Diagnostics* has already carried out 16 oligonucleotide probes making it possible to detect certain micro-organisms rapidly. As our knowledge develops, new probes can be developed more quickly, resulting in an increasingly wide range of tools. These can then be made available to other researchers, to find the link between a pathology and a given bacterial strain for example, to test the effects of diet on the presence of a particular bacteria, or to analyse the overall development of the intestinal flora.

Targeting food

The Union has supported a series of food safety research projects. These have included investigations into mycotoxins (dangerous food contaminants secreted by mushrooms) and the development of biosensors capable of detecting the presence of toxins in meat or milk. A number of major research projects have also been carried out on BSE, particularly to develop tests which monitor the progress of the disease. The Sixth Framework Programme is further boosting this research effort with €685 million dedicated to *Food Quality and Safety* (Priority 5).

Under the microscope

These new developments should help shed light on mechanisms we barely understand. In fact, we do not even know how a microbe is able to act on the general condition of its host.

Deprohealth and *Propath*, two projects in the Proeuhealth cluster, have been charged with shedding light on of the principal mysteries of probiotics: the effect they have on the immune system.

Two kinds of antagonistic pathologies are currently under the microscope. The first is inflammatory bowel disease (IBD for short), which affects many Europeans and is essentially caused by an excessive immune reaction. The second are viral (rotavirus diarrhoeas) or bacterial infections, which are indicative of the opposite phenomenon: the inability of natural defences to overcome a pathogen.

Among the bacteria the researchers are paying particular attention to, the best known is *Helicobacter pylori*, which is responsible for ulcers, gastritis, and various kinds of salmonella (a common cause of food poisoning).

The teams are working with different strains of *Lactobacillus* and *Bifido bacterium*. They are trying to discover which of the molecules produced – especially by the bacterial wall – have health benefits, how they achieve this, and more precisely the type of immune reactions they encourage or prevent. Once the mechanisms are identified, the teams create ad hoc strains and, to quote *Deprohealth* coordinator Annick Mercenier of the Institut Pasteur in Lille, try to produce 'original therapeutic agents making it possible to obtain innovative anti-inflammatory treatment and oral vaccines against *H. pylori* and the rotaviruses.'

A third project, *EU & Microfunction*, is also looking into the question of mechanisms. It is particularly interested in the effect of diet on the bacteria in the human gut. This can result from the consumption of bacteria (probiotics) or particular foods – prebiotics – which stimulate the development of a particular probiotic. Once again, we do not know why or how a particular food favours the development of a given bacterial strain.

Healthy outcomes

The improvement of human health is central to the aims of the *Proeuhealth* cluster. One associated project, *Progid*, is investigating two particularly debilitating intestinal diseases, ulcerous colitis and Crohn's disease. The latter is a serious autoimmune infection which, in some cases, can require the surgical removal of entire sections of the digestive tract.

To define the possible effects of probiotics on these pathologies, two large-scale double-blind tests – in which neither the evaluators nor the subjects know which items are controls – are being carried out in a number of countries over a period of approximately one year.

Crownalife is another project linked directly to health. The project's co-ordinator, Joël Doré of France's Institut National de la Recherche Agronomique (INRA), explains that: 'Old people represent a growing proportion of the European population… As this group is more sensitive to degenerative diseases and infections there is a growing need to develop preventive nutritional strategies.'

Each age group has its own specific demographic for its intestinal population. Understanding this evolution and its health implications is the first step towards effective nutritional advice and, ultimately, 'a new generation of functional foods'.

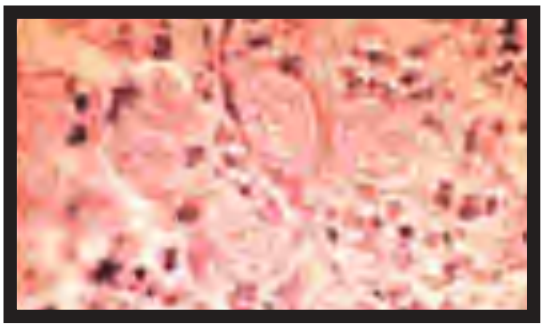
Industry onboard

The already considerable global market in probiotics is destined to grow (see box). It is perhaps unsurprising that industry (including SMEs) is participating in various EU-backed projects in the field.

Protech, for example, includes five companies among its 12 partner laboratories. The project aims to improve the technological aspects of producing probiotic foods. Generally of the lacteal variety, probiotics usually come in for considerable punishment, whether during industrial processing (heating, freezing, lyophilisation and conservation) or in the body itself (stomach acids, digestive enzymes and bile juices).

Even an excellent probiotic is only of value if it arrives alive in our intestines. 'We have a number of strategies for achieving this,' explains Dietrich Knorr of Berlin's Technological University. 'We can look for protective molecules and then combine them with microbes. We have achieved excellent results with certain pectins. We can also stimulate the natural defences of probiotics. When heated to 50°C, some microbes produce specific proteins which protect them from heat. This can help them withstand certain industrial processes. Other probiotics secrete sugars when cooled which enable them to survive freezing.'

Protech should result in new practical knowledge, particularly concerning industrial processes, ways of optimising them and how different bacteria react to them. These are all elements which should permit the development of the most effective products possible.



Cross-section of the colon showing the presence of amoeba. In this parasitic infection of the large intestine, frequent in tropical countries, the pathogenic agent crosses the wall of the large intestine and can sometimes reach the liver (hepatic amebiasis). © Institut Pasteur (FR)

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To find out more
www.vtt.fi/virtual/proeuhealth

Safety and transparency

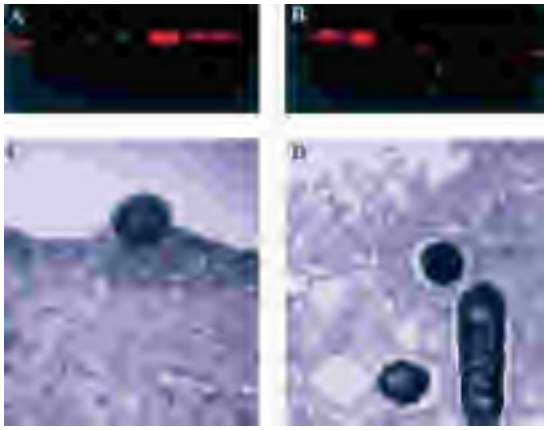
The benefits of probiotics should not cause us to forget their possible risks. 'Most of these organisms have been consumed for decades without any negative impact on health ever having been observed,' stresses Tiina Mattila-Sandholm. But an exhaustive scientific approach cannot allow matters to rest at that.

The *Prosafe* project was launched to focus exclusively on safety issues. It is looking into various problems, such as possible resistance to antibiotics, as well as the possibility of mutation, colonising capacities and the risk of poisoning. By the end of the study, the project aims, not only to have precise information on existing strains, but also to establish criteria and methods of investigating future strains that will emerge from laboratories.

The *Proeuhealth* project is also looking into public expectations, which vary from country to country, and the best ways of addressing them. Making the most of probiotics also means persuading people to consume them, usually on a regular basis for maximum effectiveness. That entails providing the general public with credible and comprehensive information on their benefits.

Marketability

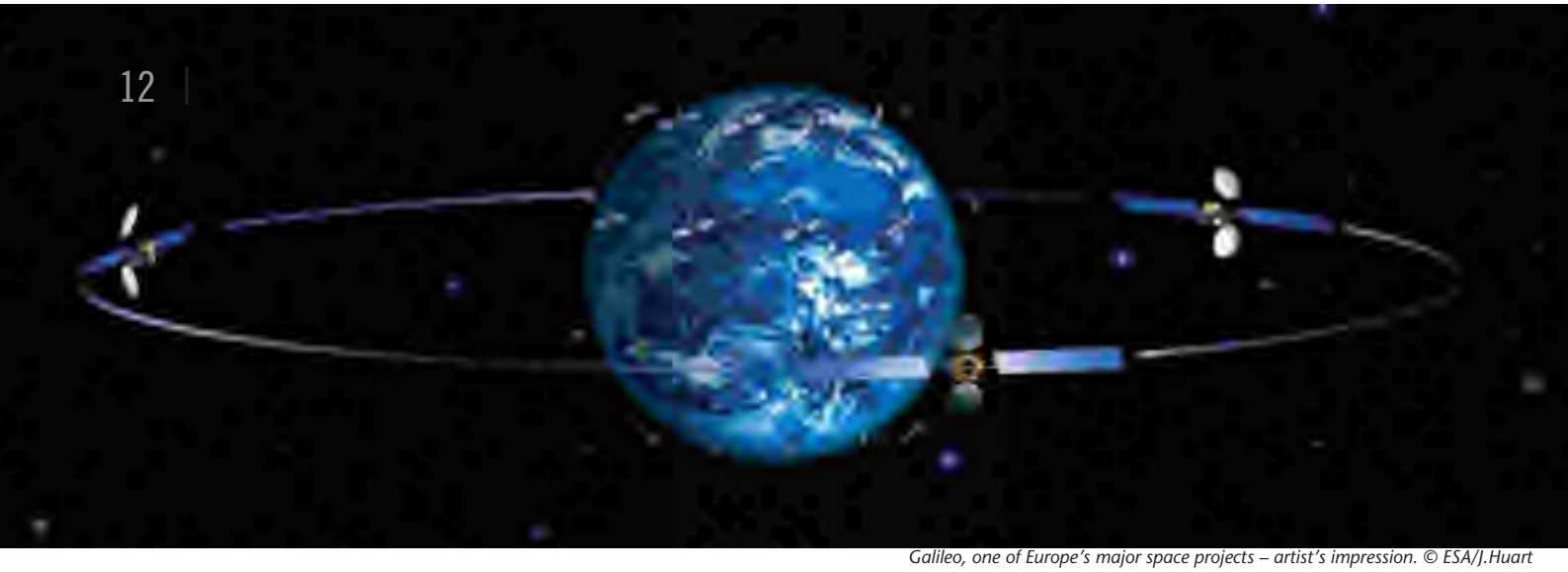
Probiotic foods are of major economic importance. According to a survey carried out in May 2001, the European market is worth over a billion euros and the figure is growing all the time. The US market, although smaller, is also growing and is a potential strategic target. Probiotics are already common currency in Japan where they are present in more than 50% of dairy products. They are generally found in yoghurts and other dairy products, but also in some soups, fruit and vegetable juices, and cereals.



Modelling (in culture) of the crossing of the epithelial barrier of the intestinal wall by a pathogenic bacteria. © Institut Pasteur (FR)

Stepping back

Our knowledge of probiotics is not new. In 1907, the immunologist Ilya Metchnikoff first came up with the idea that the body's defences could be boosted by the absorption of fermentative bacteria. Nevertheless, it is only recently that researchers have started to show an interest in prebiotics, molecules which help beneficial micro-organisms to survive and function. These prebiotics are usually complex sugars, such as the insulin in chicory. They pass unchanged through the upper section of the digestive tract enabling them to interact with the bacteria in the intestines. A growing range of foods containing probiotics and prebiotics are now being tested with the aim of stimulating the bacterial effect. These mixed or symbiotic products would appear to have a promising future as researchers meet with growing success in achieving the delicate optimal balance between bacteria and protective molecules.



Galileo, one of Europe's major space projects – artist's impression. © ESA/J.Huart

Europe faces its future in space

Look how far we have already come! And what prospects for the future! These two statements effectively sum up man's ongoing adventure in space. At the dawn of the 21st century, space holds the key to the future development of many aspects of our society. This genuine 'teleservices factory' has become essential for the workings of contemporary society in a growing number of civil, scientific and military fields. What is more, beyond the immediate periphery of the Earth, a vast reservoir of fascinating information about the history and nature of the Universe is also being revealed.

For many years, the intense technological development brought about by man's conquest of space was inextricably linked with military rivalry between the two superpowers during the Cold War. Subsequently, from the 1970s, Europe managed to acquire an autonomous space capacity enabling it to become a key player in the field of civil applications. Under the leadership of the European Space Agency (ESA), set up in 1973, these successes were achieved by virtue of a policy of exemplary co-operation between the public and private sectors.

Of prime political and industrial importance – and requiring considerable financial investment – today, the space sector is the setting for significant technological and commercial rivalry at global level. New players, particularly in Asia, are determined to join the race. Maintaining its position, autonomy and scientific and technological excellence is consequently a major challenge for the European space sector.

In the early days of ESA and the industrial development it generated, space was seen as a field for 'intergovernmental action', on the fringes of Union competency. Over the past few years, however, it has become clear that the sector's importance to our economies and societies has made it crucial to a global management of the principal European policies. Transport, the information society, industrial competitiveness, the environment, sustainable development, and civil protection are all fields where progress is linked to advances in space. The approaching enlargement to a Union of 25 Member States, coupled with the now clearly expressed European desire to set common security and defence objectives, further reinforces this need for a strong space sector.

