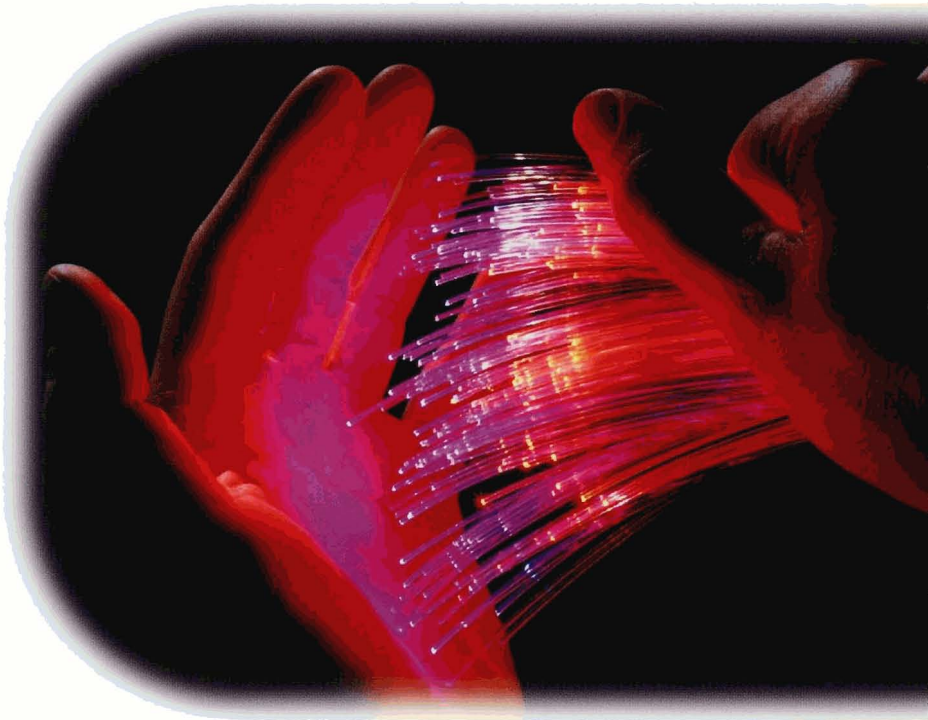
Directorate-General for Education and Culture

Europe — an area for research



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Shared values mean added value

Europe, as the historical cradle of modern science interconnected by a network of universities, research centres, industrial laboratories and innovative SMEs, has one of the richest potentials of grey matter in the world. Each country in it has its scientific traditions, its strengths and its specific features.

Researchers obviously had no need to wait for the Union to become involved in joint projects or take their place in international networks. Since the start of the 1980s, however, the European Union's framework programmes have been the driving force of a new collaborative approach and helped to create a Europe of research. They are based on the priorities which emerged from broad consultation of the political authorities responsible, the scientific world, industrialists, and user representatives. They targeted projects catering for the needs of a changing society and their budget has been increased as a function of the tasks and objectives involved. The aim of these programmes is to promote cooperation between partners in different countries by funding transnational work and promoting coordination between scientific and technological facilities.

This policy means a pooling of data, comparison of results, the completion of multidisciplinary and comparative studies, transfer and protection of new scientific knowledge and know-how, the creation or consolidation of networks, the solution of delicate problems, access to centres of excellence and the most sophisticated equipment. This approach hinges on cooperation and broadens the potential and very dimension of research, and collaboration at European level brings them an undeniable added value.

The Union's framework programmes are gradually gaining ground also as more ambitious instruments. Thanks to agreements with many countries on other continents, researchers there and in Europe have reciprocal access to expertise and centres of excellence.

The Union's support also covers the aspects and challenges situated upstream and downstream of research. Upstream, areas such as training and information are essential instruments for the blossoming of a genuine scientific culture. Downstream, innovation enables research breakthroughs to be converted into tangible benefits for society. This does not mean that these elements are situated on the fringes of the research context. They play a key role in entering into the knowledge-based society which is shaping up and in which the Union has a leading role to play.

A real 'European area of research' is thus beginning to take shape on this continent, one of the most invaluable assets of which is thought.

EKA

The revolution of life sciences

At the dawn of the third millennium, man's future hinges on new knowledge – that of the mechanisms of life. This extraordinary breakthrough of biosciences and biotechnologies is taking place before our very eyes at breathtaking speed.

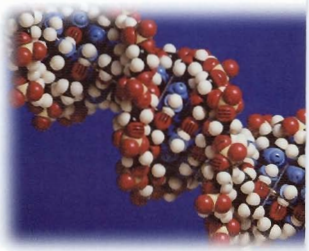
The exploits which scientists are gradually becoming capable of relate first and foremost to health. The ever increasing expertise with regard to the cellular and genetic intricacies which underpin the functioning of the human body is paving the way for revolutionary therapeutic and pharmacological treatments capable of stemming diseases such as cancer or AIDS, and even bringing about a radical change in the conditions of ageing.

Nevertheless, this fantastic uniqueness of the cellular principles in all living organisms itself means that scientific progress in this area goes way beyond the medical field. It concerns the whole of man's relationship with the biodiversity of nature. Biotechnologies open up new avenues at all levels of the animal and vegetable chains which go to make up food. As we face up to the threats to the terrestrial and marine environment, they offer ways of eliminating and regenerating waste, which can reduce pollution. Expertise in terms of life sciences is also to be found where it is least expected, i.e. at the heart of matter. The further development of computer capacity will be achieved through the performance of biochips which will put the tiny structures of micro-organisms at the service of artificial intelligence.

The Union's research policy is to mobilise the potential and capacity of European science on all these aspects. It also seeks to lay the foundations of a common approach to the essential ethical debates raised by the onset of this revolution – some would say the golden age – of life sciences.

'For scientists, a gene is primarily a key element of the cellular machine and genetic engineering involves making use of a fundamental natural system of mechanics capable of generating hitherto unsuspected progress. If it is properly understood, this approach will make it possible to counter the demonisation of a concept of the gene as an instrument to control and take over the human being.'

Alain Pompidou, Professor at the Université René Descartes (Paris), Member of the European Parliament, President of the STOA (European Parliament Office for scientific and technological options assessment).



RDT info

Living better

EKA

Health

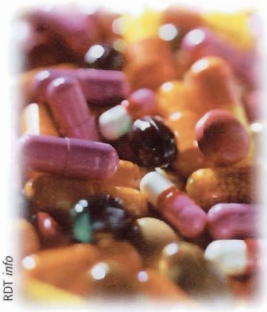
Ours is a plural continent whose citizens live in different environments and climates, have specific socio-cultural habits and provide a diversified pattern of genetic heritage, which means that strengthening the European dimension of medical research is a major asset. It enables scientists to study the development of diseases in order to improve prevention and treatment, exchange clinical experience and approaches, avail themselves of major epidemiological studies, compare the state of health of the populations. In doing so, it makes it possible to achieve the critical mass which is essential if science and practice are to make progress.

