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Committee on Science and Technology

REPORT

Conference on Science and Technology in Europe **- Prospects for the 21st Century**

Gdansk (Poland), 9 to 12 October 2000

organised in collaboration with the European Science Foundation and
together with UNESCO

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CONFERENCE ON SCIENCE AND TECHNOLOGY IN EUROPE

PROSPECTS FOR THE 21st CENTURY

MONDAY 9 OCTOBER

OPENING SESSION

Chair: Mr ELO, Vice-President, Parliamentary Assembly of the Council of Europe

The session opened at 15.05 hours

The CHAIR declared the Conference, meeting in the magnificent city of Gdansk, open. It provided an opportunity for constructive dialogue between politicians, scientists, industrialists and representatives from research funding agencies.

Scientific and cultural co-operation, which had long been advocated, must be intensified in the 21st century: the necessary structures were in place. The enlargement of Europe in the 1990s had opened up new horizons and raised fresh challenges: the countries in transition had to contend with a brain drain and a lack of funding for research which hit young people the hardest.

Today, in Europe, each country conducted its own science policy, and there had been little debate on a European science and technology policy. It was to be hoped that the Conference would enable some headway to be made in that regard. All the organisers trusted that it would lend fresh impetus to the discussion and establish a new framework, while respecting the capacities of each country.

The proceedings of the Conference would form the basis for a report to be put before the Parliamentary Assembly of the Council of Europe for discussion. (*Applause*)

Mr RAKHANSKY (Chairman of the Committee on Science and Technology, Parliamentary Assembly of the Council of Europe) welcomed all the participants on behalf of the Committee.

He thanked Mr Plazynski, Marshal of the Sejm, Mrs Grzeskowiak, Marshal of the Senate, Mr Wittbrodt, Minister for Education, Mr Kolodziejczyk, Rector of the Technical University of Gdansk and Mr Wiszniewski, Science Minister and Chairman of the National Scientific Research Committee, for attending.

He further thanked the city of Gdansk and its residents and expressed his pleasure at being in Poland in the aftermath of the democratic election of the President of the Republic: he wished everyone concerned good fortune and success. His country, Ukraine, would continue its friendly relations with its Polish neighbour. He wished the Conference every success, and hoped that the voice of young scientists would be heard. (*Applause*)

Mr PLAZYNSKI (Marshal of the Sejm) welcomed delegates on behalf of the Polish Parliament to the Conference, which was being staged in the millennial city of Gdansk, the cradle of Solidarnosc and his native city.

Following totalitarian rule, Poland had witnessed an era of political and economic renewal. The previous ten years had been a time of great upheaval and of unceasing progress in the field of science and technology, in relation to the Internet, mobile telephony, the study of the genome, genetic engineering and the possibility of cloning.

All of these advances were both exciting and worrying. Some might feel, like Jean-Marie Lehn, winner of the Nobel Prize for chemistry, that science was outpacing the development of humankind and human civilisation. Not all scientific discoveries were being used advisedly; that was a problem that needed to be debated in a democratic fashion.

The Council of Europe represented a moral authority on this issue, in which it had always taken an interest, and its experience could form the basis for legislation to prevent misuse of science. The common European home must benefit from scientific progress. At the same time, scientists must exercise self-discipline in order not to lose sight of the overriding importance of human rights.

Its influence on economic development and competitiveness meant that science deserved substantial funding from the public and private sectors. Poland, like all the countries in transition, was struggling to provide the necessary funds. It was to be hoped that economic growth would make more funds available for this budgetary priority.

Scientific research was crucially important to Poland, as it offered prospects for co-operation towards the common good, rather than rivalry, and provided those countries that were not wealthy with added opportunities.

Mr Plazynski wished the Conference, with its full agenda, every success. He trusted that delegates would have time to visit Gdansk and come away with happy memories of Poland. (*Applause*)

Mr WITTBRODT (Minister for Education) welcomed delegates. As a Minister and a former Senator and member of the Committee on Science and Technology, he hoped that the Conference would be able to formulate some recommendations to governments.

He thanked the Committee of the Parliamentary Assembly of the Council of Europe for choosing to hold this meeting in Poland, a country which, like its neighbours, had witnessed profound changes, paving the way for increased co-operation: since the changes had begun, the Council of Europe had doubled its membership.

Poland had a long-standing university tradition. The University of Warsaw, which had produced such eminent personalities as Copernicus and Karol Wojtyla, had recently celebrated its 600th anniversary.

During the negotiations on membership of the European Union, the Polish education system had been found to be in line with European standards, in terms of the percentage of those engaged in research, research funding and the freedom granted to researchers.

Thanks to study grants in particular, the number of students had risen from 200 000 to 1.5 million, while the number of doctoral candidates in science had increased by 300%.

Following the reform of primary and secondary education, a reform of the university system was now planned, with the aim of improving the entire education system.

Despite these successes, a number of problems remained. First, there was the problem of funding. Public funding needed to be supplemented by private-sector finance. Firms were displaying some reluctance, however, with the result that students were being lured abroad. Co-operation therefore needed to be stepped up at all levels, including intergovernmental and European. Programmes had been launched in conjunction with Germany, for example, and Polish students and researchers could now take part in the Socrates and Erasmus programmes, and in the European Union's Fifth Framework Programme.

The Conference was to be devoted to the future prospects for science and technology. It would be called on to consider a wide range of issues: the place of the scientific community in society, the role of the media in promoting and disseminating scientific knowledge, the moral dilemmas facing researchers and the situation of young researchers. The latter had just held a two-day forum in Gdansk, and their voice must be heard, as the future lay in their hands ...

Mr Wittbrodt hoped there would be a rich debate which would contribute not just to promoting research, but to enhancing the welfare of the entire European family. (*Applause*)

Mr KOŁODZIEJCZYK (Rector of the Technical University of Gdansk) was pleased to welcome the Conference to the oldest university institution of its kind in Poland.

Gdansk formed part of a triad of towns with Sopot and Gdynia, making up a conurbation which had a rich cultural and scientific heritage, with a prestigious university, a theatre, an opera house and a philharmonic orchestra. Today, over 70 000 students were enrolled on various courses in the fields of technology, sport, medicine and music, in both the public and private sectors.

The city of Gdansk, which was over a thousand years old, was known for its famous citizens: Krüger, Schopenhauer, Hevelius, Fahrenheit, G. Grass and Lech Walesa, to name but a few. It was known also for its cosmopolitan outlook: Poles, Germans, Scandinavians, Scots, English, French, Italians, Russians, Jews and Tatars had a long history of peaceful co-existence in the city. Gdansk had links with a large number of European towns: the audience hardly needed reminding that it had played an important role in the Hanseatic League, which had in a sense foreshadowed the European Union.

The region, a good place to live and work, had unfortunately been ravaged by wars instigated by foreign powers. The last war – it was to be hoped that it really would be the last – had been a major tragedy. The speaker hoped that, with the changes that had taken place ten years earlier, the city and the whole of Poland had entered a new era in which science, technology and culture could flourish without borders.

Before the First World War, the Royal Technical University of Gdansk had numbered 700 students; between the wars, the Technical University of the Free City of Gdansk had had 1700 students from all over Europe. One of its lecturers had been Adolf Butenandt, winner of the 1939 Nobel Prize for chemistry, who had been made an honorary director in 1994.

The Technical University had expanded continuously since the last war, and now had 16 000 students and a teaching staff of 1 200 spread over ten faculties.

It was recognised as a centre of excellence.

The Conference should serve to strengthen links with the scientific community. Mr Kolodziejczyk hoped that all the participants would come away with very happy memories, not least of their visit to the magnificent city of Gdansk. (*Applause*).

Introduction to the Conference topics

Mr VAN DUINEN (President of the European Science Foundation) was honoured to have been asked to give the introductory address, which would focus on three themes: the relationship between science and technology, the relationship between science and society, and scientific policy in Europe. (Appendix 2: statement in extenso)

Science set out to understand the material world and the relationships between living organisms: it therefore went beyond engineering in the traditional sense, encompassing the so-called “social” and “human” sciences. It comprised a set of assertions that were constantly being challenged by research: the unknown quantities, uncertainties and half-certainties far outnumbered the absolute certainties. The dynamics of science were engendered by the process of research, the search for answers to the questions we might ask about the world around us.

Technology comprised all the methods enabling science to advance. In other words, new technologies were new methods which enabled research to be carried out that would previously have been impossible. The process was therefore as follows: science spawned new technologies which made new research possible, and the latter in turn engendered further knowledge.

There was a tendency, particularly in the past thirty years or so, for concepts that had previously been regarded as definitive to shift, and even be called into question, as a result of findings from other disciplines. Thus, molecular biology had had an effect on the practice of medicine, so much so that no one could predict today how diagnostics, therapies and even daily life in hospitals would look in twenty years’ time. To cite another example: high-voltage integrated circuits, initially developed for military applications, had formed the basis for the personal computer, which had enabled the new information and communication technologies to emerge. These in turn were revolutionising research, since it was now possible, instead of carrying out experiments *in concreto*, to simulate or model them on a computer.

The concept of scientific research itself had undergone a profound transformation. Research now entailed not so much finding solutions as challenging existing solutions or discoveries. Just like an artist creating a new work on a blank canvas, the researcher was exploring virgin territory, without knowing what he would find. His patience and tenacity had to be matched by the perseverance of those funding him, as research was a long-term pursuit. Several generations of researchers were needed before a scientific discipline could be established and flourish.