There are now very active links between the Union and ESA, in particular on such major projects as the Galileo satellite navigation and positioning system and the GMES initiative for the Global Monitoring of the Environment and Security. Many European research projects on space technologies and applications also feature in the Framework Programme.

Defining a European space policy able to meet contemporary needs and challenges is currently the subject of a major debate, initiated by the Commission's Green Paper of January 2003. This document – and the questions it raises – are the subject of wide-ranging consultation involving the public authorities, industrialists, scientists and users concerned by the sector's development.

This exercise should shortly result in a redefining of Europe's space ambitions – and of the common resources it must mobilise to achieve them.

Web site on EU space policy:
europa.eu.int/comm/space/index_en.html




Everyday life in orbit

Space is all around us. A growing number of satellite applications are finding their way into our everyday lives. They enable us to receive and transmit information worldwide, guide us when we travel, issue weather warnings, manage our environment, and watch over our security. They are creating new services which are fundamentally changing the functioning of an increasing number of activities. At the same time, avant-garde space technologies are a permanent source of innovation transfer in a multitude of fields.

To find out more
- www.esa.int/tech/
- www.esa.int/export/esaCP/Improving.html
- www.esa.int/export/esaCP/Protecting.html

Europe has hundreds of millions of space consumers. The reception of satellite TV stations, long-distance telephony, five-day weather forecasts, the safe practice of certain sports with a 'high risk of distress' – such as sailing or mountaineering – all use the services of hundreds of satellites. Orbiting far above our world, they are nevertheless part of our individual lives without us being the least bit aware of their presence.

The next steps along the road to this increasingly 'personalised' consumption are already being plotted. One will take shape with the implementation of the European Galileo project (see page 12), the future guardian angel of the transport sector, which – among other things – will provide every individual vehicle with its own guidance and alert system. Other high-tech and very specific applications are also on the horizon – such as assistance to the visually impaired who could soon have access to some revolutionary new forms of identification techniques, and surveillance of the transportation of dangerous products.

Collective dimension

In addition to these individualised services, when it comes to the collective dimension satellite applications serve an even wider spectrum of activities. Earth observation from space is a fantastic management tool. In addition to Galileo – whose essential mission is to monitor global flows of air, sea and land transport – a second major European project, the Global Monitoring for Environment and Security (GMES) (see page 12), is designed to develop and coordinate a range of space technologies providing a multitude of services. Protecting the land or sea environment, town and country planning, the prevention of natural risks, crisis logistics in the event of major accident, the implementation and management of agricultural, forestry and fisheries policies, and security and defence monitoring are all f which will benefit from GMES.

A number of other sectoral applications are also being developed, in particular in the telecommunications fields – such as broad-band Internet access in outlying regions, telemedicin and tele-education.

The concept of the "SpaceHouse", pro form by ESA's 'Technology Transfer' programme, illustrates potential architectural applications of high-resistance carbon fibre plastics developed in space applications. © ESA

A vast scope for telemedicine

Take an extreme case – thanks to a small satellite dish, a first-aid worker in a tent set up in the middle of a region devastated by earthquake can, through the use of pictures, arrive at a diagnosis and perform the necessary actions, guided by a specialist located thousands of kilometres away.

If there is one crucial field the importance of which everyone recognises, it surely must be medicine. Yet it is also a field of constant change in which new knowledge and techniques have to be communicated to practitioners at every level. The concept of telemedicine is certainly one of the most revolutionary developments brought about by the advent of the information and communication society. And the ability to be 'everywhere at once', which is afforded by today's satellite transmissions, constitutes an unprecedented tool in the medical field.

Highly innovative, telemedicine is still in its infancy. But it is a uniquely promising sector experiencing strong growth which will surely ultimately find a place in medical practice everywhere.

To find out more: www.esa.int/export/SPECIALS/Telemedicine_Alliance/index.html
www.esa.int/export/esaCP/Benefits.html

Space-Earth transfers

The influence of space on society is not limited to the services provided by orbiting bodies. Whether building launchers or developing the sophisticated devices carried by satellites, interplanetary probes and manned space flights, the aerospace industry shows an extraordinary capacity to innovate. This vast high-tech 'melting pot' gives rise to numerous terrestrial applications in fields such as materials science, energy, optics, laser technologies, telecommunications, and data processing

Since the early 1990s, ESA has operated a proactive programme designed to provide a systematic dissemination of innovations initially developed for space. Several hundred technology transfers have been realised in the framework of Spacelink, a network of European space industries. These cover a range of sectors, in particular medical instrumentation, automobiles, textiles and robotics.

Artemis, a star in the – gradual – ascendant

This is the prodigal son of European know-how in the field of space telecommunications. Packed with sensing and emitting devices incorporating revolutionary technologies, this geostationary satellite weighing over three tonnes marks the debut of a totally new concept of relay station, able to link up with other satellites in a lower orbit and to transmit vast quantities of data to Earth at record speed. It is opening the door to a vast field of applications – the transmission of multimedia content, simultaneous management of a high volume of mobile communications, and combined access to data supplied by various Earth observation satellites such as the highly modern European Envisat satellite which entered into service in 2002.

But Artemis has made quite a comeback. A major 'hiccup' when it was launched by the Ariane rocket in July 2001 caused serious consternation in European space circles. Artemis went into an orbit at an altitude of 18 000 kilometres: 5 000 kilometres lower than the height required for it to operate efficiently. Fortunately, it had its own mini-system for xenon ion propulsion, a totally new idea intended to ensure its stability once in orbit. Thanks to this, European engineers were able to salvage their precious satellite. The operation, involving a delicate remote updating of the on-board software, slowly lifted Artemis to the planned orbiting height, at the rate of 15 kilometres a day. In January 2003 – 19 months later – it finally reached the right position, and is now fully operational as a relay station.

Artemis marks the debut of a totally new concept in telecommunications relay centres, able to link up with other satellites circling the globe in a lower orbit, and to send vast quantities of data to Earth at record speed.
©ESA/J.Huart

Building the Columbus laboratory module, the European contribution to the International Space Station. **Space know-how is a motor for technological innovation with many very 'down-to-earth' applications.**
© ESA

The sensor equipment on the Envisat satellite **– Scientific satellites are packed full of detection equipment for all kinds of rays and signals in all frequency spectrums, both visible and invisible. These sophisticated and delicate devices are a permanent source of innovation, opening the door to many terrestrial applications, often biomedical, such as chemical cell signalling, detection of cancer cells, and endovascular curietherapy.**
© ESA

Science without gravity

The first manned space flights, from Gagarin to the moon landing by the Apollo missions, symbolised more than anything else man's thirst for adventure. From the 1980s, the much more concentrated human presence in Earth's near space – several hundred astronauts of all nationalities have now made the trip – has concentrated on a primary objective: fundamental research under conditions of weightlessness.

Newton's law of gravity has heavy implications. None of the many experiments carried out in laboratories anywhere in the world can escape its grip. Whatever the field of research, whether working with cells, particles or molecules, the pull of gravity is always present and influences every process.

Virtues of weightle

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very wide range of research fi
opening up new scientifi
approaches not only in the
life sciences but also in the
study of matter – crystallisation, solidification, fluid dynamics, etc.

From Spacelab...

Since 1982, ESA has organised European co-operation in the framework of missions by US NASA spacecraft which have made 22 trips carrying the Spacelab module designed by ESA and national space agencies. The two successive versions of this space laboratory made it possible to carry out numerous scientific experiments involving many researchers from Europe and elsewhere.

During this same period, Europeans have been among the crew on more than 40 manned space flights, travelling to the Russian MIR station as well as on board the US Discovery, Columbus and Challenger shuttles.

...to the European "Corps"

In the process, the European Space Agency has progressively developed its own programme for the preparation of manned flights. In addition to deciding on the scientific content of missions, ESA recruits and trains the astronauts able to carry out the experiments and accli-
ditions in space.

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igneré who holds the
record for long stays in space with his six months on board the MIR station in 1999.

The big ISS project

These astronauts are trained to work on the International Space Station (ISS), a joint project involving the United States, Russia, Europe, Japan, Canada and Brazil. Work on its construction began in 1998 and the first long stay was achieved by three astronauts in October 2000. Eight teams have followed since then and all the station's infrastructures should be assembled and operational next year.

Europe is contributing approximately 8% of the total cost of building the station, essentially funding two elements.

To find out more

The ESA and NASA sites

- www.esa.int/export/esaHS/
- www.estec.esa.nl/spaceflight/inissint.htm
- www.esa.int/export/esaHS/
- spaceflight.nasa.gov/station/reference/

Brochure on manned flights

- ravel.esrin.esa.it/docs/eac10years.pdf

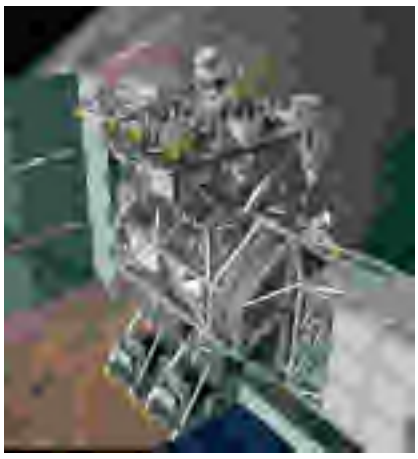
The Dutch doctor André Kuipers is one of the team of European astronauts who will be travelling to the ISS – International Space Station. A specialist in the medical aspects of manned flights, he has been involved in space research since 1991.
© ESA

The first is the design and development of the Colombus laboratory, due to be launched into space in 2004. This pressurised manned module is fully equipped to carry out experiments in the field of materials research, fluid dynamics and the life sciences, etc.

The second aims to develop the innovative concept of the 'Automated Transfer Vehicle' (ATV). This unmanned cargo vehicle, with a capacity of between six and seven tonnes and launched by Ariane rockets, is able to dock at the station, guided by ground control and the team on board the ISS. The ATV will supply the ISS with fuel, compressed air, food and scientific equipment. It will also be able to make corrections to the station's trajectory before leaving with a cargo of waste.

'Automatic servicing' missions of this kind represent considerable progress in terms of space services. The usefulness of the ATV is all the more pertinent in the light of the disaster which struck the Columbus shuttle as it returned to Earth. This was one of the key links with the ISS and the station's programme is now fully dependent, for an unknown period, on the availability of the Russian Soyouz spacecraft – making the ATV's entry into service a priority. The first flight tests are planned for later this year.

The astronaut Jean-François Clervoy during tests carried out on the European designed prototype Automated Transfer Vehicle (ATV), the 'taxi' of the future linking the ISS to Earth.
©ESA



Space mechanics busy assembling the International Space Station (ISS) – artist's impression.
©ESA

Space-aided teaching

Space, and manned flights in particular, have a unique fascination for man – especially for young people. Explaining the achievements and implications of man's exploits in space to children, adolescents and university students is therefore a formidable tool in catalysing their interest in science. This is especially true at a time when teaching the complexities of science is becoming increasingly difficult.

Hence the decision to set up two educational programmes in the framework of European co-operation on the International Space Station. Launched during the Teach Space 2001 conference, which gave rise to a whole series of teaching projects or modules, the first is designed for primary and secondary school teachers within the ISS Educator's Community, a network for the exchange of experience.

The Education Programme for Research on the ISS, on the other hand, is intended for university students. It includes many initiatives, such as a competition to present projects linked to research in space, the carrying out of real experiments under microgravity during parabolic flights, visits to European space technology centres, and participation in the simulation of experiments carried out on the ISS.

To find out more: www.esa.int/export/esaHS/education.html

Treating immobility

The experience of long stays in space has shown that life under conditions of weightlessness has significant physiological effects on the bones, muscles and cardiovascular, immune and hormonal systems. The study of these effects – and possible countermeasures – has given rise to an intense 'space' medicine activity which is not without significance for progress in 'terrestrial' medicine.

The French Space Agency at the CNES (Centre national d'études spatiales) decided therefore to set up an Institute for Space Physiology and Medicine (Medes) in Toulouse which carries out in-depth research in this field. One of the analysis techniques involves carrying out experiments on 'prolonged periods of bed rest': in a prone position, with the head tilted at an angle of less than 6° compared with the feet, the human body experiences effects very comparable to those caused by weightlessness. In 2001 and 2002, three groups of 28 volunteers took part in a trial which involved being confined to bed for 90 days – naturally this is carried out under close medical supervision and with psychological assistance. Phenomena of muscular atrophy and bone loss were studied during these trials, together with the treatment which could correct it.

The results are crucially important for the development of manned space flights involving long periods of confinement, such as would be the case for any interplanetary craft travelling to Mars, for example – a possibility under serious scrutiny by the Aurora project (see page 9).

