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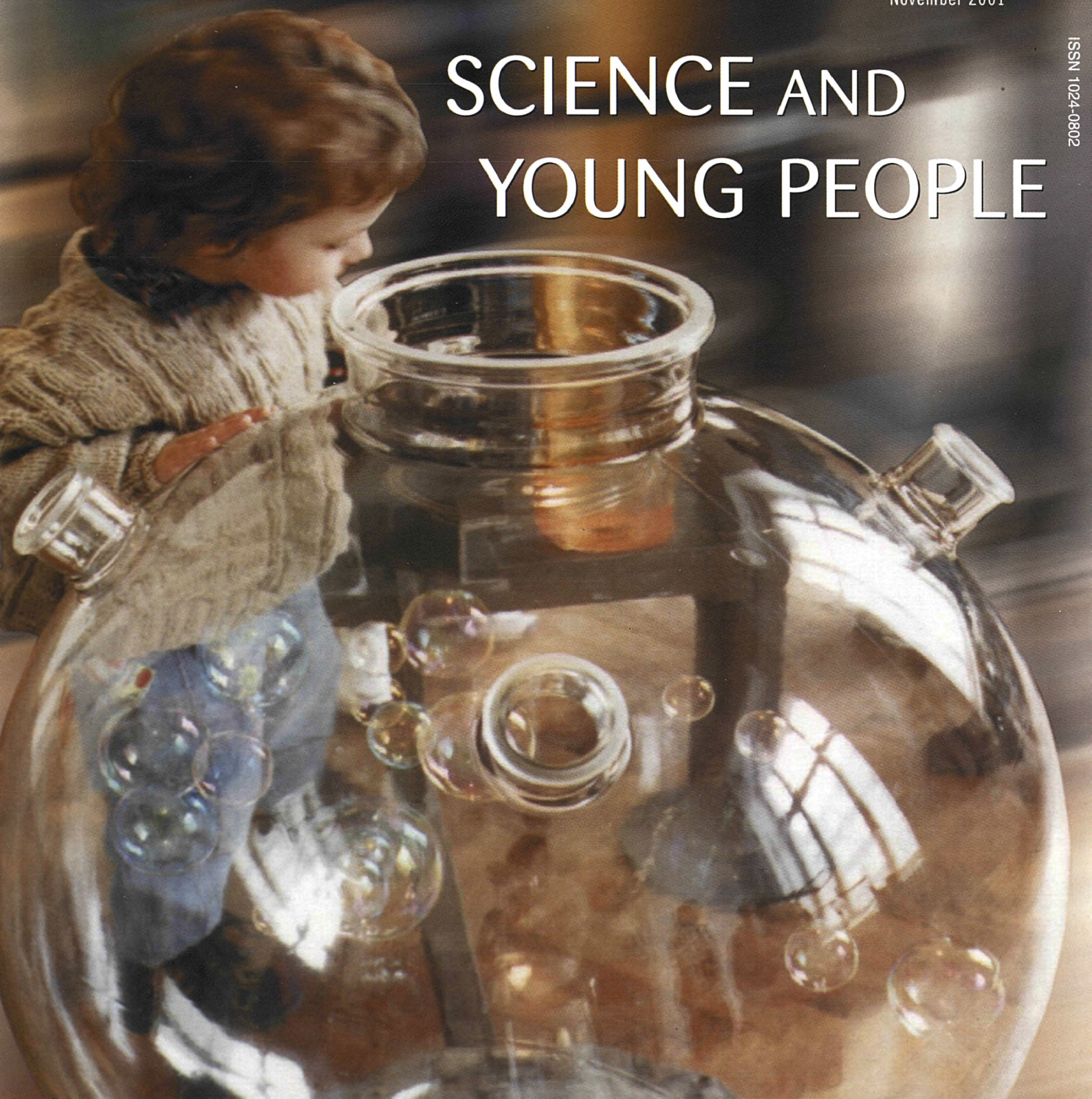
MAGAZINE FOR EUROPEAN RESEARCH

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SCIENCE AND YOUNG PEOPLE

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Editorial

The tribulations of science

If science continues to fascinate young people, why is it that they are so reluctant to study it? If medical and scientific professions are still considered to be the most noble by the majority of Europeans, why are fewer and fewer young people entering them? There are clearly many facets to the problem which reflect weaknesses in the teaching, the narrow scope of the careers and the way science is perceived by the general public and young people in particular.

However, it must also be acknowledged that sciences – in the plural – bear a share of the responsibility for their declining popularity. Broken down into ever-increasing sub-divisions, they are 'indigestible' to the general public for whom many research themes seem incomprehensible, if not futile. Parallel to this fragmentation of categories is an overlapping of tasks: the university researcher must also keep an eye on funding, while the private sector researcher ignores commercial considerations and technical applications at his peril. There is the ambiguity of sciences as a source of progress but also one of fear, and of scientists driven both by the desire to share their knowledge and to wield power and to dominate.

To a degree, the sciences are isolated, removed from culture, excluded from debates, marginalised in the media. At a time when their influence has never been so great, there is an urgent need to work together to reintegrate sciences in society and kick-start the dialogue between scientists and citizens.



3 INTERVIEW

Improving science's image

Are younger generations becoming increasingly disinterested in science? If so, what can be done to reverse the trend? European Research Commissioner Philippe Busquin gives his views.

4 TEACHING

A different way of learning

Making holograms, learning about physics by playing with tin cans and balls, experimenting with the 'life' of liquids, studying sounds to understand mathematics, measuring molecules... At schools and science centres, experimentation, play, learning in real-life situations, curiosity and confidence in the abilities of children are giving a new impetus to science education.

8 Testing time for science

Are young people shunning sciences due to the quality of the teaching? Or is it because of the apparently growing gap between science and society? Whatever the case, teachers and education experts are certainly asking a lot of questions about the methods and aims of a field of knowledge which is apparently difficult to communicate.

12 INDICATORS

How good is European education?

A study based on 16 carefully selected quality indicators provides a very comprehensive comparative assessment – ranging from pupil skills to the use of new technologies, teacher training and education expenditure – of the quality of education in 26 European countries.

14 EUROPEAN SCIENCE WEEK

November meetings

Full details on projects presented in November 2001.

16 SCIENCE AND THE PUBLIC

En route to the museum of the 21st century

A visit to the Deutsches Museum in Munich, one of Europe's giants in its field. This science and technology museum is firmly focused on innovation and diversity, regarding visitors as active 'users' and making science attractive without any 'dumbing down'.

20 MEETING

Multiplicity of cultures, universality of science

Last summer in Grenoble, Expo-Sciences 2001 attracted more than 1500 young people from every continent. RTD info reports from an event dominated by a shared quest for knowledge.

22 PORTRAIT

On-line from a silent world

From an oceanographic boat, researchers are breaking their silence by reporting on their scientific and other adventures on the Net to pupils seeking to discover the mysteries of the deep. Jean-François Rees, who heads the team, recounts his experiences.

24 EUROPEAN UNION CONTEST FOR YOUNG SCIENTISTS

The new generation

Bergen, in September, in the presence of five Nobel prizewinners, the 13th European Union Contest for Young Scientists awarded inventors aged between 15 and 20. Who said young people are no longer interested in science and research?

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Improving science's image

Why are young people shunning science? How can the taste for research be restored? What can be done to stop the brain drain? European Research Commissioner Philippe Busquin explains how he sees the situation.

Fewer and fewer young Europeans are choosing to study science subjects. Is the problem the nature of science courses or the way they are taught?

Philippe Busquin: This question must certainly be seen as part of the much wider debate in recent years on relations between science and society. But as far as the specific question of teaching is concerned, I believe the problems lie at three levels: the number of hours devoted to science, the resources allocated, and course content. Most European countries have seen a significant drop in the number of hours devoted to science education. Financial resources have also dropped – and have been doing so since the 1960s. Science courses need such resources, if only to allow as many pupils as possible to take part in practical lessons. This brings us to the question of content. Perhaps as a result of a shortage of funds, the teaching has become too theoretical, too mathematical in a way, and we must now make an effort to include the intuitive dimension. To do this, pupils must be able to spend a lot of time in the laboratory.

Are current or topical events a good starting point for interesting a class in scientific phenomena?

Current events can certainly be an inspiration, providing they are transposed into practice. Global warming, for example, can be approached using the example of a greenhouse. But there are many teaching aids which have shown their worth. It would be interesting in this respect if teachers were better able to communicate and share their successful experiences. One could imagine, for example, a magazine presenting an 'experiment of the month'.

It is also very important to awaken the interest of the youngest pupils, and that must not be left entirely up to the schools. Initiatives such as young scientists clubs provide an excellent means of learning and they, too, would benefit from extra resources.

This lack of interest may also be partly due to the rather low profile of European research. Hubble images are shown all over the world,



Philippe Busquin: 'Today's scientific research leads to tomorrow's investment and the jobs subsequently generated.'

but how many people know that Europe has the world's best equipped observatory, located in Chile?

Absolutely. There are in fact more scientific journals in Europe than in the United States, but research results often fail to arouse interest outside national borders. If an interesting discovery is made in Sweden there is only a slim chance that other European countries will pick up on it. The experiments being carried out at present – at Liège University – on the synthesis of molecules under conditions of microgravity have received little international attention.

But a lot of European researchers are working in the United States...

In addition to the shortage of people opting for scientific careers, it is true that the brain drain is very worrying. Our aim is to double the number of researchers receiving European grants, which researchers in Central and Eastern Europe can also apply for now. This is crucial to our economic prosperity. Today's scientific research leads to tomorrow's investment and the jobs subsequently generated. This is why we should also reinforce a 'return system' for researchers after a period of study abroad. A three-year grant could, for example, include two years of study in the United States followed by a year of research in Europe. We will only be able to consider that our efforts to promote European research have succeeded when the best scientists decide it is more interesting to continue their research in Europe. ■

A different



Holograms, the story of Newton, Cartesian divers, travelling exhibitions, web surfing... Teachers and educators are proposing new ways of teaching sciences, each with its own sensitivity, tools and cultural specificities. But they all place stress on the 'playful' or experimental approach in which pupils use their curiosity and intelligence to learn through practical experience.

way of learning



Making holograms in a Portuguese secondary school. An exercise in genuine scientific research which requires thought, experimentation, trial and error, and discussion.