The research projects supported by the Union concern strategic areas: the 'grim reapers' (cardiovascular disease and cancer); children's diseases (cot deaths, leukaemia, child diabetes, jaundice in newborn babies, etc.); genetic disorders; emerging or re-emerging epidemics (viral diseases such as AIDS or Ebola, prion-related diseases, tuberculosis, malaria); age-related disorders in a world where people are living longer and longer (Alzheimer). Other work, based on international and cross-disciplinary approaches, deals with issues of public health and ethics (occupational diseases, the social cost or quality of health care).

European biologists were the first in the world successfully to develop oral vaccination. Thanks to genetic engineering they succeeded in injecting into a fodder plant a modified virus which multiplies in it. This technology could revolutionise pharmacology by providing vaccines which are easy to administer and cheap to manufacture.

RDT *info*

Europe against cancer



RDT *info*

Why do established medicines have serious side effects on certain patients? Because certain enzymes which are responsible for their assimilation in the body differ from person to person. Important European discoveries on these 'variable geometry' systems today enable the pharmaceutical industry to design safer products.

- The EORTC (European Organisation for Research and Treatment of Cancer) brings together 2 500 cancer specialists practising in over 350 hospitals in 31 countries. The organisation coordinates cross-disciplinary clinical studies in order to develop the most effective treatments on a wide scale. The database so far includes observations on over 100 000 patients. The results are analysed and compared by some 100 researchers at the EORTC's Data Centre. Upstream of this clinical research, the EORTC coordinates pre-clinical studies on new treatment substances. Downstream, the organisation disseminates the results of its work through seminars, courses on clinical research methodology, conferences, publications, etc. It also instigates studies on the quality of life of patients and evaluates the cost-effectiveness of treatments. The EORTC is a partner of choice in the international fight against cancer and cooperates actively with the National Cancer Institute (USA).

- Four groups of 10 patients selected in five European countries in which they have undergone surgery on serious cerebral tumours are treated by a new form of radiotherapy (boron neutron capture therapy) developed by the EU's Joint Research Centre (JRC) in Petten (the Netherlands).

- Other leading-edge research relating to the treatment of leukaemia cancers and cancers of the bone marrow by alpha-radio-immunotherapy, is conducted by the JRC's Institute for Transuranium Elements in Karlsruhe (Germany).

'Collaborative projects enable laboratories to pool their resources. The quality of the results is therefore better and researchers are able to learn new techniques.'

Harvey Holmes, coordinator of the EVA project which brings together researchers from 12 European countries working on an anti-AIDS vaccine.

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Food

There is growing public focus on the quality of food and its effects on health. For the agri-food sector – which is capitally important economically speaking in Europe – this concern is both a challenge and an opportunity: a challenge inasmuch as scientific and technological breakthroughs, such as the arrival of genetically modified organisms (GMOs), raise major questions as regards consumer safety and protection and an opportunity inasmuch as this economic branch is traditionally one of the mainstays of European exports on the world market.

An increasing number of works relate to the food/health tandem or the control of quality and freshness of products in new preservation techniques. The Union's programmes also support the building of bridges between leading-edge biotechnological research and industry. In addition, project results are systematically disseminated by networks such as FlairFlow which has national outlets throughout the continent.

RDT info

Chicory is very rich in inulin and is an example of a food ingredient whose nutritional virtues have been ascertained by researchers.

Functional foods, foods of the future

The concerted action Fufose (Functional Foods Science in Europe) is designed to take stock of knowledge in the area of the so-called functional foods – that is to say, those which contain an element which is beneficial to health. Fifty-four researchers in 10 countries are studying the effects of various nutrients on specific physiological or biological functions (the effect of antioxidants in the fight against certain forms of cancer, the advantages of intake in the early stages of life of certain polyunsaturated fatty acids, etc.). The aim is to identify and improve certain qualities in food products with the idea of not preventing risks, in the strict sense, but reducing them.

Modified, or not?

What type of treatment are food products subjected to? In the sensitive area of GMOs, European legislation considers that only scientific evaluation can establish that a new food or ingredient is or is not equivalent to an existing food. Two institutes of the JCR – the Institute for Consumer Health and Protection (ISPC) in Ispra (Italy) and the Institute for Reference Materials and Measurements (IRMM) in Geel (Belgium) – work closely together to cater for this requirement. Their work makes it possible to obtain very accurate information on the nature of the products sold. They relate to modified maize and soya – the first two GMOs to have been authorised for sale in Europe.

The ISPC, for instance, has accordingly tested the only machine, made in the United States, capable of detecting traces of RoundupReady – soya beans genetically modified to resist herbicides. The IRMM then prepared samples of soya powder (some containing RoundupReady and some not) which were distributed to 38 European laboratories. The latter identified the presence of RoundupReady to a minimum rate of 2 %. These results pave the way for the development of reliable control instruments which will guarantee the conformity of the products and will make it possible to evaluate any threshold of GMO which could be covered by legislation.

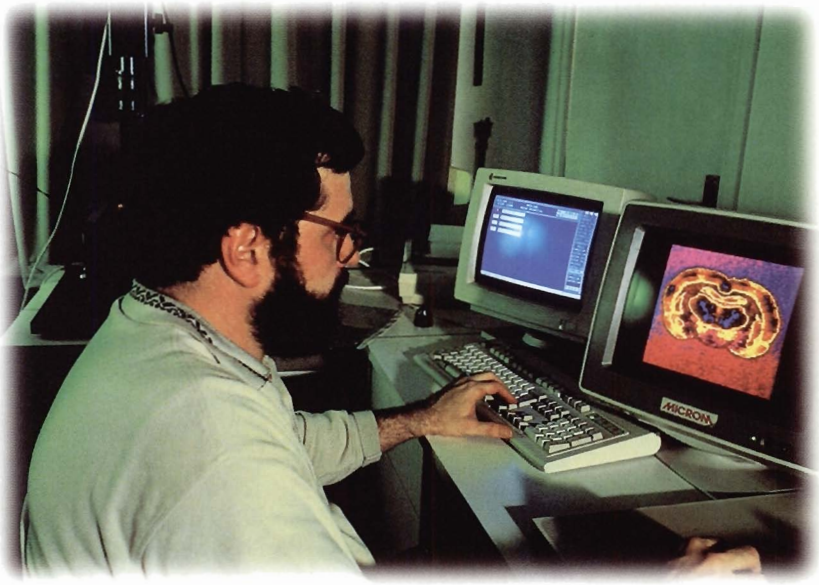
RDT info

Biopackaging is biodegradable, inexpensive to produce, and provides new qualities; it is made from plant-based polymers. Seven research centres and two agri-food companies have even developed edible biopackaging capable of supplying nutrients to complement the product it contains.