Humankind was only just beginning to understand the physical and material world of which it was a part. The view of research as a linear process was no longer valid. It was a mistake to see inventions as the most important element, giving rise afterwards to new products and economic activities. Governments and politicians often saw it as their duty to lend support to ensure that the transition from basic research to applied research occurred as smoothly as possible. If the theory proved incorrect, however, their support would have achieved nothing. This approach needed to be

turned on its head: the problem must dictate the solution, even if the solution turned out to be to another problem, as was often the case. The distinction between basic research and applied research was therefore very relative. It was more useful to talk of a “knowledge cycle” and an “innovation cycle”, each involving different individuals and different types of action. In the former case, the lead role fell to the scientists; in the latter, to business.

While the disaffection of young people with the study of science was undeniable, it should not be dramatised, as the problem could undoubtedly be overcome by migration. Mobility was an asset: the intellectuals of the future would travel and have contact with other cultures and other ways of life. That offered one of the greatest guarantees for worldwide peace and stability.

What “quantity” of science and technology did modern societies need? The most commonly used unit of measurement was a percentage of GDP. That was only partially satisfactory since, if research was growing more slowly than other activities, it was easy to jump to the conclusion that it was in a state of collapse, which might not necessarily be true. The increase in research expenditure should not outstrip the increase in the number of scientists and engineers, as science would otherwise be consuming what it itself had produced. It was no good setting over-ambitious targets: an annual increase of 15% was excessive, unless the number of scientists kept pace.

While science had much to contribute to society, the latter also expected a great deal from it; hence, the pressure on science to perform was commensurate with the expectations it raised. At times, scientists promised more than they could deliver, or presented as a certainty something that was in fact not certain. Concerns were being voiced, too, by decision-makers and ordinary people, and even among scientists themselves. The discovery and use of the atomic bomb had come as an enormous shock to many, and nuclear power had altered people’s perception of science. Now, GMOs were being seen increasingly as a threat, resulting in a grave danger that a very promising discovery would be unable to be used to feed the planet’s future population of ten billion.

Where some felt enthusiasm at the advances made by science enabling people to live longer and in better health and to enjoy more leisure time, others felt fear in face of the dangers and the questioning of their philosophical certainties or, quite simply, their way of life. Science was either the source of all good things or the source of all evil, liable to spiral out of control at any moment. Even in democracies, people had the feeling that the forces of change were beyond their control, and politicians were putting pressure on scientists to do what was expected of them.

The fact that there was pressure on scientists was not a bad thing in itself, given that a substantial proportion of research was financed out of the public purse. The quality of the work itself stood to gain from the existence of external control mechanisms. However, the pressure had intensified since the Second World War. While research funding had declined dramatically in the East, budgetary and demographic constraints were also much in evidence in the West. Scientists must therefore reaffirm, without overstepping the mark, that science was there to serve society.

While the distinction between basic research and applied research had become blurred, it was perverse to give a researcher limited time in which to demonstrate that the funding he had received had produced results. Solutions-oriented research called for a multi-disciplinary approach, which made the management and evaluation processes more complex. Such an approach had brought down artificial divisions between disciplines and prevented growing atomisation of the scientific community, which would have left the scientist as the only person who understood his own work. In other words, the multi-disciplinary approach had restored the universal nature of research. One discipline could now be evaluated by others: no longer could anyone act as judge and jury.

The last fifteen years or so had seen, in addition to the politicisation of science, the introduction of science into politics. In former times, the political powers-that-be had consulted scientists only on military matters. When Leonardo da Vinci was looking for a new patron, his chief selling point were his somewhat sketchy plans for an armoured chariot and fortifications. The contradictions in the system first became apparent in the 1970s: how was it possible to ensure that scientists did not give biased advice or, worse still, give a biased definition of the problem, to accord with their own interests? There was a great risk, for instance, that researchers might be suspected of acting as prophets of doom in order to obtain funding. To take just one example: an asteroid colliding with the Earth would clearly have disastrous consequences, but how great was the likelihood of such an occurrence? An astronomer who succeeded in convincing a government that the risk was far from negligible would be assured funding until the end of his days ...

Moreover, governments often chose their scientific advisers not so much in order to benefit from their advice as to back up their decisions with authoritative arguments, each party being validated by the other.

Political leaders expected to be kept informed of the latest state of knowledge in ever greater detail, to the extent that scientists were called upon to present some theories as certain whereas in fact they were not, or were becoming less so. The public sphere, in which the scientific community and public opinion debated topics of common interest, was largely monopolised by the media, which explained why the debate sometimes took strange turns, with the facts being simplified to the point of absurdity and scientific precautions being swept aside. The glut of media information and the politicisation of scientific discourse were conspiring to undermine the prestige and authority of science. Restoring these would not be easy, if it were even possible. There were those, moreover, who felt that it was not even desirable ...

The upshot was that the system must be reformed. The best means of achieving that was to review research priorities on the basis of the precautionary principle. The standing of scientists could be improved only by staging a frank public debate. In the past, the European Union framework programmes had been the culmination of a procedure that was less than transparent, not to say opaque. Once the programmes had been adopted they could not be revised. A decision had therefore been taken to reform the procedure, just as the University had decided that promotion should be on the basis of merit and results rather than mere seniority. Improved controls would prevent the interaction between politics and science from undermining the credibility of the latter. In addition, researchers must be made aware of the moral and ethical issues surrounding science.

Before discussing European science policy, one had first to address the question of where Europe stood in the world competitive stakes. Its position was still strong, but it had lost the top spot to the United States, albeit with some exceptions. When Europe managed to get organised as it had, for instance, with CERN or the European Molecular Biology Laboratory, it was more than a match for its trans-Atlantic rival. However, it lagged behind Japan in certain areas, owing to a failure to make economies of scale. Each country had its own research programme in addition to the European Union framework programme. The latter had brought benefits, but its overall budget was still modest, and its utilitarian nature meant that it could not compete with national programmes. Competitiveness was not everything, admittedly, but no one could deny that research was now an open, globalised, system, the results of which were in the public domain. The interaction which pushed back the boundaries of science now occurred at a global level, and the secret was to be able to change course if necessary and establish new priorities in the light of the latest developments. That meant having research scientists capable of assessing the situation when they arrived at a crossroads, and of knowing which route to take.

That was where the question of the level of resources came in, as the costs involved were of course considerable. As each European country aspired to excellence in all fields, the lack of a European policy constituted a severe handicap and a huge additional cost. If each centre wanted to attract the best teams, how could those of most interest to researchers be given an edge? In contrast to Europe, the United States had established a network of institutions that was a source of stimulation for everyone: how many European establishments could compete with MIT or Stanford? The American system was more open, too: the best people were chosen regardless of where they came from, while the European system was more compartmentalised, did not accommodate outsiders so readily and had to resort to subterfuge in order to circumvent the rules.

The old continent had, however, one major asset: its great cultural and scientific diversity. The fact that not everyone saw things from the same angle, and that people reasoned differently, was highly conducive to innovation. Making the most of this diversity was the key to reasserting Europe's leading position. The European Commission was working towards the creation of a European Scientific Area, bringing together researchers from East and West. The European Science Foundation should complement that by allowing co-operation between institutions and agencies funding research, rather than just between governments. The question was how to transcend national borders and achieve the necessary critical mass. It was to be hoped that the Conference would provide some pointers in that regard. (*Applause*)

THE CHAIR thanked Mr Van Duinen for his very useful contribution, which would undoubtedly provide fuel for debate in the days to come.

Topical contribution

Mr GABOLDE (Director for International Co-operation, Research Directorate-General, European Commission) was pleased to be speaking on such a topical issue. In January 2000 the European Commission had proposed the setting-up of a European Research Area, and on 4 October 2000 had adopted a paper on implementation of the initiative. On the basis of that paper, discussions were to be undertaken with all the players in the research field with a view to forwarding proposals for the next framework programme in early 2001.

While researchers knew that research, innovation and education were essential in order for societies to develop, this was the first time that the fact had been recognised at the highest political level.

At the Lisbon Summit, the Heads of State and Government had set as a strategic target the creation of a competitive knowledge-based economy in Europe. This was to be achieved by developing an information society for all, establishing a European Research Area, creating a favourable climate for innovative businesses – in particular SMEs – and investing in human resources.

The Heads of State and Government had called for an “open method of co-ordination” to ensure the dissemination of good practice and increase convergence. At the following Summit, they had undertaken to develop a European Research Area in particular by drawing up criteria for benchmarking Member States' and Community research policies, defining stages for financing centres of excellence, and networking national research programmes.

All the Union's bilateral summits – with the United States, India, Latin America and Asia – now systematically highlighted the issue of scientific and technological cooperation.

This new stage meant it was no longer a simple question of increased coherence between activities: all those concerned had undertaken to make the European Research Area advocated by the Heads of State and Government a reality.

Science and technology were changing all the time: the number of centres for the production of scientific knowledge had mushroomed; networking activities had increased; a large proportion of basic research was carried out in the context of possible application; the links between greater knowledge and financial and commercial interests had strengthened (hence the importance of the intellectual property issue, in an economy where knowledge was a form of capital); more and more breakthroughs were being made at the frontiers of disciplines (nanotechnologies, bioinformatics); the relationship between science and society was growing in complexity, and the old linear model was giving way to an interactive system of research, development and innovation.

All these trends complicated the task facing political leaders, who had to make increasingly complex choices owing to the international nature of research and its rising cost.

Europe faced an additional problem: the resources allocated to research, which were lower overall than in the United States or Japan, were very fragmented. Despite attempts at co-operation, for instance within the European Science Foundation, the European Space Agency and CERN, the lack of co-ordination made an overall research policy more difficult to achieve.

