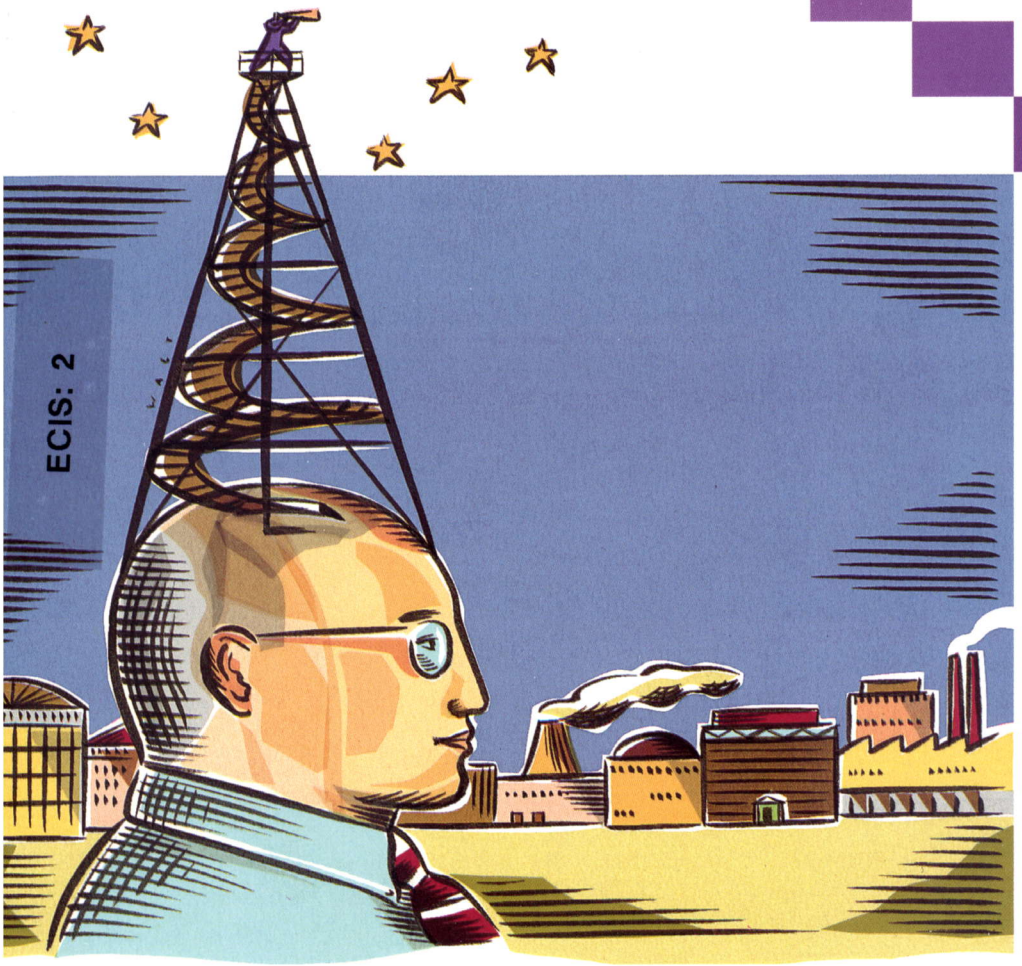
EUROPE'S SCIENCE AND TECHNOLOGY

TOWARDS THE 21st CENTURY



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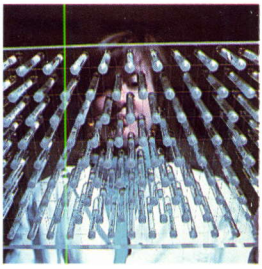
Europe on the move

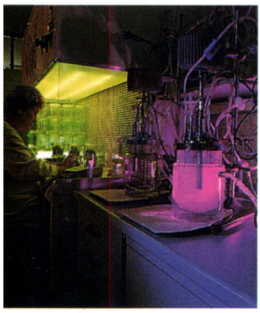


The use of clean technologies, the treatment of diseases such as AIDS and cancer, pushing back the boundaries of knowledge using multimedia technologies, the utilization of renewable sources of energy — today's challenges may become realities in tomorrow's Europe.

