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TOWARDS COORDINATED ACTIONS FOR  
EUROPEAN SCIENCE

## *Life in Science – Science in Life*

SUMMARY REPORT BY THE DANISH NATURAL SCIENCE RESEARCH COUNCIL (SNF)

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# Towards Coordinated Actions for European Science

Summary Report from the Conference: *Life in Science - Science in Life*

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# Towards a Knowledge-Driven Economy

Foreword by Helge Sander, Minister of Science, Technology and Innovation, Denmark



The ability to gain and use new knowledge and research is a critical factor for Europe's success in the global knowledge-driven economy. Therefore we must ask: how can we improve the practices of today and remove the obstacles on our way to the future?

Natural science and technology are vital for the development of the knowledge society. Natural science, however, is not only an essential part of our highly technological society but also a fundamental cultural factor that is decisive for the continued development of our understanding of the world.

Therefore it is important that we are aware of the way natural science is represented in society in general, in the media and in the educational system.

Denmark, like many other European countries, recognises a growing need for students and graduates choosing a career based on natural science and technology.

## Barcelona Declaration, Spring 2002 - A competitive economy based on knowledge

Research and Frontier Technologies.

In order to close the gap between the EU and its major competitors, there must be a significant boost of the overall research and development (R&D) and innovation effort in the Union.

The European Council therefore:

- Agrees that overall spending on R&D and innovation in the Union should be increased with the aim of approaching 3% of GDP by 2010.

This is a major challenge to both universities and society. The power to change this, along with investment in education, research and innovation - in line with the conclusions from the Summit in Barcelona - are vital for the growth in Europe.

I hope this summary report from the conference *Life in Science – Science in Life* will inspire further questions, discussions and actions.

## Bologna Declaration, Summer 1999 - The European Higher Education Area

The Bologna Declaration was signed by the Ministers of Education of 29 European countries in Bologna on 18-19 June 1999. Three more countries (Croatia, Cyprus and Turkey) signed the Declaration in May 2001 in Prague.

The Declaration forms a binding commitment between the countries to reform national higher education systems in an agreed direction. It is a pledge, in principle and practice, to create a comparable and increasingly converged system of graduate and post-graduate education across Europe, in order to maximise transferability and mobility within Europe. The process should be completed in 2010.

There are six objectives:

- Adoption of a system of easily readable and comparable degrees
- Adoption of a system essentially based on two main cycles, undergraduate and graduate
- Establishment of a system of credits
- Promotion of mobility by overcoming obstacles to the effective exercise of free movement for students and teachers
- Promotion of European cooperation in quality assurance with a view to developing comparable criteria and methodologies
- Promotion of the necessary European dimensions in higher education

# Wanted: Young People in Natural Science!

Introduction by Professor John Renner Hansen, Chairman of the Danish Natural Science Research Council

Thursday, November 7<sup>th</sup> 2002 the Danish Natural Science Research Council (SNF) hosted the conference *Life in Science - Science in Life* at the Experimentarium in Copenhagen, Denmark. The aim of the conference was to establish a common European strategy for the recruitment of young people to natural science. The conference brought together a large number of Europe's leading scientists, media representatives, research administrators and policy makers who presented their vision of how to enhance the value of natural science in the minds of young people and society in general. The broad objectives of the 5 parallel workshops were to survey the state of the art in natural science education and discuss further actions towards a better learning environment in natural science.

The preservation of the existing level of welfare in Europe is only possible through an increased number of students with a high level of knowledge in natural science. The growing demand from industry for young people with the necessary qualifications in science and technique and the need for competent and ingenious young people to engage in a research career make an urgent action necessary. The Barcelona and Bologna Declarations have defined the direction for the evolution of higher educations and the level of research in a European knowledge-based society. Now it is up to the administrators, together with teachers and researchers, to formulate and execute a strategy to reach these goals.

The young Europeans of today no longer automatically follow in the footsteps of their parents. They are most attracted by educations with high visibility, for instance those widely exposed in the media. It is commonly accepted that natural science is fascinating and European scientists must use this to maintain the enthusiasm and interest for natural science that many young people feel in early childhood.

In addition, natural science must be recognised by young people to play an important role in everyday life. Through an education in natural science they can wield a strong influence on the development of the society. It is the responsibility of European leaders to ensure that this is understood not only by the younger generations but also by all those already well established in the society.

The very successful conference in Copenhagen was only the first step on the long road towards better natural science education, and the participants promised each other to meet again in 2004 to compare achievements and adjust the strategy.



# Executive Summary

Europe has a common crisis. A life in science is not sufficiently attractive to young people, and science is experiencing a very real recruitment problem.

The European Union's goal of becoming the most competitive and dynamic knowledge-based society in the world - set by the EU in March 2002 by the Barcelona Declaration - is strongly dependent on mobilising human resources in the interest of science and technology. However, studies conducted by the EU show enrolments in science and technology study programmes to be either stagnate or only slowly rising. In addition, younger European researchers are leaving to work in other countries, especially the U.S., which is resulting in a significant "brain drain". If present trends continue, the future supply of EU graduates with a background in natural science or technology may be insufficient to maintain the status quo in both the private and public sectors, especially taking into account the demographic development registered in most member states.

On November 7<sup>th</sup> at the conference *Life in Science - Science in Life*, leading scientists, science communication professionals, and policy makers from the EU presented their visions on how to enhance the profile of natural science in our society, especially amongst young people, in order to secure the future workforce in academic and industrial research. Identified as the bases for the decline in interest in science and engineering educations were:

## 1. Lack of dialogue between science and society

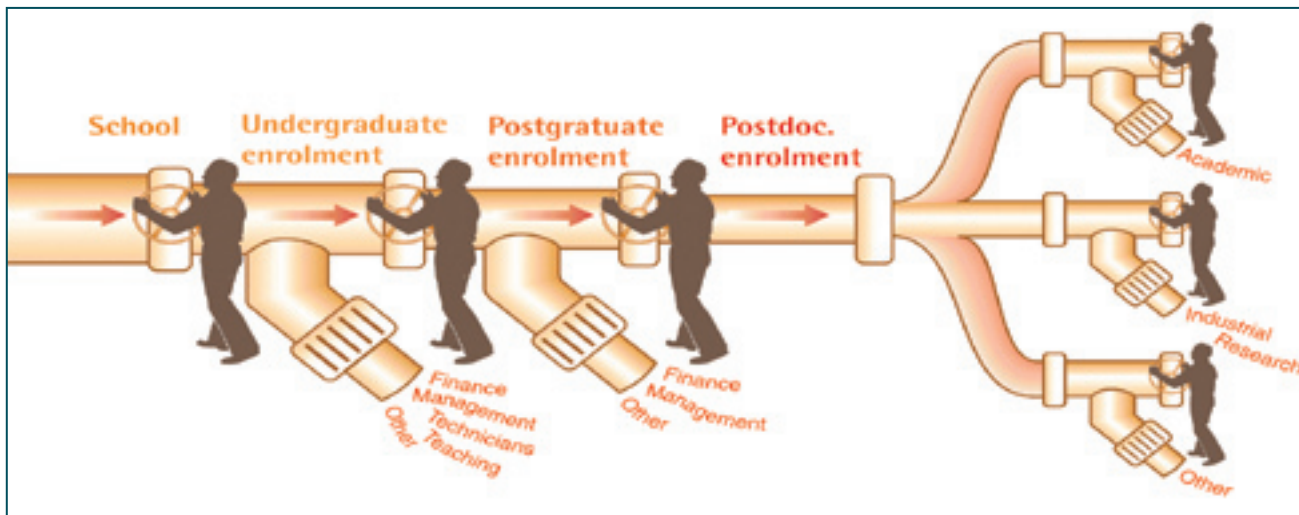
General knowledge of science and technology is insufficient in Europe, and the layperson often perceives science as a non-democratic process in which he has no influence. Scientists are a major part of this problem, as they naturally tend to focus on quality of research while sometimes neglecting to communicate with a broader audience, since no credit is given for time spent on outreach activities.