They also have major consequences for medicine in general, as correcting the effects of long periods confined to bed is a major clinical problem for our hospitals. Two research projects are being supported by the European Union and coordinated by Medes, one on tomographic instrumentation with which to assess the quality of the bone system (Advanced detection of bone quality or ADOQ project) and the other a study of osteoporosis pathologies (European research in space and terrestrial osteoporosis or ERISTO project).

To find out more: www.medes.fr

The picture on the right shows the deterioration of the bones caused by osteoporosis. *©Medes*

Manipulating matter

Together with biological experiments, materials science is one of the key fields of research under weightlessness – or, to be more precise, under conditions of microgravity – and the subject of many experiments carried out during manned flights. It is a field which will feature prominently in the activities of the European research laboratory Columbus, attached to the ISS.

All areas of industry are forever seeking new materials. Aeronautics and automobile construction, in particular, are always looking for ways to optimise the resistance, safety and economy of vehicle engines and infrastructures. They require light compounds, from high-performance ceramics to innovative alloys containing metals such as nickel, aluminium, magnesium and titanium.

Microgravity research is also an excellent field of experimentation for developing the crystalline materials needed by the electronics or telecommunications components industry as well as by instrumentation and medical prostheses, to cite just a couple of examples from the many applications in numerous sectors.

In this respect, the space laboratory is an alchemist's dream. It makes it possible to carry out experiments never done before on the interference between the gaseous/liquid/solid states, the development of forms of crystallisation, and the control of thermodynamic processes, giving scientists a whole 'palette' from which to make the 'compositions' of their choice.

To find out more: www.esa.int/export/esaHS/research.html

During a flight in October 2002, the Belgian astronaut Frank Dewinne was the first to use a new sophisticated device to carry out physico-chemical or biotechnological experiments by linking up with terrestrial laboratories – the Microgravity Science Glovebox, to be used on the International Space Station. *©ESA*

A springboard

Space exploration is not of utilitarian or commercial importance alone. It is also essential in a field on which no price can ever be put and which has been present throughout the history of humankind: the acquisition of knowledge about the mysteries of the Universe. Today, European scientific programmes are helping to provide some of the answers.


1.


1.


2.

To find out more

- www.esa.int/export/esaCP/Expanding.html
- www.esa.int/export/esaCP/Life.html

Weighing just over a tonne, the Mars Express probe – accompanied by the Beagle 2 micro-robot which it will release on the 'Red Planet' – lifted off without a hitch from the Baïkonour cosmodrome on 2 June, on-board a Soyuz rocket. This first European probe to make the trip to Mars will take nearly six months to reach its destination and enter the planet's orbit.

Equipped with an impressive battery of observation instruments, the Mars Express will add considerably to our knowledge of the Martian topography, atmosphere and even sub-soil. A sub-surface radar will be able to probe to a depth of several kilometres to check for the presence of the subterranean water tables which many believe exist.

As to the Beagle 2 (30 kilos), this will be jettisoned by the probe five days before it arrives at its destination. It will be protected during its descent by a heat shield, slowed by a huge parachute and then cushioned by air bags to ensure a soft landing on the Martian equatorial soil. In this zone, where the sediment which has built up very probably indicates the former abundant presence of water, the robot's miniature sterilised instruments will study in situ possible traces of former – or even present – biological activity.

Two decades of missions

The second highlight of the European Space Agency's scientific programme for 2003(1), Mars Express is one of a series of some 20 very varied scientific missions carried out over the past two decades or more. Some of these are particularly famous, such as the Giotto probe which, in 1986, brought back striking images and new information on Halley's comet when it passed close to the Earth.

In addition to studying the solar system – in particular, the observation and analysis of the cycles of variation in the Sun's activity which have such a marked environmental effect on Earth – spacecraft developed in Europe are making a major

A disappointment called Rosetta

Throughout 2002, astrophysicists were rubbing their hands in anticipation. At last, everything was ready for Ariane 5 to launch into space, on 12 January 2003, the Rosetta probe – a superbly equipped state-of-the-art device and the fruit of a decade's development. Its mission was one of the most ambitious ever undertaken by ESA: to repeat the superb exploit by its predecessor Giotto in the late 1980s by seizing the opportunity to follow and study Comet Wirtanen for almost two years as it passed close to the Sun.

The Rosetta mission promised to be quite a feat, as this comet chaser would not catch up with its prey until 2011, but would then follow it for two years travelling at a speed of around 135 000 km/hour. It would also release an explorer robot which would come to rest on the comet's hard core which measures one kilometre across. The mission was of enormous importance as comets are a mine of information on the history of our solar system.

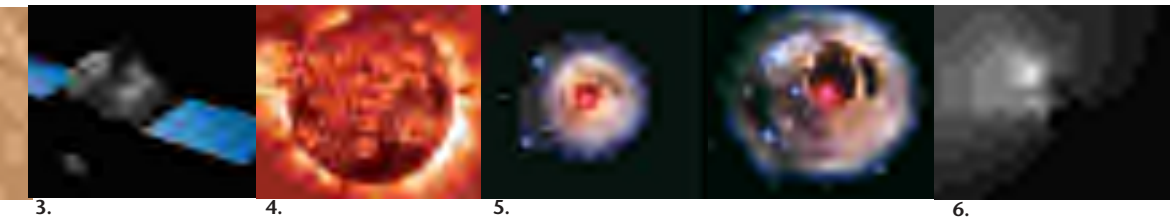
Rosetta – whose launch has been postponed until 2004 – is set to be the first spacecraft able to go into orbit around the core of a comet and deposit a robot on this core.
© ESA

Unfortunately, the Ariane 5 accident less than a month before the launch date threw everything into doubt. A ban was imposed on all further launches, and was not lifted until April 2003. The probe's flight plan required a mid-February launch at the latest as after that Comet Wirtanen would 'fly off' once again far beyond the reach of the Rosetta.

But Rosetta will only be grounded for a year. Another comet, known as the Churyumov-Gerasimenko, will fly into range in February 2004. The rendezvous is already set, although Rosetta will not show up until… 2014. As well as everything else, space exploration also requires patience.

To find out more: sci.esa.int/rosetta/

to the Universe



1. The Mars Express probe.
2. Traces of water on Mars?
3. Beagle 2 leaving Mars Express.
4. Solar storms.
5. The eyes of the Hubble.
6. The core of Halley's comet.

contribution to the astrophysical study of the distant Universe. A close partnership between ESA and NASA is responsible for the development of the Hubble, the very famous space telescope which went into orbit in 1990 and which provides a remarkable tool for progress in astronomy worldwide.

Another example is the launch of the XMM-Newton in December 1999. This detector, the best to date for analysing cosmic X-rays, has provided the international astrophysics community with an instrument with which to study such major phenomena as the history of the Universe, the birth and death of stars, and the formation of black holes, etc.

Full agenda

European scientific programmes are thus making a prestigious contribution to worldwide astronomic and astrophysical research. This commitment to excellence which is mobilising a very active elite of researchers and deploying an impressive array of avant-garde technologies is set to continue.

Each project requires a very long preparation process and the diary is very full. More than a dozen launches are currently either scheduled or being prepared for the next decade. These include sending probes to Venus (in 2005), Mercury (2011) and the Sun (2012), and the launching into orbit of an observatory to identify 'exo-planets' (2008), a replacement for the Hubble telescope, and infra-red and microwave ray detectors (2007).

(1) In January, this programme included the Rosetta mission which had to be postponed (see box). Also scheduled for launch later this year is the SMART-1 which will be revisiting the Moon.

Aurora – a view of the 21st century

And why should not man land on Mars one day before going on to penetrate deeper into the solar system? Although it still has something of science fiction about it, the question is nevertheless being studied very seriously. To go some way to answering it, in 2001 Europe decided to set up the Aurora programme with the task of identifying the direction manned flights to distant destinations could take over the next two or three decades.

Space sciences and technologies are at present developing at an astounding rate. Universe observation satellites are increasing in number and performance, as are the space probes exploring deep into our solar system. As the International Space Station comes into full service, so man's presence in space will become almost a routine affair. The combination of all these developments is leading to questions about man's command of the Cosmos and to preparations for possible new steps several decades from now.

With a view to 'man's conquest' of Mars, Aurora is acting on the 'push' and 'pull' effect of technology. How can the dynamic of 'terrestrial' technological progress be used to favour increased creativity in developing new space ventures? Conversely, how can the demand generated by ambitious space projects serve as a motor for innovation? While always remembering, of course, that investments in space research are at the origin of a growing number of derived applications, sometimes in the most unexpected fields.

Aurora is also the standard-bearer of a certain ambition on the part of European science and technology, offering young generations new frontiers which will shape their future.

To find out more: www.esa.int/export/SPECIALS/Aurora/index.html

Ariane saved at the last moment

To find out more

- www.esa.int/export/esaLA/index.html
- www.arianespace.com/

Recently, the survival of Ariane has been at the heart of the debate on European space policy. This is something of a paradox in the light of the satellite launcher's many successes over the years and its continued leadership on the commercial launching market. We look at the reasons for the crisis and the final happy outcome.

Audacity and prowess were the first requirements. When, in the 1970s, Europe decided to 'go it alone' on the space scene, it was up against a US-Russian supremacy which had dominated space from the outset. At this time the 'space market' was just beginning to open up. While the two superpowers engaged in their military and industrial rivalry, civil and commercial opportunities were becoming evident. Europe's decision to try and win this niche market was a wise one. The Russians were barred from this as a result of their politico-ideological isolation, while the Americans had decided to concentrate on the concept of multi-trip shuttles, leaving rockets for others.

Good decision

It was the right initial choice. With exemplary resolve, the Europeans designed, tested and launched the first successful generations of the Ariane rocket. Fate also intervened when the United States was handicapped by the disaster of the Challenger shuttle in 1986.

The way was now open and the Ariane gamble paid off. This was a time when the launching of telecommunications, meteorological and Earth observation satellites was at its height. Throughout the 1990s, Ariane was the leader on the commercial market, winning more than 50% of launching orders worldwide. The money was coming in and the order book for the Ariane 4 generation was full. The European space industry was booming and Europe had the means to finance its vast spectrum of space activities, especially in the scientific field.

Dramatic blow

But as the new century dawned, the success story threatened to unravel. Space swallows up investments at a sometimes alarming rate. Arianespace invested huge sums in developing the new Ariane 5 generation, driven by the need to achieve increasingly large payloads. Yet it had little alternative on a market where not only the United States but also Russia, Japan, China, India and Brazil were now competing very aggressively.

The other problem was that the demand for satellite launchings was falling. Telecommunications, which had always been an important sector for the order books, was now in trouble. Developments in this key sector were impeded in particular by the failure – albeit no doubt temporary – of third-generation telephony systems (such as UMTS which permits Internet access from a mobile telephone).

Between 1996 and 2002, the first family of the Ariane 5 generation – with a useful payload of between six and seven tonnes – made just 12 successful launches (out of 13 attempts). But one of the most strategic of these, the launch of the European Artemis geostationary telecommunications satellite (see page 4) failed to achieve its exact orbit. Then, in December 2002, came the dramatic blow of the in-flight explosion of the 157 rocket, which was to have marked the debut of the new Ariane 5 ECA '10 tonnes' version designed to launch a double payload of heavy satellites. This failed effort caused serious questions to be asked about the future of this new generation of heavy

payload launchers on which Arianespace had staked so much. It meant going back to the drawing board to review the design and at least two test flights before a further commercial launch could be undertaken – and that meant 2004 at the earliest.

Ariane in the red

In April 2003, this failure was offset by the success of flight 160, using a 'generic' Ariane 5 of the initial design. Europe was not without satellite launchers – but was nevertheless in dire financial straits. The costs involved in reviewing the ECA version came at the worst possible moment. The market was shrinking, with just six satellite launches planned for 2003 compared with 12 launches from the Kourou base in French Giuiana in 2002. Arianespace – and behind it all the industrial subcontractors and thousands of jobs – had been losing several hundred million euro a month since 2000.

During the first five months of this year the situation looked grim. The threatened survival of Ariane was headline news. But given the economic and strategic importance of access to space, could Europe afford to abandon the fruits of three decades of efforts during which it had so spectacularly achieved its space autonomy? Pulling out would mean marginalising a whole section of its industry in a key field in the age of globalisation.

New impetus

New political impetus was needed. On 27 May, at the Council of Ministers of the ESA member states, the decision was taken to further finance the Ariane 5 programme –in particular, the cost of redesigning the large payload model. A specific programme for the years 2005-2009 was also adopted to develop a genuine European policy for the 'institutional utilisation' of Ariane 5.

This radical review of European space policy is very timely. The long success story of Ariane was based entirely on a drive to win the commercial space market. The initial calculation was the right one. Over the past 20 years, civil – and especially private – demand to launch television relay, telecommunications, meteorological and Earth observation satellites has experienced extremely strong growth. Today, it has reached a plateau and the competitive environment which enabled Ariane to win more than 50% of the market worldwide has changed a great deal. Obliged to reduce its prices compared with the competition – such as Boeing's new Delta IV launcher which has some lucrative contracts with the Pentagon to supplement its commercial payloads – Arianespace is at a great disadvantage and has been forced to operate at a loss.