'The scientific community which is interested in the food area is at first sight not very homogeneous. This project has made it possible to develop very profitable interaction between different schools of thought. Communication between the Nordic-Germanic sphere and the Latin sphere, representing very different traditions, has thus expanded spectacularly.'

Einar Risvik of the Norwegian Food Research Institute, coordinator of the multi-disciplinary network SENS bringing together 12 scientific organisations involved in studying European food habits.

The information age



Information and communication. This dual revolution takes world society into a new era of civilisation. Information-based technologies and applications are continually and radically changing human activity – starting with the world of research in which the new tools of artificial intelligence bring an extraordinary momentum. In parallel with this, digital communications and the mastery of space cancel out distance and time and trigger a new economy based on virtual trade.

Esprit: a pioneer

As early as the 1980s, the EU put considerable effort into bringing together the capacities of European industry in the area of information and communication technologies. The well-known pioneering programme Esprit made a substantial contribution to maintaining the continent's place in the most recent developments in microelectronics and software expertise. In communications, European research has played a major role in the progress of television and its entry into the digital era, and also in the spectacular growth of telecommunications – particularly mobile telephony.

Electronic security

International electronic commerce generates a turnover of around EUR 200 billion. One third of bank transactions are expected to be virtual in five years' time. The prevention of fraud, the security of transactions, the protection of private life and intellectual property rights therefore require appropriate electronic security methods. A high-performance operational architecture adapted to Internet-based commerce has been devised by the partners involved in the European project Semper. Any consumer wishing to make a transaction using this system can access a database of catalogues, fill in order forms and settle his/her purchases electronically thanks to the use of a security protocol known as SET (secure electronic transaction) or by a smartcard of the e-cash type. The consumer, the supplier and the financial institution are 'interfaced' for all operations in a single message. The SET protocol guarantees the security of transactions in a perfectly transparent and user-friendly way.

Mobile telephones made in Europe

Europe does not support only technological research and development projects. It also seeks to establish standards which allow the utilisation and dissemination of achievements. The standards and their technical specifications are very often the results of advanced research projects. Mobile telephones are an example of this. Under the Eureka initiative, this first involved the development of different architectures of ultra-miniature electronic circuitry. This was then followed by the establishment of the single mobile telephone standard which is today used by over 230 telecommunications operators in over 110 countries, including the United States. 'In order to prevent proprietary models dominating the market, as happened with PCs, it might be possible to introduce memoranda of agreements similar to that on the GSM [mobile telephone], which enabled Europe to lead the field in the mobile telephony market', remarks Ken Ducatel, expert at the Institute for Prospective Technological Studies, one of the institutes of the JRC established in Seville (Spain).

RDT info

Which car park has free spaces? What itinerary to take during rush hour? Where is the nearest bus stop? All these questions can be answered using a portable terminal. The Promise system, associating mobile telephony and a PDA (personal digital assistant), has successfully come through tests undertaken in six European countries (Finland, France, Germany, Netherlands, Sweden, United Kingdom).

'Preparing children to live in a technological environment is essential but is not an end in itself. The aim of our interactive education projects is to teach respect of others and of oneself. Technology or no technology, the point is to teach.'

Walter Van de Velde, coordinator of Today's Stories, one of the European projects whose applications target children and are devised with the help of children.

Community policy is also characterised by the irresistible rise of the Internet, informatics, digital broadcasting using radio waves or satellites, which bring material expression to the onset of the information society.

Changing the way we live

The programmes supported by the Union offer a global approach which encourages industry to cooperate in order to be at the leading edge of research and generate tomorrow's technological breakthroughs. This approach supports the development of applications – many of which have still to be imagined – which improve the life of the European people who have entered this new era.

The spectacular rise of the 'virtual' indeed throws up considerable socio-economic challenges. Teleworking, which today involves over 4 million people in Europe, is expected to increase tenfold between now and 2007. The expansion of this system offers various advantages: productivity gains, less traffic, job opportunities for those living in the more isolated regions. While these trends are based on the development of new instruments, many European research projects are also studying the reorganisation of work it entails both in terms of production and of human resources.

Other projects concern the technological development of innovative means of production, the invention of multimedia and education learning tools (interactive teaching material, access to sources of contents), the development of e-commerce, the creation of new services. There are numerous information society technology applications in the sectors of health – telemedicine, assistance for the elderly, management of electronic medical records, etc. – and education, as well as in the area of the environment, where there are projects which seek to develop intelligent systems for monitoring and providing aid in the management of risks and emergencies. Lastly, many research projects are endeavouring to strengthen communication between individuals, groups, citizens and public authorities, and – by extension – to open up new societal and democratic links.

Taking action against the cowards' weapon

Anti-personnel land mines kill or maim around 26 000 people every year. The European Union is carrying out major research in order to neutralise between now and 2010 the 120 million mines still hidden underground in around 60 countries and which can remain active for half a century. Although there are a number of technologies (metal detectors or infra-red thermal radiation detectors, radars, biosensors, gamma radiation detectors, etc.) which can detect certain of these mines, there is no single approach for a global solution to the problem.

Various European research projects are currently looking at a combination of several technologies, particularly by developing multiple sensors which combine metal detectors, infra-red radars and ground penetration radar. Other researchers are compiling a database of 'mine signatures' capable of being used by the multi-sensors. The performance of these new methods and equipment will be studied in the Ispra (Italy) JRC's test and evaluation facility. The JRC also directs and guides research on civilian mine clearance and is responsible for transfer and exchange of information with the United States and the United Nations.

Software and neurons

Seven million Europeans suffer from cerebral lesions, which to varying extents and in very varying forms ranging from impaired vision to paralysis, condemn them to dependency on external aid. A network of experts and practitioners from 53 specialised centres situated in the European Union, as well as in Switzerland and Turkey, has jointly developed computer programmes tailored to the needs of rehabilitation centres. These tools are particularly effective with regard to language, memory, attention span and impaired vision – the most common symptoms. This large-scale cooperation is based on the pooling of the knowledge of the research and centres involved and has made it possible to standardise test procedures (some of which have acquired the status of official standard) and rehabilitation methods.

For a bluer planet

RDT info

'A look at the relentless development of new chemicals reveals – and it is somewhat disconcerting – that we do not know much about the medium and long-term risks that they can generate. There is therefore an increasingly big demand for environmental research and technology.'