These challenges know no national boundaries, which is why the Member States of the European Union need to pool their know-how and experience in order to achieve the 'critical mass' needed. To this end, the European Union supports research activities specifically aimed at promoting, coordinating and extending cooperation between the Member States. The activities form part of the Union's fourth framework programme, which runs from 1994 to 1998, and are designed to improve our quality of life and to make our businesses more competitive. By taking account of the impact of technological developments on people's lives, the activities aim to manage better their impact on society.

By helping to create a true 'Europe of science and technology', the Union's support for research does not just mean more research, but better research.

As sources of knowledge and welfare, science and technology have gone hand in hand with progress throughout history. This is just as true today: at a time when Europe is really beginning to take shape, science and technology can and must play a crucial role. Investment in research is preparation for tomorrow's Europe.



Mike St-Maur Sheil

Research on molecular engineering in plants: along with telecommunications and information technology, biotechnology will play a key role in tomorrow's economy. If Europe is not innovative enough today, it will have no place in these developing world markets tomorrow.

WHAT HAS SCIENCE GOT TO DO WITH IT?

As the 21st century approaches, we are faced with many questions which are crucial to our future. How can we reconcile industrial development and respect for the environment? What will our sources of energy be in the future? How can we cut down on the harmful effects of human activity on the climate? Even if we questioned the basis of our whole civilization (and who would want to?), it is obvious that no progress will be made on these fronts without research and technological development.

Science and technology play a fundamental role in our society, bound up as they are with economic progress and the development of ideas. Moreover, science and research were born in Europe. They are the pillars of our cultural identity and shared intellectual heritage. The origins of science and research go all the way back to the emergence of Europe. Today science and research are still at the centre of our vision of the world: a survey carried out on behalf of the European Commission in 1992 showed that over a third of Europeans are 'very interested' in new scientific discoveries, inventions and technology.

Science and technology constitute the force driving industrial economies. By creating new markets, they can generate new applications and create jobs. Europe must be at the forefront. In its White Paper on competitiveness, growth and employment published in 1993, the European Commission identified progress in technology as one of the key factors in the process of Europe's economic recovery.

Science and technological developments mean progress, though we tend to forget this all too quickly. Take plastic, for instance: we are inclined nowadays to view it as cheap rubbish, overlooking all the benefits it has brought in terms of hygiene (food packaging etc.), medical progress (catheters, grafts), comfort (furniture, clothing) and safety.

IMPROVING THE QUALITY OF LIFE IN EUROPE

A central issue in the years to come will be how to combine industrial development with respect for the environment. If we carry on as we are, our civilization may not be able to survive.

We are responsible for churning out more than 40 000 tonnes of carbon dioxide (CO_2) per minute into the atmosphere. There are predictions that, if this continues, it will intensify the greenhouse effect and raise the average surface temperature of the earth by 3 °C by the end of the next century as well as raising the sea level by 50 cm and pushing the large areas of vegetation in Europe about 1 000 km further north.

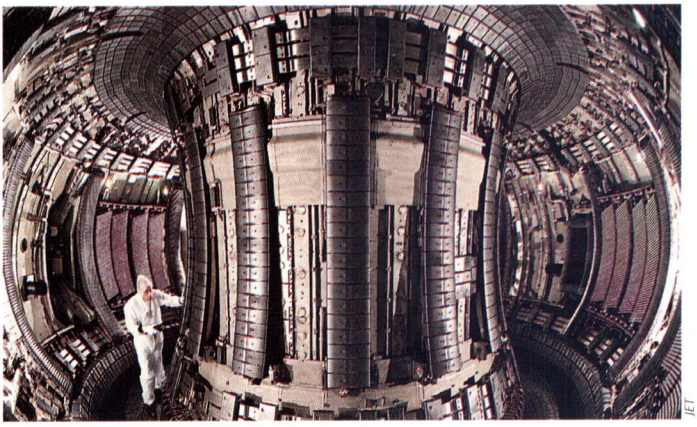
Admittedly, science and technology are not magic wands which can be waved to solve all problems overnight, but there is no doubt that research and technological development can help to prepare better for the future. The medium-term challenge is, therefore, to improve the quality of life in Europe, in particular by introducing clean technologies and by more effective management of the impact of human activities on the environment. This challenge cries out for Union-wide action: it would be futile to seek out purely national solutions to problems which cut right across national boundaries.