The price of autonomy

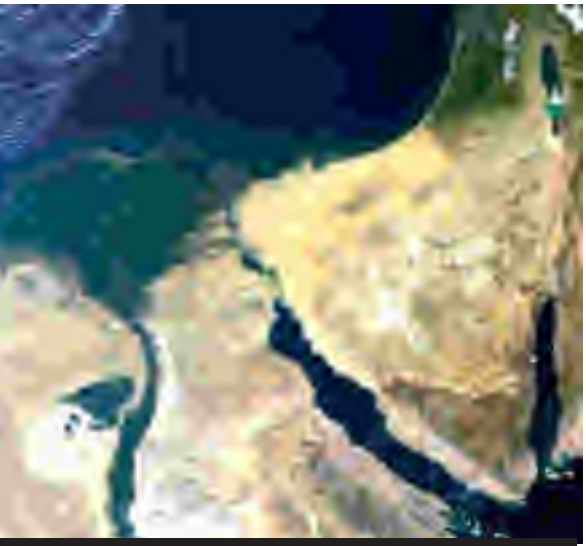
To extricate itself from these financial straits, not only is it necessary to restructure the way the company operates and its relations with its partners and industrial suppliers, but a genuine European space strategy is also required which goes beyond simply occupying a commercial niche market. Projects such as Galileo and GMES show to what extent it is time to strengthen an 'institutional' demand for space infrastructures and services. These are proving increasingly necessary in meeting the requirements of implementing European policy in sectors such as transport, the environment and security. Without these public orders, Ariane – and with it the next generation of European launchers which are already on the drawing board – will be unable to survive. That is the cost of maintaining Europe's autonomy in space.

More rockets for Europe

Although Ariane continues to be the mainstay of European launching capacity, the next few years will see considerable expansion and diversification. First there is the agreement currently being discussed with Russia to create, at the European spaceport of Kourou, a specific launching pad for commercial launches of the very reliable Soyuz rockets. This increase in the fleet would be a major asset, permitting more efficient management of a centre which plays a major role in Europe's global strategy.

Secondly, the new generation of Vega 'light' rockets should be operational in 2006. The decision to develop them was taken in 1998 in response to a clearly identified market need which had been largely ignored due to a global demand for heavy satellites. Vega will launch – at a very competitive cost – payloads of between 300 and 1 500 kg into very low orbit. These will be small satellites primarily, often for observations of a specific scientific or environmental nature.

Soyuz – the European spaceport in Kourou will soon be the departure base for Russian rockets participating in Europe's global space strategy. *© ESA*



The Nile Delta photographed by the Meris satellite. ©ESA

Galileo and GMES: two vehicles of European ambitions

European space policy over the next few years will be centred largely on two ambitious projects. Both are rooted in the aim of achieving genuine independence in key fields dependent on a command of space: positioning (particularly crucial to the transport system), and control of Earth observation (essential for reasons of environmental management and security).

The history of space is fundamentally dualistic. One of the most powerful motors for the development of many space applications has been military considerations, especially during the Cold War.

It was in this 'Star Wars' climate – at its peak in the 1980s – that the two superpowers set up their respective navigation and positioning systems. Based on 'satellite constellations', the US Global Positioning System (GPS) and the Russian Global Navigation Satellite System (Glonass) continue to constantly scrutinise the entire surface of the globe.

As the international situation eased in the 1990s, these tools began to be used for civil and commercial purposes. The services they provided proved to be of major importance, in particular for managing transport systems, but also in many other fields (customs, insurance, single judicial area, agricultural monitoring, etc.).

Essential autonomy

Throughout this period, Europe – lacking a common vision of its defence and security – had few ambitions in this field. It was not until 1999 that the idea was hatched of giving the Union an autonomous capacity. The need for such a project, known as Galileo, was based on a number of considerations.

First of all, a positioning system is essential for regulating contemporary transport systems. The GPS and Glonass, however, continue to serve military needs before anything else – which, in case of crisis, take priority over any foreign civil clients. Galileo will also offer improved performance. Above all, European autonomy in this sector is a key element of a new independent European Defence and Security Policy (EDSP).

At a cost of over €3 billion, Galileo is certainly a 'mega project'. It is based on launching some 30 satellites to an altitude of over 20 000 kilometres, coupled with a major terrestrial infrastructure. It was a long and sometimes laborious process to design the system and to set it up financially, on the basis of Union and ESA funding as well as that of a consortium of private partners. On 27 May this year, the firm and final decision was made to implement it and the system will be operational in 2008.

Global monitoring

The second major ambition concerns the deployment and integration of Earth observation capacities within an increasingly operational and coherent global system. At present, a multitude of satellites is continuously scrutinising the Earth. These transmit a mass of information which is used increasingly for the purposes of environmental policy, town and country planning, meteorology, the prevention of natural or industrial risks, and support for civil protection operations in the event of disaster. In future, such satellite information will also be important for managing the peacemaking and peacekeeping operations the Union plans to undertake as part of its common defence policy.

This mass of information is, however, particularly difficult to manage and to use because of the many sources and the lack of any data integration or standardisation. The Global Monitoring for Environment and Security (GMES) initiative is one of the major space projects in which the Union and ESA are coordinating co-operation between the many public and private players involved in the systems of collecting, processing and exploiting satellite observations of the Earth. The aim is for Europe to have, by 2008, a coherent, efficient and operational system able to exploit to the maximum the growing uses and services made possible by the space tool.

To find out more:
europa.eu.int/comm/space/prog/galileo_en.html
europa.eu.int/comm/space/prog/gmes/gmes_en.html

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

Treating SARS with respect

The SARS (Severe Acute Respiratory Syndrome) epidemic now seems to be under control: the global state of alert triggered by the 'uncontrolled' spread of the virus has been lifted. The most seriously affected regions were China, Hong Kong, Taiwan, Canada and Singapore. On 1 July, the total number of recorded cases worldwide was 8 445, including 812 deaths. A total of 111 cases were recorded in Europe (38 probable and 73 suspected), including one death.

Although the scientific community was particularly quick to react to the SARS epidemic, concern remains that the disease may return. Data is still being collected on SARS and its transmissibility, but serious gaps in our knowledge remain as to the transmission, reservoirs, stability and origins of the virus.

Under the new flexibility mechanism included in the EU's Framework Programme for research[1] and aimed at permitting a rapid response to urgent needs for scientific support, the European Commission has launched a special call for proposals – with a projected budget of € 9 million – relating to surveillance and monitoring, clinical symptoms and the transmission of the disease, infection control procedures, intervention and vaccines, and risk evaluation. It was judged essential for partners in the regions affected, such as China, to participate in these projects, especially those concerning the long-term follow-up of recovery cases and ecological reservoirs.

Research projects resulting from this call must also provide useful knowledge in dealing with the emergence of new pathologies and, thereby, contribute to the European network for the prevention and control of diseases.

http://europa.eu.int/comm/health/ph_threats/com/sars/sars_en.htm

(1) The Policy-oriented research actions are due to close on 30 September 2003 (see table of calls).

ITER: a French or Spanish site?

After more than 50 years, research in the field of nuclear fusion of light atoms, such as hydrogen – offering a new and potentially unlimited source of sustainable energy, with zero greenhouse gas emissions – is on the verge of taking a major new step: the choice of location for the new ITER international reactor, as work is now complete on the design and construction of key prototype components. This vast project conducted by Canada, the EU, Japan, Russia, the United States and China, aims to demonstrate the scientific and technical feasibility of fusion energy and to put to the test the essential technologies for a future industrial reactor.

Four sites are currently on the table: one in Canada, one in Japan and two in Europe – Cadarache in France and Vandellòs in Spain. The EU must now agree on a single candidate site to negotiate the location under the best conditions and maximise the chances of the ITER site being built in Europe. To make it easier to reach the necessary consensus among Member States, the Commission has charged a group of high level experts with issuing a technical opinion based on objective criteria and taking on board all the implications.

http://europa.eu.int/comm/research/energy/fu/fu_en.html
http://www.iter.org/

Stem cells: ethics and funding

Stem cell research is fertile terrain for the development of possible new treatments for a number of diseases, including Alzheimer's, Parkinson's and certain kinds of diabetes. Research in this area can result in a better understanding of biological phenomena and the development of new medicines. However, the use of stem cells remains a very sensitive issue when they are taken from human embryos. At the beginning of July, the Commission adopted a proposal setting out ethical guidelines for Union funding of research in this field.
These include:

- Research of this kind will not be funded in Member States where it is banned and EU support will only be authorised for research that aims to combat certain diseases.
- Human embryonic stem cells can only be taken from 'spare embryos' aged between five and seven days old and frozen following in vitro fertilisation. They also have to be donated voluntarily and free-of-charge by the parents. The protection of data and privacy also have to be guaranteed.
- The laboratories involved must undertake to make new stem cell lines available to other researchers. A European register will be compiled to guarantee traceability.

For more information: *Octavi.quintana-trias@cec.eu.int*

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

WETO report: a gloomy energy future

Global energy consumption is expected to double by 2030. Fossil fuels, and petroleum in particular, will still be the principal energy source and carbon dioxide emissions will be running at almost twice the 1990 level. That is the warning sounded by the European report entitled 'World Energy, Technology and Climate Policy Outlook' which, for the first time, presents a detailed picture of the challenges the world will be facing 30 years from now. (1)

The report looks into the long-term impact of environmental measures designed to reduce greenhouse gas emissions and to encourage the use of renewable energy sources. It describes the development of global energy systems, taking into account the effects of climate change policies and on the basis of hypotheses concerning economic activity, demography and hydrocarbon resources between now and 2030. The authors estimate that global demand for energy will increase by approximately 1.8% a year during this period. Developing countries will account for more than 50% of this, compared with the present 40%, consequently increasing their CO_2 emissions. The United States is on course for a 50% increase in its emissions, compared with an 18% increase for the Union, against the 1990 reference year. Global oil production will increase by approximately 65% and gas production is set to double. Electricity production will grow by 3% a year with an increase in gas, coal and renewable energy (principally wind power).

'We cannot remain silent about these projections and their effects on sustainable development in the world,' stresses Research Commissioner Philippe Busquin. 'To safeguard energy supplies and meet the Kyoto undertakings, Europe must step up its research efforts. The new Framework Programme will allocate €2.12 billion to sustainable development, planetary change and ecosystems, especially to encourage applications based on renewable energy sources, fuel cells and hydrogen technologies.'

www.world-nuclear.org/policy/weto_final_report.pdf

(1) The WETO report was drawn up by a consortium of EU research teams: ENERDATA (FR), CNRS-IEPE (FR), the Federal Planning Bureau (BE) and the Commission's Joint Research Centre in Seville (ES).

Saving 200 000 rabbits

Results obtained by European research now make it possible to use human, rather than rabbit, blood cells to detect potentially pyrogenic substances in parenteral drugs commonly used in the treatment of a number of illnesses. The traditional method involved injecting a test substance into rabbits which were then monitored for any increase in body temperature. To date, the only *in vitro* alternative solution has been the Limulus Lysate Test, based on the coagulation of the blood of the horseshoe crab (Limulus polyphemus). But this produced only partial results – detecting just one type of pyrogen – and did not provide a total safety guarantee for the use of medicines in humans. Research on the febrile reaction in humans and the development of research methods for investigating fever mediating molecules, coupled with perfected cell biology techniques, have now made it possible to use human cells as biosensors for pyrogenic substances.

The EU research project was a joint effort by researchers from national public bodies, private companies and the European Centre for the Validation of Alternative Methods (ECVAM) at the Commission's Joint Research Centre. The researchers compared and analysed six *in vitro* tests relating directly to the reactions of human white blood cells which produce these inflammation mediators. This was done to develop a state-of-the-art method with a view to its inclusion in the European pharmacopoeia – which defines the quality control requirements for medicines in Europe.

The regulatory authorities and various companies outside the consortium have expressed great interest in the project. These tests – less laborious, less costly and more sensitive than previous tests – have already been used successfully in some 200 laboratories worldwide. If widely used, they are expected to save the lives of about 200 000 laboratory animals a year.

http://ecvam.jrc.it/index.htm
http://europa.eu.int/comm/research/quality-of-life/cell-factory/volume1/projects/qlk3-1999-00811_en.html
http://www.cordis.lu/fp6/inco.htm
http://europa.eu.int/comm/research/iscp/welcome_en.html

News in brief. . .News in brief.

Tipping the gender balance

More and more higher education students – particularly women – are opting for science and technology subjects. In nine of the 12 Member States for which figures are available for the 1999/2000 academic year,(1) women outnumbered men.

In terms of degrees obtained, the balance between men and women varies according to country and subject. It is notable that women complete their studies later than their male counterparts (at age 25-29).