The media frequently portrays scientists as stereotypical "middle-aged white men in white lab coats" and journalists very seldomly show the people behind the science. As presented in the general media, science is often connected to problems (like pollution or GMOs), while big victories and discoveries remain untold. Dialogue between the media and the scientific community is crippled by the lack of both qualified science journalists and scientists who understand the mechanisms of media communication.

## 2. Lack of inspiring science education

Science education is key to solving the recruitment problem. A shortage of qualified teachers and good teaching methods will result in fewer students with an interest in science and fewer qualified researchers in the future. At present, it was generally agreed, the EU's education systems do not sufficiently prioritise science education. Natural science should be part of our cultural background, much as art, history, and literature are today.

### Fuel the Science Careers



In many European countries, children and teenagers do not “meet” science in their schools. They are not exposed, for example, to well-educated and inspiring teachers or visiting scientists. Young people do not have the necessary opportunities to meet role models in science or to acknowledge the relevance of science in their daily lives. Although it is widely accepted that interactive teaching and hands-on science learning produce excellent results, such methods require currently unavailable funding and training. Furthermore, due to poor communication between schools and scientists, science education often lags behind with respect to topics on cutting-edge research (nanotechnology, etc.).

### **3. Lack of attractive career opportunities**

Young people do not view a career as a professional scientist as an exciting or interesting option, and, even for those who do pursue a science career, the working conditions can be unattractive. Many scientists in the public sector do not obtain a permanent position before the age of 40. Today’s science career also involves multiple shifts from one university to another, often between different countries. One young scientist at the conference called this a “gypsy life”, incompatible with family values. Furthermore, mechanisms of gender discrimination are deeply rooted in the research community, which restricts women from higher positions.

## **Recommendations**

### **1. On a national level**

- Science communication should be upgraded on the political agenda and identified as a key element in national science policies. Governments should be more active and creative in showing the relevance and importance of science through government-supported communication programmes.
- Science education should be an important part of public policy. Research grants should contain funding for outreach activities (for instance, in the form of scientists presenting their research at schools). Teachers must be better educated in science, and improving teaching materials and laboratory facilities in schools must be made a priority.
- Further development of attractive career opportunities for young scientists are essential. To exercise research knowledge and skills requires an inspiring job environment e.g. with exciting challenges, committed colleagues, ongoing competence development, no gender discrimination, the necessary salary packages and a high level of job security.
- Programmes in journalism should contain science education.

### **2. On an EU level**

- The creation of an "observatory" for science education and communication was recommended. This institution could become a powerful force in

collecting and comparing data on successful methods of science communication, science education and its effectiveness, and the factors considered by young people when choosing careers.

- EU research grants should contain obligations to communicate the funded research to the public.
- Analysing the scientific labour market in Europe and establishing mechanisms to increase transparency in recruitment will be important in improving the job possibilities for young scientists.

### **3. Recommendations of methods**

- Overall, new concepts in scientific communication must be developed, through both an intensive exchange of successful methods and a continuous evaluation of the effects of different communication. Scientists need to take responsibility for popular communication. They should be trained to work with the media and to conduct a dialogue with the public.
- More effective methods of science learning and didactics must be researched and applied. Students must develop a "personal ownership" of their science.
- More information is needed to further our understanding of the mechanisms in career choice. Data collection and analyses must be developed and implemented in constructing new strategies to make science careers interesting and appealing.

# Workshop 1: National Strategies for Science Recruitment

Chaired by Director Jens Peter Jakobsen, Danish Ministry of Science, Technology and Innovation, Denmark

In many European countries various initiatives are currently taken to enhance young people's interest in science. These initiatives arise from an urgent need for a comprehensive strategy on both national and European levels to enhance the public awareness of the significance of science as the basis for welfare and growth. It is essential to review the scope of the current actions and discuss how to design an appropriate portfolio for a National Strategy on Science Recruitment.

## Speakers' Presentations

- **Professor Jose Mariano Gago, former Minister of Research, Portugal:** *Developing a National Strategy on Science Recruitment*

The problem of recruiting a sufficient number of young people into science is well known and well documented. The tertiary sector is growing and industry's need for a well-educated workforce is also growing.

An international strategy for science recruitment is difficult to make. Issues may vary from country to country; e.g., do rich countries have bigger problems attracting young people to science than poor countries?

Science education must be a part of the national research policy, and therefore a national strategy must be in collaboration between the ministry of education and ministry of science, which, in some cases, can be difficult.

In Portugal, 5% of research and development (R&D) budgets is given to the promotion of scientific and technological culture, like science centres, campaigns, collaboration between science and schools, etc. The key point is the personal contact between scientists as role models and young people in schools. This effort is coordinated on a national level in Portugal.

The European Council's decision in March 2002 in Barcelona to raise research spending to 3% of the EU's GDP by 2010 is very important and must be spread all



the way down to individual schools and universities in the next 7 years. To fulfil this ambition, an influx of researchers from outside the EU is necessary. We should not be “brain draining” developing countries but should instead encourage young people from third-world countries to come to Europe and later return to their own countries.

● **Associate Professor Carl Th. Pedersen, University of Southern Denmark, Denmark:** *The Attitude Towards Science*

There is definitely a problem with recruitment of young people into science. Many initiatives have already been tried to attract more young people to science. The question is: What works?

There has been a great change in society’s attitude towards science. From the optimism of the beginning of the 20th century, the public conception of science has changed to scepticism and mistrust. Pollution, DDT and other environmental issues have been highlighted in the media, but the big victories are not mentioned.