The Commission's proposal for a European Research Area had been an attempt to respond to this situation. The idea was not new, but had never been put into practice, because it had not been explored in detail and the time had not been ripe. Today, the idea had won acceptance and was starting to take practical shape: the Council of Ministers had set out a programme for achievement of its objectives. The aim was not to impose a further level of co-operation on top of existing activities, but to take structured action at European level, not just within the European Union: the candidate countries too were involved. The aims included:

- strengthening and integrating European infrastructures in order to create capabilities for excellence with the necessary critical mass, with networking of existing centres of excellence;
- defining and implementing a policy on infrastructures and large-scale facilities;
- developing a pan-European electronic research network;
- encouraging researcher mobility;
- developing European career paths for researchers;
- creating a favourable climate for innovation (start-ups, intellectual property rights, venture capital and taxation, etc.);
- taking account of the relationship between science and society.

There would be monitoring of national research activities and mapping of centres of excellence.

The European Research Area was not designed to be a "closed shop", but would be open to the rest of the world. Its completion would be the product of joint efforts by the Union, the Member States and researchers, with the emphasis on complementary action by the Union and the Member States.

There were three aspects to be taken into account:

1) the overall coherence of European scientific and technological co-operation (better co-ordination of the activities of the various organisations and between those activities and EU activities, more systematic use of the scope for joint measures);

2) the regional dimension (making full use of the dynamic of the regions and taking into account geographical or economic characteristics specific to particular areas);

3) the international dimension (enabling European researchers and industry to have access to knowledge and technologies produced elsewhere in the world, harnessing European scientific and technological capacities for the benefit of the international community in areas in which Europe had recognised expertise).

These three aspects would be taken into account by implementing joint measures with the structures of intergovernmental co-operation (ESF, EUREKA, ESA, CERN, etc.), the Structural Funds, the European Investment Bank and the programmes of assistance to the countries of central and eastern Europe and Mediterranean third countries, or measures complementing their activities.

With regard to selection criteria and priorities, Community action obviously formed only a limited part of total public expenditure in the Union. There was thus a need to focus on a few priority areas and to justify public funding for research.

Mr Van Duinen had made a plea for flexibility. The speaker also favoured a flexible approach, having been involved in the launch of the framework programmes. There had always been a desire to be able to react promptly, which had remained largely unfulfilled.

In future the approach would focus on implementing a coherent set of measures with an overall financing plan, in which the EU contribution would represent only part of a broader whole.

Measures would also be more structured and longer-term, based on forms of support mid-way between the current support for projects and permanent “institutionalised” financing. The schemes relating to researcher mobility and infrastructures were to be simplified in order to exert greater leverage on national initiatives.

“Variable geometry” instruments would be used to introduce greater flexibility into programmes. The use of all these instruments was designed to increase the number of activities financed by the Union whilst simplifying administrative procedures.

Mr Gabolde gave a brief overview of the research activities concerned:

- networking of national programmes. This was to be achieved by enhancing the mutual opening-up of national programmes with support from the Commission, in the context of the “open method of co-ordination”, and by co-ordinating the implementation of national programmes. In priority areas, the Union might participate in research programmes undertaken by several Member States, as provided for in Article 169 of the Treaty. The national programmes involved could be implemented by means of joint or co-ordinated calls for proposals, with the Union bearing the costs of co-ordinated implementation. Its financial contribution would be greater if the programmes were also open to associated countries;
- networking of public and private-sector capabilities for excellence through long-term joint programmes of activities. Such programmes would be based on a clear division of tasks and would

entail a minimum level of staff exchanges, use of electronic networks and development of interactive working methods;

- large-scale targeted research projects carried out by consortia of companies, universities and research centres on the basis of pre-established overall financing plans, the whole defined on the basis of the greatest transparency involving peer review. EU intervention would be linked to a commitment to getting a result in terms of technological achievements and economic and social impact. Some of these major projects could be based on the “clustering” of separate components, for instance in the form of technological platforms in the case of industrial research activities.

In a bid to link research and innovation, start-ups and SMEs, Europe would provide backing for regional and national efforts in support of technological innovation, the dissemination of results, research in SMEs and the setting-up of technology companies by means of: “collective research” activities or “co-operative research”, stepping up economic intelligence activities (collecting information of interest to SMEs), supporting initiatives to network researchers, entrepreneurs and financiers, and developing spin-offs and incubators.

In the interests of coherence, all these initiatives would have to be implemented in the context of overall action plans.

EU support for research infrastructures would be increased. Existing support for trans-national access to research infrastructures would be extended to include other aspects, in the context of association agreements. In the case of infrastructures recognised to be of European interest the Union could bear part of the construction costs, eg by co-financing feasibility studies.

It would do so in the context of financing schemes which combined funds of national and regional origin, from the European Investment Bank, the Structural Funds, from user companies and from private foundations.

On the human resources front, the number of mobility grants for researchers in EU countries, candidate countries and third countries would have to be increased.

In addition to grants for initial and continuous training, grants could be given for the transfer of knowledge and technologies to SMEs.

With regard to stimulating the development of scientific employment in Europe, measures to encourage the participation of women at all levels in scientific careers would be stepped up, while specific measures would be launched to encourage young people to take up scientific studies and subsequently carry out research.

Under the heading of science, society and citizens, a series of activities could be grouped together under the following themes:

- support for policy-making, in particular for the application of the precautionary principle (guarding against any drift away from it) and the sustainable development principle;
- development of a European scientific reference system through the intermediary of national research bodies or institutions in the Member States;
- research activities in the economic, social and human sciences on topics of European interest, with foresight and analysis work;

- initiatives relating to the “science/society” dialogue, including bringing into contact researchers, industry, policy-makers, researchers and citizens and promoting the public’s knowledge of science and technology;

- specific research in the field of ethics.

What means of implementation were to be used? Transparency continued to be key, with public calls for proposals and evaluation based on peer review. But changes were needed in the way research programmes were managed.

The activities carried out in the context of national programmes executed in a co-ordinated fashion with EU participation would be managed in that context. Some of the implementation tasks performed by the Commission could be externalised to enable the Commission to refocus on its essential tasks, which was one of the central elements of the reform of the Commission currently in progress.

The management of co-operative research grants for SMEs and of individual fellowships could be entrusted to Community structures of the “implementing agency” type.

What were the next stages? More detailed discussions would be held with all the parties concerned, on the basis of the communication of 4 October and of other papers, currently in preparation, concerning a European space strategy, benchmarking methodology and indicators, and science, society and citizens. A paper on research infrastructures was to be published later in the year, and another on mapping of excellence. In the first half of 2001, three papers would be published on human resources and mobility, the regional dimension and opening up to the rest of the world.

Changes were already being made within the Fifth Framework Programme to simplify procedures and increase the size of projects by raising the financing threshold. In the annual update of the “work programmes” of the research programmes, the emphasis would be on the use of electronic networks and the “clustering” of research projects. An initiative on the theme of genomics was due to be launched, involving activities in the fields of nanotechnologies and action to combat major illnesses. However, only with the Sixth Framework Programme would the objectives and implementation methods of the European Research Area be fully reflected in EU activities, following the discussions that had been announced.

That was why this Conference was so useful. One of the tasks ahead was to step up consultations with the candidate countries. Once the Commission had forwarded its formal proposal for a framework programme in the second half of 2001, the legislative decision should not take long, as the dialogue would already have been in progress for over twelve months. Whether by a happy accident of timing or the prescience of the organisers, the Conference marked the beginning of the discussions planned as a follow-up to the Commission’s communication. (*Applause*)

Mr JANUSZAJTIS (former President of the City Council of Gdansk) outlined the history of science and technology in Gdansk. Founded in the Middle Ages by the Polish dukes of Pomerelia, the city had been made German, under the name of Danzig, by the Teutonic Knights. It had come under Polish rule again after the Battle of Grünwald, before returning to Germany following the second break-up of Poland in 1792. For a number of years, under Napoleon, it had had the status of a free city, to which it had reverted between the two world wars, before returning to Poland for the third time in 1945.

The scientific tradition in Gdansk, a city which today had six scientific and technical higher education institutions, stretched back a very long way. Compulsory schooling had been introduced as early as 1525, and the city library had been founded by the *Senatus Gedanensis* in 1596, sixteen years after the Gymnasium, a secondary school of university standard, which had numbered among its teachers such luminaries as Bartolomeus Kekerman, author of numerous treatises on logic, mathematics, physics, astronomy, geography, politics, metaphysics and rhetoric, Philipp Cluwer, the father of historical geography and Peter Krüger, a pioneer of trigonometry.

One of Krüger's disciples, the Dutch astronomer Hevelius, had built an observatory on the roof of his house in Korzenna Street equipped with a micrometric-screw telescope of his own invention, which had functioned until his death in 1687. He had received subsidies from two kings: Louis XIV and Jan Sobieski, whose coat of arms featured on Hevelius's sky charts. Hevelius, who had been the first foreign member of the Royal Society in London, had written 28 scientific treatises, and his correspondence with scientists and academics from all over the world ran to a further 16 volumes. Of his students in Danzig, perhaps the most notable were the watchmaker Wolfgang Günther, who, together with Hevelius, had discovered magnetic declination, and Israel Kronen, also a member of the Royal Society, and the founder of modern cryometry.

A number of other illustrious scientists had lived in Gdansk: Fahrenheit, the inventor of the mercury thermometer and author of the first temperature scale; Daniel Gralath, who had built the first capacitor and had also been the first to measure the forces acting between two electrodes, using scales developed in Gdansk by the mathematician Heinrich Kühn. The latter had also proposed a geometric interpretation of imaginary numbers and had drawn up an initial version of Coulomb's Law forty years before his time. Others included Hugo von Conwert, who had been behind the adoption in Germany of the first European law on the protection of animals and Adolf Butenandt, author of works on hormones and winner of the 1939 Nobel Prize for chemistry.