Damia Barceló, coordinator of the Waste Water Cluster network which groups a number of research centres, university laboratories and industrialists from seven European countries; the network leads five projects which study the preservation of the quality of water resources.

Pollution knows no frontiers and environmental protection has become quite 'naturally' one of the main responsibilities of the European Union which establishes, for all Member States, quality standards for air, water, and the food we eat. The exercise of this right of common regulation is based on an intensive research drive which, beyond the fight against pollution, seeks to promote sustainable development.

Europe and the Earth

In this context, the Union's responsibility also goes beyond the frontiers of a single continent. In the face of the threats which menace the whole of the earth's ecosystem – global warming, deforestation, encroaching desertification, shortage of water, depletion of the protective ozone layer – the European countries must speak with a single voice in international forums. Their researchers help to push forward the understanding of the complex balances of nature and the damage wrought by human activity, and what can be done to remedy this situation.

The Union provides support for networks of specialists which examine the chemistry of stratospheric clouds above the north and south poles, and other groups of researchers use satellite observation to monitor and endeavour to protect the planet's heritage of tropical forests. Oceanologists plumb the depths of the seas in order to understand their essential role in the major terrestrial balances and to preserve their irreplaceable heritage of biodiversity. Scientists produce models of scenarios of climatic change and their potential effects on the major regional divisions of the planet.

Quality of life and know-how

European environmental research also involves an in-depth approach to regional and local ecosystems. There are numerous projects studying the preservation, restoration and 'friendly' management of mountain ranges, lakes and rivers, wetlands, fertile land, coastlines, and underground water resources. But seeking to protect the quality of the environment is not restricted to nature and the prevention of natural risks. It also applies to the towns and cities in which 80 % of Europeans live, by

The secrets of the Mediterranean

1993–96. The pilot phase of a large-scale targeted research programme brings together 10 scientific projects involving 70 institutions in 14 countries, along with the Union's JRC, in order to understand the complex processes which regulate and characterise the vast enclosed space of the Mediterranean Sea. This collaborative work has given rise to a genuine European community of scientists concerned by the *Mare Nostrum.* A second research phase (1996–99) involved 53 partners from 13 European countries, along with Morocco and Tunisia.

Nearly 300 researchers analysed the results of the campaigns conducted by scientific ships which spent nearly 1 000 days at sea studying trends in the temperature of deep waters and salinity, the increase in the discharge of nutrients due to the intensification of human coastal activity, the density of plankton and marine fauna, rates of heavy metal pollution, e.g. lead. Climatic forecast models were also developed.

The advantages of remote sensing

The Earth is seen more clearly from the sky and progress in remote sensing makes new tools available for managing its resources. Between 1988 and 1998, the big MARS (monitoring agriculture with remote sensing) programme, for instance, developed a system capable of giving an objective image of areas under crop. Various models, prepared after preparation and decoding of the raw data derived from satellite pictures, make it possible to identify the types of crop, to estimate yield, or to consider complex data (nature of the soil, wet weather flow, temperatures, etc.). All these are essential elements for implementing a common agricultural policy.

The MARS programme is coordinated by the Ispra JRC's Institute for Space Applications (ISA) and involves around 750 people. It has given rise to a number of developments, e.g. tools for control and prevention in areas affected by desertification, famine, deforestation (particularly in the tropics) and the detection of forest fires, soil degradation, etc.

The Vegetation instrument is the latest in this series and was put on board the SPOT 4 satellite in 1998. It is the first system designed specifically to observe the planet's vegetation cover. Its pictures are broadcast daily and are used by researchers (functioning of ecosystems, climatic changes, etc.), environmental managers (the encroachment of forest fires, location of a natural disaster) and political decision-makers (agricultural restructuring, regional development, decisions on international emergency food aid, etc.).

carrying out research on air, noise, transport and the preservation of the cultural heritage.

In parallel with this, Europe has built up an impressive corpus of know-how with regard to clean technologies, means of production and management. In a world which purports to be 'sustainable', respect for the environment is a technological and economic challenge to which Europe is bringing its share of solutions.

The 'hole' in the ozone layer in perspective

- 1991. 250 scientists from 18 countries carry out a preliminary series of measurements over the Arctic. A thousand sounding balloons and three laboratory aircraft collect a large quantity of physical/chemical data and transmit them to ground stations. The aim is to analyse the trends and reasons of the formation of the 'hole' which in winter grows in the ozone layer over Europe. During the second series (1993–95), a former Soviet spy plane, converted into a laboratory, carries out a series of flights at 21 km altitude with 1 500 kg of scientific instruments on board capable of operating at minus 80°C. A third, even more ambitious, series of measurements was concluded in 1999. During the very cold winters, the researchers identified losses of sometimes up to 50 % of the ozone layer which protects the living organisms of the terrestrial biosphere against damage from direct ultra-violet radiation emitted by the Sun.

  This research, conducted from the Arctic to the Indian Ocean, provides a better understanding of the chemical interactions and the circulation mechanisms of the different gaseous substances produced by human activity responsible for this situation and measures the relevant trends (particularly with a view to preventive measures; the notorious CFCs, for instance, have been banned since 1987). They have *inter alia* established a link between the depletion of the ozone layer and emissions of greenhouse gases which are responsible for climatic change.

- The further south ones goes in Europe the greater the concentration of benzene (a carcinogen caused by vehicle traffic). These are the conclusions of a pilot study conducted in six European cities by the JRC's European Reference Laboratory on Atmospheric Pollution (ERLAP). This laboratory is equipped with state-of-the-art instruments and mobile laboratories and assists the European Commission in preparing directives on air quality.

RDT info

Researchers from a variety of fields (climatologists, microbiologists, chemists, etc.) together examine our heritage and propose innovative solutions for conservation and rehabilitation. Example: innovative anti-seismic materials and systems, based in particular on shape-memory alloys as were used to restore the basilica in Assisi (Italy) badly damaged by the 1997 earthquakes.

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The advantages of biodiversity had been anticipated but not demonstrated. Its fundamental role has been studied simultaneously and systematically by researchers in eight European countries. The analysis of 480 experimental plots situated in all the climates and latitudes of the continent has enabled them to check the positive effects of biodiversity in terms of quantity (productivity) and quality (plant resistance, insect population variety, soil quality, etc.).

'Biodiversity is a large-scale problem and taking part in a European project makes it possible to widen our range of action and to approach this matter of scale in an appropriate way.'

Angela Karp, Lecturer at the University of Bristol, coordinator of the five Molecular Tools for Biodiversity projects which covers the full range of animal and vegetable biodiversity and involves 40 or so public and industrial laboratories.