The fact is that only science can solve the environmental problems and secure the welfare society. Governments should be willing to pay what price it takes to make science communication better. For instance, the formation of an organisation of science communicators, who will publish more popular science, might make a great difference. In addition, scientists must come forward, overcome their fear of the media, and fight to popularise science.

● **Director Peter Maasen, HEDDA, Norway:** *The Decline of Interest in Science Education and Careers*

There are a lot of explanations as to why young people do not choose science as a career. Some reasons are rational, while others are not. One reason is that a science career is not economically attractive. Adding to this are socio-cultural factors like youth culture and technophobia. Science is perceived as hard to study and time consuming, so it is difficult to keep a student job concurrent with the studies. This can create financial problems for the student.

Better information is needed about the cost-benefit problem surrounding a scientific career. Scholarships to ease the financial problems for science students can be of great help. Also, entrepreneurs in science must be highlighted. In the U.S., 15% of the scientists manage to build their own business; in Europe, this figure is only 5%. We still need more knowledge about the subject and continuous data must be collected.

### Workshop 1 is concerned about:

- Low share of science and technology within labour force.
- Uncertain employment destination of graduates.
- Science education and careers are not considered attractive.
- Gender segregation.
- Obstacles to mobility.
- Drop-out rates in science education.
- Lack of science education for teachers at primary and secondary level.
- Lack of networking between science and schools.
- Lack of communication with the media.
- Position of science as part of our culture.
- Lack of role models.

● **Post Doc. Anja Andersen, Nordic Institute for Theoretical Physics, Denmark:** *Women in Science – Science for Women?*

There is a tremendous polarisation between genders in science, as women are strikingly under-represented in science, technology and development. There has been a significant increase in numbers of female students, but the percentage of university-employed women in Denmark has been at a constant 14% in the period of 1970-2001. The male domination of science is self-perpetuating, feeding back to media images, education and pedagogy.

Long-term approaches must insure that discrimination is removed and more women get a chance to pursue a scientific career. These strategies should involve changes in the pedagogies in schools, for instance, by stripping science subjects of their gendered identities and to make science subjects compulsory for a longer period to keep girls from dropping out of science earlier.

## Key Discussion Points

### Science recruitment

The workshop agreed that there is a problem both in science recruitment and in keeping young people in scientific careers. This problem results in a lack of skilled workers in science, technology and research and a lack of competition for jobs and research funding, which again leads to a lack of quality in research.

Recruitment of young people into a scientific career is a complex problem. The reason why young people do not choose a science career is related to a number of factors: science education in schools, negative images of jobs and

salaries, non-scientific youth culture and values, negative gender and “nerd” stereotypes, the lack of positive media stories on science, and the overall lack of recognition of science as an important part of culture and society.

Scientific careers do not seem attractive to young people. The workload and demands for geographical mobility is very hard for young researchers with families. The gender polarisation and subtle mechanisms of discrimination exclude many women from a scientific career. Attractive salaries and conditions in the U.S. can lead to brain drain in Europe.

The problem, however, is different in different countries, and one specific strategy will not apply to all countries. The lack of interest in science seems to be a bigger problem in richer countries than in poorer countries.

#### **National strategy**

On a national level, an effort must be taken to increase the quality of science education in primary and secondary schools. Science subjects must be compulsory for a longer period, education must focus on inter-disciplinarity and pupils must meet scientists as role models through networking between science and schools. Science education must be a strategic part of public policy, and scientists should be encouraged to take part in outreach programmes towards science education.

The public image of science should be changed through a creative governmental strategy of science communication

using media and campaigns. The media cannot be expected to change journalistic methods, and therefore scientists must adapt their stories to a form attractive to media. On one side, scientists themselves must take a greater responsibility for popular science communication and overcome fear and disrespect for the media. On the other side, the journalism curriculum should contain education in science, which in many countries is not the case today. The scientific voice must be heard in public debate, and scientists should gain a greater understanding of the mechanisms of public debate.

It is necessary to make scientific careers more attractive to young scientists by creating jobs that will match the standards for jobs outside science.

A national strategy is expensive. The Portuguese model is to allocate 5% of the R&D budgets to science communication.

#### **European strategy**

Within the EU, the workshop recommends establishing an observatory for science education and science communication to collect data, gain knowledge, and make recommendations regarding best practise. The workshop also recommends an analysis of the labour market for academic jobs, an Erasmus programme for exchange of science teachers, the establishment of mechanisms to increase transparency of recruitment and overall improving investments in science and science careers in Europe.



#### **Workshop 1 recommends:**

On a national level:

- Changing educational structure: Flexible study programmes, interdisciplinarity.
- Making science classes at primary and secondary levels compulsory.
- Focusing on drop-out rates.
- Maintaining a policy of networking science, research institutions and schools.
- Becoming more creative in financial support of science education.

On an EU level:

- Creating an observatory for science education and science communication.
- Establishing Erasmus programme for science teachers.
- Analysing the labour market, with emphasis on academic jobs.
- Creating transparency in recruitment.
- Fighting gender inequalities.
- Improving investments in science and in science careers.

## Workshop 2: Science Communication – A Broad Approach

Chaired by Director Per-Edvin Persson, Heureka Science Centre, Finland

Science communication to a broader audience aims at giving science a more visible profile in people's everyday life. Useful tools include science centres, popular magazines, news media, and science events. The impressions are, however, often short lived. The workshop reflected on the need for a more continuously and didactic interface between science and public to ensure a lifelong interest in science and better public understanding of science (PUS).

### Speakers' Presentations

● **Head of Information Jens Degett, European Science Foundation:** *Science Illiteracy*

It is important to improve science communication in Europe. An Eurobarometer survey by the EU Commission shows that, in general, the public in the U.S. possesses more basic scientific knowledge than the public in Europe. This is a direct consequence of the U.S. investing far more in science and science communication than is evident in any European country. Also, scientific institutions in the U.S. spend a greater amount of money in the fields of science and science communication than is the case at similar institutions in Europe.

To increase the political and financial investment in science, it is important to enhance the public interest in science and make science valuable to people. Increasing both interest in and understanding of science at a public level will lead to a greater influence in the political arena, making investments in science more likely to occur. It is recommended to create a basic investment in science communication of 1% of the European governmental budgets.

● **Director David Dickson, SciDev.Net:** *Science Communication – A Process of Interaction*

The public should have an accurate picture of scientific achievements and the potential of modern technology, that also includes the more critical issues in science. Too often the importance of science in everyday life is either overlooked or underestimated, resulting in lack of support for scientific work. This leads to both a reluctance on the part of young people to embrace a scientific career and difficulty in integrating scientific ideas into social and economic policies.

#### Workshop 2 notes:

- Science communication is NOT just a transfer of scientific knowledge but also information ABOUT science.
- We recognise science communication as a complex process that engages a wide range of individuals from different professional groups, such as scientists, journalists and information officers.