France has the highest number of graduates in absolute terms (277 000 in 1998/99) while men continue to dominate in the United Kingdom (227 000). In 1999/2000, five times more male than female S&T students graduated in the Netherlands, and in Germany four times as many did.

All disciplines combined, Finland has the highest proportion of university graduates: 23% of over 15s in 2001, compared with an average of 15% for the Union as a whole. Sweden, Belgium and Denmark also top the 20% mark.

On the employment front, what are generally known as the 'scientific and technical professions' are on the increase in Europe. In 2001, 25% of men worked in a profession which falls into this category. For women, the figure topped the 20% mark – the EU average – in Finland, the Netherlands, Sweden, Denmark and Germany.

For the scientists and engineers sub-group, the proportions are different, with a high prevalence of men. In Germany and France, there are four men for every woman working in the field. In 2001, it was in the United Kingdom that an employed male was most likely to be a scientist or an engineer, while women had their best opportunities in Finland, Ireland and Belgium.

These 'statistics in brief' published by Eurostat are very valuable in providing gender-specific figures on which equal opportunity policy can be based.

(1) Figures for this academic year are not available for France, Greece and Luxembourg.

Towards a European knowledge society: the contributions of men and women – Statistics in brief, Science and Technology, Theme 9 – 5/2003 – Eurostat – EC – ISSN 1609-598.

Opinion

The path to self-sufficiency

It has been a long time since Europe claimed to be the centre of the world. Some even believe it has become old and set in its ways. In reality, it is very much on the move and in directions which are not always to the liking of its critics across the Atlantic. Its industrial projects in the aeronautics and space sector are one such example. For the countries which have teamed up to develop the Airbus A400M cargo plane and the Galileo satellite navigation system, the aim is to make the most of their scientific and technical potential, develop their most efficient industries, and achieve autonomy from the US in sensitive fields such as military transport or satellite positioning. These efforts can only be applauded, even if one would like European research to pursue more motivating applications.

Galileo Galilei, one of the founding fathers of modern physics, is credited with having exclaimed 'But it moves' – referring to the Earth around the Sun – after having been forced to renounce his beliefs in the Copernican system. This is why there could be no more fitting name than his for the European system that over the coming years will offer an alternative to the Global Positioning System (GPS) to which the US Army holds the keys. With Galileo, representing both scientific progress and resistance to conservatism, is it not Europe that is holding its head high?

Of course, we have come a long way since the Inquisition and the reign of terror it imposed to protect its absolutist vision of heaven and earth. But blinkered thinking, the fight against 'the axis of evil', economic monopoly and military supremacy are still a part of our world. And while, in many countries, citizens are raising their voices to say that rather than this 'best of all worlds' they prefer a multipolar world in which dialogue and balance dominate within the institutions, it is for the scientific community – taking as their models such illustrious ancestors as Copernicus, Galileo, Kepler and Newton – to ensure that progress in knowledge goes hand-in-hand with progress in society.

Candide

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

European patents: ICTs in the lead

In 2001, the share of the Information and Communication Technologies (ICT) sector in the total number of patent applications submitted to the European Patent Office (EPO) by EU Member States was 2.3 times the 1991 level. For the United States, it was twice and for Japan 1.3 times the 1991 level. In 2001, the ITC sector represented 15.5% of all patents registered for the EU. Nevertheless, the proportion remains higher for its two major competitors, at 24.6% and 18.7% respectively.

Six countries accounted for 90.7% of European patent applications in the ICT sector: Germany (29.9%), the United Kingdom (18.6%), France (15.3%), the Netherlands (10.4%), Sweden (8.9%) and Finland (7.5%). Relatively speaking, Finland is in the lead with 136 applications per million inhabitants, followed by Sweden with 94 and the Netherlands with 62.

At the regional level, the leading trio is Oberbayern (DE) with 855 applications, Noord-Brabant (NL) with 800, and the Ile de France (FR) with 800. In terms of population size, Noord-Brabant (NL) ranks first with 340 patent applications in the ICT sector per million inhabitants, followed by Uusimaa (FI) with 280, and Stockholm (SE) with 240.

EU-Middle East: research as a catalyst for dialogue

'Research is an area in which contacts and co-operation can transcend political and cultural barriers, and in which Arab and Israeli scientists can work in partnership on European projects,' Research Commissioner Philippe Busquin said recently. He was speaking on the occasion of the renewal under the Sixth Framework Programme of the EU-Israel co-operation agreement. Israel was actively involved in the previous framework programme, implementing 612 projects, 147 of which were coordinated by Israeli teams.

A significant aspect of this co-operation is the opening up of the Mediterranean: many research projects of interest to the region's economy and environment, such as agriculture and the management of water resources, have included Arab partners, including the Palestinian Territories, Syria, Lebanon, Jordan, Egypt, Tunisia, Algeria and Morocco. Commissioner Busquin believes that 'this dialogue in the field on subjects of common interest is valuable and should be systematically encouraged.'

Israel will be contributing an estimated €192 million to the Sixth Framework Programme's budget, funded out of the Ministry of Trade and Industry's R&D budget (45%), university research budgets (45%) and by the Ministry of Science, Culture and Sports (10%).

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

Diary

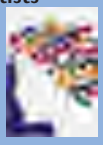
Meetings under the Italian Presidency

http://buongiornoeuropa.istruzione.it/index_en.shtml
or **http://www.cordis.lu/italy/events.htm**

- **Research and enterprise setting up in view of the enlargement: foresight contribution** – 2-3/10/03 – Rome
- **IST 2003 (The EU's annual Information Society Technologies event)** – 2-4/10/03 – Milan
- **Euro-Med Forum to implement scientific, technological and industrial cooperation in the Mediterranean Region on a bilateral and multilateral scale** – 5-6/10/03 – Capri
- **International Conference "Industrial Property – Quo Vadis?"** – 6-7/10/03 – Ischia
- **Research infrastructures: exchange, training and excellence centers** – 21-22/11/03 – Trieste
- **4th GMES (Global Monitoring for Environment and Security) Forum** – 26-28/11/03 – Baveno
- **European Nanotechnology Forum** – 9-12/12/0303 – Trieste
- **Women in Science: strengthening equal opportunities in the European Research Area** – 3-5/12/03 – Rome

European notebook

- **The European Union contest for young scientists 2003** – 20-26/09/03 – Budapest (HY)



http://www.europa.eu.int/comm/research/youngscientists/

- **First international conference on sustainable planning and development** – 1-3/10/03 – Skiathos (GR)

http://www.wessex.ac.uk/conferences/2003/planning03/index.html

- **International conference on environmental protection from radiation** – 1-3/10/03 – Stockholm (SE)

http://www-pub.iaea.org/MTCD/Meetings/Announcements.asp?ConfID=109

- **European transport conference (ETC)** – 8-10/10/03 – Strasbourg (FR)

http://www.aetransport.co.uk/etc/etc2003/index.html

- **Conveying science into policy** – 16/10/03 – Brussels (BE)

http://www.greenfactsfoundation.org/conference/

- **Research and Technical Development for a Sustainable Extractive Industry in the EU and Candidate Countries** – 3-4/11/03 – Prague (CZ)

http://www.nesmi.net/

- **EU science week**
3-9/11/03 – Rome, Berlin, Paris, Stuttgart, …

http://www.cordis.lu/scienceweek/home.htm

- **Forum for European-Australian science and technology co-operation (FEAST): networking for excellence** – 13-14/11/03 – Canberra (AU)

http://www.feast.org/feast4.html

- **Genetics, determinism and human freedom** – 14-15/11/03 – Heidelberg (DE)

http://www.embo.org/projects/scisoc/scisoc2003.html

- **Awarding of the Descartes Prize (for noteworthy scientific and technological results by co-operative European research)** – 20/11/03 – Rome (IT)

http://www.cordis.lu/descartes/home.htm

- **The meaning of genomics** – 20-22/11/03 – Exeter (UK)

http://www.ex.ac.uk/egenis/events/meanings.htm

- **The world summit on information society** – 8-12/12/03 – Geneva (CH)

http://www.geneva2003.org/wsis/indexa01.htm

For other meetings, see also:
http://www.europa.eu.int/comm/research/headlines/archives_diary_en.html

Discovering... Competing... Investi

Science comes out of

Science is coming out of the shadows, presenting and explaining its work to stimulate interest and promote understanding. Internet sites are detailing the mechanisms and highlighting the implications of scientific progress. Discussion forums and 'science cafés' are encouraging debate. Museums and teachers are launching imaginative initiatives to present progress in knowledge and stimulate a desire to find out more. This issue of RTD *info* marks the launch of a new column: 'Science comes out of the shadows'. Included in all future issues, it will focus on initiatives or activities designed to communicate science and enrich the dialogue between the research community and society.

Under the microscope

When, why and how did the prehistory of human language begin?

Humanity finds its voice

Why is language peculiar to humans? This fascinating question is of great interest to scientists. In the early 1970s, the American linguist Philip Lieberman and anatomist Edmund Crelin published the hypothesis that physiological changes (the flexion of the base of the cranium and lowering of the larynx) served to create a kind of 'echo chamber' (the pharyngeal cavity) which amplified and contrasted the sounds emitted by the vocal cords. In monkeys and babies, the larynx is placed too high to make this possible. But when exactly did this change take place? Reconstructions by palaeoanthropologists at the Museum of Man (FR) have shown that the cranium and larynx in Neanderthal man (between 500 000 and 300 000 years ago) were already in similar positions to our own.

In 1999, a new line of inquiry opened up. Researchers from Duke University in the USA studied the hypoglossal canal which encases the nerve controlling tongue movements. They believed that the power of speech depends on the size of this canal and that Neanderthal Man had the necessary volume. Unfortunately, a team from Berkeley University soon discovered that about 15 primates have a canal which is even larger than man's.

More recent hypotheses have focused on the organisation of the brain. A comparative study of humans and the chimpanzee shows that the Broca and Wernicke zones, which are associated with language, are present in both species. But there is more than just the brain involved. The French palaeontologist Yves Coppens believes that articulated speech, which marked the transition from pre-humans to humans, developed between 2.5 and 3 million years ago. The climate is seen as being a defining factor for this, with the *Homo genus* differentiating itself from the Australopithecus after a long period of severe drought. What is the connection? Climate change apparently caused a change to the respiratory system and it is this which permitted the development of phonatory capacities.

Other scientists place the emergence of speech much later, with the arrival of *Homo sapiens* (100 000 years ago). In this theory, humans first learned to speak in Australia as a result of life experiences, namely a difficult sea crossing which required more precise communication skills, forcing them to add speech to gestures. This is one of the working hypotheses of Jean-Marie Hombert (CNRS) who coordinates the international multidisciplinary programme 'the origin of man, language and languages'.

Researchers at the human genetics centre at the Wellcome Trust (UK) and at the Institute Max Planck's (DE) Svante Pääbo Centre are, however, working on a gene, known as FOXP2, which is probably linked to the acquisition of articulated speech. They have studied this gene in mice, various monkeys and in humans, in whom a variant of FOXP2 apparently appeared. But the question remains open with the hypotheses placing the emergence of speech anywhere between 50 000 and 200 000 years ago.

www.ohll.ish-lyon.cnrs.fr:591/ohll/index.htm

TV: 2003 Midas Prize

Science is succeeding in getting its message across to the general public. It can even attract a large European audience by using their favourite media, television. Every year the EuroPAWS project awards the Midas Prize for the best efforts in this field. The aim is to encourage initiatives to present science and technology, either directly or indirectly, through documentaries or fiction. The three criteria applied by the jury are 'persuasion' ('was the programme convincing?'), the presentation of the scientific or technical element, and the effectiveness of the message for the target public. The films may address different audiences and be educational, family entertainment or in-depth documentaries.

The EuroPAWS team.

The projects selected will then be presented at the Image and Science Festival (Paris, 4-5 October) in the course of the two days devoted to television dramas. Prizes will be awarded in London at the end of the year at an event organised by EuroPAWS.

www.europaws.org

gating..Reflecting..Learning..Disco

the shadows

What's new on the Web?

Bionet: answering your questions

Are you for or against GMOs and why? Can new medicines extend life – and if so for what purpose? Will it one day be possible to choose your children's genes and what will happen to these 'designer' babies? In what cases will the cloning of embryos be an option? How does national legislation vary on all these questions of science and ethics? Will stem cells revolutionise the future? These are all questions posed by members of Bionet: eight European science centres(*) and the European Collaborative for Science, Industry and Technology (ECSITE) consortium. Documents and films help provide some of the answers as visitors explore the subjects of their choice.

Arguments for and against are summarised and, for those who want to find out more, there are links and a bibliography. Finally, for those who want to have their say, there is a system of on-line voting.