For several years, the European Union has been supporting research and technological development projects aimed at reducing the harmful effects of human activity on the environment. For example, in the transport sector research is in progress on batteries for electrical vehicles and on developing engines made of composite materials in order to curb gaseous emissions.

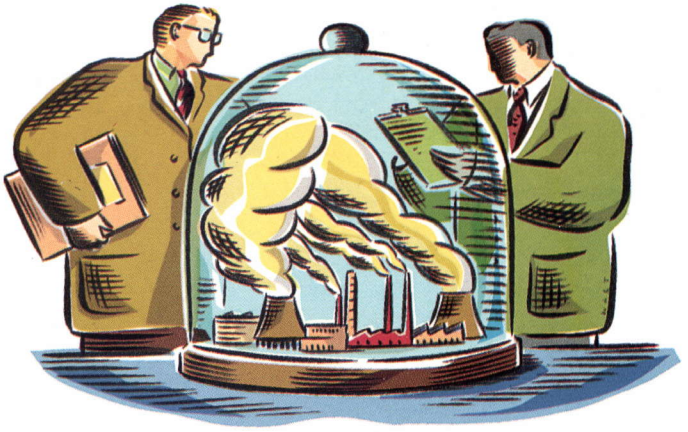
The European Union also supports the largest international programme on the effects of pollution on our cultural heritage, such as historic monuments, books and megaliths.

There are also several projects on developing energy sources for the future, especially renewable sources such as solar power, wind power, geothermal energy and biomass. The European Union also has the world's first 'wind farm' built in the sea. The 'solar house' programme, which was launched in 1992, selected 49 architectural projects dealing with the conversion or construction of buildings to use as much solar power as possible.

The European Union's Joint European Torus (JET) at Abingdon (United Kingdom) is one of the most successful experimental / thermonuclear fusion facilities in the world. The JET is designed to reproduce, under laboratory conditions, the fusion reactions between hydrogen nuclei which take place at the core of all stars. On 9 November 1991, for the first time, 1.7 megawatts were produced of energy for 2 seconds, which is encouraging for the prospect of one day harnessing energy to produce electricity.



JET



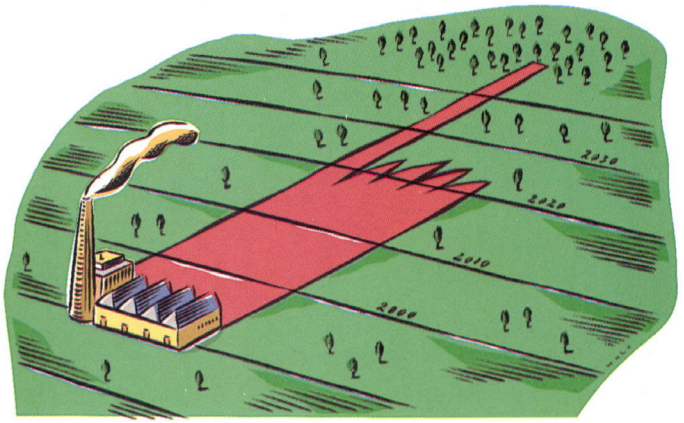
The European Union is actively involved in the development of thermonuclear fusion which in 50 years' time may well be an important source of energy in our countries. The Joint European Torus experimental fusion facility at Abingdon in the United Kingdom is the most successful of its type in the world.

ENCOURAGING TECHNOLOGICAL INNOVATION

Recent history has shown that a nation's investment in technological development is closely connected to its industrial power. Despite this, modern economies are always on the lookout for the formula that would enable them without fail to convert bright ideas into profit-making new products. There have been changes in the way of looking at innovation ('innovation' meaning a technical invention which has become an economic product), partly because the nature of progress itself has changed. The divide between basic knowledge and applied science is narrowing all the time, which is why 'techniques' are increasingly synonymous with 'technologies' — for example, in the way science is associated with technology, or the laboratory and the factory are rolled into one.

Current approaches describe the mechanism of innovation as a complex process involving the following factors in particular:

- pure research: certain generations of medicines, for example, derive direct from progress in biology;
- cooperation between universities and industry: innovation depends on close interaction between basic research and industry, as shown by the recent examples of electronic components resulting from research on semiconductors;
- education and training: end-users and manufacturers are as much a part of scientific and technological progress as researchers.