#### Workshop 2 is concerned about:

- Lack of public trust, in and appreciation of, science.
- Inaccurate public picture of science.
- Concept of PUS too narrow.
- Low knowledge of and political support for science.
- Science communication not identified as important.
- Weak networks between key players.
- Lack of communication training and capacity building.
- Scientists not credited for PUS work.

Science communication has frequently been (and still is) a case of passing on the accumulated scientific knowledge to the public, and very often the effectiveness of science communication is measured in terms of the amount of scientific knowledge absorbed by the public. Instead, new approaches to science communication need to be considered in order to enhance the public interest, understanding and trust in science and scientists. It is recommended that science communication should be viewed as a process of interaction and enlightenment, and that a wider dialogue between scientists and the public is created in order to generate a positive image of science.

It is, however, equally important to consider the political dimension as well. Often the public feels that science has escaped the democratic process and that scientists pursue their work regardless of what the public feels about what they do and how they do it. Therefore a new political willingness is required to ensure that the concerns of the society are taken fully into account in developing research projects and research programmes – science practice must correspond with social priorities.

Science needs to justify its existence to the public. This way public pressure can force politicians to be more inclined to favour science in their party programmes.

● **Ph.D.-student Klaus Seiersen, University of Aarhus, Denmark:** *Less Talk, More Action !*

In Denmark, a number of communicative initiatives have been taken to enhance the interest in science among young people; e.g. *Biotech Science Camp 2002* (6 days vacation for high school students doing science at an university), *Physics Show* (physics students teach physics to school children) and *Science in the City* (a tent where science is communicated to the general public by science students). The initiatives show the importance of young scientists communicating science. Young science communicators are enthusiastic, entertaining, pedagogical and can act as role models for young people.

For science teaching to be successful, it is important to consider the didactics. Teachers should not readily present the answers to the students/public but help them find the answers themselves. The students must not remain passive but should be activated by hands-on experiences. It is equally important that the teacher does not isolate himself from the audience but engage the audience on the appropriate knowledge level. Science must also be related to the real world to capture the interest of the students.

We propose that the experiences of the *Danish Physics Show* should be taken to a European level in a new project, *EuroPhysicsFun*, where students at universities provide youthful and enthusiastic communication of physics at a high professional level to pupils in the range of primary

school to upper secondary school. The project involves the development of 70 physics shows in 15 European countries over a 3 year period. The aim is to reach approximately 200.000 to 300.000 students.

### Key Discussion Points

Initial concerns were that public understanding and appreciations of science is poor; that science communication is left to the scientists and does not involve experts in communication; that all the different parties in science communication very rarely have a chance to meet and discuss their strategies and problems; that science communication is not a key element in national science policies.

### Bridging the communication gap

The lack of public trust and appreciation of science reflects the general communication gap between the scientific world and the public. The public thus has an inaccurate picture of science, and people feel that science is a non-democratic process in which they have no influence. However, some scientific areas and institutions seem to have more public appreciation: e.g. environmental and health sciences, and science museums in general have a good dialogue with the public. Nevertheless, it is important to consider in what ways scientists could take the public concerns and priorities in science into account and how these could be part of the agenda of national science policies.



### Workshop 2 suggests:

- Changing science policies to reflect public concerns and priorities.
- Engaging science at all educational levels.
- A change of mind-set.
- Two-way dialogue in communication.
- Instruments for bottom-up approach.
- Supporting PUS work from institute leaders.
- Increasing investment in science communication to 1% of science budgets.
- Increasing a development in communication skills in university programmes.
- Supporting co-operation between media and research institutes.
- Funding for science events and communication programmes, e.g. *EuroPhysicsFun* and science centres.
- Reporting science in general news sections.
- Creative evaluation methods.
- Establishing a culture of science.
- Creating reward systems for PUS work.
- Promoting transparency in science policy decisions.

### Two-way dialogue

Science communication is not just a matter of transferring scientific knowledge to the people but also about passing on information about science in general. In doing so, the scientific communities must be involved at a greater level than today. The scientific communities must be willing to engage in a two-way dialogue with the public. Furthermore, this dialogue should also be incorporated into educational programmes, making science students more qualified to communicate with the public.

### Communications skills

Science communication is too often left to the scientists. This fact embraces the main problems in science communication. Often scientists are forced by their superiors to engage in public relations but at the same time they do not get any credit for the time spent. This greatly reduces their motivation for communicating science to the public. Furthermore, many scientists do not have proper training in communication, and scientific language does not apply to the general public.

Science communication needs to be recognised as a skill to be learned, and communication training and capacity building programmes need to be established. In addition, science institutions should involve professional and skilled communication people to cooperate with scientists in science communication.

### Science and the media

Emphasis should also be placed on the relationship between science and the media. In general, communication between scientists and journalists is poor and the network of scientists, journalists and the media needs to be strengthened.

There should be more funding available to the media for broadcasting science. It is important to note that in broadcasting science the media should make use of people with a scientific background to comment on the scientific issues. With respect to magazines and newspapers, focus should be placed on extracting the stories in science from the science sections and placing them in sections read by the general public.

Generally, science is regarded as restricted and impersonal, and the public has difficulty in associating science with the people behind it. In this sense, the media might be helpful in promoting scientists as role models for the public or even as idols on the same level as rock stars and sports stars. This promotion will beyond doubt enhance the dialogue between scientists and the public and make it more attractive for young people to pursue a scientific career.

### Communication: a key element in science policies

Several political actions are recommended to ensure an enhancement in science communication. First, science communication should be upgraded on the political agenda and identified as a key element in national and European science policies. In addition, science policies ought to reflect public concerns and priorities, and a greater level of transparency should be present in political decisions. Furthermore, resources should be used in changing the mindset of the public, making people appreciate how important science is to their everyday lives and thus incorporating science into the culture of society.

### Workshop 2 recommends:

- Funding for cooperation between key players at the EU level.
- Establishing a postgraduate European programme for science communication.
- Funding for research in science communication.
- Investing in communication training.
- Promoting integration between educational systems, industry, media and research institutions.
- Funding for public broadcast programmes in science.
- Positioning science on the agenda of the European Parliament.

# Workshop 3: Science Learning and Didactics

Chaired by Head of EPR Department Richard West, European Southern Observatory

To stimulate and enhance the recruitment of young people into science, there is a need to develop a deeper understanding of the existing barriers for selecting science as a topic and for science learning. This workshop discussed how to create a successful learning environment at highschool and university level. Attention was directed mainly towards the criteria that are crucial for the success of learning processes.

## Speakers' Presentations

● **Professor Hans Niedderer, Bremen University, Germany:** *Motivation and Learning in Science Teaching*

It is possible to outline a number of concerns regarding the field of science. Concerns are about the low level of interest among young people, an insufficient math preparation, lack of learner motivation and students with lower motivation. With respect to the latter statement, it has become clear that students nowadays invest less effort in their studies.