A spectrometer to control the quality of waste water treatment, which is effective and inexpensive, has been developed by the water quality monitor project. This is an excellent tool for small water treatment plants of a type which will shortly proliferate in Europe (where every built-up area of more than 2 000 inhabitants will have to have one by 2005).

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A yellow remote controlled machine deposits research laboratories 4 500 metres below sea level. The technological performance of this prototype [called Sirene from the name of the project coordinated by the French (IFREMER)] is of interest not only to researchers but to offshore oil prospecting and drilling.

Ifremer – A. Massol

A continent which uses multiple types of energy

RDT info

The new potential of 'thermal solar energy' (energy to be found throughout the Mediterranean Basin and the Middle East) has its main site for tests and demonstrations in the Plataforma Solar d'Almeria (Spain).

RDT info

Europe imports 50 % of its energy requirement and its consumption could rise by nearly 20 % between now and 2020. The Union nevertheless committed itself at the Kyoto Conference in 1998 to reducing carbon dioxide emissions from fossil fuel. The various avenues of research it supports are therefore increasingly geared to sustainability and self-sufficiency.

The use of renewable energy – wind power, solar power, biomass energy – in which various Member States already have impressive know-how, should double in the short term. Europe accounts for over half the world's production of wind energy and manufactures over 90 % of large and medium-sized turbines. The aerodynamics and the weight of the machinery involved, the reduction of noise pollution and the incorporation of wind power into the electricity power grids are the subject of a wide range of research supported by the Union. As for solar energy, the most advanced technologies relate to photovoltaic solar energy, which is increasing by around 20 % yearly, and for which Europe represents a quarter of world production – its researchers have in particular helped to improve the efficiency and reliability of the cells and to reduce the cost of the panels used. Research into the clean use of fossil-based products available in Europe – coal or hydrocarbons – is being stepped up. Research into the use of biomass energy has the twofold interest of supporting agriculture and reducing carbon dioxide emissions.

Other work which has an impact that concerns decision-makers and users more directly relates to savings and the rational use of energy (transport, buildings, industrial processes, etc.).

In nuclear energy (in addition to research on the safety aspects), the Union is the cornerstone of very long-term international work on the revolutionary technique of nuclear fusion, where Europe has acquired internationally-acknowledged competence.

The fusion of the future

The world's first installation to study thermonuclear fusion, the Joint European Torus (UK) passed the 16 MW energy mark in 1997. Compared with nuclear fission, the energy derived from the fusion of atom nuclei makes it possible to obtain plentiful fuel, generates no dangerous waste and eliminates any risk of the reaction running out of control. Its development calls for sophisticated technology and a considerable research drive, which is henceforth conducted in association with Russia, Japan and the United States.

RDT *info*

The giant wind generator at Tjaereborg (Denmark), developed with the help of the Union, beats all records of energy production, generating some 3 500 MWh yearly.

Cleaner sources of energy

- A new fuel without any noxious emissions and perfectly economical. This is the promising result of a project (30 partners, 13 countries) which has studied the co-combustion of coal and vegetable waste.

- Eight European laboratories have synthesised new molecules capable of capturing certain radioactive elements, including caesium and actinides, present in nuclear fuel retreatment waste. Once patented, these molecules are widely commercialised, particularly in the United States.

'The success of a project of this kind is based as much on the technical competence of the firms involved as on the quality of the human relations between the various participants. Confidence in one's partners is essential from the preliminary discussion phase right up to the final tests – which sometimes hold surprises.'

Dominique Gilson, coordinator of the HOFIM project which brings together industrial partners from four countries in order to develop a compressor unit to store natural gas.

Air, land and sea: the challenges of mobility

EKA

Around 10 % of European GDP and employment is generated by the transport sector. Road haulage has increased by 150 % since 1970 and represents over three quarters of the European freight market. During the same period, rail transport fell from 32 to 12 %. Air traffic, on the other hand, could well rise threefold by 2010.

Transport is on the up and up, but this is not always to the good. It is a major polluter and energy consumer, our roads kill, while traffic-jammed towns and cities lose their quality of life. The total cost of the 'collateral damage' of the mobility of people and goods as far as the environment is concerned is estimated at EUR 250 billion yearly.

An electric vehicle powered by a fuel cell which consumes only hydrogen and oxygen. A 'zero emission' prototype (capable of maximum speed of 120 km/h) has emerged from the cooperation between five partners in three countries, co-ordinated by the French manufacturer Renault (FEVER project).

RENAULT

Total safety

Transport safety is a crucial factor and is the subject of numerous European research projects which examine all types of mobility. Some projects bring innovations in regard to child restraint systems in vehicles. As for air traffic safety, it is the role filled by crews (70 % of plane accidents are reportedly due to human error) which has been studied by the ISIS (Institute for Systems, Informatics and Safety) at the Union's JRC. With the Traincol project, industrialists, research centres and railway companies from four companies of the EU are developing a new design of carriage which is far stronger, particularly in the case of frontal collision.

So there is no shortage of challenges for researchers and industrialists. The vehicles of tomorrow – automotive, aircraft, rail and seagoing craft – are vital technological and competitive challenges and require studies and synergy. In addition to design and safety, many EU-supported projects concern their consumption and the control of their pollutant discharge. Other research examines infrastructure, traffic management and intermodality, i.e. the smooth transition from one mode of transport to another.

Quiet, we're flying

Nine universities and research centres and seven aircraft manufacturers have developed new mathematical models with the aim of improving cabin soundproofing at the aircraft design stage. This upstream approach adopted to solve a problem which goes beyond mere passenger comfort will permit considerable time to be saved in the manufacturing lead-in time of aircraft.

The safest route

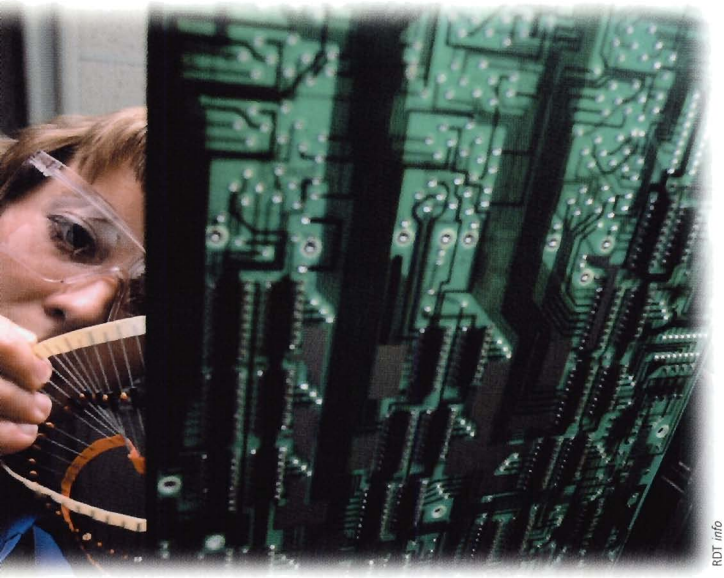
Manufacturing reliable vehicles which comply simultaneously with safety standards and environmental standards, consuming less energy and still remaining competitively priced. This complex challenge thrown down to the car manufacturing industry means it has to design vehicles which are both light and sturdier in the event of accident. These developments imply in particular the development of new materials and new passive safety structures (beams, protection bars, roll bars, etc.). The JRC's ISIS at Ispra (Italy) has a test facility which is unique in the world, namely, the large dynamic testing facility (LDTF) a peculiar feature of which is to be able to carry out precision measurements of shock waves. The LDTF is 200 metres long and can amongst other things test the impact strength of materials (steel or aluminium sheet, composites, polymers, etc.), measure the energy absorption of various structural components of bodywork in the event of collision, and tests certain safety elements such as safety fencing installed on roads and motorways.