Two naturalists from a family of Scottish émigrés, Johann Reinhold Forster and his son Georg, had taken part in Cook's second round-the-world voyage. On his return, Georg had published a description of the flora and fauna of the countries visited, and had taught palaeontology at the University of Vilnius. His theory of evolution had foreshadowed Darwin's. He had died in Paris shortly after the Revolution, having influencing Alexander von Humboldt, who had twice visited him in Gdansk and had described the cathedral of Oliwa as the eighth wonder of the world.

Finally, it should not be forgotten that the philosopher Arthur Schopenhauer had been born in Danzig, in Holy Spirit Street. In the wake of the second break-up of Poland, his parents had moved to Hamburg, taking him with them. He had died in Frankfurt, but had maintained throughout his life that his homeland was on the banks of the Vistula.

The region was also home to a number of engineering achievements. The lighthouse at Wislouchcie, the oldest on the coast, had been built in 1482, and remained operational until 1758; in 1887 the first electric lighthouse in the Baltic had been erected on the same spot. The famous crane of the port of Gdansk, erected in 1444, had been rebuilt after the Second World War, and its huge pulleys could lift up to four tonnes. It had been used principally for placing or removing ships' masts, Gdansk having been a famous centre for shipbuilding and ship repairs for over a thousand years. The water tower, which had seen the introduction of modern irrigation techniques from Holland, dated from 1536, and the city's fortifications, including some 20 strongholds also in the Dutch style, had made the city one of the main fortified towns in the region in the 17th century. Finally, the astronomic clock on Our Lady's Cathedral, which had recently been restored and was

now working again, had lost no more than a few minutes from its construction in 1560 until it had been destroyed by bombs during the Second World War.

Having played host, throughout its history, to scientists and technologists from all over Europe, Gdansk was surely the most European of Poland's cities, a place where any European might feel at home. (*Applause*)

THE CHAIR thanked the speaker for his thoroughly-researched address, which brought the introductory session to a fitting close.

The session rose at 18.40 hours

TUESDAY 10 OCTOBER

SCIENCE AND TECHNOLOGY IN EUROPE

Chair: Mr BIRRAUX (First Vice-Chairperson of the Committee on Science and Technology, Parliamentary Assembly of the Council of Europe)

The session opened at 09.05 hours

THE CHAIR welcomed Mr Wittbrodt, the Minister for Education, a former member of the Committee on Science and Technology and a pivotal figure in the organisation of the Gdansk Conference.

The pursuit of excellence in European science

Mr MICHALOWSKI (Head of the Megascience Unit of the OECD) reminded the Conference that research employed 1.8 million people in Europe, or 1% of the labour force. He stressed the excellent standard of European science, choosing to highlight the positive aspects rather than dwell on the negative aspects about which so much was heard: Europe's failure to keep pace with the United States and Japan, its lack of infrastructures, the lack of interest shown by young people in science. While these were all issues that merited the attention of policy-makers, science was experiencing a Golden Age. Talented scientists everywhere were coming up with extraordinary findings, and the accumulation of knowledge was enriching the culture and improving the daily life of Europeans.

Those in charge of management must endeavour to capitalise on the strengths of Europe's research system and remedy its weaknesses. The speaker proposed to take a look at the major scientific issues of the day, with the aid of slides.

The first issue concerned the structure of the universe, the distribution of matter and the beginnings and the end of the world. Copernicus, with his theory of heliocentrism, had been the first in a long line of researchers to produce spectacular findings. Today, it was common knowledge that the sun was just one of the 400 billion stars making up the Milky Way.

A group of English, American and Australian researchers had measured the galaxies and their relative positions with the aid of a telescopic robot in New South Wales. Their first

publication described the structure of the universe: the light from the furthest galaxy would take 2.5 billion years to reach the observation station. Copernicus had been quite right in saying that the Earth did not occupy a privileged position, but moved around in a sidereal void which might be best compared with a loaf of bread. That had been the case since the original 'Big Bang'. A joint Euro-American study using a balloon launched in Antarctica two years previously provided a snapshot of that initial state, by measuring the radiation emitted.

So what were the prospects for the future? Infinite expansion or a final Big Bang? The majority of astronomers inclined towards the former hypothesis.

While cosmology had enabled humankind to solve a great many mysteries, there were still many questions remaining unanswered. The answers to some would be found in the 21st century, with the aid of the appropriate equipment. The extraordinarily high cost of such equipment called for co-operation between Europe, America and Asia. Projects in the pipeline included a giant telescope with a mirror fifteen metres in diameter, a giant radiotelescope with 400 antennae of five metres diameter, the sending of three satellites which, by means of the triangulation of laser beams transmitted at a distance of five million kilometres, would prove the existence of the gravitational wave postulated by Einstein, thus making it possible to pinpoint the exact moment of the Big Bang.

At the other end of the scale was the study of the cell. The discovery of DNA had been the revolution of the past fifty years, and the sequencing of the DNA genome was now almost complete. The advent of the post-genomic era would require a much higher level of investment than sequencing had done. In order to decipher the structure of proteins, particle accelerators such as synchrotrons were needed. The molecular biology team in Oxford had managed to demonstrate the reverse transcriptase activity involved in contamination with the HIV virus, thus marking the beginning of the post-genomic era. On the basis of a physical image of the enemy (the virus) it was possible on a computer to devise a three-dimensional response and thus arrest the process. In relation to Aids, that discovery had culminated in the manufacture of a substance called nevirapine, which was currently undergoing toxicity and safety trials and had the potential to improve the lives of Aids sufferers.

The basic mechanisms of life were not as yet fully understood, but that would be achieved in the 21st century. It was interesting to see how the study of the universe and of the cell were linked.

Science in Europe was tremendously exciting. It had the capacity to save lives and provide the answers to fundamental questions, and therefore deserved support.

The speaker was aware, however, of the political issues surrounding funding, international collaboration, right of access to data, intellectual property and ethics, all topics on which he had deliberately not touched. (*Applause*)

European science and technology in a global perspective

Mr PAPON (President of the Observatoire des Sciences et des Techniques, France) thanked those responsible for organising the Conference, which came at an important time for research in Europe. The production of scientific and technical knowledge in Europe required resources on a continental scale. From the outset, European integration had had a scientific and technological dimension, as demonstrated by CERN, ESA and Airbus.

European research had taken shape over the past century thanks to a network of public and private institutions with a wide variety of statutes. There was no single model for public research,

but instead a number of systems ranging from largely decentralised funding in Switzerland and the Scandinavian countries to strong central structures such as the CNRS in France, the DFG and the Max Planck Institute in Germany, the CNR in Italy and the science academies in central and eastern Europe.

The new departure had been the setting-up, since the 1950s, of a handful of European research institutions (CERN, ESA, ESO, ESRF, etc.) with large-scale facilities, which had paved the way for common practice and co-operation, with the framework programmes acting as a catalyst. Today the EU countries administered 14.5% of their civil public research budget within a European framework. In 1999 the budget of these European research infrastructures had totalled 3.5 billion euros, compared with the 3 billion euros earmarked annually for the framework programme.

Europe – the EU, EFTA and the countries of central and eastern Europe – ranked second in the world in terms of research and development expenditure, after North America, with figures of 27.8% and 36.7% respectively in 1996. Whatever Mr Van Duinen might say about the need to treat statistics with caution, there was no doubt that measuring the temperature – one was reminded of Fahrenheit in Gdansk – while it did not give a precise reading of the situation, did provide some insights. Research and development expenditure as a percentage of GDP, which provided an approximate gauge of the level of the research effort, had in 1999 averaged 1.8% in the European Union (0.5% in Greece and 3.6% in Sweden) and 0.6% in the CIS countries, as against 1.9% in Asia and 2.8% in the US.

Scientific publications and patents provided a further basis for comparison.

Europe had accounted for 37.5% of world scientific output in 1997, compared with 36.6% for North America and 10.8% for the industrialised countries of Asia. Europe had therefore managed to achieve scientific excellence, despite the fact that per capita output was lower in Europe, whose population was 75% greater than that of North America.

Overall comparison of world technological performance was not in Europe's favour. In 1997, Europe had registered 46.3% of European patents and 19.7% of American patents, while North America had registered 35.2% and 51.5% respectively and the industrialised countries of Asia 15.5% and 27.5%. A loss of market share of 25% demonstrated Europe's difficulty in putting the results of its research into practice. In his January 2000 communication on a European Research Area, the European Commissioner Mr Busquin had highlighted the lack of a European research policy and strategic vision.

The diversity of national and European scientific institutions was both a strength and a weakness. That diversity, rooted in the history and culture of each country, was an asset which made it possible to respond to multiple needs. However, it also acted as an obstacle to concerted action and researcher mobility. Nevertheless, the network of European research infrastructures contributed to Europe's scientific importance and attracted researchers, eg to CERN, the ILL neutron reactor and the synchrotron facility in Grenoble.

Another weak point in Europe was the lack of cohesion between national efforts, resulting in great imbalances in development. The countries of southern Europe (Portugal, Spain, Greece) and Ireland had made considerable efforts to catch up, but those efforts were still not enough, particularly in the technology sectors. As for the countries of central and eastern Europe applying for EU membership, their investment in the research field had been on the decline for ten years,

whereas they should be modernising their infrastructures and training a new generation of researchers.