The motivation of student learning can be affected by a number of factors, e.g.,

- The level of autonomy, freedom and responsibilities so-called student "personal ownership".
- Everyday life connections or real-world contexts.

Student ownership is very important in modern science teaching. It allows students to choose the topic of investigation and to express their own questions, own tasks and own presentations. They literally produce their own products. It was also stressed that student ownership is important because it allows students to work on their own educational levels.

Learning science means conceptual change. This change occurs through a difference in the concepts of the everyday domain and science domain. In the everyday domain, concepts are vaguely defined, as opposed to the sharply defined concepts within the science domain. Therefore, it is hardly surprising that students construct their own conceptions, which can sometimes be alternative to the goals of the teacher.

In conclusion, it is important to give more ownership to students, e.g. through minor projects. It was also suggested that small sessions of interactive activities during lectures would create more teaching diversity.



● **Professor Svein Sjøberg, Oslo University, Norway:**  
*Why Don't They Love Us Anymore*

This contribution was initiated with the following statements:  
We think that the science crisis involves:

- Falling standards among students.
- Negative attitudes towards science, and
- Falling interest in science.

If these assumptions are true, recruitment is the key problem. However, there is no evidence of falling standards, and basically there are positive attitudes in society towards science and scientists. An investigation has shown that scientists are trusted more than e.g. doctors, consumer associates, politicians, journalists and business people. People believe more in scientists than in other groups of the society. It therefore appears that the recruitment problem is deeply rooted in only a falling interest in science. In this context, it was mentioned, “we are not seeing the best students any longer”.

In summary, recruitment is the main challenge and the lack of qualified science teachers is more important than the lack of researchers. A lack of qualified science teachers will produce fewer qualified students and therefore fewer students that will pursue a career within research.

We believe that changes in the worlds of the young people and changes in science and its relation to society are responsible for the recruitment problem. In popular language an individual of the present young generation is called “Homo zapiens”. The “zap” culture has led to a maximum of 8 seconds of attention at a time among young people, and that is too little for science. Young people are restless, self-orientated and narcissistic. They seek immediate satisfaction and pleasure, and their personal meaning is of major importance. Young people no longer have scientists as heroes and idols. Instead, pop stars, movie stars, media people and sports idols have taken over as role models for the young generation.

**Workshop 3 is concerned about:**

- Current lack of interest in science education and careers.
- Low or decreasing enrolment in some of the key scientific disciplines, e.g. physics and chemistry.
- Threatening shortage of qualified science teachers in European countries.
- Associated negative consequences for society in terms of welfare and competitiveness.
- Increasing complexity of society requires a public that is knowledgeable about scientific issues.

The poor relationship between science and society is not mainly about understanding science, despite the long absence of priorities for communicating the good scientific stories. The poor relationship is rather a question of the culture of science and the body language of science. Scientists are not good sellers of science: they are not fancy looking, and their messages are not clear enough. The culture of scientists needs to be more up to date and in line with the surrounding society.

● **Ph.D.-student Rie Troelsen, University of Southern Denmark, Denmark:** *Teachers' Views and Attitudes*

The following are criteria for a successful learning process:

- The social setting - students need to feel safe.
- Student presuppositions.
- The subject itself e.g. complexity.
- Teacher's view on teaching/learning.

It is extremely important to establish a “didactical contract”, which means a common understanding of the purposes of the teaching: why do we have to learn this?, when do we have to learn it?, where do we learn it?, for what reason do we need to learn it? etc.

A lack of a didactical contract may lead to a discrepancy between teachers' intention and the student outcome. When traditional teaching is changed, it may also lead to the above discrepancy. To avoid such mismatches, it is recommended to:

- Reformulate course descriptions.
- Be aware of evaluation forms.
- Educate teaching personnel.
- Start the first lesson by defining aims and objectives.

It was commented from the workshop that the importance of a safe social setting is related to the concept of student personal ownership. Further comments concluded that students also may feel safe during traditional lectures during which they avoid exposing their (lack of) knowledge and experience. Although a U.S. investigation of 5000 students has shown that interactive teaching is more effective in terms of learning than traditional teaching, it was emphasised by a workshop participant that it is wrong to ask whether method A is better than method B – it is simply necessary to apply a set of different strategies when teaching science. There is a great need to ensure teaching diversity.



## Key Discussion Points

### New didactics

In order to create a successful learning environment, it is necessary to give students more personal ownership, by means of which they have more influence on the learning process. It allows them to participate in the choice of the topics of investigation, and to express their own questions, own tasks, and own presentations.

It is also imperative to include everyday life connections and real world contexts into the learning process, e.g., cooperation with the business community and creation of products. Student personal ownership may also be implemented through minor projects, i.e. projects of short duration which also incorporate the same influence by the students on the learning process exposed above.

### The nature of science

Today, the personal opinion of young people is of absolute importance. However, in science there is no place for personal views - results are either right or wrong. This is one reason why young people tend to lose interest in science. Furthermore, today's science no longer provides role models as before, when the public viewed scientists and their work less sceptically than now. Young people do not consider scientists as their heroes and idols – their role models are now stars, who are present in the media, highly visible to the public and, not least, whose accomplishments are easy to understand.

This effect exacerbates the present recruitment crisis for science. An important step towards overcoming this crisis is therefore that the scientists, “science culture”, and the way science is taught must be more aligned with the surrounding society, its needs and perceptions. There is a clear need for didactical rapprochement between the very different worlds of youth and science.

### The didactical contract

Before initiating the teaching process it is paramount to establish a “didactical contract”, i.e., a common understanding by the teachers and the students of the purposes of the teaching. This approach will help to establish an optimal and qualified teaching situation where both parties (jointly) identify the same procedures and goals. However, there may still be obstacles towards an achievement of the same goals, because students also create their own conceptions. This can be explained by the difference between the vaguely defined concepts of the everyday domain and the sharply defined concepts within the science domain.

### Workshop 3 recommends:

In primary schools:

- Ensuring that teachers are sufficiently qualified in the fields in which they teach in order to motivate the children.
- Carefully adapting teaching content to the needs and interests of the children.
- Making sufficient funds available to supply the necessary equipment for modern and efficient science teaching.
- Undertaking initiatives to ensure that the status of primary school teachers will be sufficient to attract highly qualified persons.

In secondary schools:

- Employing only teachers qualified for science teaching.
- Developing curricula and science teaching strategies that make science education move towards young peoples' attitudes and values.
- Introducing incentives that work towards the recruitment of future science teachers.

At universities:

- Increasing incentives for universities to give higher priorities to their teaching and outreach function, and increased emphasis on teaching quality in recruitment and tenure decisions.
- Reconsidering traditional arrangements for training of science teachers, aiming at increased professionalism.
- Increased emphasis on innovative forms of teaching, including student-centred activities.