There was a sense of excitement at a certain Portuguese secondary school. Pedro Pombo, the young physics researcher, had just arrived with his armoury of lasers, mirrors, lenses, photographic plate and anything else you might need to make a hologram. The material would remain available to the volunteers at the physics club throughout the year. After giving a brief talk, during which pupils received basic information and reference texts, Pedro was on his way, leaving behind the pupils, their teacher and the desire to make their own hologram – which is not easy. Throughout the year, these pupils, aged between 15 and 19, would have to conduct their own research. 'It is an open situation,' explains Pedro. 'They spend time thinking, obtaining results, making mistakes, and debating – essentially the activities of scientific research.'

Making a hologram

But such an approach is not a question of tinkering around until you manage to put something together. The constant interplay of practical experimentation, explanations and reference texts serves to progressively – and painlessly – instil an understanding of theoretical notions. 'It is a good way of teaching optics or geometry in a real context. The pupils realise that it is not so difficult to learn.' Tests carried out at the end of the year did indeed show that the pupils had acquired considerable theoretical knowledge in fields thought to be difficult. The project is now set to expand from the present seven participating schools to 24, with maths and art teachers also keen to participate. All aspects highlighted by the teachers are being studied: personal reflection, experimentation, the

play angle, the link with the practical world – holograms are everywhere, on credit cards and on future euro notes. Even the social links are considered, as the pupils take their work home and discuss it with their parents.

Advocates of play

Thousands of kilometres away, in Slovakia, the young visitors to an exhibition are working with parallel tubes filled with coloured liquids containing natural elements. The surprise element is that the movements inside the tubes do not correspond to the way in which they are rotated. Indeed, they are *surprising liquids* and one of the most recent interactive demonstrations given by *Scola Ludus* (The School of Play). Based at the Department of Educational Sciences at Bratislava University, this foundation organises travelling exhibitions across the country aimed at all sections of the population, but which are proving very popular with secondary school pupils and teachers. Katarina Teplanova, director of the department and founder of the Scola Ludus, describes herself as a 'mother of two children, dissatisfied with secondary school, seeking something better for the pupils'. Visitors have access to experiments, objects, films and texts. They are helped by monitors – students at teacher training college – or by their own teacher, in the case of classes. 'In addition to the usual experiments proving physical laws, modern physics should include an introduction to concepts explaining the behaviour of complex systems,' explains Katarina. With her extensive experience of how play can be a useful approach to science, she has proved that such 'extra curricula' concepts are of interest to secondary school pupils and suitable for a classroom situation.

On the web

- ▶ Association for science education (ASE)
www.ase.org.uk/aseinfo.html
- ▶ Raising Public Awareness of Mathematics
www.sees.bangor.ac.uk/public/cpm/rpamath/
- ▶ Scola ludus
<http://popolvar.ddp.fmph.uniba.sk/>
- ▶ Center for studies in science education (DK)
www.nat.au.dk/cnd
- ▶ 'Café Pédagogique'
www.cafepedagogique.net/



Rafael Garcia Molina, physics lecturer at the University of Murcia (Spain): balls, tin cans, simple toys... All kinds of things can be used in physics and to learn without getting bored.

The physics of everyday life

Rafael Garcia Molina, physics teacher at the University of Murcia (Spain), prefers toys. Balls, toothpicks, straws, tin cans – just about anything can be used for physics. ‘I became interested in the question of teaching when some secondary school teacher friends of mine told me that their pupils didn’t like physics. So I gave seminars for the teachers, and then in schools, to show that the subject is not boring and that many articles in everyday use relate directly to it,’ he explains. Most recently, he has been working with students aged 17 and 18, who were more than willing participants. Under his guidance, they built a kind of *Cartesian diver* controlled by pressure. The way to do it is to screw up a sheet of aluminium paper into a relatively compact ball and then place it in a bottle almost filled with water. If you press on the bottle sides the ball descends, then rises again when you release the pressure. ‘When I asked them to explain how it works, they discussed it and very quickly arrived at the right answer, which involves the principles of Pascal and Archimedes.’ Rafael also believes that pupils of all ages have a much better understanding of the underlying physical concepts of phenomena than one thinks, ‘even if they do not express it using standard terminology.’



Experiments of the past...

But what can teachers do in class every day? School curricula include a number of notions which must be ‘taught’ whether or not play is involved. Nicolas Witkowski, professor of physics in Paris, chose to approach these subjects from the angle of the history of science. ‘Whether it is XVIIIth century society or recent history, Newton’s inquiries, or front page news on GMOs, science must be seen in context. It is not something that just falls from the sky.’

In France, the movement of the planets is on the secondary school curriculum. At the age of 15 or 16 that can seem rather dry. ‘What is the point of teaching Newton’s law if you do not explain, by placing it in a historical perspective, how and why the phenomenon was studied?’ asks Nicolas. This approach also avoids any jargon and premature modelling and can lead to some fascinating questions. ‘Is it really irrelevant to know that Newton was an alchemist and that Kepler earned his living writing horoscopes. What motivated the thirst for knowledge at that time?’

And, rather than the usual classroom experiments, he suggests, why not repeat the major experiments of the past using the facilities available to the researchers at that time? For example, Franklin’s experiment to measure the size of a molecule is suitable for a second-year class: a drop of oil is placed on water and it spreads, leaving only a layer of molecules. You must then measure the surface of the stain and calculate the actual length. But, to do that, you have to know the volume of the drop, which can be calibrated using a pipette. Then the stain is highlighted (by putting talcum powder on the water) and measured (using tracing paper). You have to be inventive. ‘In the end, the pupil will have measured the molecule, and will know that it is not easy.’

... and the technologies of the future

No conference or report on science education can be complete without reference to information and communication technologies (ICT). Tools which Alain C., a maths teacher in a Paris secondary school, uses regularly: ‘The internet is primarily a means of acquiring documentation and exchanging experiences with colleagues. I often visit the Café Pédagogique⁽¹⁾ for example where I find tools

The ‘surprising liquids’ presented by the Scola Ludus association (Slovakia).

(support, software) for working on computers with pupils.' The main problem is actually selecting what to use and what not to use – which is also the case for the pupils, but with an additional risk: 'They also use it to find information for project work. But the problem with the internet is that you are often unfamiliar with the source of the information and you do not know how reliable it is. For many pupils, the very fact that it is on the web is enough to make them take it at face value.'

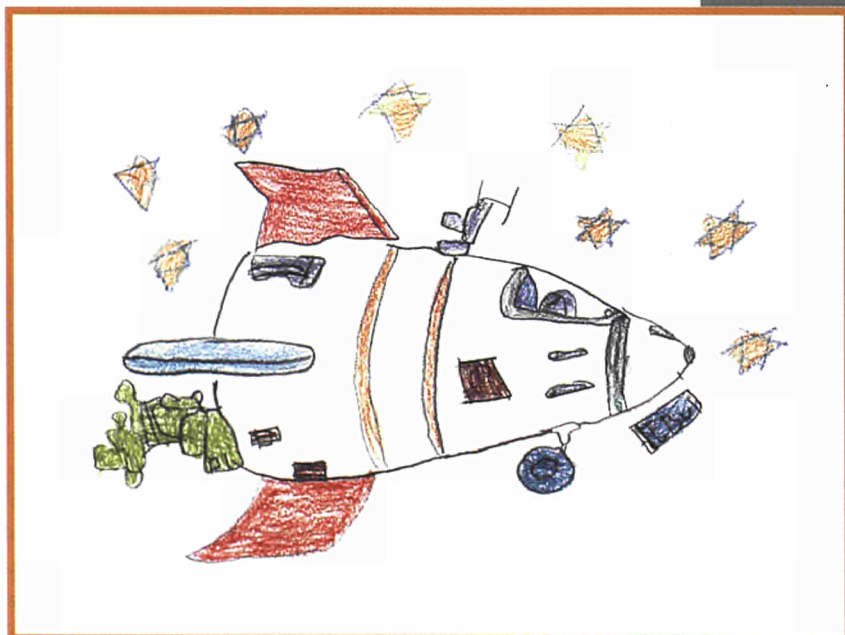
The revision and exercise software is particularly useful. But there is also the need to have a written record of what the pupil has studied, so that the teacher can check the progress made and correct any errors. John Leach, professor of education sciences at Leeds University, stresses the limitations of such aids. 'ICT are not a cure-all. They can boost the efficiency of certain methods of teaching, but cannot solve the fundamental problems of course content, pupil motivation and teacher recruitment,' he states. But the internet does allow teachers to find out about experimentation elsewhere and to take inspiration from them for their own work. ▸

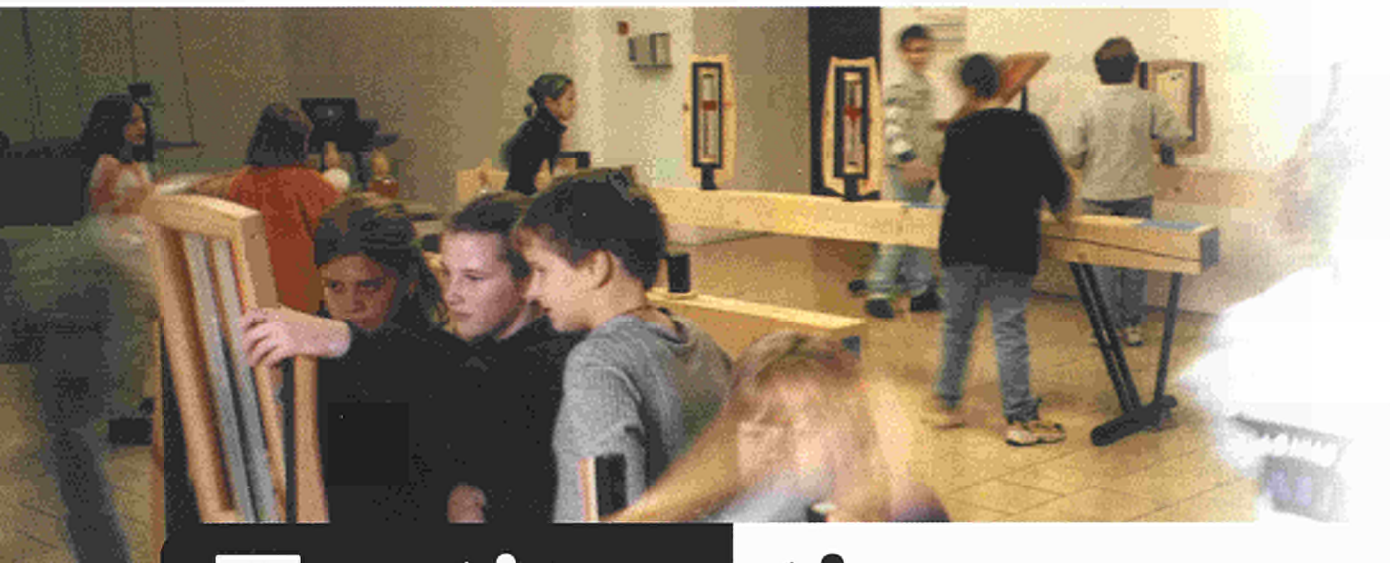
(1) Electronic newsletter reporting on the latest developments in teaching methods and a discussion forum which shows that many teachers build their own websites aimed at pupils, parents or other teachers, full of information, exercises, charts and software programmes.
www.cafepedagogique.net

Science in the cradle...