RDT *info*

All in all, 75 % of goods are carried by road because the train is deemed to be inefficient for short journeys (which are the most typical in Europe). Three industrialists, two academic partners and the Italian railway company have got together to develop a new type of automated horizontal transhipment which is efficient and cost effective, which should attract the transport sector (FLIHTT project).

Anticipating maritime 'motorways', the plane-boat hybrid (Seabus-Hydear project) will give the ferries new wings by offering a maximum speed of around 120 knots, (220 km/h) and consuming 20 % less fuel than current passenger vessels.

From discovery to innovation



RDT *info*

Anticipating, discovering, analysing, checking ... the scientific route is that of knowledge. This knowledge can subsequently be converted into innovations which are tangible and available to the public. Progress such as information technologies, biotechnologies and new materials highlight the capital importance of this process. Through innovation the work of researchers leads to new services, clean products and technologies, and new jobs, thus putting us on the road to 'sustainable' development and society.

Channelling good ideas

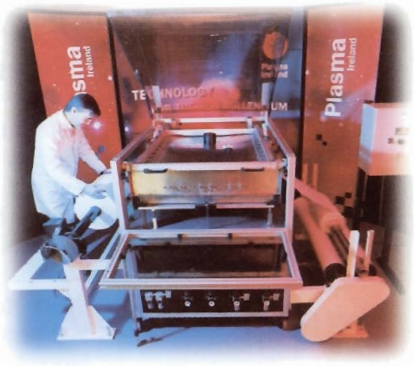
The European action plan to promote innovation was adopted in 1996 and seeks to push forward an environment in which European research can bring tangible results through new products and services. Many Innovation Relay Centres are available to the researchers – in universities and companies – who have good ideas. They help them to protect their discovery by filing a patent or granting licences, to obtain the financial help to bring it to fulfilment, to understand better the managerial practices whereby this innovation can be turned into a commercial success.

Small is efficient

While the big European companies are often at the source of these major changes, they also rely increasingly on networks of efficient SMEs to which they subcontract leading-edge technological activities.

Digital orthopaedics

Four SMEs manufacturing orthopaedic footwear and a technological consulting company have given a fresh boost to a craft area – made to measure footwear – by enabling it to incorporate new high technology elements. A CAD-CAM system remote-models the data measured by laser sensor and replicates the exact form of the foot in three dimensions. Once fed into the machine, this information will lead to the creation of perfect-fit shoes. Conceived initially with the world of orthopaedics in mind, the system can offer new added value to the traditional manufacturers of leisure footwear which has nothing to do with the medical world. It cost a million euro to develop the prototype, a figure which could never have been envisaged by craft enterprises without the support of the Union. The completion of this project is also marked by the creation of a company responsible for industrialising and marketing this new system.



Janice O Connel

A pilot project involving two research centres in six European companies demonstrates the feasibility of plasma treatment of textiles at atmospheric pressure. This innovation should make it possible to cater for new and particularly tricky requirements (biocompatible textiles used in medicine, fire-resistant fabric, etc.) in this sector.

The SMEs – which represent 98 % of companies and 60 % of employment on the continent – also provide the capillary system which offers flexible dissemination of innovations throughout society. It is these companies that create most of the specific applications tailored to special niches and environments. The Union has perfectly understood their importance and has devised special measures to help them. In particular it offers them the possibility of subcontracting research work by providing co-funding.

'Involvement in European projects enables SMEs to strengthen their network of partners through a common objective of innovation.'

Eric Chanie, Director of Alpha MOS, a French company which develops odour sensors, coordinates the 'Odour sensors in food industry' project and is a partner in the Fregmegs project.

RDT info

Leadd (Netherlands) is developing a cancer prevention agent capable of generating a genetically programmed elimination of cancer cells. Genopoietic (France) is developing the production of a plasma virus capable of infecting cancer cells through the expression of a foreign gene. Commission support has enabled them to study the way their work dovetails. The evidence was conclusive and has led to the launch of a demonstration project involving a third SME, Biotecnol (Portugal). The objective is to demonstrate the effectiveness and safety of this new cancer treatment before launching the first clinical tests.

Bridges through life sciences

Biotechnology is a leading-edge area and the Union has for a number of years been endeavouring to build bridges between research and industry. Various industrial platforms bringing together laboratories and the business sector, focusing on cutting-edge fields such as genome research, have been introduced. They provide forums for dialogue, principally in the biochemical, pharmaceutical and agri-food sectors, thanks to which industrialists establish close contacts with scientists and gain access to the results of their work. This synergy speeds up the process of innovation in research results.

Putting into orbit

Materialise is a Belgian SME specialised in rapid prototyping industrial technology and has taken part in the development of a process for manufacturing three-dimensional organ models (Phidias project). Since 1996 it has sold around 20 licences throughout the world and opened a commercial service in the United States. It was created in 1990 by two researchers from the University of Louvain and today employs 100 or so people. 'This growth owes much to support from Europe', acknowledges Kris Wouters, a medical applications engineer. With the support of the Commission, Materialise today coordinates a vast thematic network bringing together 40 technological and medical institutions and is involved in another research project on the development and manufacturing of implants.

Training in research, training through research

Young researchers are an invaluable asset in that they represent the relief garrison for science in Europe. In order to help them pursue their work in a most advantageous context and confirm their vocation, the European Union offers them training in research through research, by making use of mobility. The opportunities offered by Europe are intended to be tailored and a full and varied range of grants is available to young scientists to allow them to complete part of their doctorate or to pursue their post-doctorate work in another country.