Europe needed a proactive policy aimed at greater overall cohesion and avoiding a “two-track” scientific Europe. Would the recent communications from the Commission act as a wake-up call? There was reason to doubt that they would. Central and eastern Europe needed some modern equivalents of Marie Curie.

Commissioner Busquin’s report, approved by the Council of Research Ministers, had prompted a discussion on aims and means. The Europolis project, piloted by seven European research institutes and coordinated by the OST, was devising scenarios for research policy. There were a number of points of convergence: the need to assess Europe’s strengths and weaknesses; the need for flexible co-ordination of national research programmes and for networks linking public laboratories and private enterprise (here, the notion of “variable geometry” already put into practice by CERN and ESA seemed to be making headway); the need to support basic research (project funding, doctorate and post-doctorate grants, etc.), since, in a knowledge-based economy, it was important to broaden Europe’s scientific base; the need for greater co-ordination between research programmes and the framing of public policies with a European dimension (health, environment, transport, etc.).

European research was carried out in a world context: Europe participated in international programmes (climate study, the study of biodiversity, etc.) and in development aid programmes in African and Latin America.

With regard to world research, there was no common approach on objectives or programmes. The EU countries rarely co-ordinated their position concerning participation in major programmes such as climate study, with the exception of the EuroGOOS consortium’s participation in the Global Ocean Observing System. European participation in these major world programmes, and in Third World development programmes, must be co-ordinated. Owing to its colonial past, Europe had maintained close links with some Third World countries, and it must work together to organise scientific co-operation with them.

Research and technology were key elements in the globalisation process, a process which widened gaps between nations. A *de facto* dual system had evolved, comprising the fifty or so countries which produced scientific and technical knowledge (including all the European countries) on the one hand, and the rest of the world on the other hand. The intellectual property policy of the developed countries acted to protect systematically, and often abusively, scientific discoveries before their widespread dissemination, particularly where life sciences were concerned, thereby further widening the gulf between developed and developing countries in sectors such as biology and genetics. Europe should adopt a common approach to intellectual property in order to boost the widespread dissemination of scientific knowledge, currently under threat from the practices of multinationals. It was a question of the “governance” of world science. Europe should lend its support to attempts to deal with such problems and to the regulatory mechanisms which should be introduced on a global scale. That should be one of UNESCO’s tasks, one which it was slightly inclined to overlook. The Council of Europe was one of the forums for discussing such issues relating to the ethical aspects of knowledge. Europe had to put across a coherent message on the “governance” of world research, showing its solidarity – a word that had particular resonance in Gdansk – both with the developing countries and with the countries of eastern Europe. (*Applause*)

Mr IACCARINO (Secretary-General of the World Conference on Science organised by UNESCO and the International Council for Science) said that the gradual realisation by

scientists that all natural phenomena could be explained using scientific laws had given rise to positivism, a school of philosophy which had gone out of fashion, but which had had a profound influence on the social sciences.

Beliefs that had acquired the status of established facts had been shattered by new theories such as Max Planck's quantum theory or Hubble's theory on the expansion of the universe. Prigogine's work on thermodynamics and recent research in the biology field had brought to light complex interactions which could not have been predicted except by using very powerful computers and presenting the problems in an extremely simplified form. Thus it was fair to say that no method existed of apprehending the universe in all its complexity. Discussing the future of science meant first of all taking account of the philosophical problem thrown up by that very complexity.

Nevertheless, science had been one of the chief motors of development in the 20th century. It had revolutionised not just people's day-to-day lives, but also the way in which they saw the world. Most of the great scientific discoveries had originated in Europe, and more than half of the Nobel prizes had gone to European scientists. Of these, most had come from western Europe, not because the East had not produced some excellent scientists, but because they had been cut off from the international scientific community for decades. Today, European science was still in a strong position, even accounting for a growing share of scientific publications worldwide, but no single country could claim the leading role: hence the need for intensified co-operation.

It was important to bear the demographic forecasts in mind: by 2050, Europe would have only 630 million inhabitants, compared with 730 million today, ie 9% of the world's population as opposed to 13%. The population explosion in the Third World would spark off conflicts linked to poverty and the failure to satisfy basic needs with regard to water, food and energy. Europe was very close geographically to both Africa and Asia, and would struggle to withstand such pressure at its borders. It must therefore endeavour to ensure that science and technology promoted equitable development of the less wealthy countries.

While all governments were in official agreement in that regard, creating the practical conditions for such development was less straightforward. Claiming, as had been the fashion twenty years previously, that the developing countries needed technology more than science was a very egocentric view to take. In 1999, UNESCO and the International Council for Science (ICSU) had held a World Conference on Science, the final declaration of which had called for the transfer of know-how with a view to the formation of indigenous scientific networks in the developing countries. The Conference had been attended by representatives from governments, NGOs and scientific institutions and from the Parliamentary Assembly of the Council of Europe. In addition to the final declaration, there had been unanimous approval – ie also from the United States – for a paper entitled “Science Agenda –Framework for Action” which advocated the intensification of international scientific co-operation.

At the same time, governments had a tendency to give priority to research likely to produce short-term tangible results for the economy, with the result that funding for basic research and international co-operation was declining. However, co-operation was precisely a means of mobilising more funds to the benefit of more people. Governments must therefore learn to share out investment, in particular between eastern and western Europe. History had shown that the most creative countries were those located at the crossroads of several cultures, as was the case in Europe. It was to be hoped that the Committee on Science and Technology of the Parliamentary Assembly of the Council of Europe would manage to persuade governments to step up co-operation within Europe and assist the developing countries in overcoming their handicap. (*Applause*)

Mr BUDINICH (Director of the Third World Academy of Sciences, Trieste) was honoured to represent the Third World Academy of Sciences at the Conference. He would sketch out the history of the Academy before speaking about its activities and projects.

In 1964 the International Centre for Theoretical Physics (ICTP) had been set up in Trieste, a city which had found itself after the Second World War on the border between the two halves of Europe. The ICTP had been administered by the International Atomic Energy Agency until 1966, when it had come under the aegis of UNESCO. Its *raison d'être*, from day one, had been to provide backing for research in developing countries. Its first director, moreover, had been a representative from a Third World country, the eminent Pakistani physicist Abdus Salam, winner of the 1979 Nobel Prize for physics.

The setting-up of the ICTP had been the culmination of a long-standing European project developed by Bohr, Einstein and Oppenheimer. The success of the enterprise had brought other scientific institutions to Trieste, including the synchrotron radiation laboratory and the International Centre for Genetic Engineering and Biotechnology (ICGEB), which also had a branch in New Delhi. In 1983, at the instigation of Abdus Salam, the ranks of these organisations, known collectively as the “Trieste system”, had been expanded to include the Third World Academy of Sciences. The Academy, which had 543 members, including 17 Nobel prizewinners, awarded grants and prizes to young researchers from developing countries, funded seminars and advised governments on science policy. The Trieste system had also contrived throughout the Cold War to maintain scientific co-operation, unique in its effectiveness, with researchers in central and eastern Europe.

The Davos World Economic Forum in February 2000 had decided on the setting-up of an InterAcademy Council (IAC) designed to gather data on subjects of importance to the Earth's future such as climate, water and energy resources and biotechnology. In Tokyo in May, a decision had been taken to locate the headquarters of the new body in Amsterdam and to link it up with the InterAcademy Panel on International Issues (IAP), with a permanent secretariat in the Third World Academy of Sciences in Trieste. The IAP, co-chaired by a Frenchman and a Brazilian, would be up and running early in 2001.

As there were no signs of a slowdown – quite the opposite - in the rate of scientific progress, the stakes were set to become ever higher, and governments must have access to reliable, objective and impartial information, updated on a regular basis. The IAP must therefore be able to call on the world's leading experts, who in turn must retain their independence vis-à-vis pressure groups. That was why the choice had fallen on the Trieste system, which had demonstrated both high scientific standards and objectivity and which had the added bonus of providing a pleasant place to live and work. Virtually all the Nobel prizewinners had spent time there, like the physicist Alfred Kastler, who used to go every year and had said that, although he might be offered two hundred times more money to go to the United States, at least when he went to Trieste he returned home to Paris with a clear conscience.

Some research topics would be determined by the international community. The World Bank had recently launched a ten-million dollar research programme on global warming. The IAP, however, could establish its own work programme. The following year, for instance, it was organising a congress of African academies followed by a workshop, with a view to bolstering the position of scientific academies in Africa.

In Italy, President Ciampi had taken the Trieste system to heart, and the Italian state would therefore doubtless continue to be generous in its support. It was to be hoped that the European

Union and its Member States would display similar generosity, given that the other participants in the ICTP, whether Third World countries or countries applying for EU membership, were not well placed, for financial and administrative reasons, to step up their involvement.

The Third World Academy of Sciences was currently engaged in setting up a project, known as ECSITE, aimed at fostering a culture of science and technology in Africa. At its Dakar conference in the autumn of 1999, educational videos had been shown, some made in Trieste and some in Senegal, which had been enthusiastically received by schools and, when shown on television, had prompted discussions between students and their families. In addition, the major European science museums had got together to organise travelling exhibitions on the continent, starting in Mali and Senegal. Assistance from the European Union would, once again, be welcomed, and tangible results were expected from the next ECSITE meeting, to be held in November 2000 in Naples.

Europe had a moral obligation to Africa, which had been the source of a large part of its culture and wealth. The library of Alexandria, after all, housed the greatest treasures of the world's cultural heritage. (*Applause*)

Science as part of European culture and co-operation

Mr BEKSTA (Minister for Culture, Lithuania) endorsed the words of the Conference programme to the effect that science and technology had always been of importance for development, culture and co-operation in Europe and in the 20th century perhaps more intensely than ever before.