'There's no doubt about it: young children like science. Just look at the success of museums, television programmes, experimentation programmes, for example. But they don't like school science.' Edgar Jenkins' views are echoed by experts and teachers. Interesting children in science is not a problem. Play, experimentation and discovery are the most natural things in the world for children, which is why it is so important not to inhibit their curiosity with an excessively formal approach. The Spanish physicist Rafael Garcia Molina, for example, introduced the notion of the centre of gravity to primary school pupils by showing them how to build an *acro-batic bird* able to balance on the tip of a finger placed under its beak. A few toothpicks, modelling clay for the ballast and coloured paper ('purely for decoration') are all it takes. The children quickly learned to discover the science present in many toys. 'I even noticed how my youngest daughter, who is three, develops a certain scientific intuition by playing with soap bubbles or a coloured spinning top,' he says.

But even in primary school there are exercises to be done, notions to be learned and tests to pass. This is why the BBC has launched an 'on-line school' offering children aged between four and 11 a whole variety of games and software to help them acquire these basic ideas. Ranging from matching the right 'house' to the right animal to discovering living conditions in Scotland during the Second World War (a spy game), it also includes a little maths revision to prepare them for the summer exams. Using the 'cartoon approach', the presentation has child appeal. There are also many associations which offer extra-curricular science activities based on experimentation, study or invention. It remains to be seen whether or not children introduced to science at an early age will retain that interest into adolescence.





Testing time for science

Why are secondary school students giving up on science subjects just about everywhere in Europe? Education experts are trying to explain the reasons and come up with some solutions. Meanwhile, many teachers in the field are trying alternative methods, often based on active experimentation. Whatever the case may be, they all share the same sense of urgency.

'We have fewer and fewer maths students. Young people who are not trained in deductive reasoning are increasingly avoiding the subject. Physics is suffering even more. It is to escape physics that my students opt for maths applied to the social sciences rather than maths, computer science and scientific applications.' Mireille Chaleyat-Maurel, lecturer at the René Descartes University (Paris 5) is all too aware of the damage being done.

It is the same picture all over Europe. In Germany (enrolment in physics courses down by one half since 1991), Belgium (a 5% fall per year in civil and industrial engineering), and in France (enrolments in science subjects down by 12% since 1996), the number of students choosing to study 'hard' science subjects is steadily declining. In Great Britain the situation is causing particular concern, to the point where some are anticipating problems in replacing university staff. 'With 19 students enrolled to train as lecturers, we are the biggest group in Great Britain!' exclaims John Leach, lecturer in education sciences at Leeds Uni-

versity. The picture is the same in southern Europe. Pedro Pombo, who teaches physics in Portugal, notes that 'students are no longer studying maths, physics or engineering'.

A good start

Yet young children like science. That much is clear from the success of museums, after-school science clubs and all kinds of science events. A European survey carried out in 1998, entitled *Science in School and the Future of Scientific Culture*, states that 'primary school children like science and are enthusiastic when they start learning it, but the enthusiasm wears off as they move through school'. So what happens? School no doubt is not the whole explanation, but science education in secondary school is often called into question. Through the many reports, studies and conferences which Europe has witnessed over recent years, teachers and education experts have identified a number of key themes.

The need for change

Whatever the system, the actual teaching must change. Everybody seems to agree on this – as is evident from the many experiments in new teaching methods being carried out all over Europe (see *A different way of learning*). Some want history, others experimentation, play, the illustration of links between science and society or more use of information and communication technologies (ICT). But nearly all are agreed on the importance of the experimental approach, a method favoured by Anglo-Saxon countries for 20 years or

more where the emphasis is on practical experiments in the laboratory. Pendulums, micro-rockets, resonating tubes... the possibilities are endless.

The French *Association Sciences, Techniques, Jeunesse* (ANSTJ), which organises extra-curricular research activities, believes that 'the successive phases of observation, questioning, debate, experimentation and analysis allow young people to progressively build up their knowledge and to structure their thinking. They progress from simple contemplation to a more active and rigorous attitude, which leads to formalised knowledge.'

Nevertheless, some voices are being raised to dampen their enthusiasm. 'The use of experimentation seems essential at primary school, but teachers are under an illusion about the value of experiments in secondary school,' believes Nicolas Witkowski. His view is that 'experiments using complex material, where all you have to do is press a button to get a result, serve no purpose. Pupils do not proceed by trial and error, but obtain the right result straight away – a result they usually know in advance.' Pedro Pombo, who uses holography to teach concepts of physics to pupils at all levels, sounds the same warning: 'Experimentation, yes, if it is a genuine inquiry. But it doesn't work if you already know the result you are looking for.'

First of all, school does not bear sole responsibility for the current state of affairs. What we are seeing in school reflects a general underlying trend. Nicolas Witkowski, a physics teacher at a French secondary school, believes that 'we are seeing a kind of backlash in the way science is perceived. There is general distrust since Challenger, Chernobyl, Bophal and BSE. The positive aspect of this social phenomenon is that the right questions are being asked directly, without the filter of scientists working for official bodies. On many subjects students know as much as their teachers.'

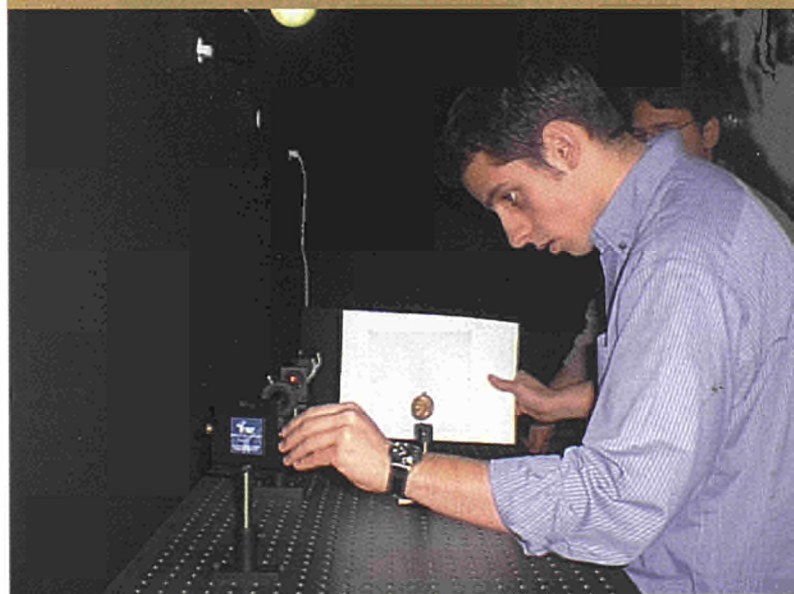
Back to reality

But what about the actual teaching? Katarina Teplanova, head of the Department of Education Sciences at Bratislava University (Slovakia), sums up her students' grievances: 'They find the subject matter incomprehensible and do not believe their interests are being taken into account. The teaching is too formal and the gulf between theory and reality is widening. Schools underestimate the knowledge, experience and abilities of pupils by presenting phenomena outside the real conditions in which they occur. Also, more attention is paid to marks than to knowledge.' In short: science education is too abstract, too removed from reality and places the emphasis on teaching ready-made concepts rather than stimulating individual thought and experimentation.

Then there is the question of mathematics, the real stumbling block for many (see box). This means that not only the course content must be changed – the sacrosanct curriculum – but also the way the subject is taught.

What's the point?

But there is more involved than developing new methods or adapting course content. Gérard Fourez, a social scientist at the faculty of Notre Dame de la Paix in Namur (Belgium), believes that: 'It is the very meaning of the science courses which is at



The benefits of experiments. A global consensus, but with a word of caution from some teachers. 'Experimentation, yes, if it is a genuine inquiry. But it doesn't work if you already know the result you are looking for.'

'Do young people have the feeling that science courses help them to understand the world? Or do they feel they are being made to see the world the way scientists see it?'



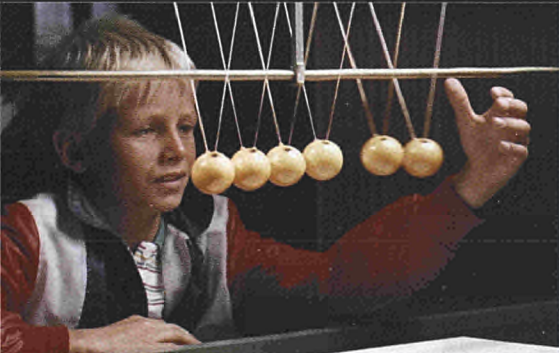
stake. The world of scientists can be divided into physics, chemistry and biology, and that of young people into the environment, pollution, technology, medicine, space exploration, the history of the universe and of living creatures, etc. So do young people have the feeling that science courses help them to discover their world? Or do they feel – rightly or

wrongly – that the main aim is to make them see the world the way scientists see it, without this giving them a vision of their world?' Finally, the students, most of whom will not become scientists anyway, simply ask themselves 'what's the point?'

There is also the matter of replacing researchers, engineers and teachers.

Patrick Dowling, president of the Association for Science Education – a British foundation which promotes science education and which has close links with industry – describes the group as *professional scientists* and wants to see them become 'involved in developing curricula and courses'. But how? Should we accept the fact that only a minority will become scientists and adapt school in line with the majority, if necessary offering extra lessons for future specialists? Some countries, such as Britain, already offer a modular system in secondary school, but far from all Europeans favour this approach. Education experts and teachers will certainly have their work cut out over the years to come. The already long-standing debate on science education is not over yet, but what has changed over recent years is that there is now a sense of real urgency. ▸

Inevitable mathematics



There are no two ways about it: even the advocates of less abstract teaching recognise the need to acquire systematic knowledge and the mathematical tools required to proceed further in the study of science. Edgar Jenkins, lecturer in education sciences at Leeds University (UK), admits that 'many scientific

concepts are difficult as they are essentially mathematical and contradict intuition'.