In the countries of the Union, doors are therefore open to them in universities, centres of excellence, institutions which have particularly sophisticated equipment, in teams working on their area of research and thanks to which they will make progress. This immersion in a different environment enables them to push forward or complete the research project, to compare their methods with those of other researchers, to be immersed in a different culture, to broaden their language skills, to be part of new networks.

There are two major types of these grants, which are called 'Marie Curie'. The young researchers themselves can apply to the Commission proposing their research project. The host structures (research institutes or companies) can submit offers of high-level training placements which they make available to young European researchers of their choice.

In addition, there are fresh opportunities for researchers and institutions of the less favoured European regions. 'Return grants' enable 'Marie Curie' researchers who have had a placement in another country to obtain the support of the Union to pursue their work in their country of origin. Development host grants introduced by the structures of these regions also enable them to be able to rely on the support of persons from other countries working on their doctorates.

Fifty per cent of 'Marie Curie' grant holders say this experience has helped them get a job more easily.

The selection is based on very stringent quality criteria both for individual applications and for those from institutions.

RDT *info*

'Living and working in another country is the best way to understand a people different from your own in terms of history, culture and identity, and from whom you have a lot to learn.'

Michaela Dietsch, German biochemist who worked on the development of a vaccine against hepatitis C at the Hellenic Pasteur Institute of Athens.

An outward-looking Europe

RDT info

The 'black triangle'? A region afflicted by emissions of sulphur, a pollutant to which forest areas are particularly sensitive, situated on the borders of Germany, the Czech Republic and Poland. The EASE project is based on expertise developed in the countries of eastern and western Europe to study a programme to control and forecast atmospheric pollution. This work has produced the development of integrated evaluation models with make it possible to establish strategies which are economically viable to reduce emissions.

Research centres are proliferating throughout the world. The opportunities for cooperation are increased tenfold by the new information technologies. Vital problems such as health or the environment require solutions on a planetary scale. The Union accordingly supports the establishment of lasting and mutually advantageous links between Europe and its scientific and technological partners on the other continents. For the same reason, it also promotes the involvement of its researchers in the main challenges which arise, particularly in the developing countries.

The Union endeavours to coordinate its research policy with that of other international organisations involved in scientific and technological cooperation, and with the major specialised organisations. It has bilateral agreements with certain industrial countries and countries which have an emerging economy.

After the fall of the Berlin Wall specific relationships were built up with the States of the former Soviet Union. The aim is to help them not to let their research potential dry up and to help them through scientific and technological development to make a success of their transition to a market economy.

The priorities of the southern countries are also an important aspect of cooperation, and support is accordingly given to a number of projects conducted in partnership with their researchers, mainly in the vital areas of health, agriculture and the environment.

Cooperation without barriers

- The development of a fundamentally new vaccine against tuberculosis, which takes account of AIDS-related immune deficiency, is being developed by a cross-disciplinary team of European and Ethiopian researchers. This approach should allow a breakthrough in the fight against a disease which is re-emerging strongly and which is killing three million people yearly.

- A total of 20 000 scientists and engineers specialised in military technology are today redirecting their talents in the civilian area at the new International Centre of Science and Technology in Moscow. Over 400 projects, supported amongst others by the Union, are being pursued there in the area of civil nuclear energy, aeronautics, new materials, etc.

- A 'biotechnology task force' was set up by the European Union and the United States in 1990 as a means of offering, in an area which is both sensitive and strategic, a forum for consultation on the main scientific and technological guidelines followed on both sides of the Atlantic.

'The support of the European Union has helped us to get back on our feet again. It is up to us to learn once again how to walk and then to run'.

Zoltán Kolozsváry, Director of the Plasmaterm Research Laboratory in Bucharest, specialised in surface treatment. Plasmaterm is involved in various European projects and has helped to develop innovative solutions in the treatment of metal surfaces.

South-East Asia: ecosystems and agriculture

EKA

The ecosystems of three major Asian deltas – the Red River and the Mekong in Vietnam, the Chao Phraya in Thailand – have been jeopardised for many years now by the development of agriculture and the demographic expansion in these regions. The problem is how to find the most appropriate irrigation methods for the crop diversity which exists in this region. Seven cross-disciplinary teams bringing together European (German, Belgian and French) and Asian (Vietnamese and Thai) researchers are looking into ways of finding a solution to this question. More specifically, they are analysing the 'Chinese ridge' technique which consists of developing raised crop beds in irrigated systems. Its application would make it possible to respect the general ecological balance of the deltas and in economic terms to pursue different types of crops, particularly market garden and fruit crops, which can be exported.

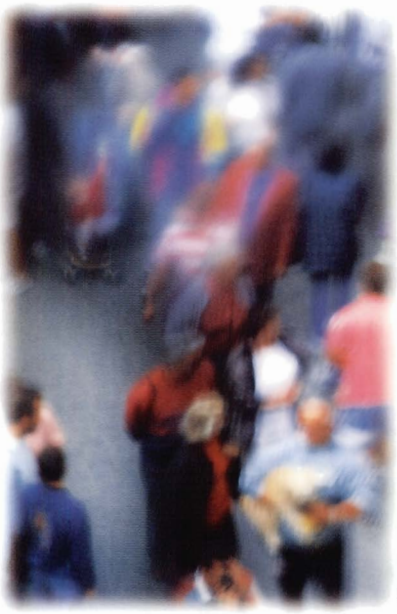
The place of human sciences

ENTWICKLUNGSGESELLSCHAFT DUISBURG

'Go!'. This initiative to provide help in starting up companies introduced in Duisburg (Germany) has been evaluated under the ELSES project. This analysis of the work of local associations in disadvantaged areas has from the outset involved social science researchers and field players and has been conducted in six European towns. The work has brought out certain 'good practices' capable, not of being reproduced, but adapted to a variety of socio-economic contexts. They have also illustrated methodological and strategic elements which can help in decision-making by local development coordinators.

Are human sciences the poor relations of European research? This was undoubtedly so for a long time. However, in response to the wishes of the European Parliament, since 1994 the Union has broadened its research approach. Henceforth its support policy takes account of the increasing impact of scientific and technological development on the daily life of citizens – an impact which makes itself felt by changes in the area of employment, the creation of new professions and new types of training, the appearance of conditions of life which are different and which are not necessarily reflected at all levels in terms of quality. This approach implies promoting cross-disciplinary projects involving amongst others teams of human science researchers – in projects relating to diseases such as Alzheimer's or AIDS, for instance, whose social and psychological consequences are huge both for the sufferers and their families.