These various aspects are taken into consideration in the European Union's research programmes.

Since one of the Union's key objectives, as reaffirmed in the Maastricht Treaty, is to make Europe's industries more competitive, the promotion of innovation is included in its research and technological development programmes at several levels, both horizontally and vertically. The programmes are designed to expand:

- pure research and the development of so-called generic technologies which can be used in several different industries;

- cooperation between universities and industry, which is not as widespread as it should be in the European Union, despite the fact that it is crucial and of benefit in both directions, since it promotes the conversion of new ideas into marketable products and helps to take account of the actual needs of the market;

- transfer of technologies and utilization of research findings; the distribution of research findings to businesses ranks high in priority.

It has been shown that many supported projects have generated results with commercial applications. By encouraging innovation, the mechanisms introduced by the European Union will mean that research and technological development have a greater impact on the industrial competitiveness of its Member States.

Mike St-Maur Sheil

Over a third of the BRITE-EURAM projects (Basic research in industrial technologies for Europe — European research in advanced materials) have led to the patenting of new inventions. Research carried out as part of this programme on superconducting materials at high temperatures (photo) may one day enable us to move around by magnetic levitation, make huge savings on energy and monitor the activity of the brain in detail.

An atlas of avoidable deaths

In 1991 the Commission published the second edition of the *European atlas of avoidable deaths.* It was produced by 27 teams from the 12 Member States and provides a whole range of data on avoidable death in the European Union, in other words deaths which could have been prevented if medical attention or public health facilities had been provided in time.
For the various parts of the Union the atlas gives the number of actual deaths and the number of likely deaths for 65 pathological conditions, such as tuberculosis, cervical cancer, asthma and appendicitis. The atlas reveals, for example, that cervical cancer, which can be successfully treated if detected early enough, is more often fatal in the United Kingdom and Denmark than elsewhere in Europe, whereas infant mortality at birth is still rather high in Portugal, Greece and southern Italy.
The atlas is a useful aid to assessing the effectiveness of the Member States' health systems.

RESEARCH FOR PEOPLE

The European Union's research and technological development activities also cover matters affecting the public.

For example, in many areas such as the environment and energy, socio-economic behaviour and trends have to be analysed in order to optimize the introduction of new technologies.

Many projects have a direct bearing on our health and safety. For several years the European Union has been supporting research projects on different types of natural disasters such as earthquakes, fire, flooding and volcanic eruptions. In an area such as this, where the problems are naturally oblivious to national borders, pooling the activities of the Member States cannot help but benefit all the people of the Union.

Although health standards and life expectancy in the Union are among the best in the world, the Union has for several years now included health at the centre of its research and technological development programmes. The European vaccine against AIDS project (EVA) is reckoned by specialists to be one of the most promising in the search to, one day, find a vaccine against AIDS. After examining the infection caused in macaque monkeys by SIV-type viruses (which are similar to the HIV virus which is responsible for AIDS), the project should make it possible to test the effect of potential vaccines against AIDS.

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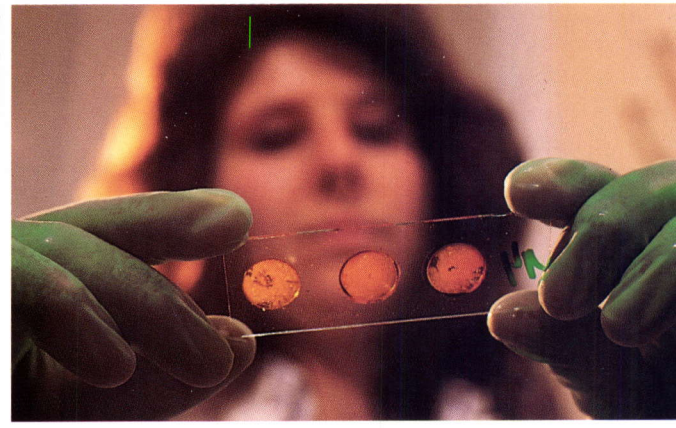

Research is also being conducted on how better to protect people from the risk of industrial accidents. Between 1987 and 1992 the European Union supported over 70 projects on how to control the risk of explosion of flammable gases, gas cloud dispersion and industrial fires. These research projects have led to the stepping-up of safety measures in high-risk industries and, therefore, to an improvement in the health and safety of people in all the Member States.