It is not so much the subject matter of a science which is a 'turn off' for students – space exploration and animal cloning are both fascinating to them, for example – as the mathematical formalisation, which is very important in physics. So, how can we get round the obstacle? Nicolas Witkowski raises the problem of jargon: 'In maths, and only in maths, words have an unequivocal meaning. The teacher must clarify this vocabulary. It is no good just coming out with Newton's law ($F=Gmm'/d^2$). That doesn't work. You have to say how Newton first formulated his discoveries, in everyday language, and

then explain the reason for this formulation, namely the ability to say it all in just four letters, or being able to calculate, etc.'

But Mireille Chaleyat-Maurel warns against having too many illusions: 'Maths is a difficult subject, and it cannot be simplified. So you have to find ways of encouraging students to dig deep.' It is also perhaps necessary to remember the recommendation given at the *Physics on stage*⁽¹⁾ conference to 'make physics less mathematical for the majority of pupils'.

(1) Held as part of European Science Week at the CERN (Geneva) in November 2000 (see the special issue of RTD info published in January 2001).



Europe on-line

The fifth Netd@ys will run from 19 to 25 November. Launched on the initiative of the European Commission in 1997, they are designed to make the general public more aware of the new media and to promote the creation of original content through the on-line presentation of projects of an educational, artistic or informative nature on a number of common themes. Youth on the Net, Citizenship and the Internet, and European Cultural Diversity on the Net are the three 'themes' for 2001. Several partners are expected to contribute to all initiatives, from local to transcontinental level. Some 300 projects involving 150 000 organisations from 85 countries participated in last year's event. www.netdays.eu/

► Contact
netdays@cec.eu.int

Educating minds in Denmark

Tubes of different material and varying lengths and diameter make sounds of different pitch when you tap them. What determines the note you hear? There was no guesswork involved in this contribution by Danish secondary school pupils to the *Hot Physics* project headed by the educationalist Poul Thomsen of Aarhus University. The approach was rigorously intellectual. After an initial presentation session, essentially designed to explain 'what it is about', they explored the material and then reported on their research and findings.

The sounds emitted by 18 tubes were compared two at a time to try to understand what causes the note to vary. Is it only the length of the tubes? On what

basis can that claim be made? How many comparisons are necessary to arrive at that conclusion? 'We also want to introduce the notion of control of one variable (the pitch of the sound) by other independent variables (the tube characteristics),' explains Poul Thomsen. This kind of approach is then adopted by *normal* physics lessons. For example, rather than learning the law of perfect gases by heart, as if it were a cooking recipe, there is a need to *construct* it, or to conceive experiments showing the effects of one variable on the others.

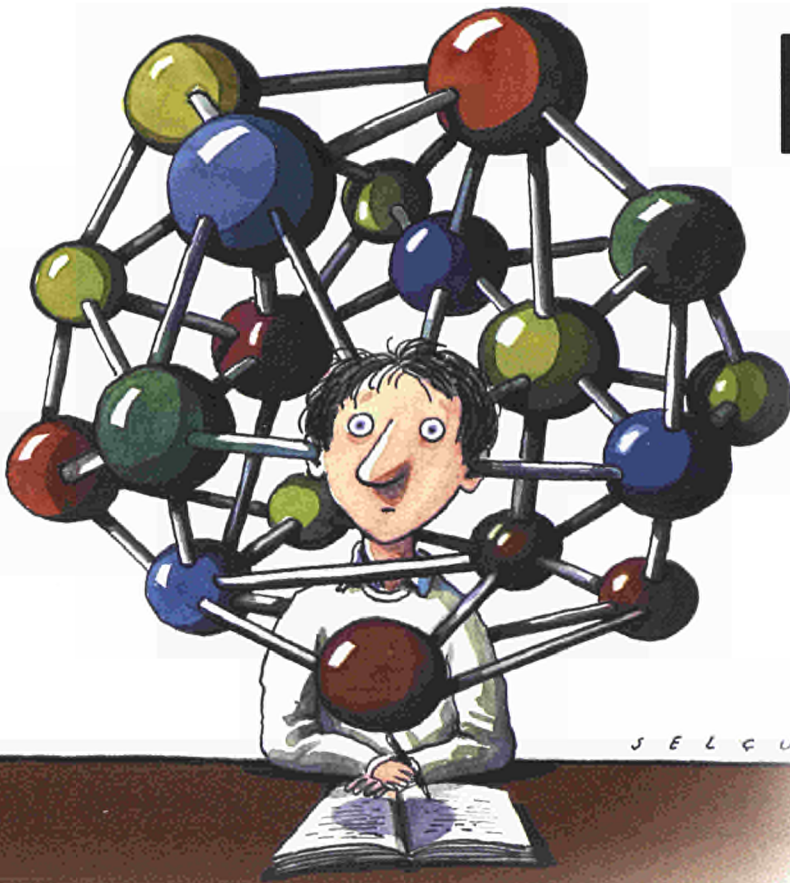
It is thus more a question of developing intellectual tools than of engaging in 'science for science's sake'. In this respect *Hot Physics* is following on from

the example of the British CASE experience initiated in 1982 and supervised by Philip Adley, lecturer at King's College London. For him 'science becomes the gateway to general intellectual development. It is an excellent vehicle for that.'

Two decades after the event, it is possible to take real stock of what was achieved. Philip Adley believes it is positive: 'We are seeing the long-term effect. Pupils taught using the CASE method at ten years of age have better results at 14, not just in sciences, but in maths and English too.'

How good

Pupil skills, teacher training, use of new technologies, expenditure on education... How can the quality of education in Europe be measured? On what criteria can reliable international comparisons be based? And what lessons can be drawn? This exercise was conducted on the initiative of the European Commission. We focus on a report which merits attention, pausing to look at science education in particular.



'Subject areas are given different priorities in different Member States. Varying emphases are placed on the context of learning at different ages and stages. Methodologies differ. Teaching and learning is embedded in different structures. Countries diverge in their linguistic and cultural histories. These cultural patterns bring a depth and richness to the dialogue at European level. They provide a strong basis for Member States to learn from one another.'

This is one of the principal messages from the authors of the *European report on the quality of school education*. Published by the Commission in May 2000, this comprehensive document offers a comparison of Europe's education systems, in particular in science subjects. It follows two other studies carried out at the Union's initiative in 1999 and designed to define the indicators on which a qualitative evaluation of school education in Europe can be founded.

Choosing your indicators

Sixteen quality indicators were identified. They 'should be regarded as starting points, limited in their internal meaning but unlimited in their implications for raising standards for all.' They should be able to stimulate an open dialogue on the future, and be alert to the policy implications of the data obtained and to the avenues to be explored in the future. Although it is important to take account of socio-cultural differences, the comparative

assessment of pupils' performances and education in 26 countries is a formidable tool for preparing education in Europe, which in effect means Europe's future.

According to its authors, this new report is the Commission's first response to the conclusions of the European Council which met in Lisbon in March 2000: 'The European Union had set itself the strategic objective of becoming the world's most competitive economy.' Ambitious to say the least! To achieve it the acquisition of knowledge – and the ability to keep up with its rapid development – must become an essential priority. This is why mathematics, natural sciences in general (physics, chemistry, biology, environmental studies, etc.) and information and communication technologies were priority concerns of the group of experts responsible for this mission. The sample population selected consists of pupils around 13 years of age in the seventh or eighth year of study (according to the school grades in most countries).

Central Europe is best at maths

Does the standard of maths education in Europe show an East-West divide, for example? The data used to find out were taken from an international aptitude test developed for the Third International Mathematics and Sciences Survey (TIMSS). This shows that pupils in central European countries (Bulgaria, Czech Republic,

is European education?

Hungary, Slovenia, Slovakia) are strongest at maths. Another important finding is that, as a general rule, there is a close correlation between the results achieved in the seventh-eighth year and in the fourth year, suggesting that a liking for maths develops very early. Performances fall nearly everywhere, however, when pupils arrive in the twelfth-thirteenth year. This begs the question as to why there is this falling off of standards? Is it due to the teachers, the pupils, or both?

This and many other questions (such as how to help pupils overcome a negative attitude towards mathematics) were asked by the report's authors, who stress the importance of maths in acquiring skills of analysis, logic and reasoning. Reference is made to a number of national experiences. In Cyprus, for example, motivating competitions are open to even the youngest pupils, while in Germany teachers have access to multimedia teaching materials (CD-ROMs, videos, etc.).

The role of ICT

Similar examples are also given for the natural sciences. For example, in 1999, Italy launched a four-year programme aimed at improving science education. One of the working hypotheses was the need to place the emphasis on developing experimental skills and interdisciplinarity. In the field of information and communication technologies (ICT), interpreting the results is becoming increasingly complex, not only because of rapid technological change but also as a result of their varied status in different countries. In most central European countries they are taught as subjects 'in their own right', whereas elsewhere – Norway, Sweden, Italy – they are seen as tools to assist in the teaching of other subjects. Furthermore, some teachers show a certain suspicion of such technologies which are sometimes regarded as posing a threat to their own jobs. Here, too, the response varies – Estonia, for example, has set up a system whereby older pupils tutor younger ones in ICT.

There is also, of course, the question of resources – or more specifically, the cost of computers. The report notes that

their price is falling, but also that this is not the only factor. As living standards improve, so pupils in general spend longer in the education system. This is seen at both ends of the scale, with more nursery classes and more students in higher education. Indeed, the importance of learning experiences at a very early age are known to be crucial for the later intellectual development of individuals. The conclusion is obvious: there is a need for more and better trained teachers with the ability to adapt – this is a long-term investment which will determine Europe's future. ▀

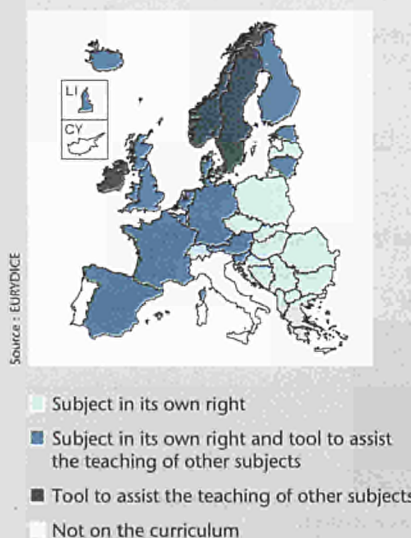
Sixteen indicators, four areas

Seven attainment indicators: mathematics; reading; sciences; ICT; foreign languages; 'learning to learn'; and citizenship. *Three indicators of success and transition:* drop-out rate; completion of secondary education; and participation in higher education. *Two indicators of monitoring school education:* evaluation of and guidance in school education; and parent participation. *Four indicators of resources and structures:* teacher education and training; participation in nursery education; number of students per computer; and educational expenditure per pupil.