Other projects supported by the Union focus on socioeconomic research. Many analyse the problems of social exclusion and unemployment and how these problems are tackled in different European countries. A look

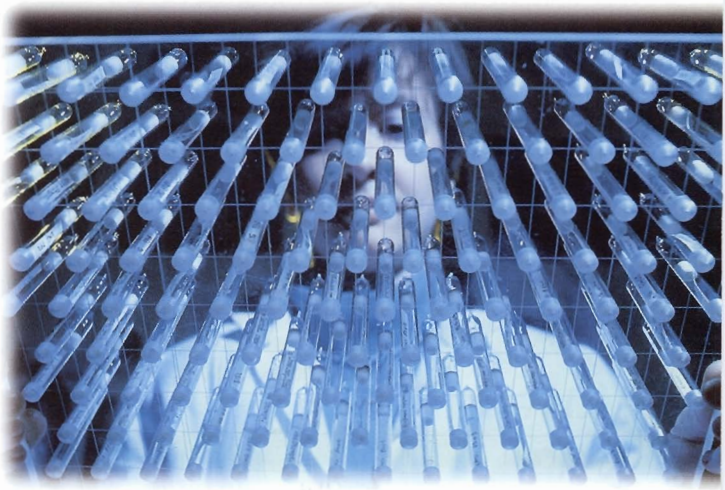


EKA

at their successes and failures in their contexts, which may be comparable and specific, very often provides fresh insight for reducing the social damage and in boosting employment levels. These researchers provide assistance to decision-making for those in charge of regional and national social policies. They also make a contribution to the construction of a social Europe.

Catering for the expectations of society

Since 1984, the Union has defined the scale and guidelines of its research drive within framework programmes, each lasting five years. The fifth (1998–2002) of these was proposed by the European Commission after broad-based consultation of the players concerned (scientists, industrialists, consumer associations, etc.). This programme was adopted by the Council of Ministers in the European Parliament in December 1998 with a budget of EUR 14.96 billion.



An innovative approach

The fifth framework programme is based on two very simple questions: what is the point of research and who does it benefit? While the role of research and technological development is obviously to go into matters in depth and to innovate, it is first and foremost in order to solve real problems and to cater for the expectations of society.

This guideline gives rise to two essential objectives, firstly to concentrate on the research themes which correspond to the major scientific and technological changes taking place at the moment and to the social, environmental and economic issues they raise. This implies promoting multidisciplinary research approaches. The very structure of the framework programme, which is divided into seven programmes and mapped out into 23 targeted key actions, is designed to respond as efficiently as possible to this approach.

Supporting European excellence

Alongside the key actions, some 30 % of the resources of the fifth framework programme are devoted to fundamental research activities – the development of knowledge and basic technologies which are the sectors of the future which are rapidly emerging – and to support for research facilities. This last aspect is designed to ensure the optimum use of scientific and technical installations (European or national).

The fifth framework programme also devotes particular attention to the SMEs, which are the driving force in the dissemination of innovation and in job creation. A range of assistance is provided for them so that they can take part in transnational research projects.

Through this research policy the Union thus seeks to develop a European area of science and technology equipped with the best competencies, favouring top quality research, the establishment of networks of excellence and transnational cooperation, encouraging the mobility of players and ideas, boosting cooperation between the academic world and the business sector, contributing to build up an environment conducive to innovation, favouring the transfer of technology. These programmes fully respect the principle of subsidiarity and support projects to which the European dimension gives an advantage and an effectiveness which they could not have achieved by national development.

Research is also at the forefront of Community policies in that it was the first to open up to the countries which have applied to joint the European Union.

Getting involved in a project supported by the Union

The fifth framework programme is open to research centres, companies, natural persons, etc., provided they are involved in research and established in the 15 Member States and – subject to certain conditions – countries which are not part of the Union. The support is provided following calls for proposals or specific invitations to tender published in the Official Journal of the European Communities. Research projects must involve at least two partners established in two different countries. Provided the legal and administrative criteria for eligibility are complied with, the only selection criterion for projects is the quality of the proposals.

The Joint Research Centre

The JRC, which employs some 2 500 people and is financed primarily by the Union, is part of the European Commission. Its mission is to provide scientific and technical support as a function of the users, in designing, developing, implementing and monitoring European policies. As part of the Commission, the JRC stands as a scientific and technical reference centre for the Union. It plays a part in the preparation of policies and serves the common interest of the Member States while remaining independent of any private or national interests.

JRC research is carried out for the benefit of the citizen and relates in particular to health, the environment, protection and safety (in the area of food, natural risks, waste management, informatics security, etc.).

The eight specialised JRC institutes operate in five countries and have top level scientific facilities. The Institute for Advanced Materials is located in Petten (Netherlands), the Institute for Reference Materials and Measurements in Geel (Belgium), the Institute for Prospective Technological Studies in Seville (Spain), the Institute for Transuranium Elements in Karlsruhe (Germany), while four institutes are located at Ispra (Italy): the Institute for Systems, Informatics and Safety, the Institute for the Consumer Health and Protection, the Institute for Space Applications and the Environment Institute. The JRC pursues its mission in cooperation with many national scientific teams. The centre also receives and trains young European researchers.

More information on European research can be obtained from:
http://europa.eu.int/comm/research

Keeping abreast of the latest scientific and technological developments, debates on research, European projects etc. by consulting *RDT Info* the European research magazine
http://europa.eu.int/comm/research/rtdinfo.html

Information on the formalities for taking part in European research projects
www.cordis.lu/

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European Commission

Europe – an area for research

Series: Europe on the move

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Europe, as the historical cradle of modern science interconnected by a network of universities, research centres, industrial laboratories and innovative SMEs, has one of the richest potentials of grey matter in the world. Each country in it has its scientific traditions, its strengths and its specific features. Since the start of the 1980s the European Union's framework programmes have brought fresh momentum based on transnational cooperation. Benefiting from ever increasing resources and targeting priorities which have emerged from a broad-based consultation of the competent political authorities, the scientific world, the business sector, and user representatives, these programmes are putting in place the bare bones of a genuine European research area, an area at the services of its citizens as is shown by the objectives pursued, which correspond to the wide-ranging needs of a changing society.

Other information on the European Union

Information in all the official languages of the European Union is available on the Internet. It can be accessed through the Europa server **(http://europa.eu.int).**

Information and publications in English on the European Union can be obtained from:

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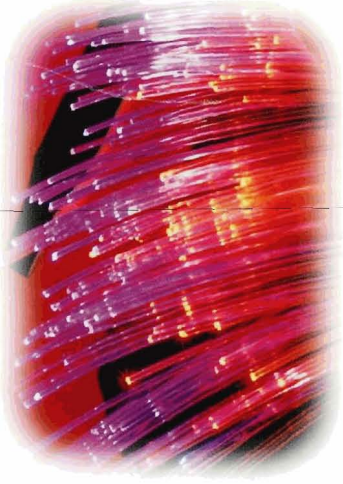

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