Research project on the transmission of the HIV virus from mother to child during pregnancy: the European Commission is involved in one way or another in over half the research projects on AIDS in Europe.

PREPARING EUROPE FOR THE 21st CENTURY

As the birthplace of modern science, Europe is acknowledged as having developed high-quality scientific and technological research. However, its position has weakened in recent years with a relative fall in both pure research and applied research: fewer Nobel prizes, fewer patents, fewer high-tech products put on the market.

It was in response to these weaknesses that the European Union decided to step up its support for research and technological development activities. Since 1984 these have been strategically planned as part of 'framework programmes' covering a five-year period. Their content and priorities reflect not only the major scientific issues of the time, but also the strategic concerns of the Union, for the aim is to ensure that research and technological development activities tie in with the other policies of the Union more effectively.

A typical project involves several European countries (development of transnational cooperation), several firms (proof of compliance with regulations on competition) and, where possible, small businesses and universities (promotion of technology transfer).

What are the tangible results of the Union's investment in research and technological development projects each year? This question is both difficult and easy to answer. It is easy because certain practical results are readily identifiable. This would include the various world 'firsts' such as the complete sequencing of a chromosome from a living organism, the production of thermonuclear fusion reactions, the development of the 'transputer' (a new type of electronic component now used worldwide), the analysis of the ozone layer over the northern hemisphere, the development of new computer architecture, the development of a new method of laser welding and so on.

However, a list like this does not take account of the many qualitative and indirect results of these activities. How can you measure the effect of the links built up by the framework programmes, bringing together virtually 10% of the bodies involved in research in France and the Netherlands, for example? How can you take account of the fact that these programmes have introduced 'research in partnership' as a new highly effective style of conducting research?

Proposed budget for the various specific programmes under the fourth framework programme (million ECU)

Activity 1 — Research, technological development and demonstration programmes	
1. Information technology	**1 932**
2. Remote data processing	**843**
3. Communications technology	**630**
4. Industrial technology and materials	**1 707**
5. Measurements and testing	**288**
6. Environment and climate	**852**
7. Marine science and technology	**228**
8. Biotechnology	**552**
9. Biomedicine and health	**336**
10. Agriculture and fisheries	**684**
11. Non-nuclear energy	**1 002**
12. Nuclear-fission safety	**414**
13. Controlled thermonuclear fusion	**840**
14. Transport	**240**
15. Socioeconomic research	**138**
Activity 2 — Cooperation with non-member countries and international organizations	**540**
Activity 3 — Dissemination and optimization of research findings	**330**
Activity 4 — Stimulation of training and mobility of researchers	**744**
TOTAL	**12 300**

The structural changes in European research are also considerable. In Greece, for example, there were no major research agreements between universities and industry before the European Union programmes. Since the launching of the first framework programme, the level of cooperation between researchers in the European Union has gone up by over 30% judging by the nationalities of co-authors of research papers. Under the Esprit programme, it has been noted that a third of those involved maintain contact with each other after the initial project is over.

It is thanks to these projects that the European Union is in a position to make the most of technology for the benefit of society and to plan ahead, so as to meet the challenges of the 21st century.

The Joint Research Centre (JRC) could be called the laboratory of the European Union. Made up of eight institutes spread over five sites, the JRC conducts its own research on specific issues and, in so doing, supports the implementation of the Union's policies. The Centre also carries out research for outside clients on a contract basis. (Photo of the JRC's ELSA equipment, which simulates in laboratory conditions the effect of earth tremors on materials and constructions.)

An important step forward for the future of Europe

Through the impetus given by Professor Antonio Ruberti, Member of the European Commission responsible for research, development, education and training, the European Union launched its fourth framework programme covering all the research and technological development activities for the period 1994-98. With a likely budget of over ECU 12 billion, the programme will help to map out a genuine common policy on science and technology in Europe. Professor Ruberti has identified two priority areas:

- stepping-up of coordination between research activities at all levels;
- concentration of research and technological development activities on a small number of subjects and technologies which may have applications across a variety of industries.

This is the first of the framework programmes to include specific programmes on transport and socioeconomic research, and should, therefore, promote social uses of new technologies.

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