(*) At-Bristol (UK), La Cité des Sciences et de l'Industrie (FR), Experimentarium (DK), Heureka (FI), Fundació "la Caixa"/Museu de la Ciència (ES), Deutsches Museum (DE), Museu de Ciencia da Universidade de Lisboa (PT), The Science Museum (UK).

www.bionetonline.org

Water for all

Turning on a tap and filling a glass of water is not something everybody can do. An educational site, created by a humanitarian organisation (WaterAid) and plastics manufacturers, explains in very simple but thought-provoking facts and figures the problem of access to drinking water and the lack of sanitary installations which affect billions of people all over the world. The material can also provide ideas for teachers – languages, maths, geography, art and history can all be approached through water – and information for young 'Internauts' (three categories between ages 11 and 18). This British site is in English but the simplicity of the language used means that it can also be used for language learning.

www.wateraid.org.uk
www.aquaplastics.org/

Competition: science photography

For the past two years, the Novartis pharmaceutical company and the British newspaper *The Daily Telegraph* have held the 'Visions of Science Photographic Awards', an original photographic competition open to professionals and amateurs alike. Most of the photographs presented are taken using inexpensive equipment which is accessible to everybody (such as a simple Kodak camera) in what is a homage to the low-tech approach.

One of the prize wining photos from 2002.

The prizes are awarded on 23 September in five categories: action (capturing a scientific process or natural event); close-up (a different take on reality); people (the impact of science and technology on daily life); concepts (explanation of a scientific concept); art (the beauty of science). This year, there will also be special prizes for a DNA image (to mark the 50th anniversary of its discovery), a photo of human medicine and of veterinary medicine, plus a young photographer's prize for the under-18s. In addition to the prize money, winners will also have their pictures published in the press and exhibited throughout the United Kingdom. A symposium for scientists and artists will be held at a later date.

www.visions-of-science.co.uk
www.ase.org.uk

Biology teachers

The European Molecular Biology Organization (EMBO) and the European Molecular Biology Laboratory (EMBL) are co-organising a series of nine workshops for teachers. They will be held in eight countries during 2003 and 2004 and an international meeting was held in Heidelberg last May. On each occasion, teachers and scientists look into – through interprofessional discussions and exchanges of good practice –the best ways of teaching the life sciences. They debate scientific developments and the ethical issues they can raise. 'We hope that this initiative will help establish a pan-European platform which will raise the level of biology teaching through the exchange of good practices,' explained Andrew Moore, head of the Science & Society programme at the EMBO.

www.embo.org – ellen.peerenboom@embo.org – info@embl.de

Sixth RTD Framework Programme

Overview of calls for proposals

The latest news on calls for proposals open on 18 July 2003. For additional specific information on each of these calls, go to: http://fp6.cordis.lu/fp6/calls.cfm

This overview is now updated weekly at the following address: http://europa.eu.int/comm/research/fp6/calls_en.html

CALL IDENTIFIER	RESEARCH FIELDS OF ACTIONS TARGETED	CLOSING DATE	BUDGET (MILLIONS €)
INTEGRATING AND STRENGTHENING THE EUROPEAN RESEARCH AREA (ERA)			
	Joint call: Information society technologies and Nanotechnologies and nanosciences, knowledge-based multifunctional materials and new production processes and devices	**[ist@cec.eu.int] [rtd-nmp@cec.eu.int]**	
2002-IST-NMP-1	Thematic call in the area of "Manufacturing, and services engineering in 2010"	16/09/03	60
	Joint call: Aeronautics and space and Sustainable development, global change and ecosystems	**tren-fp6@cec.eu.int**	
2003-TREN-2	Periodic call in the areas of "Aeronautics and space, Sustainable energy systems sand Sustainable surface transport"	17/12/03	175(1)
	Life sciences, genomics and biotechnology for health	**[rtd-genomics@cec.eu.int] [rtd-genomics-biotec@cec.eu.int] [rtd-diseases@cec.eu.int]**	
2003-LIFESCI HEALTH-I	Thematic call in the area of "Life sciences, genomics and biotechnology for health"	13/11/03	411
		rtd-genomics-biotec@cec.eu.int	
2003-LIFESCI HEALTH-II	Strategic Specific Support Actions (SSA) in the same area	15/04/04	4
	Information society technologies	**ist@cec.eu.int**	
2002-IST-C	Future and emerging technologies (FET) (continuous submission)	31/12/04	60
2003/S 90-079940	Provision of assistance in various technical, administrative and organisational tasks occurring in the IST Programme (continuous submission)	27/04/06	_
2003-IST-2	Second thematic call on applied IST research addressing major societal and economic challenges	15/10/03	525
	Aeronautics and space	**rtd-aerospace@cec.eu.int**	
2002-Aero-2	Specific Support Actions (SSA) in the aeronautics field	23/09/03	7 (2003)
	Sustainable development, global change and ecosystems	**rtd-sustainable@cec.eu.int**	
2002-Transport-2	Specific Support Actions (SSA) in the area of "Sustainable surface transport"	23/09/03	5 (2003)
2003-Global-2	Thematic call in the area of "Global Change and Ecosystems"	9/10/03 and 17/02/04	180
	Citizens and governance in a knowledge-based society	**rtd-citizens@cec.eu.int**	
2002-Citizens-3	First thematic call covering, in particular, the dynamics of the knowledge-based society and its economic and social impact, social cohesion, changes in working methods, enlargement and governance	10/12/03	48
	Policy support and anticipating scientific and technological needs	**rtd-nest@cec.eu.int**	
2003-NEST-A	New and emerging science and technologies (NEST): ADVENTURE projects, INSIGHT projects and Support Actions	22/10/03	28
2002-SSP-2-SARS	Policy-orientated research: Special call on "Severe acute respiratory syndrome (SARS)"	30/09/03	9
	Horizontal research activities involving SMEs	**rtd-sme@cec.eu.int**	
2002-SME-1	Specific research project for SMEs: co-operative research projects	27/11/03	60
	Specific measures in support of international co-operation	**rtd-inco@cec.eu.int**	
2002-INCO-DEV-1	Specific Targeted Research Projects (STREP) and Coordination Actions (CA) for developing countries (DEV) in the field of health, natural resources and food safety	11/09/03	50
2002-INCO-DEV/ SSA-1	Specific Support Actions (SSA) for developing countries (DEV) (Periodic call)	4/09/03, 8/03/04, 8/09/04, 7/03/05, 7/09/05, and 6/03/06	1 (2003)

(1) The total indicative budget is broken down as follows: Aeronautics and space: €20 million - Sustainable energy systems: €107 million - Sustainable surface transport: €48 million.

	Specific measures in support of international co-operation	**rtd-inco@cec.eu.int**	
2002-INCO-MPC/SSA-2	Specific Support Actions (SSA) for Mediterranean partners countries (MPC) (Periodic call)	4/09/03, 8/03/04, 8/09/04, 7/03/05, 7/09/05 and 6/03/06	0.6 (2003)
2002-INCO-WBC/SSA-3	Specific Support Actions (SSA) for Western Balkan countries (Periodic call)	4/09/03, 8/03/04, 8/09/04, 7/03/05, 7/09/05 and 6/03/06	0.6 (2003)
2002-INCO-Russia+NIS/SSA-4	Specific support actions (SSA) for Russia and other NIS (Periodic call)	4/09/03, 8/03/04, 8/09/04, 7/03/05, 7/09/05 and 6/03/06	0.6 (2003)
2002-INCO-COMultilatRTD/SSA-5	Specific Support Actions (SSA) for the multilateral coordination of national RTD policies and activities (Periodic call)	4/09/03, 8/03/04, 8/09/04, 7/03/05, 7/09/05 and 6/03/06	0.6 (2003)
	STRUCTURING THE EUROPEAN RESEARCH AREA (ERA)		
	Human resources and mobility (Marie Curie actions)	**rtd-mariecurie-actions@cec.eu.int**	
2002-Mobility-1	Marie Curie Research Training Networks	19/11/03	115
2002-Mobility-2	Marie Curie Host Fellowships for Early Stage Training	11/02/04	70
2002-Mobility-3	Marie Curie Host Fellowships for the Transfer of Knowledge	19/05/04	45
2002-Mobility-4	Marie Curie Conferences and Training Courses	20/04/04	10
2002-Mobility-5	Marie Curie Intra-European Fellowships	18/02/04	55
2002-Mobility-6	Marie Curie Outgoing International Fellowships	12/02/04	18
2002-Mobility-7	Marie Curie Incoming International Fellowships	12/02/04	11
2002-Mobility-8	Marie Curie Excellence Grants	18/05/04	30
2002-Mobility-9	Marie Curie Excellence Awards	18/05/04	0.25
2002-Mobility-10	Marie Curie Chairs	21/01/04	5
2002-Mobility-11	Marie Curie European Reintegration Grants (continuous submission)	31/10/04	19
2002-Mobility-12	Marie Curie International Reintegration Grants (continuous submission)	31/10/04	10
	Research infrastructures	**rtd-infrastructures@cec.eu.int**	
2003-Infrastructures-3	Communication network development in conjunction with Priority 2 (Information society technologies)	2/10/03	100
	Science and society	**rtd-sciencesociety@cec.eu.int**	
2002-Science and society-1	Support and networking for the Science and Society approach	28/08/03 and 9/12/03	4
2003-Science and Society-5	European Science Education Initiative	8/10/03	7
	STRENGTHENING THE FOUNDATIONS OF THE EUROPEAN RESEARCH AREA (ERA)		
	Coordination of research activities	**rtd-sciencesociety@cec.eu.int**	
ERA-NET/1/CA-SSA	Supporting the co-operation and coordination of research activities carried out at national and regional level (ERA-NET Scheme)	2/03/04, 5/10/04, 2/03/05 and 4/10/05	24 (2003)
	RESEARCH AND TRAINING IN THE NUCLEAR FIELD (EURATOM)		
	EURATOM	**rtd-euratom@cec.eu.int**	
Euratom Call Open	Specific support actions (SSA), trans-national access to large infrastructures and actions to promote and develop human mobility in the Euratom Research and Training Programme on Nuclear Energy (Periodic call)	14/10/03, 13/04/04, 12/10/04, 12/04/05, 11/10/05 and 11/04/06	2 (2003)

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

Research DG publications

Studies

- **Raising EU R&D intensity: improving the effectiveness of the mix of public support mechanisms for private sector research and development – 140 pages**

arie.van-der-zwan@cec.eu.int

- **Public perception of science and technology in the new Member States, Eurobarometer – 120 pages**

research@cec.eu.int

- **The potential of regional foresight, mobilising the regional foresight potential for an enlarged European Union – 40 pages**

guenter.clar@cec.eu.int

Results of projects and programmes

- **European fuel cell and hydrogen projects 1999-2002 – 144 pages**

rtd-energy@cec.eu.int

- **Science, our future – 15 years of the EU contest for young scientists 1989-2003 – 156 pages**

- **Strategic accompanying measures in life sciences: from FP5 to FP6 – 17 pages**

rtd-genomics-biotec@cec.eu.int

- **The global socio-economic dimension of research under the Fifth Framework Programme – 112 pages**

rtd-citizens@cec.eu.int

Reports

- **Science centre stage: reports from European science and technology week 2002 – 36 pages**

rtd-sciencesociety@cec.eu.int

- **Science for society, science with society – how can research on food and agriculture in Europe better respond to citizen's expectations and demands? – 32 pages**

Hans-joerg.lutzeyer@cec.eu.int

Magazines, brochures, leaflets

- **Growth in action n°8 – In the new materials age – 24 pages**

growth@cec.eu.int

- **COST networks for success – 24 pages**

COST@consilium.eu.int

- **Third European report and science & technology indicators 2003 – 451 pages**

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

Hard questions about software

Is computer software patentable intellectual property or openly accessible public knowledge? In the digital world, controversy over this question – vital for the development of the information society – is raging as never before. What stance does Europe plan to take in the face of growing demands for free and open source code?

In the early days of micro and mini computers, free software was taken for granted. In the late seventies and early eighties, manufacturers such as IBM and Apple launched their first PCs complete with elementary software programmes – for word processing, tabulation, etc. – which could be copied and transferred freely.

Moreover, the question of software creativity was central to the development of the famous family of operating systems known as Unix. This was developed in the 1970s by a small group of computer scientists and mathematicians, most of them graduates of the University of California (USA) and working at the famous Bell Labs or Lucent Group (USA). Free of any immediate commercial pressures, these pioneers, particularly Ken Thompson and Dennis Ritchie,[1] laid the veritable foundations of the information society.

The 'Unix War'

From the early 1980s, the remarkable functionality of successive Unix versions – the way they could be used on any hardware, interconnect with other machines and be continuously upgraded – resulted in this operating system quickly becoming the standard for all medium- and high-performance computer systems.

In 1984, however, AT&T – a key player in the software market at the time – started to claim commercial rights. This marked the first shot in what came to be known as the Unix War.