## Workshop 4: Science in the 21st Century

Chaired by Professor Flemming Besenbacher, University of Aarhus, Denmark

There are a number of fields in which the frontiers of science are developing very fast and in parallel with each other. This creates important challenges in remodelling the modes of research towards more interdisciplinary approaches, restructuring the mode of teaching and learning, and (re)allocating sufficient funding to these research areas. It is essential to discuss how the university research and education system best can provide students with the skills and competences that will be requested by the public and private sector of tomorrow. It is equally important to consider the integrity and independence of science, and the public understanding of science.

### Speakers' Presentations

● **Professor Bengt Kasemo, Chalmers University of Technology, Sweden:** *Science and Society*

Science and its applications in technology have created a dramatic change of our society and our conditions of living in the past centuries. Science and its relation to society have gone through several evolutionary phases. Science and technology are now viewed as one of the fundamentals for societies' growth and creation of wealth, as we strive to build a "knowledge-based society."

Today there is an intense discussion about how science is transforming its way of operation (e.g. from disciplinary to interdisciplinary research) and about the implications of such a change for future research and educational systems. There is a noticeable trend towards more interdisciplinary research. The optimal balance between interdisciplinary and disciplinary research and development (R&D) in both research and education is not obvious and has been subject to intense debate.

There is a real need for change of both the educational and research systems in order to address problems of increasing complexity and in conducting research within multiple disciplines. One of the "hottest" R&D areas today, nanoscience and nanotechnology is a useful example to illustrate trends and future needs in R & D, especially when it is combined with biotechnology: nanobiology. Here such diverse fields as, solid state physics, molecular biology, stem cell research and medical diagnostics merge and interact.

Due to the increasing impact of science and technology on society as a whole and on the conditions of human life, there is also an increased responsibility of science practitioners to communicate "in real time" with the public, directly and through the media, especially since most of the public sector research is funded with tax payers money. Sometimes this lack of communication is referred to as "the lack of public understanding of science" (PUS) but also as "the scientists' lack of understanding of the public". This constitutes a major future challenge for the research and educational system and may result in a closer relationship between natural science and technology with social science, liberal arts and the media.

● **Professor John Pethica, University of Oxford, United Kingdom:** *Science education*

Whilst it is clear that the coming century will lead to significant scientific advances, and hence demands for new, specialised skills amongst trainees, there is less certainty about the means to provide the education for those skills. This partly stems from the fact that the most productive science areas advance and change rapidly, whereas implementing a completely new type of course can be rather slower. It is also because it is difficult to predict the type of skills that will be required for posttraining. Indeed, it is often suggested that the purpose of a university education is to train people to think, analyse and be rapidly adaptable, as much as to provide specific vocational training.

It is likely that for the future of frontier science, a more significant distinction needs to be made between the nature of undergraduate training and postgraduate (doctoral) training. The former should give the basic skills and facility/adaptability (like the finger exercises for music), whereas the doctoral experience provides the specific subject-related skills and interdisciplinary breadth/exposure for the cutting edge of scientific research.

There is little doubt that some of the most productive new areas of science come from the boundaries of subject areas, and the ability to hop disciplines is obviously important. This argues against too detailed a training in a narrow discipline at an early stage, but does this not conflict with the requirement for exposure to a high skill/ expertise level at some stage of undergraduate training?

The experience of Materials Science departments, which are particularly research intensive, but with relatively small undergraduate training programmes, makes very clear the importance of interdisciplinarity and of not narrowing the undergraduate subject experience too much. In order to illustrate some of the problems, the speaker compared and contrasted the nature of undergraduate and postgraduate training in Materials with its equivalents in Physics and Chemistry. Conceptual frameworks within which undergraduates are trained can narrow the flow of ideas, yet too much breadth leads to the indigestion of too many facts and inadequate depth of analysis.

● **Professor Sune Svanberg, Lund Institute of Technology and Lund Laser Centre, Lund University, Sweden:** *Science and Priorities*

Enthusiasm and dedication as driving forces in science are of utmost importance for society, and for its long-term well-being the recruitment of a sufficient number of students dedicated to scientific endeavour is a key issue. In this process the role of enthusiastic teachers who can convey the message cannot be overemphasised. The best key to success in science is to keep up the enthusiasm and dedication – powered by the feeling that something useful and constructive is achieved.

Highly specialised knowledge and a useful interactive language are the means for successful interdisciplinary endeavours. Since the scientific frontiers are moving very quickly, it is not very fruitful to drive specialisation far on the undergraduate level; on the contrary, undergraduate teaching should focus on basic knowledge as the foundation of all specialisation. It is always possible to send a company employee to a specialised course on circuit design or on multivariate analysis, but normally it will not be possible to send someone off to make up scarce knowledge of electromagnetic field theory.

Basic science and diversity can coexist reasonably with “priority research areas.” Many of the most fruitful and rewarding research fields are presently interdisciplinary in nature and cannot be well described by a single classification; frequently physics, chemistry, biology and medicine are all required for a successful end result in a research project. However, there is danger in educating research students too broadly, so that they know only little about many things. This may be useful in management, but not in highly competitive scientific and industrial developmental projects. In-depth knowledge and cross-boundary interaction with mutual respect for the capacity of each collaborator are key components in achieving the unconventional.

**Workshop 4 is concerned about:**

- Society needs to recruit more people into science.
- The investment in science is inadequate for likely future developments.
- In a knowledge-based society scientists have an increasing obligation to communicate more effectively with the public, the media, business and politicians.
- The teaching of science is inadequate at all levels of the educational system with respect to the future knowledge-based society.

Certain new areas, such as material sciences, nanosciences, information technologies, and genomics, are frequently identified as key priorities. While the importance of such fields is undeniable, a warning must be given against simultaneously suffocating other fields and basic science, which happens in many countries. With the majority of financially successful researchers running in the same direction, it is bound to become crowded if and when they reach the corner - the reasonable support for those wanting to run in other directions must be warranted to achieve long-term stability in technical development. It should be kept in mind that a majority of great technical discoveries, such as those leading to Nobel prizes, were made unplanned and outside major priority areas.

● **Ph.D. Pernille Winding Gojkovic, University of Copenhagen, Denmark:** *Entrepreneurship*

As a young scientist, the speaker described the skills necessary to participate in the upstart of a biotechnology company, as this illustrates some of the areas that the universities can develop for the benefit of its students, themselves and the private sector.

When starting a biotech company, the first thing necessary is an idea that can be developed into a product. This calls for a degree of innovative thinking – or, to put it differently, the ability to apply what one already knows in a different way. The second step is to perform an initial assessment of the possible market value of the idea – this requires interaction with people of a mercantile training and the ability to interact in an interdisciplinary way. To finance the costs of developing the idea, it is necessary to present the idea for investors - this requires the ability to present scientific information for non-scientists. Lastly, cooperative skills and flexibility are required for working together in a team consisting of people of different backgrounds with one common goal.