From the monasteries to the universities, Europe's identity had been forged by intellectual activity. It was in Europe that science and scientists had been alternately persecuted and revered.

The 20th century had not just been the century of co-operation: it had also been a century of division into two blocs, preventing any co-operation. Developing science and technology meant pooling resources: the further knowledge advanced, the more costly the tools needed and the greater the need for new methods. As technological development became too closely linked to the pursuit of profit, competition grew and there was a growing trend towards industrial secrecy.

Private firms' expenditure on research and technology was substantial, compared with the State budget, the reason being that they could justify it easily as a means of boosting profits. Governments had a more difficult task: faced with citizens demanding to know how their money was being spent, policy-makers had to come up with a satisfactory answer.

The countries of central and eastern Europe had for a long time been cut off from scientific development in the West. The collapse of the Iron Curtain had opened up new horizons for scientists, particularly in terms of participation in international programmes.

In the former communist countries, which had lost the military market, science could not flourish without European co-operation.

Inequalities between North and South and between East and West had to be redressed in order to halt the brain drain. There was a need to replace infrastructures, step up co-operation, in particular with the smaller countries, and make greater use of information technologies, while taking account of cultural diversity and allowing freedom of expression.

The large multinationals promoted the development of the exact sciences and of technology, a situation not without an impact on the human sciences. The European Union had implemented the principle of free movement of goods, services, capital, ideas and persons, but too little consideration had been given to the human and social aspects. The vision of Europe had been created by politicians and economists. In his address to the World Conference on Science in Budapest, the President of the Lithuanian Academy of Sciences had deplored the fact that so little attention had been paid to the social and human sciences, which helped to shape national identity.

The people of Europe were not merely interested in what EU membership could do for them, they were also concerned for their national identity, as the recent votes in Denmark and Norway had illustrated. Resolution 986 of 1992 on the risks of technology had highlighted the fact that, while the public benefited from the new technologies, people had also become aware of their ethical and environmental implications.

As science was an integral part of culture, a debate was needed on how it might help to forge a European identity.

What were Europe's values? What kind of identity did it want? What decisions should be taken to uphold it? A group of scientists and intellectuals should meet to answer these questions, prepare research programmes and organise a conference of scientific, cultural and political leaders with the task of drawing up a declaration on European culture.

Tomorrow's Europe was in the making. The process must include everyone: scientists, cultural figures and politicians, from both East and West. (*Applause*)

THE CHAIR thanked the speaker for his outline of future prospects. The Council of Europe and what, from January 2001, would become the Committee on Education, Science and Culture, were indeed appropriate forums for devising a common strategy and defining a new vision.

Mr KUKLINSKI (European Institute for Regional Development, EUROREG, University of Warsaw) referred back to what Mr Van Duinen had said about the military-industrial complex. It was true that the United States and the Soviet Union had, historically, been in the vanguard of science. The result had been very intensive growth of science, bringing benefits to civilians, but also causing over-development of the sector and creating huge numbers of scientists.

Should research in central and eastern Europe be subjected to the same draconian regime to which a Polish peasant had subjected his horse – resulting in the death of the horse? Policy-makers in these countries were imposing a harsh regime on the science sector to the detriment of scientific research: for every 500 dollars spent by Germany, Hungary and Poland spent 50! What chance did they have to compete on equal terms?

It was impossible not to be irked by western colleagues who called on the central and eastern European countries to reduce the numbers of scientists, when to do so would be an act of suicide. These countries needed scientists in order to enter the era of information technology and new technologies. They were able to find the money to subsidise wholly unprofitable mines: that money could be put to better use. Political leaders must impress upon their fellow citizens the importance to their countries of supporting the development of scientific research.

Finland, on losing the Soviet market, had responded in the right way, by increasing its research budget. Poland, by contrast, had cut its budget! (*Applause*)

Mr PAPON, although a native of western Europe, agreed with Mr Kuklinski's analysis. The central and eastern European countries, which had often been poorly advised by the IMF, needed to inject funds into raising standards, as Hungary was planning to do.

Within the European Union the resources allocated to the cohesion countries (Spain, Portugal, Greece and Ireland), in particular from the Structural Funds, had enabled them to improve their infrastructures and achieve scientific success.

The accession negotiations must address this issue with a view to devising development plans to train young researchers and stop them leaving for good, and to bring research infrastructures up to standard. The situation called for a political response.

Mr MAN (Romania) felt that devoting less than 2% of GDP to science and less than 5% to education was jeopardising the future. Globalisation meant preparing for the future: the global economy depended on global politics and strategy.

For every three billion ecu spent by Europe the United States – which had just boosted its military budget by 41 billion ecu – spent a hundred times that much!

Furthermore, six billion of the world's population suffered from hunger and one billion from famine, meaning that they had fewer than 1000 calories a day. There was therefore a development problem. The market economy, which held sway throughout Europe, appropriated 40% of the world's oil resources.

An economic crisis was predicted in the next cycle, ie in the next seven years. The necessary decisions must therefore be taken now, as GDP levels in the future would not be adequate to finance the 2% earmarked for science or the 5% earmarked for education.

The answer was to adopt a new approach to economics and a new attitude, both information-based, in order to avoid repeating past mistakes. At the moment the economy was in the grip of speculative forces which swallowed up millions of dollars (more than the GDP of the United Kingdom, France and Germany) in pure losses. National States were no longer protected: when the situation was stable, there was no problem, but if a crisis loomed, immediate action was needed to halt it. It was important to act today, as tomorrow would be too late. (*Applause*)

Mr VIDA-SIMITI (Deputy, Romania) spoke of the problems facing research and technological development in his country, which was a candidate for membership of the European Union.

Romania was undergoing a period of economic, moral and institutional reconstruction. Economic reconstruction was aimed at achieving the transition from a planned economy to a market economy and at making up lost ground, in order to rejoin the European family.

Scientific research was an area of huge potential and one of the leading items on the negotiating agenda.

Some reforms had already been carried out in Romania: decentralisation of funding on the basis of the national plan, in accordance with the government's programme; support for innovation to allow products to compete; the creation of mechanisms designed to pool funding from enterprises; transparency in the use of public funds; targeting of research on SMEs; international

co-operation and participation in European programmes; introduction of multi-annual budget programming.

Romania had been taking part in the EUREKA and COST programmes since 1997, and in the framework programmes since 1998.

The European Union had stressed the substantial progress made by Romania. On the legislative front, the initial goal had been achieved: it was now a matter of continuing implementation. There had been some setbacks in that regard owing to the lack of financial resources, which was contributing, *inter alia*, to the alarming decline in the number of young researchers.

Research funding had declined steadily, representing 0.18% of GDP in 2000 instead of the 0.8% that had been planned.

What was to be done? For the reforms to have any effect, the level of funding must cover requirements, and the latter must be clearly defined in the light of priorities. The national plan for research, technological development and support for innovation was under discussion. The following priority areas had been identified: the information society, agriculture, biology, biotechnology and nanotechnologies, new materials, environment, basic research, physics, co-operation and standardisation.

The research programmes must form a clear part of a coherent approach in order to contribute to achieving economic and social reform.

Mr Vida-Simiti thanked the Polish authorities and the University of Gdansk for inviting them to this lovely historical city, which had given the world the century's leading figure, the Holy Father, John Paul II.

THE CHAIR reminded delegates of the Council of Europe report on new technologies and technology transfer to SMEs, which described how to gear applied research to the economy and to meeting people's needs. Europe, both East and West, had only just embarked on a process which was gathering momentum.

Mr GVINDADZE (Minister for Foreign Affairs, Georgia) observed that the number of scientific papers published in Africa, the Muslim-Arab world, eastern Europe and China, which had been virtually nil just five years previously, was growing substantially. These countries were enjoying a boom in scientific and intellectual activity that was not always recognised in western Europe and North America. It was vital, therefore, for their leaders to realise the need to preserve their scientific potential and, accordingly, to devote more money to it. In Georgia, a country with considerable experience in the field of fifth-generation combinatory techniques for processing information, the equivalent of the average salary of a researcher in the West would pay 300 members of staff at the National Science Institute. A similar situation obtained in all the countries of the former USSR, which had a large number of high-calibre scientists and scientific establishments. The brain drain must be halted as a matter of urgency.

Mr IACCARINO wished to confine his address to just two points. The first point, which some might regard as cynical, related to international co-operation. While institutions such as the Council of Europe and the European Science Foundation might show proof of generosity, the same could not be said of governments, which were responsible for national budgets. One useful approach to persuading them to provide more funds despite the financial constraints consisted in

pointing out that cultural diversity stimulated creativity. A large part of European scientific knowledge came from Muslims who themselves had inherited it from Indians, Chinese and other peoples. Europe as a continent was very diverse culturally, and it was therefore in the European Union's interests to strengthen its ties with central and eastern Europe.

In the West, and to a lesser extent in the East, scientific policy was directed largely at making industry more competitive. That being the case, why not let industry itself finance the research? The task of government was not just to devise industrial policy, but to provide a long-term scientific vision. Western leaders needed to be persuaded that it was in their interests to head off future conflicts by transferring know-how to assist developing countries, whose material and intellectual resources they had plundered in the not-so-distant past.

His second point related to publications. While, as Mr Papon had pointed out, the number of publications was not the sole criterion, there were grounds for caution concerning Europe's performance. Having collapsed between 1990 and 1995, eastern Europe's share had risen again, but China's had increased by 40% during the same period, thanks to the return from exile of large numbers of scientists and to the resources which had been invested in scientific education over a long period. Equally, the fact that a country like Italy, which lacked natural resources, had made such strides since the last war was due to the emphasis it had placed on education throughout the 20th century. It was a shame that the emphasis been less strong in recent years ...