The conflict pitted software companies seeking to develop products derived from the Unix system against computing research circles taking issue with what they saw as an obstacle to intellectual creativity. They began to campaign against these costly controls that companies were seeking to impose on their freedom. The free software movement was born on US university campuses.

The *free* commandments

Under the influence of the movement's first major figure, Richard Stallman, a computer scientist at the Massachusetts Institute of Technology (MIT) a doctrine was soon formulated. Stallman launched the ambitious GNU[2] project with the which aimed to help create free software suites. Then, in 1985, he founded the Free Software Foundation (FSF).

(1) It was written that, if the Nobel Foundation had created a prize for computer science, it would certainly have been awarded to them.
(2) The choice of the animal acronym GNU (a strange hoofed mammal found in South Africa, something between an antelope, a bull and a horse) says something about the rather strange character of Stallman, who has cultivated the image of an eccentric outsider. The meaning of the acronym was also somewhat esoteric as it was based on a recursive play on letters meaning GNU's Not Unix…

The Union considers its position

The European Commission has been considering the question of free software for a number of years, as is clear from a report, published in 2000, by an information society working group. Torn between the favourable opinions of the scientific world and certain sectors of industry on the one hand, and the stated opposition of the Business Software Association (BSA) – whose views are largely shared by the European Patent Office – and the mixed feelings of the European Parliament on the other, the Commission has yet to decide on an official stance. Whatever the case, free software is among the priority subjects for debate in connection with the 'knowledge society'.

ISTAG, a group of advisers charged with preparing the Information Society Technologies component of the Sixth Framework Programme, recommends the use of open source licences where they are useful for European industrial strategy, 'and in general for software produced in the framework of the IST programme, and even the Framework Programme as a whole.' Nothing has yet been decided, but these recommendations will probably be acted on in the field of e-government, medical decision support systems and grid infrastructure.

The IDA strategic initiative for data exchange between the public administrations of Member States has already opted to share open-source software. A pilot study on the migration to free software has been launched for this purpose. A call for tenders is planned to create a central point of exchange in the form of a server hosted by the Commission.

The FSF proclaimed the four commandments or fundamental freedoms necessary for a genuinely 'free' software market: the right to run a computer program for any purpose desired by the user; the right to know how the program works (implying access to its 'source code', the actual commands and instructions that drive the software) so as to adapt it to individual needs; the right to redistribute copies; the right to improve the program and to release these improvements to the public so that the whole community can benefit.

The originality and dynamic of this initiative lay in the fact that it was the users who got together to exercise control over developments. Brian Fitzgerald, an economist at Limerick University (IE) and an expert studying this original approach to software development, believes it constitutes 'a good working model for an economy and a society which is increasingly based on networks.'

The 1991 watershed

Two decisive steps in gaining recognition for this libertarian manifesto were taken in the early nineties. From 1991, the Computer Systems Research Group or CSRG – again a product of the ever-creative Berkeley campus – began to distribute Network Release. This was the first free 'clone' of the Unix system, in which all the elements of the operating system had been rewritten to escape the copyright owned by AT&T. After several setbacks on the legal front, AT&T threw in the towel and the Unix War came to an end. The functionality of this major operating system had now entered "liberated" space.

That same year, a modest but inspired young man named Linus Torvald, who worked at Helsinki University (FI), announced the development of the first version of Linux. This new and entirely original operating system offered functions just as advanced as Unix and, what is more, it could run on a PC. For the FSF, the launch of Linux was a genuine victory, as Torvald, committed to the principles of the free software movement, released his system under the GNU's GPL (*General Public Licence*). Since then, Linux has become an operating system recognised and used worldwide.

The cathedral and the bazaar

Over the past decade or more, we have seen the emergence, in many fields, of communities of hundreds or even thousands of advanced users developing protocols and software free of charge. The most significant example is certainly the spectacular growth of the Internet. Originally designed for military and then scientific use, this formidable communications and networking tool expanded both spontaneously and remarkably effectively outside of any industrial logic, triggering a major social revolution.

Richard Stallman, founder of the Free Software Foundation and the GNU project.

Linus Torvald, creator of Linux.

Eric Ramond, founder of the Open Source Initiative.

Another major figure in the free software movement, Eric Raymond, founder of the Open Source Initiative, calls this model the 'bazaar' as opposed to the 'cathedral', which is a software firm's R&D department. But he stresses that this bazaar is, nevertheless, quite structured: the core developers who created the software coordinate operations. They are aided first by regular collaborators, then by users who provide a few tweaks, and finally the software goes out to the passive users.

A growing movement

Although it originated on university campuses, free software has today spread far beyond the confines of the academic world. Other players have progressively made their presence felt as specialised user groups have developed common professional tools, such as in the health sector.

The movement has also begun to attract growing interest from industry, starting with the giants of the computing sector. In 1998, Netscape announced that its Communicator (formerly Navigator) browser would become free and it revealed the source code. The browser was renamed Mozilla and a special licence was created. Apple also decided to grant access to elements of its operating system's source code. Sun and other manufacturers have since followed suit.

The movement is also growing among users. Telephone operator France Telecom, computer manufacturer Bull and the French Institut National de Recherche en Informatique et en Automatique (INRIA) recently teamed up to create the ObjectWeb consortium. ObjectWeb is developing 'open' software designed to manage various types of network. OpenCascade – the computing branch of European aeronautics company EADS, now owned by Principia – has developed an open-source digital simulation program. Such examples are constantly appearing, even if software giant Microsoft is spending a lot of money and expending great energy combating a trend that could jeopardise its position.(3)

Is free software a passing fad, an academic hobby horse, or a radical revolution in the software industry? For it to truly be revolutionary, free software must overcome its principal handicap, namely a lingering distrust among corporate customers who, for essentially cultural or even ideological reasons, are reluctant to use these tools, doubting their quality and associated services. Just as importantly, this concept needs first to be legitimised by the regulations currently being discussed at major global forums. In this respect, Europe has yet to adopt a stance on its own market (see box).

(3) In 1998, the leaking of a confidential internal Microsoft report – known as the Halloween papers *– revealed the crisis strategy which was being implemented within this global computer giant at the time as it sought to combat Linux and free software in general.*

To find out more

Associations:

GNU and Free Software Foundation

www.gnu.org

www.fsf.org

FSF Europe

www.fsfeurope.org

Open source

www.opensource.org/

Concrete initiatives in Europe

www.objectweb.org

www.opencascade.com

History and analysis

livinginternet.com/?i/iw_unix_war.htm

opensource.ucc.ie/

www.linux-france.org/article/these/cathedrale-bazar/cathedrale-bazar.html

www.softpanorama.org/index.shtml

Research at the forefront

Although the free software movement originated in radical US intellectual circles in the 1980s, most serious research circles all over the world soon saw the benefits and have today rallied to the cause. What is the reason for this growing militancy?

To find out more

- Initiatives in favour of free software in research: openscience.org/ www.openinformatics.org/ www.opensource.ac.uk/
- Initiatives in favour of free publications: opencontent.org www.fsf.org/licences/licences.html#FDL

First of all, there are the purely economic reasons. Philippe Aigrain, until recently head of the free software sector with the European Commission's IST programme, makes the point that 'research infrastructure, from hardware to documentation, and from networks to journals, is a big software consumer. Whether in astronomy, chemistry or biology, in material sciences or environmental sciences, scientific results are increasingly being stored on computer files and can only be processed by models closely integrated in databases and simulation tools.' This makes it easy to understand that non-commercial – or, in any event, low cost – software is becoming, as he puts it 'a *sine qua non* of research'.

'I have only used free software since 1995,' says Bernard Lang of the French Institut National de Recherche en Informatique et en Automatique (INRIA). 'At first, I chose this path for purely budgetary reasons, before discovering other benefits.' The technical benefits are clear: users have the power to adapt tools to meet their specific needs. 'It is impossible for a research group to change an element in a proprietary system. That means our hands are tied.' As to whether or not all scientists are capable of making such a transformation, that is another question.

The meeting of science and software

But the main reason, or at least the one given most frequently, is the similarity between the way free software is developed and the scientific method itself. Transparent procedures, freedom of exchange, the accumulation of knowledge and peer review are common foundations for them both. As in the case of recognition of excellence in research, the main reward for software program developers is the esteem of their colleagues.

Nikolai Bezroukov, professor of computer science at Fairleigh Dickinson University (USA), writes that 'the development of open source systems is a particular kind of academic research.' He compares virtual communities engaged in software development and operating through the Internet with equally virtual communities of scientists grappling with a common scientific problem and exchanging their views in specialised journals, in either case 'for the benefit of humanity'. Less lyrically, Brian Fitzgerald believes that the use and development of open source software has now become essential for research.

Many see scientific publication and the distribution of free software as virtually inseparable.(1) Neil Thacker of Manchester University (UK), a developer of analysis software for medical images, chose to distribute his creations under GPL licences. 'Otherwise our research would be almost valueless,' he explains. 'We write articles to explain our work, but the process would be too long and difficult for others to recreate software on the basis of these articles. Remember that, as academic researchers, our role is to achieve progress in knowledge.'

INRIA's Lang goes further: 'a scientific publication must provide all the elements necessary for the experience to be reproduced. So, it would only be logical to include the software used to process the data.'

No need to reinvent the wheel

This explains the growing militancy in favour of open source software among members of the scientific community, and in the field of biotechnology in particular. There have been a number of actions inspired by the Open Informatics Petition, an initiative by US researchers demanding that software resulting from government-funded research 'remain public'. They also have technical arguments to back up this position of principle. First of all, there is no point reinventing the wheel: once a laboratory has completed a development, it is a waste of time and money to repeat it elsewhere. In the longer term, peer review is likely to improve the software quality and the results it produces.

To find out more

- cip.umd.edu/Aigrain.htm# Q2opensource.mit.edu/papers/aigrain2.pdf

In keeping with this spirit, on 30 April 2002, the Free Software Foundation published a text recommending that the European Parliament and Commission should take into account – and encourage – the use of free software under the Sixth Framework Programme (see box on previous page).

(1) Recent years have also seen a number of initiatives by researchers in favour of the free and rapid on-line publication of scientific results. Inspired by free software, their demands have provoked the displeasure of scientific publishers (see related article in RTD info *31, September 2001. europa.eu.int/comm/research/news-centre/ fr/pol/01-09-pol03.html)*

Glossary of freedom

The free software movement has made such progress that, in line with practices in the world of proprietary applications, it has introduced 'licences' for free software which provide clear definitions of the use to be made of the four original freedoms.

Free or open – The term "free" has been progressively challenged – except by the FSF which is committed to its philosophical and political connotations – by the term "open source", promoted by the Open Source Initiative. There is no real technical difference between the two and the licences accompanying open source programs also grant the four fundamental freedoms.

It should be noted, however, that open source or free software is not necessarily free in monetary terms, even if this is generally the case in practice. Distributors of software packages can charge for the support material and its distribution without infringing on the licence.

Copyleft – The GNU-GPL licence, one of the most commonly used, includes an additional constraint, "copyleft". This obliges whoever redistributes the software, whether modified or not, to grant the same freedoms. This is designed to prevent anyone from changing the software (or incorporating it into another) and then protecting it.

Semi-free – To complicate things, there is also semi-free software, the licences for which only grant the four fundamental freedoms if they are used for a non-profit motive. In practice, this means that researchers, teachers and individuals, but not companies, can use, copy, modify and redistribute them.

Proprietary – Proprietary software, on the other hand, is neither free nor semi-free, explains the FSF. This means that at least one of the fundamental freedoms is not granted. In general, it is forbidden to copy, redistribute or change it, and there is no access to the source code.

Freeware – Free software should not be confused with "freeware", which is generally proprietary software whose redistribution is authorised, but the source code is not available because changing it is not permitted.

Commercial – Some commercial software is developed by companies which plan to benefit financially from it by virtue of its sale, distribution or provision of related services. But this software may still be free – even if in practice it tends to be proprietary.

Public domain – Finally, software which is in the public domain is not protected by copyright. If the source code is available, it is equivalent to free software, but not copylefted. This means that a new modified version of it can be created to make proprietary software.

To find out more

- www.opensource.org/licenses/index.html
- www.fsf.org/licenses/license-list.html

A patent controversy

The general rule in Europe is that software is protected by copyright. The European Convention on patents considers, in principle, that software programs, like mathematical models, are not 'inventions' that can be patented. Considerable inroads have, nevertheless, been made through the jurisprudence of the European Patent Office to push out this theoretical limit.

On 2 February 2002, the Commission submitted a draft directive (2002-092) on the patentability of 'inventions implemented by computer' aimed at harmonising the practices of Member States. Software cannot be patented as such, unless it is part of an 'invention making a technical contribution'.

There has been much opposition to this draft text. Experts in the field, political parties (notably the Greens) and champions of free software see it as opening the door to the unrestricted patentability of software. The draft will soon be submitted to the European Parliament, where some lively debates are expected, for a second reading.