These skills can be developed and honed through a higher degree of interdisciplinary interaction at the universities. Although a high degree of specialisation is required to produce graduates of the required technical and scientific expertise, it is desirable to simultaneously expose students to different research environments. This will promote the ability to communicate and see their field in different perspectives and will push students to think in new directions. Whether young scientists leave for the private sector or remain at the universities upon graduation, these skills will benefit their future careers. Furthermore, universities will benefit directly by an enhancement of communication between the staff of its departments, institutes and faculties; this will provide opportunities for new ideas to arise.

## Key Discussion Points

### Interdisciplinary frontiers

The frontiers of science are developing very fast in particular within strongly interdisciplinary areas like:

- Nanotechnology, which is expected to penetrate every walk of life; computers and information technology, drug delivery, diagnostics, tissue engineering, chemistry, catalysis, sustainable energy production, and a broad range of new industrial products.
- Biotechnology, which may lead to new and superior crops, better drugs and new and sustainable production technologies in industry and agriculture, as well as renewable biofuels.
- Materials science, which is developing new materials with a wide range of specific properties. The new materials may be extremely light, durable and strong, or they may possess intelligent capabilities.
- Information processing technology, which will assist in analysing the vast amount of data that is now being accumulated in science. Data processing is important in constructing and manipulating information in biological databases of genomes, proteomes and metabolomes. Other important stores of information are in climate research and astronomy. Meanwhile IT and electronics are penetrating industry, as well as private homes.

This is just the beginning. Multidisciplinary science and technology is developing at such a speed that it is difficult to predict what will emerge just a decade ahead. The situation calls for greater interdisciplinarity in research and education, which will create important challenges for

universities and research institutions all over Europe. In addition, it is important to note that the distinction between basic and applied research may disappear, as results from basic science will be applied to products at an ever-increasing pace.

### Investing in our future

At present, the investment in science is inadequate for likely future developments. More funds must be allocated to science from private companies, national governments and the European Union, as is planned in the Barcelona Declaration of 2002. However, only a reasonable fraction of science funds should be allocated to priority areas and programmes. The greatest discoveries often come from scientists exploring fields outside the mainstream. In addition, funding should be given to encourage the formation of larger research groups, which is needed to promote multidisciplinary research in the future.

Another critical investment in emerging technologies will be efforts in analyses of teaching modes. Despite the new breadth of science, highly specialised knowledge is necessary for successful multidisciplinary work, and the acquisition of this knowledge must be sustained. We must also remain aware that not all students aim at a career in research science. Universities, therefore, should prepare students to enter private companies or set up their own business.

### Workshop 4 recommends:

- Presenting inspiring, applicable science at all stages of education, such that students are aware of the "endless frontier" of science (G.W. Bush).
- Offering both interdisciplinary and more traditional education. Depth of knowledge is still required, but should be combined with exposure to wider disciplines, including entrepreneurship, communication skills, finance, ethics, etc.
- Striving for better teacher education at all levels.
- Researching and presenting concepts on new methods of instruction and teaching students how to learn.
- Enhancing communication and analysis of the potentials of the scientific discoveries from the scientist to the politicians and the media serving society in general.
- Committing to fully communicating science (the good, the bad, and the uncertain) so that the public is informed enough to democratically participate in governmental decisions.
- Urging an awareness among scientists of their role and responsibility in relation to society.

# Workshop 5: Science Education and Careers

Chaired by Dr. Wolfgang Kerner, DG Tren, Technology Development and Dissemination of Results

It is generally considered that there is a serious lack of scientists and engineers in Europe and that an effort must be made to boost the number of young people choosing a science career in order to continue the development of our society. Europe needs better scientifically trained individuals at all levels from primary to tertiary education. In order to increase the number of researchers in public research positions in Europe, it is necessary to discuss how to make science education and careers more attractive.

## Speakers' Presentations

### • Dr. Wolfgang Kerner, DG Tren, Technology Development and Dissemination of Results: *Preface*

In his introduction, the chairman of the workshop reminded of the goal of the EU becoming the most competitive and dynamic knowledge-based economy in the world, set by the Lisbon European Council on 23-24 March 2000. In addition, he referred to the Barcelona European Council meeting on 15-16 March 2002, where the Council decided that, by 2010, the overall spending on research and development (R&D) and innovation in the EU should be increased to 3% of the GDP. These council decisions recognise the importance of a sound science and technology basis for the economy, and it is agreed that continuous progress and innovation should be based on three pillars: basic research, applied research, and intelligent use of technology.

An increased effort strongly depends on the human resources mobilised for the tasks of research, development, and innovation, and here we face a paradox; despite the onset of the knowledge-based economy, the career path of a scientist

or engineer is not perceived in a favourable light, and the interest of our young generation in science and technology seems to be decreasing. Even worse, there are indications of a shortage of human resources in several R&D areas.

It was suggested to address the following problems:

- Negative public perception of research and researchers
- Lack of qualified teaching skills in schools
- Decline in university enrolments
- Academic "brain drain" from Europe

In order to set a common ground for the discussions, three definitions were established:

- Researchers: As given in the Frascati manual (OECD, 1993), "professionals engaged in the conception or creation of new knowledge, products, processes, methods and systems, and in the management of the projects concerned."
- Science and Technology (S&T): The focus of the discussions, comprised of the areas including engineering, chemistry, physics, mathematics, biotechnology, informatics, etc.
- RTD: Research, technological development, and demonstration.

In addition, the time perspective in developing human resources for RTD is important to note. In the Bologna model, it takes 8 years to complete university training through to Ph.D. level, and if secondary school is included, 12 to 14 years of continuous training are the norm.

### Workshop 5 notes:

- In mobilising and retaining resources for RTD, Europe as a whole is lagging behind our strongest competitors in the knowledge-based economies.
- Our future supply of graduates of high research competence may be insufficient, even to maintain the status quo, if present trends continue.
- The remuneration and conditions of employment in public RTD are inadequate and not sufficiently attractive for the sector to compete for quality human resources.

### Workshop 5 is concerned about:

- The shortage of skilled teachers.
- An emerging preference for applied research and financial returns.
- Underfunding in the training and research sector.
- Career structure based on short-term contracts.
- Brain drain / gain.
- Ageism in science careers.
- The lack of positive media images and role models of happy, well-adjusted scientists.



● **Post Doc. Henrik Mouritsen, University of Oldenburg, Germany:** *A Career in Free Public Research – A Risky Future With Poor Perspectives?*

The Danish teachers in the field of natural sciences in primary school are too poorly educated, and the teaching is often targeting the poorest performing pupils in the class. This leaves no chance for the brightest pupils to reach their potential and is thus a serious waste of valuable human resources. Another problem is that most young people choose education on basis of interests rather than job prospective. To increase science recruiting, improved education for primary school teachers and an increase in the number of class hours on natural sciences are necessary. In addition, some sort of economical incentives for natural science students could be a way forward.