European report on the quality of school education - Sixteen quality indicators

Published by the European Commission, Directorate-General for Education and Culture.
Downloadable document: europa.eu.int/comm/education/indic/rapinen.pdf

Method of approach to ICT as defined in the school curriculum (secondary education) – 1997-98



November meetings

Seven initiatives, aimed at a wide public, are highlighting current research and its implications. These projects, involving young Europeans, are being presented during the European Union's annual Science and Technology Week which, as always, promises to be a week to remember.

PUSH 2001

da Vinci, Darwin, Linnaeus and the life sciences

Under the banner of these three major figures, the association *Public Understanding of Science and Health* (PUSH 2001) – a partnership of the Darwin Centre (Pembrokeshire, UK), Florence University (IT), and Uppsala University (SE) – will be bringing together some 150 teachers and pupils from the three home countries of these illustrious Europeans, namely Italy, England and Sweden.

With the help of experts, PUSH 2001 aims to take a close look at educational modules which permit an active approach to scientific concepts by giving students the opportunity to carry out experiments. Over three days, participants will talk with researchers and attend the many workshops rich in 'dramatisations' of science. Evocations of the work of da Vinci, Darwin and Linnaeus will also provide an opportunity to place discoveries and their development in a historical context.

The educational modules will be on the life sciences. Genetic engineering will be illustrated, for example, by showing the expression of a fluorescent protein in bacteria, enzyme activity through bioluminescence, immunology applications, and plant biotechnology. It will be possible to evaluate the modules presented so that they can be used by other teachers and adapted to different kinds of teaching.

Action

- ▶ Meeting of science teachers and students – workshops, debates, dramatisations
Villa del Poggio Imperiale, Florence (IT)
5-7 November

Contacts

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Cm.pazzagli@dfc.unifi.it
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Darwin Centre for Biology and Medicine (UK)
CampbellAK@Cardiff.ac.uk
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peter.bergsten@medcellbiol.uu.se

Website

www.poggio-imperiale.it/push2001/
welcome.html
www.darwincentre.com

EuroPAWS

Telegenic science

Why isn't science a source of inspiration for the media? After all, it certainly has its adventures, sometimes heroic figures, and discoveries full of suspense. Why would the layman fail to be fascinated by research if it is presented in the right way for a mass audience? Television alone can reach such an audience and is also the most suited for a 'dramatisation' of science. EuroPAWS (European Public Awareness of Science initiative) is encouraging efforts to this effect with initiatives such as grants for TV drama scriptwriting, a new festival of TV dramas and the first Midas prizes. The latter will be awarded to the best television dramas: one prize for dramas based on factual science stories, and the other for fictional stories in which science or technology play a major role.

Coordinated by the CCLRC (Council for the Central Laboratories of the Research Councils/UK), EuroPAWS is an association of five partners, two of

them European groups of actors/producers and scientists. Its website offers some interesting avenues to be explored by anyone seeking to launch drama projects drawing on science and technology.

Visitors to the Paris Science Film Festival at the end of September were able to get a foretaste of Science Week and an introduction to the work of EuroPAWS by attending the screenings and other events.

Action

- ▶ Awards ceremony
Institute of Electrical Engineers, London (UK)
5 November
- ▶ Press conference and presentation
Musées Royaux d'Art et d'Histoire, Brussels (BE)
7 November

Contact

events@europaws.globalnet.co.uk

Website

www.europaws.org/

Infoplanet

The benefits of renewable energy sources

The sun, the wind, plant waste... Each one is an energy source which respects the environment and is the subject of increasingly significant research. Infoplanet presents the latest developments in the field of renewable energy sources with a particular focus on Europe's Mediterranean region. Four educational exhibitions, complete with explanatory posters and videos, will be held simultaneously in four cities: Rome, Thessaloniki, Barcelona and Porto.

At each venue, the general public – and secondary school teachers and pupils in particular – will be able to meet and debate with researchers and other experts on renewable energy sources.

There will be an extensive campaign to raise public awareness prior to the event while the Infoplanet website will report on the ensuing debates and results achieved. One of Infoplanet's principal aims is to close the gap which too often separates scientists from the general public, due to a lack of information and communication.

Request for free subscription to RTD info

Complete in block capitals and return to:

Research DG – Information and Communication Unit
Rue de la Loi, 200 – B-1049 Brussels
Fax: +32 2 295 8220 / e-mail: research@cec.eu.int⁽¹⁾

Language version desired English French German

Name: Organisation:

Type of activity (please indicate together with sector of activity and level of responsibility/qualifications if possible):

University/Research centre Industry Services Public sector NGO

Teacher Student Press/Media Other:

Sector (e.g. chemicals)/position (e.g. researcher)

Full address⁽²⁾:

(1) If subscribing by e-mail, please indicate your activity (see categories below)

(2) If possible give tel./fax numbers and e-mail address



November meetings

Action

Museo dei Bambini, Rome (IT)
CEDEFOP, Thessaloniki (GR)
ISEP, Porto (PT)
5-17 November

Contact

a.picano@innova-eu.net

Website

www.infoplanetproject.com

Energetic Friends

Young scientists at work

The competition was open to teams of young scientists (three to five youngsters aged between 12 and 18), supported by an adult, from Estonia, Latvia or Finland, and ideally forming international groups. Their research projects had to lie within the broad field of energy but were allowed greater freedom in approach. The aim was to encourage innovative initiatives by teams from the Baltic countries. Scientists were allowed to help them to develop their projects. A jury, comprising experts from science centres in the three countries, researchers and engineers, selected the ten best projects. These finalists will now be travelling to the Tallinn Technology and Science Centre to present their work with the aid of multimedia resources. A range of other activities is being organised on this occasion, including excursions, science dramatizations of science and a quiz. The winning projects will be presented on the Energetic Friends internet site.

Action

- **Final of the 'Energetic Friends' research projects**
Technology and Science Centre Energy,
Tallinn, Estonia
5-8 November

Contact

kertu@energiakeskus.ee

Website

www.energeticfriends.org

Life in the Universe

Who are we, and where do we come from?

In the beginning, probably between 13 and 17 billion years ago, came the Big Bang. But what does this theory mean? What is our present understanding of the Universe? What forms of life could possibly exist outside the solar system? What in fact constitutes life? What do scientists know about the origins of our world and the worlds around us? Secondary school students (14 to 19 years) in 23 European countries are invited to present their 'conception of the Universe', their ideas on its development, and the questions it raises in the form of projects. These can take virtually any format, from the creation of a website to theatre.

Two winners per country will then be selected to come to CERN (European Laboratory for Particle Physics) in Geneva where they will present their projects and have the opportunity to discuss them with seasoned international experts.

This three-day event will culminate with the awarding of the *Super Contest Prizes* in the form of an invitation to the launch of the Ariane rocket at the European Space Agency (ESA) site in Kourou (French Guyana) and a visit to the European Southern Observatory (ESO) at Cerro Paranal (Chile), site of the world's largest telescope (see *RTD info* n° 31). This final will be broadcast on the internet.

As partners of CERN, the ESA and the ESO, the European Association for Astronomy Education (EAAE), the European Molecular Biology Laboratory (EMBL), and the European Synchrotron Radiation Facility (ESRF) will also be contributing to these events.

Action

- **A three-day meeting-debate at CERN**
Geneva (CH)
8-11 November

Contact

monica.de.pasquale@cern.ch

Website

www.lifeinuniverse.org/

Biotech Europe

Biotechnologies and daily life

Demonised by some, and presented as the inevitable solution for the future by others, genetically modified organisms (GMO) are at the forefront of the debate between science and society, which is currently interesting a growing number of Europeans. It is also a subject on which expert opinion is divided. A documentary on plant biotechnology and a conference debate on the implications of GMOs in the areas of health, food, the environment, the principle of precaution and freedom of research, will be shown at four European science museums: in Munich, London, Brussels and Madrid. The aim is to provide the general public with the most comprehensive and objective information possible in the interests of a well-informed debate. This film will report on the latest European research in the field. It will be produced in five language versions (Spanish, Italian, German, French, English) and will be available on video, CD, DVD and on the Net. A five-minute presentation version will be available in science museums and on the Net.

A video conference organised by the Nature Publishing Group and the Deutsches Museum in Munich will accompany the documentary's first screening. This will be attended by science journalists and publishers, politicians, education experts, etc. There will also be an award for investigative journalism in the field of biotechnologies.

Action

- **Film premiere and video conference**
Deutsches Museum, Munich (DE)
Brussels, London, Madrid
5-11 November
www.terra-eu.org

Contact

info_en@infoplanetproject.com
100715.331@compuserve.com

Small is beautiful

How microsystems perform

Airbags installed in cars are controlled by microsystems (MST) no bigger than your fingernail. Electronic noses are able to detect whether or not food is fresh. In the fields of health, the environment, transport and safety, minute devices are playing an ever-bigger role.

The European Week on Microsystems Technologies – Chances, Changes, Challenges exhibition will be presenting the products, applications and developments of the future of this invisible world of micro-intelligence. Mobility, daily life, work and communication are the exhibition's four main themes.

Information days with seminars, conferences and debates will be devoted to three target publics: young people, students and teachers; elderly and disabled people (whose daily lives are greatly facilitated by MST innovations, in the field of electronic surveillance and home care, for example); and SMEs, with a special day set aside to meet European microsystem producers. At a closing session, sociologists, industrialists, user representatives and the general public will meet to debate the ethical, social and environmental implications of growing MST applications.