Many experts believe that patents are ill suited to software due to the very nature of the beast, as well as the cost, complexity and time involved in obtaining one. Authorising patents would risk placing the small and often innovative players – whether informal networks or SMEs – at a disadvantage. It is perhaps unsurprising that a report for the Commission by the universities of Sheffield and Sussex (UK) concluded that SMEs are opposed to the patenting of software.

INRIA's Lang points out that, unlike copyright provisions, patents do not protect finished software as complete works but relate to the actual writing techniques which could also be used to create other software. He believes that 'patents will jeopardise research itself'.

'How is it possible to know if a software component, or even an unexpected interaction between two components, is going to infringe on a patent?' he asks. 'Especially as programmers are not necessarily aware of the techniques they use because a part of programming is automatic'.

The triumphs of a gene

Internationally recognised as a pioneer and one of the world's leading experts in molecular genetics, Leena Peltonen owes her vocation – and success – to her family background and country of origin. Her fascination with the 'innate' and the 'acquired' in determining the health of every individual led her to base her scientific investigations on the unique and isolated genetic pool of her native Finland.

Leena Peltonen: 'The big question posed by research into the genetic origins of diseases is to distinguish between what really depends on the genetic make-up and what is linked to environmental factors.'

Leena was ten years old when her younger brother, two years her junior, became seriously ill. He was diagnosed as having an insidious disease which would affect him for life: juvenile-onset diabetes. 'As a little girl I felt both a sense of deep anguish and profound injustice. I thought I would get the disease too.' She decided to fight and refused to accept as inevitable this disease which was attacking her brother and frightening her: she would become a doctor.

This drama unfolded in the small port of Oulu, on the Baltic coast, 600 km north of Helsinki and close to the Arctic Circle. Remote as it is, the town has a school of medicine housing one of the best research departments in Finland. It is there that Leena Peltonen was introduced to the world of research, thanks in particular to her doctoral supervisor, Kari Kivirikko, a renowned specialist in the biochemistry of collagen and related dermatological diseases.

Genetico-genealogical detective

In 1978, increasingly fascinated by the genetic dimension of diseases, she stepped up her research activities and decided to make the most of the 'Finnish laboratory'. 'Traditionally isolated from Europe's principal migratory flows and comparatively small in number, the Finnish population – records of which have been kept meticulously since the 16th century – provides a uniquely interesting 'genealogical database', with a marked inbreeding due to a common ancestry which provides fertile ground for autosomal-recessive genetic transmission.'(1)

Pursuing a remarkable career as both 'genealogical detective' and 'gene hunter', this tenacious researcher followed up all the possible genetic leads behind a vast range of pathologies – both rare and common – which occur within the Finnish group. These range from Marfan's syndrome (resulting in excessive growth and a heart condition) to schizophrenia and other neuropsychiatric disorders, including familial combined hyperlipidemia, lactose intolerance and multiple sclerosis.

From Finland to California

Over the years, Leena Peltonen has become recognised universally for the excellence of her research – first in her native Finland, where she was elected to the Academy of Sciences, appointed Chair at the University of Helsinki and, in 1987, charged with founding and heading the Department of Human Genetics at the National Institute of Public Health. And subsequently abroad, where she participated in many international research programs.

In 1997, the School of Medicine at the very prestigious University of California, Los Angeles (UCLA), asked her to create and head a new department of genetics in the field of paediatrics and neuropsychiatry. 'I did not hesitate for long. It meant interrupting the comfortable scientific career I could have pursued in my own country, but the challenge of this expatriation was not something I could refuse.' Soon after she arrived in Los Angeles, accompanied by a whole team of Finnish researchers.

This brilliant American interlude ended in 2002. She was beginning to miss Finland, and Europe, for its cultural traditions as well as for scientific reasons. 'With its variety of populations and characteristic lifestyles, our continent offers a wealth of raw material for demographic genetics. In addition to this diversity there are infrastructures and health systems of the highest quality, and

hunter

a population with a high average level of education. These are all essential assets for research and create a unique environment to study genetic background of human diseases.'

The twin laboratory

On her return to Finland, Leena Peltonen continued her investigations among the vast samples of 'real population' groups by launching an ambitious European research project which she had been aiming to do for some time: the systematic analysis of the genetic inform[illegible]led by the medical observation of twins. 'The big question posed by research into the genetic origins of diseases is to distinguish between what depends on the expression of a given gene and what is linked to environmental factors, i.e. lifestyles which could be the cause of good health or a pathological condition. In this respect, twins – and real twins have common genes – provide the ideal test population. They have also shared a common environment during their fœtal and early childhood, both determining periods for the health of the human being. Therefore, it is possible to see precisely the causes of health problems later in life, depending on whether they share them genetically or display them because of their different lifestyles as adults.'

'All the research data we have built up on twins tells us how marvellously different they are.'

This ambitious project was made possible thanks to a unique wealth of data widely available within the Union. Six European countries – Finland, Sweden, Norway, Denmark, the Netherlands and Italy – have records dating back many years on the medical history of twin populations, making it possible today to study a total of around 600 000 pairs. Ten research teams of epidemiologists, geneticists, mathematicians and bio-informaticians carried out an in-depth analysis of this 'documentary material'.

The post-genomic revolution

The ultimate motivation for Leena Peltonen's latest research is the completion of the human genome project which she believes is a major scientific revolution. 'The complete sequencing of the human genome changes all our strategies. For the first time in history, we can start to examine the full genetic spectrum of the human being and the essential interactions which take place there, rather than just one gene at a time, or the role of just one of them in an illness, whether during growth or ageing. This will overturn the whole medical approach. When a patient sees a doctor about a specific illness, the doctor will be able to consult his genetic profile and the specific risks related to it. As a result of this information, he will be able to decide on preventive measures and treatment which are genuinely made to measure for each individual.'

But how does this leading geneticist, renowned for her excellence worldwide, view the prospect of human cloning? On this point, Leena Peltonen is categorical. There is no legitimate scientific justification for seeking to clone men and women. 'All the research data we have built up on twins tells us how marvellously different they are. No two identical individuals exist, even if their genetic make-up is exactly the same. The fascination some people have with human cloning reflects a kind of pathetic fear of death and an impossible desire for immortality. Although genetics is in the process of changing our knowledge of man so radically, it is absurd to think that one day he will be nothing more than the sum of his genes.'

To find out more

- National Public Health Institute of Finland www.ktl.fi/index.en.html
- UCLA School of Medicine www.genetics.ucla.edu/
- European Life Scientist Organisation www.elso.org/

(1) A gene is said to be autosomal recessive when it produces the trait which is linked to it on the condition that it exists simultaneously in the X sex chromosome of the XX (male) and XY (female) constitutive pair.

Utopia on wheels

Some 100 000 Europeans currently take part in car sharing schemes, a system which gives access to an automobile at any time without the hassle of ownership. As part of its research into mobility, the European Union is supporting efforts by the MOSES project to coordinate the technological and organisational solutions essential to this transport revolution.

Stuck in traffic or circling endlessly for parking spaces – motorists themselves are the first to suffer from cars clogging up our towns and cities. Although policies designed to deter or offer alternative mobility are emerging, the fact remains that the fight against the urban congestion – and the resulting invasion of public space – is like striking at a multi-headed hydra. This is because, in many circumstances, the car still seems the solution of choice.

But what if the real nature of the problem lay elsewhere – that is, in individual vehicle ownership? Apart from anything else, owning a car is an extremely costly 'privilege', as in towns the costs involved must be offset by short trips of no more than a few kilometres.

The pioneering Swiss

First viewed as rather a utopian idea, car sharing began in Switzerland in the 1980s with the first co-operative car fleets. These cars were positioned throughout Swiss cities and members could gain access to them at any time.(1) Today, Switzerland has 44 000 car sharers using a fleet of 1 750 cars located in 350 municipalities.

The idea has since spread to other European cities, such as Stockholm (SE), Bremen (DE), London (UK), Bucharest (RO), Turin, Genoa and Palermo (IT), as well as some districts of Wallonia (BE). The international network, World Carshare Associates, has recorded dozens of examples of micro-projects adopting variations on the theme. This admittedly small-scale movement has not passed unnoticed by the Union. As part of its 'City of Tomorrow' action, the Commission decided to support the MOSES (Mobility Services for Urban Sustainability) research and demonstration project, which consolidates the principal European experiences cited above.

(1) Car 'sharing' should not be confused with car 'pooling', a practice of private car owners sharing journeys. Car sharing is aimed primarily at reducing private car ownership by providing a co-operative alternative.

Technology to the rescue

The potential of car sharing is closely linked to developments in telematics technologies, including global positioning systems (GPS) and the functionalities of mobile telephony for spatial management, as well as the follow-up of maintenance services and smart card systems. The latter serve as ignition keys for the vehicles and provide the means for identifying and invoicing users.

This new tool for urban mobility cannot be developed in isolation. It must be incorporated – according to needs, distances to be travelled, frequency of use, costs for the user – in multimodal policies which include services rendered by other means of transport, such as bicycles, taxis and public transport. Its promoters view it as a 'missing link' and know that city dwellers are not about to abandon all idea of car ownership. But at least car sharing may induce them not to own two or even more cars as the solution to family mobility. 'We believe we can achieve a 10% reduction in the number of private cars in towns,' stresses Michael Glotz-Richer, coordinator of the Moses project. 'In terms of the freeing up of space and reduction in pollution such a result would have a very significant impact on the quality of life.'

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To find out more

Moses project site
www.moses-europe.org/
Europa site
europa.eu.int/comm/research/growth/gcc/projects/car-sharing.html
World car sharing
www.worldcarshare.com/cs_index.htm

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

Tipping the gender balance

More and more higher education students – particularly women – are opting for science and technology subjects. In nine of the 12 Member States for which figures are available for the 1999/2000 academic year,(1) women outnumbered men.

In terms of degrees obtained, the balance between men and women varies according to country and subject. It is notable that women complete their studies later than their male counterparts (at age 25-29).

France has the highest number of graduates in absolute terms (277 000 in 1998/99) while men continue to dominate in the United Kingdom (227 000). In 1999/2000, five times more male than female S&T students graduated in the Netherlands, and in Germany four times as many did.

All disciplines combined, Finland has the highest proportion of university graduates: 23% of over 15s in 2001, compared with an average of 15% for the Union as a whole. Sweden, Belgium and Denmark also top the 20% mark.

On the employment front, what are generally known as the 'scientific and technical professions' are on the increase in Europe. In 2001, 25% of men worked in a profession which falls into this category. For women, the figure topped the 20% mark – the EU average – in Finland, the Netherlands, Sweden, Denmark and Germany.

For the scientists and engineers sub-group, the proportions are different, with a high prevalence of men. In Germany and France, there are four men for every woman working in the field. In 2001, it was in the United Kingdom that an employed male was most likely to be a scientist or an engineer, while women had their best opportunities in Finland, Ireland and Belgium.

These 'statistics in brief' published by Eurostat are very valuable in providing gender-specific figures on which equal opportunity policy can be based.

(1) Figures for this academic year are not available for France, Greece and Luxembourg.

Towards a European knowledge society: the contributions of men and women – Statistics in brief, Science and Technology, Theme 9 – 5/2003 – Eurostat – EC – ISSN 1609-598.

Opinion

The path to self-sufficiency

It has been a long time since Europe claimed to be the centre of the world. Some even believe it has become old and set in its ways. In reality, it is very much on the move and in directions which are not always to the liking of its critics across the Atlantic. Its industrial projects in the aeronautics and space sector are one such example. For the countries which have teamed up to develop the Airbus A400M cargo plane and the Galileo satellite navigation system, the aim is to make the most of their scientific and technical potential, develop their most efficient industries, and achieve autonomy from the US in sensitive fields such as military transport or satellite positioning. These efforts can only be applauded, even if one would like European research to pursue more motivating applications.

Galileo Galilei, one of the founding fathers of modern physics, is credited with having exclaimed 'But it moves' – referring to the Earth around the Sun – after having been forced to renounce his beliefs in the Copernican system. This is why there could be no more fitting name than his for the European system that over the coming years will offer an alternative to the Global Positioning System (GPS) to which the US Army holds the keys. With Galileo, representing both scientific progress and resistance to conservatism, is it not Europe that is holding its head high?

Of course, we have come a long way since the Inquisition and the reign of terror it imposed to protect its absolutist vision of heaven and earth. But blinkered thinking, the fight against 'the axis of evil', economic monopoly and military supremacy are still a part of our world. And while, in many countries, citizens are raising their voices to say that rather than this 'best of all worlds' they prefer a multipolar world in which dialogue and balance dominate within the institutions, it is for the scientific community – taking as their models such illustrious ancestors as Copernicus, Galileo, Kepler and Newton – to ensure that progress in knowledge goes hand-in-hand with progress in society.

Candide