Many problems are also faced by young scientists in their research careers. Most scientists in the public sector do not achieve a permanent position before the age of 40. They are forced to spend considerable time for applying for various short-term postdoctoral projects – often involving shifts from one university to the other and between different countries. This “gypsy” lifestyle is hardly compatible with family life and raising children, and is thus unattractive. Making permanent positions available at a younger age might be a possible solution. Another suggestion is the introduction of evaluations every five years of individual scientists in permanent positions. Negative evaluations should not result in unemployment but transfer to other positions, e.g. administrative jobs. In this way further permanent science positions could be made available.

● **Professor John B.C. Findlay, University of Leeds, United Kingdom:** *Benchmarking Study on Human Resources in S&T in Europe*

In a study carried out on behalf of the European Commission, it was found that the number of scientific papers per million people in the EU is at a similar level with that in the U.S. However, the industrial exploitation of scientific discoveries is superior in the U.S., as is seen when the number of patents is compared. It is also relevant to note that enrolment into S&T study programmes in Europe are either stagnating or only rising very slowly. Another interesting observation is that Sweden and Finland are in the front, and far ahead of most other countries in terms of university enrolment of S&T students and production of Ph.D.s. This is not surprising in the view of their high RTD investments, but it is nevertheless worthwhile to study the reasons for the differences. A significant part of European Ph.D. graduates get their first job in the academic world, but also a significant ratio (about 30%) moves to the industry, not necessarily doing RTD. The industry needs these highly qualified human resources, but politicians are not aware that this calls for increasing the number of Ph.D.s produced.

The EU needs more and better scientifically trained individuals at all levels, and retention of enthusiasm for science at the later stages of school is crucial to this goal. When employment statistics are considered, it is found that departure from public research positions is as high as 40% in some European countries. Career progression is threatened by the many short-term contracts, and there

is a culture of ageism for the research scientist. However, some signs of encouragement are visible: some of the problems are perceived and accepted by politicians; new programmes, although not comprehensive, are being introduced; research funding is intended to be raised to 3%; and there are signs of recognition of the stipend and salary deficit which has slowly taken place.

● **Director Ove Poulsen, NKT Research, Denmark:**  
*Science Literacy, Education and Careers*

Society's science literacy needs to be improved, to a level of "Science for All." For this purpose, instruments should be developed for establishing an interactive dialogue between the science world and the rest of the society. Science should thus leave its self-inflicted isolation and the perception that science is for the few. In addition, educational reforms should be initiated, based equally on didactics and science information. Time has come where the European countries must collaborate to better understand the barriers in science teaching and the importance of an integrated science and technology culture being part of a socially robust knowledge infrastructure.

Tertiary education should understand better, and value, the primary and secondary levels, and that the present concept of one-way communication from science to society must be replaced by real dialogues based on knowledge. In addition, science and technology in our primary and secondary school system should be brought on equal footing with the social sciences and the humanities. The university level must tone down the "expert" syndrome and instead work for science to become a natural part of the common cultural background. In short, what is required is a shift from dissemination to knowledge, from science for the few to science for all.

Concerning science careers, a more transparent employment structure should be introduced and that the postdoctoral period should be limited to 3 years. In addition, the concept and use of tenure needs to be evaluated.

## Key Discussion Points

### Maintaining human resources

The remuneration and conditions of employment in public RTD are inadequate and not sufficiently attractive for the sector to compete for the most skilled human resources. A more differentiated employment and salary system should be implemented in order to better meet society's need for scientists.

Another factor in considering a science career is its probable basis on short-term contracts. Special support measures for installing the partners of the scientists, when moving from one place to another, are a possible measure for improving the situation. The initiatives of the Sixth Framework Programme in expanding scientific training and mobility activities to comprise the whole world may be an important step forward. In addition, the postdoctoral period should be limited and replaced by additional permanent positions.

### Political science

Today's world finds an increasing number of governmental decisions dependent on technology. In order to present politicians with the higher scientific knowledge required in making important policy decisions, scientists must come forward into the public sphere, presenting their research and results for the society. (However, it remains important to maintain the scientific world as politically independent.) Furthermore, applied and basic research should not be separated when discussing science and public research. To leave applied research out of the discussion would be the same as cutting the future feed-line for university research.

It is again noted that politicians' calls for more scientists are not reflected in scientist salaries, and that the public training and research sector is underfunded. Especially considering the ongoing brain drain from European public science organisations, actions should be initiated for making European universities more attractive for scientists, both in terms of salaries and working conditions. In this regard, public investments should move from a consumer attitude to an investment role.

### Workshop 5 recommends:

- Strongly supporting the political goal of rising to the 3% funding target of the Barcelona Declaration.
- Striving to improve science literacy and integrating science into our cultural background.
- Improving the focus on science and instruction skills in teacher education on all levels.
- Initiating actions in order to encourage all talented persons in science, no matter their gender, race or ethnic background.

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Professor Sune Svanberg, Lund Laser Center, Sweden  
Professor Lotte Søgaard-Andersen, University of Southern Denmark, Denmark  
Associate Professor Helene Sørensen, Danish University of Education, Denmark  
Director Albert H. Teich, American Association for the Advancement of Science, U.S.  
Ph.D. student Jacob Thorhauge, Young Scientist Association, Denmark  
Ph.D. student Rie Troelsen, University of Southern Denmark, Denmark  
Dr. Terje Tuisk, Foundation Archimedes, Estonia  
Nicolas Villeminot, French Embassy - Scientific Department, Denmark  
Head of EPR Department Richard West, European Southern Observatory  
Head of Section Louise E. Willumsen, Danish Research Agency, Denmark  
Dr. Elin Winther, Denmark



## The Danish Research Agency

Ministry of Science  
Technology and Innovation

In connection with Denmark's presidency of the EU, the Danish Natural Science Research Council hosted the international conference *Life in Science - Science in Life* on November 7<sup>th</sup>, 2002 in Copenhagen. Over 100 participants gathered to discuss science awareness, education, and career opportunities within Europe.

Opening remarks were made by:

- Hanne Severinsen, Chair of the Research Committee, Danish Parliament
- Enric Banda, Secretary General, European Science Foundation
- Gregorio Medrano, Head of Unit, Research DG, Science and Society, European Commission

Reflection on the programme theme *Life in Science - Science in Life* was presented by:

- Alan Friedman, Director, New York Hall of Science

Participants then attended one of five workshop sessions in which invited speakers gave brief presentations on the designated session topic. After a thorough discussion within the workshop, each group drafted a paper describing proceedings, shared viewpoints, and recommendations for action. These papers were presented at the conclusion of the conference. The participants agreed to meet again in 2004.

The conference was financially supported by the EU Commission, Research Directorate-General.