Action

Exhibition in Manchester (UK)
5-11 November

Contact

micro-world@vdvide-it.de

Website

www.micro-worlds.org/

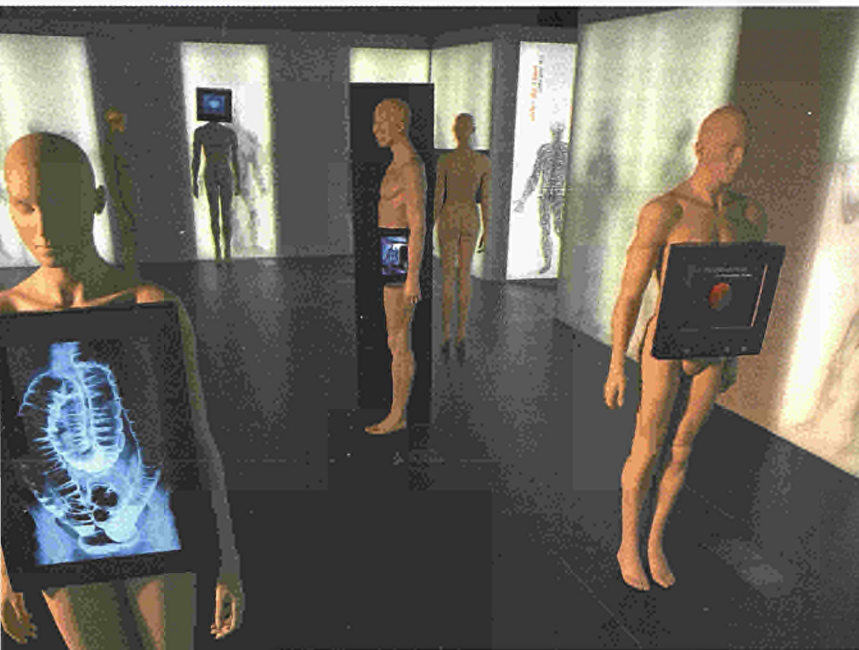
European Science
& Technology Week

Information

melanie.kitchener@cec.eu.int
www.cordis.lu/scienceweek

En route to the museum of the 21st century

Together with the Conservatoire des Arts et Métiers in Paris and the Royal Science Museum in London, the Deutsches Museum is one of the 'dinosaurs' of European science and technology museums. But a very innovative dinosaur, featuring a science theatre, an observatory where children can stargaze through the night, an internet site for the very young, and special facilities for welcoming teachers and pupils.



'Under the skin':
exhibition of medical
imaging techniques.

On a September morning Lufthansa flight LH 4435 lands at Munich-Riem airport at 10.10 am precisely. The stream of passengers heads for tramway number 8. 'Unterföhring: would passengers please take the left doors,' announces a woman's voice. It is seven stops to the Isar Gate and a 45-minute ride from the airport to the city centre. That gives just enough time to take a look through the museum guide. The Deutsches Museum is described as being 'part of Munich, just like the Frauenkirche, the Hofbräuhaus brewery and the Olympic village'.

11.15 am. 'Isar Gate: would passengers please take the left door.' It is now just a few hundred yards to the Deutsches Museum. 'Do you know where the main entrance is?' asks Sieglinde Sander, who is from a Wiesbaden suburb, as she crosses the *Ludwigsbrücke*. Good

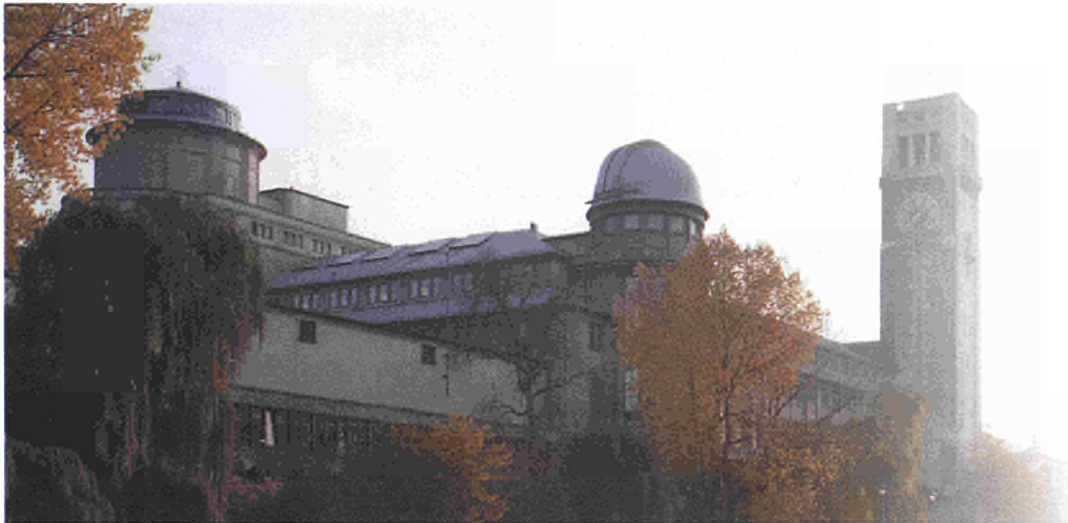
question! Because the museum, situated on an island in the Isar, has 55 000 square metres of exhibition space. Frau Sander first visited the museum with her husband 30 years ago, and is now returning with her 16-year-old daughter Evelyn. What does she expect to find at Europe's biggest science museum? 'I don't know,' she shrugs, 'I'll see.'

Please touch....

Aerospace, astronautics, power machinery, railways, the historical Zeiss planetarium... there is certainly plenty to see. Lars Madson, an electrical engineer, has come all the way from Copenhagen for what is his fourth visit to the museum. His sons Peter (14) and Sven (16) are with him. Every year 1.4 million visitors from 100 countries visit the Deutsches Museum – more than the total population of Munich.

'We want to welcome visitors with a totally new approach,' states Wolf Peter Fehlhammer, the museum director. The emphasis is on the 'pleasure' element, as its designer Oscar von Miller intended back in 1903 with the idea of a 'touching museum'. An engineer, he had already dazzled the public at the Crystal Palace with a waterfall driven by a remote electrical device. In a Europe gripped by the fever of industrial growth, Oscar – together with the physicist Wilhelm Röntgen, the engine designer Rudolf Diesel and the inventor of the refrigerator Carl von Linde – gave Germany a museum with a diversity of exhibits and clarity of explanation which successfully conveyed the way science and technology impact everyday life.

Some 100 years later, the old museum – home to such historical exhibits as the very first Benz automobile (1886) and first diesel engine – is adopting some new educational approaches.



Deutsches Museum von Meisterwerken der Naturwissenschaft und Technik

Museuminsel, 1 – D 80538 München
www.deutsches-museum.de/
info@deutsches-museum.de

Covering 55 000 square metres on an island in the Isar and with its own observatory where children can play at astronomers, Munich's Deutsches Museum is a European site where science and technology can be discovered through new and different approaches designed for different publics.

The chemistry of life

The *Pharmaceutics* permanent exhibition inaugurated in 2000 is one example of the way this Munich museum is innovating. It invites visitors to take an inside look at the microcosm of a human body cell. 'This is great,' exclaims Seftab Inan (23), an assistant pharmacist, as she enters the dark tunnel leading to the cell interior. The cell is magnified 350 000 times to form an area measuring 11 metres by six where visitors can closely observe the cell structure and mechanisms. A cell forest shows the different cell types and the molecular changes triggered by illnesses such as Aids, tuberculosis and cancer. Under the motto *You Are Chemistry*, the exhibition also offers interactive multimedia systems to enable visitors to learn about the biochemical processes of the human body. 'Our aim is to

focus on the human body,' stresses Wolf Peter Fehlhammer, a former lecturer in chemistry at Berlin University.

A different kind of class

Children – tomorrow's researchers – are more than welcome to the Deutsches Museum. Every year it welcomes 60 000 visitors aged under six! From 2002, they will have a specially designed Children's Museum.

'I see the museum as a generator of new ideas. I want visitors to leave with strong and memorable impressions which will remain with them for a long time,' explains Annette Noschka-Roos, an education expert at the Deutsches Museum. The natural curiosity and creativity of



When women guide women

Women have often been the instigators of scientific discovery. Yet the vast majority of Nobel prize-winners have been men. 'Without the work of Lise Meitner, Otto Hahn would not have been able to explain the structure of the atom.' This is why Sylvia Hladky is committed to doing justice to the importance of women scientists throughout history. As the Deutsches Museum's first curator, she convinced her male colleagues to set up a bust of this famous Austrian in the museum's hall of honour. With the launch of the programme entitled *Women Guiding Women* 10 years ago, she gave the museum a special attraction. 'Women are

not enemies of science and technology. Their approach is simply more pragmatic than that of men.' It is on the basis of this specific difference that Sylvia Hladky developed the educational aspect of her project. From October to May, Wednesday morning is women's morning at the Deutsches Museum with professional women guides showing women visitors around the exhibits for an hour and a half. Programme themes include Bits et Bytes (from the calculator to the computer), cooking and solar energy, the history of construction games and the creation of perfume.



Sylvia Hladky, engineer and former curator of the Deutsches Museum, who initiated weekly guided tours of the museum by women for women.



the child require a special approach. 'It would be disastrous to try and make the museum conform to some narrow model,' she continues. 'The museum must also appeal to the visitor's senses and emotions. Such as when the visitor discovers the impressive mining exhibit, or the "high tension" section where, safe inside a Faraday cage, the person can be bombarded with lightning without being struck.'

Theoretical learning does not dominate a visit to the Deutsches Museum. Things move, spark and splutter. Children can touch and make things, and even spend a night at the museum – a really exciting adventure for the under-12s. As a living space and after-school leisure facility, it should be able to attract growing numbers of visitors. Last year, for example, it presented an exhibition in co-operation with the European Patents Office, which exper-

imented with physics through the theme of *A Revolving World*. By using their legs to activate a crane, rather like hamsters on a wheel, and themselves activating turnstiles to transform muscular power into motor power, the children certainly put all their energy into scientific discovery.

Such activities will be a permanent feature of the new Children's Museum. Today, already budding researchers are setting off with a four-page questionnaire for adventures such as 'a journey to the stars', 'around the sun' or 'a space trip'. The centre of the Earth, distant universes, the sonorous world of music, the mysteries of the atom, and the powers of the microscope are all explained to the visitor. And when, on clear nights, its young visitors climb the 84 metres of the East Tower or when they enter the planetarium dome, they are transformed into real little astronomers. ▸

Three questions for Wolf Peter Fehlhammer

General Director of the Munich Deutsches Museum



Museums used to have the reputation of being rather sterile places of 'conservation'. What do you do to make a museum a more lively place?

We are trying to introduce an emotional component. We want to reach the public through the senses too. We do this through various means, such as the science theatre and the art exhibitions. I do not believe too many demands should be made on visitors. This is why our current exhibitions do not try to show everything but to make a very rigorous selection of what will be shown. The phenomena are explained by carefully selected examples and rest areas are provided. The guided tours,

which follow a narrative, are also very popular. Stories are also a way of reaching people.

But our concept is a very open one. Above all else we want to target new groups of visitors, such as women.

Do you feel that women are neglected?

A technology museum attracts predominantly male visitors. One sees many more fathers and grandfathers with their grandchildren than mothers with their daughters.