Mr RAKHANSKY echoed the sentiments of the previous speakers – how could science hope to survive in a country where it received only 0.18% of GDP? He failed to comprehend why the resources allocated by governments continued to decline, thus jeopardising all the potential that had been built up over decades. Parliaments and governments needed a firm reminder of the debt which the present generation owed to its predecessors.

Mr BUDINICH recalled how the ICTP had managed for thirty years, with scant resources, to devise ways of helping isolated researchers both in the developing countries and in eastern Europe. For instance, researchers who were isolated in their own countries could be made associate members, enabling them to spend one or two months a year in Trieste over a period of three or four years, on condition that they did not take advantage of their stay to emigrate. Conversely, the ICTP was able to welcome prestigious guests who were content with a modest *per diem*. Furthermore, the Centre's contacts at government level meant that, if necessary, visas could be obtained in 24 hours, as had happened, for instance, with Czech researchers in 1968. It should be possible to make more widespread use of these simple and not too costly procedures.

THE CHAIR thanked the speakers, inferring from what they had said that the pursuit of excellence often entailed passing the hat around. (*Smiles*) Nonetheless, the discussion had managed to rise above that aspect and afford everyone an insight into the current state of science and its future prospects. The question of evaluation, however, had scarcely been touched upon, despite the current context of increasing globalisation, which was in danger of heightening the disparities between countries.

THE ORGANISATION OF EUROPEAN R&D CO-OPERATION

Chair: Mr TIURI (Deputy, Finland)

An overview

Mr BANDA (Secretary General of the European Science Foundation) felt that the future lay with the creation of a European Research Area. Speaking on behalf not of an intergovernmental organisation, but of an association of researchers, he stressed that the Europe in question was not confined to the 15 Member States of the Union.

As Mr Papon had pointed out, the organisation of science and technology in Europe was a complex affair. The forty or so countries, with their different structures and languages, lacked the resolve to act together, and the complexity of those national structures made it even more difficult to gain an overall picture. There were historical reasons for that complexity. The main structures for co-operation had been set up between the 1950s and the 1970s. After that had come the framework programmes, which, on the upside, had lent a European dimension to research, and on the downside, had stifled all initiative. With the aid of slides, Mr Banda described the current situation: a constellation of bodies with different tasks which sometimes overlapped, and a set of partners including parliaments, governments, funding agencies, universities and industry. (It should be noted that there were no East-West tensions within the scientists' associations: it appeared that science was ahead of politics.) Within such a complex system, there were bound to be tensions between countries, between institutions, and between the Council of Ministers, the Commission and the European Parliament, etc.

However one felt about them, the various statistics were useful in that they gave some idea of the relative amounts allocated by different countries. Thus, in 1999, 3.1% of Japanese GDP had been devoted to research and development, compared with 2.7% in the United States and 1.8% in the European Union. Scientists knew that the most important government action was the approval of the budget.

According to the Eurostat statistics, the gap between Europe and the United States in research spending was widening, a situation which gave grounds for pessimism. However, it was wrong to focus just on the negative statistics. At the Olympics, for instance, very little had been made of the fact that Europe had won 239 medals compared with the United States' tally of 97. The American press, for its part, had deplored the fact.

It was easy to say that the whole was greater than the sum of its parts, but was it necessarily true? Not in the case of European research, where efforts were being duplicated. At European level, funding the same research twice was deemed acceptable, as it would not be at national level. The three latest winners of the Nobel Prize for physics were Europeans who worked in the United States, a fact which spoke volumes about the environment they had encountered in Europe.

The idea of a European Research Area was not new, as Mr Gabolde had said, but the time had come to make it a reality. The Commission had adopted a number of documents and the message had got through to the scientific community, which had the impression that at least it was being consulted.

The ESF had considered the concept of a European Research Area as an overall project providing a coherent framework. It was important to:

- define a European research policy. Just a year previously, claims that no such policy existed had been frowned upon; now, the fact was officially recognised;
- define the responsibilities of the different players;
- apply the principle of “variable geometry”, to use the European jargon, but in a context of transparency and openness;
- make a long-term commitment to basic research;
- promote a multi-disciplinary approach, taking in the social and human sciences;
- create networks of research infrastructures;
- integrate the whole of Europe, not just the European Union, into the research area;
- encourage mobility;
- explore the relationship between science and society.

As the latest paper from the Commission had observed, the key lay in the mechanisms used. Everyone agreed on priorities, but what counted were the mechanisms for making scientific research more inventive.

Funding was a political choice. There was a need to invest in intelligence (education and training) on the basis of a transparent and open “variable geometry”, while respecting the principle of subsidiarity.

As part of its EUROCORES initiative, the ESF was to co-finance certain programmes to help them attain critical mass – in accordance with the above-mentioned principles.

CERN was one successful example, but new means needed to be found of dismantling the barriers between countries. (*Applause*)

Mr KUKLINSKI felt it was a pity that the English version of the European Commission documents spoke of a research “area” rather than a “space”, which seemed to him less restrictive.

Mr BANDA could not speak for the Commission, but observed that the word “space” suggested emptiness, which he felt sure Mr Kuklinski would not wish to see in relation to research. (*Smiles*)

Mr HALLIDAY (Particle Physics and Astronomy Research Council, United Kingdom) trusted that the discussion would not become bogged down in the finer points of terminology, but would concentrate on the mechanisms for implementing research.

Mr IACCARINO felt that there could be no European research policy unless Europe knew what it wanted. In 1945, the United States had had a vision of the future for research – did Europe have one now?

Mr BANDA recalled that Mr Van Duinen had set forth such a vision the previous day, and that the Conference was now discussing the organisational aspects, in accordance with the programme for the session.

Mr GABOLDE gave a further reminder that the session was devoted to the organisation of research and development. He was concerned to hear people talk simply about scientific policy, since the old linear model had become obsolete. There was now an integrated, interactive system of research, development and innovation. It would be wrong simply to talk about scientific policy.

How could equality be restored between eastern and western Europe, given the economic situation and financial constraints in the countries of eastern and central Europe? The Structural Funds had helped Portugal and Greece to bolster their scientific and technological capacity, despite the fact that they had given initial priority to building motorways and airports rather than to medium and long-term investment in the non-material assets which were also necessary to their economic and cultural development. Obviously, in a situation of pressing need, that kind of choice was difficult. While there was no doubt that more investment was needed in research in Europe, priorities also had to be set in the light of society's needs. Targeted research required an inter-disciplinary approach, networks, links between universities and industry, etc.

Mr BANDA acknowledged the truth of Mr Gabolde's remarks, but felt that, being unable to cover every aspect, the speakers had stuck to the essentials, and thus inevitably simplified.

CERN as an example of European and global co-operation

Mrs JARLSKOG (CERN) introduced herself as a physicist specialising in elementary particles – that is to say, in microscopic and large particles, the ones that determine both the history of the universe and its future.

CERN was founded in 1954 on the initiative of UNESCO, a body which, as we all knew, had devoted its energies to education, science and culture.

Poland had joined CERN in 1991, although physicists in the east and the west had always had unofficial exchanges prior to that. What was the secret of CERN's success? Its Director changed every five years, so there was no danger of ossification, and although CERN staff grew older, users continued to be young researchers, and dynamism was therefore guaranteed. CERN was also in touch with universities in about 80 countries.

CERN worked well because the people who worked for it shares a common objective. They loved to cause collisions for the magnificent spectacle: from the clash of two stable particles came the unheard-of, the never-been-seen-before. Mrs Jarlskog used slides to describe CERN installations in Geneva: a ring in which electrons circulated, crossing frontiers without a passport, and bigger and bigger subterranean detectors like the Atlas detector, which was the size of a six-storey building.

Elementary particles had neither gender nor political affiliation; the study of elementary particles relied on technologies of the future. Researchers worked with no anxiety as to their careers, and their places were precious; there were not enough for everyone. On the other hand, those who passed through CERN found jobs afterwards, and they usually did so in industry, which appreciated people able to work in a team and keep to a strict timetable.

The fundamental research conducted at CERN had practical applications: it was there, for example, that the idea of the worldwide web was born, and that work was carried out on medical imagery to reduce X-ray dosages. Research was currently under way into high-energy physics.

CERN produced so much data that the web could not cope, and a network grid project had now been completed. In conclusion, Mrs Jarlskog described how CERN had recently spent an exciting few days following the discovery of a new particle.

The point of view of industry

Mr SOBOLL (Director of Technology Policy, Daimler-Chrysler AG) said that Daimler-Chrysler, one of Europe's leading industrial groups, employed more than 2000 researchers and earmarked over 7bn euros for R&D every year. That was a *sine qua non* of competitiveness, but the sum was so great that its use had to get the go-ahead from the Board of Directors.

We needed to re-examine the difference between discovery and innovation. Although most industrial products had their origin in a discovery of fundamental research, they would not exist unless the discovery had been exploited and developed. For example, if we compared the situation in Europe with that in the United States or Japan, we saw that the old continent was certainly not lagging behind as far as pure research was concerned, but that it was definitely trailing in applied research. Japan envied Europe its successes in the former domain, and had determined to redouble its efforts for the coming decade; Europe must do the same in the fields of innovation and R&D.