One of our aims is to make the museum rather more feminine. At the moment there is something of a male



© Deutsches Museum/S. Wamser

Schools at museum

The several thousand items exhibited at the Deutsches Museum represent an inexhaustible source of knowledge. 360 schools are permanent members of the institution. This means that classes can be held in the museum at any time. The physics teacher takes his classes there to explain quantum physics while the biology teacher takes his older pupils literally to the heart of the human cell with a visit to the 350 000 times magnified model at the *Pharmaceutics* exhibition.

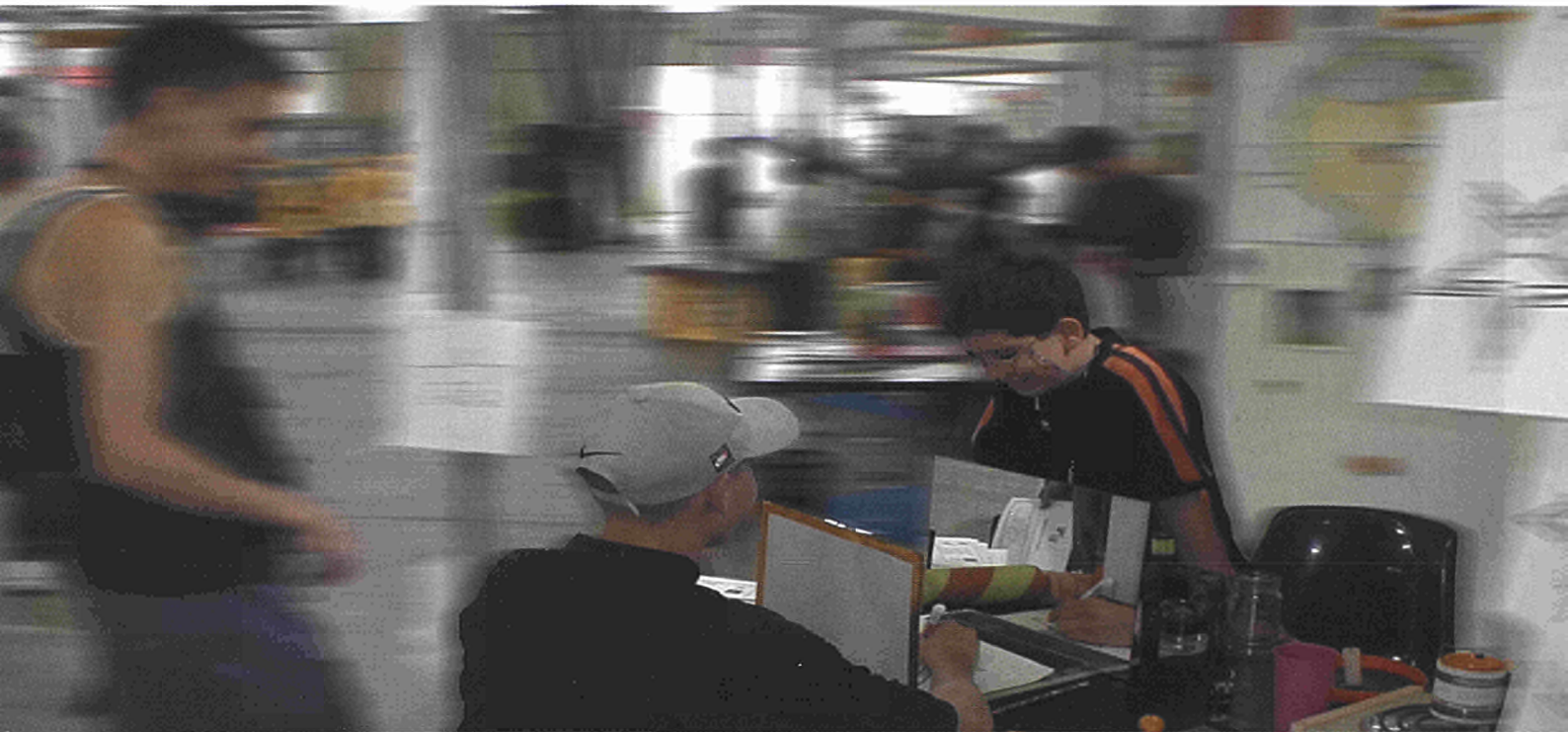
Science on show: at the *Pharmaceutics* exhibition, visitors get an inside view of a giant cell to understand how it works.

bastion about it. We are trying to lighten and soften the environment. One way is by hiring more women staff – until a few years ago the surveillance staff was exclusively male – or by allowing retired women to work as volunteer guides. And more women are also now holding the post of curator at the Deutsches Museum.

And what is the Deutsches Museum doing to attract children in particular?

We have simplified procedures and reduced the cost of admission for children. Schools can obtain a special reduced rate membership card. As a result, there are now 360 schools which are permanent members. Teachers can use the museum's facilities whenever they want, bring their class here and teach. We want to turn the visitors into users. The wealth and diversity of our collections means that there is something new to grab your interest on each visit, rather like at a library where you are free to read one book and then another, at leisure.

For the very youngest, for example, every weekend in December we are organising a programme of fairy tales, which stage the stories in the various museum rooms. This initiative has proved very successful among children and parents. At the moment we organise this kind of special event on an occasional basis, but from 2003 the Deutsches Museum will have its own Children's Museum. Young people will then be able to visit us whenever they want, and explore the various sections in the company of trained and attentive staff as they complete a special 'researcher's questionnaire' specially drawn up for them. We already have experience of this kind of action with children, who are certainly our favourite visitors. We never cease to be amazed by their enthusiasm and infinite patience, such as during holiday courses when they spend two or three days building a plane which can really fly.



Multiplicity of cultures, universality of science

Between 9 and 13 July, Grenoble hosted the eighth International Expo-Sciences – ESI 2001 – an event which alternates between continents. It was an occasion for more than 1 500 young people from all over the world to come together to share their passion for learning and discovery.

Grenoble – an important university city and centre of scientific research (home to a synchrotron) – was chosen by the International Movement for Leisure Activities for Science and Technology (IMLAST) to host one of the world's most important science events: International Expo-Sciences. This was an occasion which allowed young people from more than 40 countries to present a whole array of creations, prototypes, reconstructions, discoveries, thoughts and questions on the world of science to the public.

No rivalry

'Expo-Sciences is not a competition,' explains Jean-Claude Guiraudon, IMLAST president, 'but a forum for intercultural exchange'. The selection of projects is left to the discretion of the participating countries. This gives

young people the opportunity to compare their scientific creations and ideas without any notion of competition. 'Whether you are from Latin America or Central Europe, the universal language of science always makes it possible to instigate a discussion with colleagues from the other side of the world,' believes Michel Bois, one of the Expo-Sciences founders. In other words, science is a unifying force. The young participants from the Czech Republic and from Slovakia gave a wonderful demonstration of this by taking the stage together during the delegations' evening.

Guy Romier, manager of ESI 2001, was pleased to announce that this year's event attracted record numbers of participants and that the organisers are now considering the possibility of perhaps splitting Expo-Sciences into a number of separate events. This is certainly easy to

believe when you take a walk around the 300 stands at Grenoble. Nearly every scientific and technical discipline is represented, from a six-legged robot, modelled on ants, to photographs taken by a galaxy enthusiast.

From the curiosity cabinet...

The history of science was not forgotten either. Pupils from a secondary school in Angoulême. (FR) made a curiosity cabinet, of the kind found in the XVIIth century, with a whalebone, ostrich egg, armadillo, insect collection and other *naturalia*. One of the curators of this mini museum admitted that, while the scientific 'value' of the objects may seem anecdotal, the idea of bringing them together and the way they are juxtaposed displays a cultural and aesthetic dimension. 'It is perfectly possible to reconcile art and science,' she says. Our secondary school students also know how to mix 'business with pleasure' by presenting a systematics workshop, a fun way of comparing present classification methods with the somewhat confused methods used to 'arrange' the contents of a curiosity cabinet. Question: Should an egg be classified with minerals, by virtue of the fact that it is an inanimate object, has neither top nor bottom and resembles in every respect a malachite egg? The question may cause a smile, but it actually warrants clarification.

... to bio-indicators

Just a few metres further on, the focus was on a very topical concern: air pollution. A group of young Spaniards, encouraged by their biology teacher, had come up with the idea of analysing air quality by studying lichens. Their enquiries showed, as one of their budding researchers explained, that arborescent lichens are highly sensitive to air pollution, in particular by sulphur dioxide, and thus constitute one of the best pollution bio-indicators available. Often given bad press for bringing new risks, it is reassuring to learn that young people are very much aware that science can in fact help avert the dangers to which we are all exposed.

But there is more to science than occasionally sounding the alarm bell. It can also offer concrete solutions, as a tour of the stands at Expo-Sciences makes abundantly clear.

Practical benefits

A team of young Germans has developed a type of assisted driving system. Watching their prototype as it negotiates its tortuous route, one is tempted to imagine that soon drivers may be able to doze peacefully at the

wheel! Meanwhile, some young Belgians from the Martin V college have been getting to grips with a vital issue: water supplies in arid zones. Their invention is based on the fact that the air in the Sahara contains as much water, in gaseous form, as it does in Belgium (160 billion tonnes). They believe it is technically possible to condense this water using a cooling system such as the one they presented at Expo-Sciences. They estimate that to condense one litre of water in this way would require the consumption of 380 kJ at an approximate cost of 0.064 euros. Over to the investors...

Michel Bois, in fact, makes the point that it is not unusual for a project presented at Expo-Sciences to attract the attention of a commercial company. This was the case for a process allowing disabled people to answer the telephone without moving, simply by clapping their hands.

Trusting in science

In the maze of stands, certain areas were set aside for various events and round tables, creating the impression of a genuine hive of intellectual activity. There was a children's theatre presenting some 'explosive' chemical experiments, and a reconstruction of the famous Foucault pendulum. Meanwhile, the roundtables generated a potent brew of ideas, especially on the relationship between science and society and the various ways in which science can be popularised. A high point in these discussions was an account by one teacher working with young people with problems. She explained with obvious conviction how astronomy, like sport, can provide an excellent means of integration: 'I knew nothing about astronomy, but decided to join a local club. The young people I was working with quickly showed an interest in the subject, too. It is possible to teach in a very practical way, by learning 'simply' how to take pleasure in recognising the constellations. The more theoretical questions then come quite naturally as everyone wants to comprehend what they see. They finally understand that they too can have access to scientific knowledge and thus to knowledge in general. It is a very good way of regaining self confidence...'

Moscow 2003

Young people from Bulgaria, Hungary, Russia, the Ukraine, the Czech Republic, Slovakia and Slovenia were much in evidence at the Grenoble Expo-Sciences. The 22 Slovakian projects included one by members of an astronomy club who presented their photographs of the solar eclipse of August 2000, as well as a group of young biologists who had made teaching panels on river ecology. Guy Romier believes this very strong presence on the part of these countries reflects their real desire to be a part of Europe. In fact, Moscow has already been chosen to host the next event, in 2003.

Expo-Sciences at every level

The International Expo-Sciences regularly attract between 1 000 and 1 200 participants presenting 250 projects. Organisation is handled by IMLAST, with 50 member countries whose regional secretariats or national representatives select participants and coordinate the events. The national Expo-Sciences attract something in the region of 200 participants, presenting about 60 projects. The Regional Expo-Sciences (Europe, Asia, Latin America) fall between these two numbers.
www.milset.org/



On-line from a silent world

A biologist and expert on deep-sea fauna, Jean-François Rees shares his passions and life as a researcher via a website named Nemo. With a ship's log updated daily, photos of expeditions, scientific descriptions, action stories and more, the site is sure to capture the imagination of young oceanography enthusiasts as they discover the secrets of this 'silent world'.

As a boy, Jean-François Rees was gripped by the tales of Jules Verne and the adventures of Captain Nemo deep beneath the sea. Through his reading he discovered unknown worlds, a natural environment that he went on to study, specialising in underwater biology. 'I did my final year thesis under the supervision of Professor Baguet, an expert on the bio-luminous animals of the deep. It seemed incredible to me that it was possible to work on such creatures...'

Exploring the deep seabed

To share his passion, stimulate scientists to reveal some of the secrets of the ocean depths and make the public more aware of their work, Jean-François Rees came up with the idea of 'showing, in real time, exactly what a researcher's life is like'. That is the reason behind the Nemo site, which is aimed in particular at school pupils and students who are invited to enter a very special world of knowledge. 'The deep seabed forms the biggest ecosystem on the planet. Yet it remains largely unexplored. So come with us

on a voyage of *Discovery*. And experience live, day by day, our expeditions to study the extraordinary creatures who live there. Read the daily ship's log of our adventures. And, most important of all, send us your questions and comments by e-mail. We will reply from dry land or from our boat if we are on a mission...'

'I do not see it so much as popularising our work as a way of sharing the day-to-day experiences of a sea expedition, with all its joys and disappointments. Those who follow us will notice that there is more to research than cold logic. It is a genuine adventure with all the uncertainties that implies.'

Sea spray via the Web

Thanks to satellite communications it is possible to follow the daily progress of the expeditions, underwater explorations and work of the scientists on board an oceanographic boat. The ship's log reveals the scientists' state of mind, the excitement of the departure, difficulties linked

to weather conditions, and the anticipation among the crew as the nets are dragged up from the ocean depths. Reading the description of a terrible storm on 27 September you can almost feel the spray lashing against your face. You find yourself asking the same questions as the researchers (What are these animals producing these flashes of light that can be seen on the videos? Why do some fish give off such an awful stench during dissection?), and sharing the same sometimes critical problems of their crews (How can the research continue when the deep-sea net tears?).

Blue octopus and sea cats

The blue octopus on the home page has been adopted as a mascot by one class of secondary school pupils. Other youngsters have nicknamed the crew 'Cousteau.be'. Questions arrive by e-mail from all over the place, rich in variety and sometimes decidedly unexpected ('There are sea horses and sea lions... but what about sea cats?' asks Alice). 'On each expedition we are taken to the very limits of our knowledge. So it is only normal for their questions to make sense to a researcher such as myself. Underwater biology is a kind of *terra incognita* and the deep seabeds are the biggest ecosystems on the planet. It is easy to understand how such a situation can excite young people's imagination...'

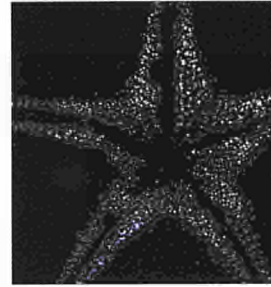
Back to natural history

The paradox for Jean-François Rees is that, as our knowledge of biology expands, so the researcher is becoming

increasingly detached from nature. 'The naturalist side of this discipline is on the decline, yet it is often this aspect which is the most interesting. Natural history stimulates an interest in biology and adds to the need for a general understanding.'

This is the kind of aspiration to which a site such as Nemo tries to respond. As does the 'natural history showcase', another initiative launched by Jean-François Rees and others. It involves asking young people to discover the secrets of an animal chosen from the collections in a natural history museum. Through dialogue and a set of questions, its story is told. Why does it have such a shape? Why, for example, does a crocodile swallow stones? Little by little, by trial and error, and as the questions are asked and answered, the 'truth' is revealed. 'There is not enough practical, hands-on experience in science lessons. The aim of the exercises I propose is to add to our understanding of the world through experimentation.'

When asked whether all these activities to promote biology take up too much of his time, Jean-François Rees admits that the hour he spends every day drawing up the log and answering questions is demanding. 'But it is a choice, and a very gratifying choice.' The next trip is already planned: in January or April the team will be setting off to study the animals of the hydrothermal sources in the Pacific Ocean. The aim is to dive to a depth of 2 500 metres under the sea deep within the submarine "Le Nautilus". Further adventures are already being discussed... ▸



Plutonaster

Captured off the Irish coast, this *Plutonaster* starfish lives at a depth of several thousand metres. Its ventral surface emits a light which it is believed scares off predators.



Jean-François Rees

'Underwater biology is a kind of *terra incognita* and the deep seabeds are the biggest ecosystems on the planet. It is easy to understand how such a situation can excite young people's imagination...'

Nemo Site

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The 'Discovery'

Ninety metres long and able to accommodate 50 crew and passengers, the 'Discovery' is a 'genuine little factory, operating day and night so that the scientists can make full use of the time spent on board'. Sailing under the British flag, the vessel belongs to the National Environmental Research Council (UK).

The new generation

It was 20°C in Bergen at the end of September. Prince Haakon and his young wife lent a special sparkle to the event, as did the presence of five Nobel prizewinners – Ivar Giaver, Sir Harold Kroto, Ben Mottelson, Jen Skou and Gerardus 't Hooft. With visits to Bergen Aquarium, scientific lectures and a reception at the university, a symposium on European research, and a concert at Grieg's house, there was certainly no shortage of activities.

This was a celebration of young people, aged between 15 and 20. Some would describe them as 'model students', but they were more than that. They were young people with ideas, ready to bring real enthusiasm to a job they believe in. In fact, they were the researchers of the future.

It was the 13th Contest for Young Scientists to be organised by the European Union. Prior to the European competition, more than 30 000 students had participated in national competitions. A total of 95 successful students then travelled to Bergen to present their 65 projects to a discerning international jury.

Pauline Slosse, the jury president, is a lecturer at Brussels University (BE) and also works at the Centre Universitaire Didactique pour l'Enseignement de la Chimie. 'The quality of the projects made the task more difficult than ever this year. I am sure all the jury members will long remember this unique experience and the passionate dialogue with young scientists from all over Europe and beyond.'

For the young competitors, the experience was no doubt equally memorable. In this city lying somewhat on the 'fringes' of Europe – it is not a capital, is not situated in a Member State, and for many evokes images of the Far North – the young scientists suddenly found themselves plunged into a scientific and European maelstrom, communicating with other like-minded young people and meeting adults who were prepared to take their work seriously.

Launching pad

With many competitors from the Central and Eastern European Countries and a few from as far afield as Israel, Japan and the United States, this was far from being an exclusively EU event. The fields of study (environment, health, mathematics, astrophysics, biology, etc.) were many and the research topics varied. Three projects won the first prize of € 5 000. Thomas Aumeyr and Thomas Morocutti, two 19-year-old Austrians, won with their digital camera and radiotherapy device which is connected to a computer enabling a precise calculation and dosage of radiation to be made in the treatment of skin diseases. Sebastian Abel, an 18-year-old German student, was rewarded for his analysis of satellite pictures of clouds, providing meteorologists with a tool with which to

distinguish cloud masses from snow-covered terrain.

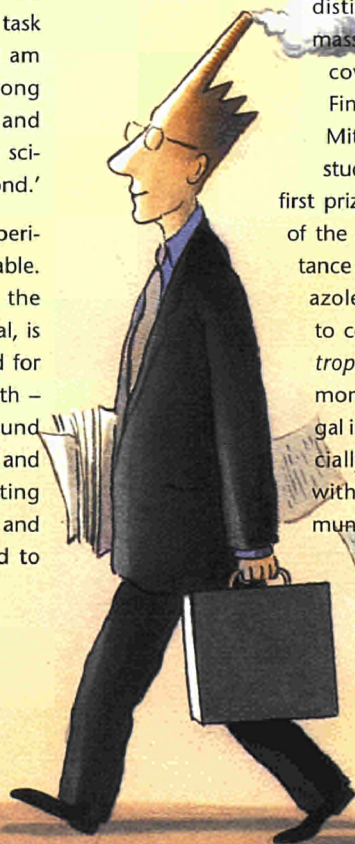
Finally, James Lee Mitchell, a British student (18), won first prize for his study of the causes of resistance to the effects of azole, a drug used to combat *Candida tropicalis*, a common cause of fungal infections, especially in patients with deficient immune systems.

Second prizes (€ 3 000 per project) were awarded to three projects, presented by Hungarian and Polish students, while a Dane, an Irish team and two British students won third prizes. A number of special awards were also made, including an invitation to attend the 100th Nobel Prize award ceremony and the chance to attend training courses at the European Southern Observatory on the Canary Islands, the European Space Agency and the Norwegian Polar Institute.

Although pleased at having brought together so many young scientists at such an event, Director-General Achilleas Mitsos of the European Commission nevertheless pointed out that 'the principal difficulty today is probably to encourage young people to take up the challenge of embarking on a career in science and technology'.

No doubt he could find some reassurance in the fortunes of some former prizewinners, such as Henrik Mouritsen from Denmark, a winner in 1991, whose passion is ornithology. Today he travels the world to observe the movements of certain birds and monarch butterflies and has just been awarded more than €1 million from the Volkswagen Foundation to continue his research. More recently (1999), the young Irish researcher Sarah Flannery presented a new algorithm whose applications in the field of cryptography are currently opening up some very concrete opportunities in terms of patents and innovative applications.

The next young scientists meeting will be held in Vienna in September 2002. ▀



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