It was often said that the linear model was out of date, and that it was better to network by centres of competence. That certainly favoured control of downstream research, that was to say through applications and therefore by industry, but did not necessarily go far enough when making well-considered predictions: a market study around 1900 concluded that the stock of motorcars in circulation in the United States would never exceed one million units because there were not enough people to drive them. That only went to show that research must not lock itself up in laboratories, but instead anticipate shifts in society's needs. The idea of one's 'own car' existed, the idea had been perfected, but it was still too expensive for the public to buy it.

Industry was constantly under pressure, not only from clients but from legal and societal demands such as safety, concern for the environment and energy independence. To respond to this pressure, industry must organise itself, and that was what enterprises were doing with ever more enthusiasm. The European aeronautics industry, for example, embraced six large groups that worked together in 'variable geometry' partnerships depending on the project, with each group sometimes being a partner, and sometimes competing with the others. Industry was drawing the lessons of globalisation: when Daimler-Chrysler had to decide where to establish its research facility, the choice was narrowed down to three competing university cities; in the end, Stuttgart was selected. Today, competition was worldwide.

If we analysed the money that companies spent on research and development, we saw that outsourcing was on the increase; that meant a proliferation of partnerships with universities and public research bodies. However, if we looked more closely, we see that these institutions were now in competition not only with their foreign counterparts, but also with the research laboratories of other enterprises that might even be located in other countries. This opened up huge perspectives of funding for the scientific community: many were called but few were chosen. In other words, only the best survived.

Daimler-Chrysler collaborated with more than a hundred universities and research centres within a framework of seminars or on joint projects. In an ideal world, knowledge would be passed on by individuals, but in Europe, in the absence of statutory flexibility and of mobility between industry and research, that remained a pious wish. In many cases, transfer took place when results had already been obtained. Preferably, dialogue would commence at the outset in the framework of a networking organisation.

Co-operation certainly entailed both benefits and dangers: the former were complementarity, standardisation, critical mass and sharing risks; the latter were possible

infringements of intellectual property, and the additional costs and delays that could result from the large number of partners involved. It was down to political leaders to create an environment that was favourable to the solution of these problems. It was not just a question of money. The automobile industry had been short of money for 20 years, and it was precisely this relative poverty that had stimulated research into efficiency. Europe had the resources, the skills and the people needed. It must stop wasting time. *(Applause)*

Mr RADULSKI (Chairman, Alstom Power, Poland) took the opportunity to present the activities of the company of which he had been chairman for three months. After Alstom merged with ABB, it was necessary to convince the management of the new group (consolidated sales figures: over 20bn dollars; workforce: 40,000) of the specific role to which its Polish subsidiary, Alstom Power Poland, might aspire. As soon as the restructuring was completed at a cost of 14.5bn euros, the Group would continue to employ 3500 staff in Poland, the bridgehead in the company's campaign to conquer the East European market; of these 3500, 70% would be working in the energy sector, which in turn accounted for 80% of Alstom Poland's activities.

The Elblag factory, the most modern industrial site in Poland, was at the leading edge of technological progress. It produced steam turbines, generators and turbo-generators, and had also acquired both considerable competence in renovating power stations and production units, and diagnostic and advisory skills in new technology. The company had merged Alstom's and ABB's technological know-how and the industrial culture inherited from the earlier period, and had itself come up with solutions for modernising its plants.

The company was already well placed in the CIS market, and had been able to propose a new concept of development aimed at two other important and potential markets: Asia, and Eastern Europe as far as Turkey. It planned to increase the capacity and life of plants for a relatively modest overall layout, a key factor in countries that had limited financial resources and could not afford to sell their old plants for scrap. Modernisation was achieved by 'retrofit', that was to say gradually replacing obsolete items, and making savings in energy consumption, thereby financing subsequent stages in the transformation. This was how the entire Polish electricity and gas network, which now made a profit of 320m dollars, had been entirely modernised.

As the Polish market was not infinitely extendible, it was vital to find new outlets: a contract had been signed with Estonia for the upgrading of a power station from 200 to 245 megawatts, and with a concomitant reduction in costs and compliance with stricter safety standards.

For two years, the Elblag factory – this had been a source of satisfaction and pride - had also been one of the Alstom Group's four European R&D and engineering centres. Shareholders had agreed that some of the profits should be reinvested immediately in this area of work, which was being carried out in co-operation with several Russian, Ukrainian and even British research institutes and establishments. As a result, a new model of turbine had been designed, and would soon be launched on the North American market.

Success was a question of strategy, determination, and a balance between know-how, ideas and putting them into practice. However, it also demanded more and more time, and the capacity to take all factors into account, because the pressure of competition had become so great; indeed, it was now so intense that it was becoming increasingly difficult to boast of lasting successes at all. Alstom Poland would need a good 10-15 years to establish its own identity fully. *(Applause)*

Mr KUKLINSKI regretted that multinationals setting up in Poland should start off by getting rid of the R&D facility. The felicitous, contrary example of Alstom at Elblag was unusual.

Poland had been unable to imitate Ireland and lure foreign enterprises to come on condition that they were in research and development. Polish engineers were therefore, according to Mr Radulski, competitive on the international market.

According to a study carried out by the British Department of Trade and Industry, the three multinational leaders in R&D were General Motors, Ford and Daimler-Chrysler; their research budgets were larger than the R&D budgets of the European Union and Poland. Why three automobile manufacturers?

It had been said that the leaders in innovation in the 21st century would be multinationals rather than states. How did Mr Soboll see the future of society?

Mr RADULSKI explained that Alstom-Poland had benefited from pragmatic decisions taken by group management on evaluating local capacity. In the context of globalising activities, the Polish firm had had to prove itself. It was worth noting that after all the mergers and restructuring exercises, Alstom's R&D centres had fallen from 54 to 20.

Alstom Poland had also inherited ABB's know-how, and had been able to develop a product that met a demand. This had won shareholders' support.

In a centralised system where cost-cutting was vital, Alstom Poland had managed to be competitive. The company had also secured a bridgehead in both the East European and the Russian markets.

Mr SOBOLL thought that three automobile manufacturers had the biggest R&D budgets because they were involved in mass production and had a large market. Other firms among the ten leading enterprises, like the oil companies, did not need to invest so much in research because they only had to extract their product.

It was true that Daimler-Chrysler's annual research budget was greater than that of the European Union, but the comparison told us little: it was more a question of technological research than R&D, and the development of new production units was part of this. Research in the strict sense of the word accounted for only 5% of this budget. The pharmaceutical industry alone spent more.

It was absurd to claim that multinationals were more powerful than political decision-makers: in fact, there was competition between countries and their governments to attract enterprises. Nobel prize-winners who were born in Europe but had done research in the United States had selected the most attractive market. Governments must realise that they, too, had a role to play in world competition, whether in training the workforce, fixing the level of taxation or any other field.

Mr TURINI (Senator, Italy) asked Mr Soboll about progress on research into hydrogen-fuelled engines, and if his firm received public funding.

Mr SOBOLL replied that his group normally funded its own research, except for participation in the framework programme under standardisation, research into new automobile fuels (production of prototypes ordered by the European Union) and new batteries.

The aim was to develop centres of excellence in Europe, even if it was the American market – that was to say the most solvent market – that was targeted first.

It was not necessary to have a narrow national vision. Science knew no frontiers. An investment only gave a return in the medium or long term. The German government had understood that only too well.

Mr EDWARDS (President, Association of European Universities) began by stressing that fundamental research was the greatest contribution that universities make to research and development. This fundamental research was also carried out in other institutions such as academies, and public and even private laboratories. However, what was unique about universities was the marriage of research and teaching and the interaction between them. The best teaching was done in an environment of research, and the best research was done in a context of teaching because it was so stimulating to have to confront young minds.

Powerful pressures had been brought to bear on universities over the last few years. For one thing, there had been demographic pressure. Student numbers had risen sharply all over Europe: in the United Kingdom, for example, 30% of 18-22-year-olds were now at university, which would not matter if the number of teachers had also increased, but that was not the case and classes were therefore 40% larger; this in turn reduces the opportunities that teachers had to do research. In addition, there were the heightened expectations of governments and of society: they wanted more applied research, particularly in life sciences and in the new information and communication technologies.

Universities were trying to compensate for their inadequate resources by expanding related, profit-making activities such as consultancies and vocational training. That meant there was even less time and energy to put into fundamental research. Were we not killing the goose that laid the golden eggs in exchange for the microchips' gorgeous eyes?

University funding had got to be selective; otherwise, no single institution would be able to afford to conduct research efficiently. To overcome the contradiction between calling for closer co-operation and advocating competition on the grounds of efficiency, we needed to create a framework that stimulated creativity among individuals whose natural desire was to share their experiences with colleagues all over the world. That meant more money for researcher exchange and conferences, and for a high-quality electronic transmission network; none of these were really happening yet at international level. The example of CERN showed, like the European Space Agency, that co-operation between European countries was vital, and that no single country could claim to have all the necessary infrastructure.

Just the same, there was a need for pragmatism. Research funding was currently carried out on a national basis, and the rules varied from one country to the next. The fact that the contribution of universities in fundamental research was irreplaceable did not mean that they must not carry out applied research. Quite the reverse. Initiation into research was essential to students' education, and selectivity ensured that fundamental research would not be possible in all establishments. Good links between fundamental and applied research within the university network were a necessary condition for the microchips themselves to turn into geese laying golden eggs. (*Applause*)

Mr SVASTA (Romanian National Agency of Science, Technology and Innovation) spoke in favour of the international twinning of universities, and for networks that could also become service providers for SMEs and other bodies. In Germany, there was a project called 'Production 2000' in which five research centres came together to carry out technology transfers in

the field of electronics, and assist enterprises in developing their products. We now needed to go further, and set up a genuinely international network that would ultimately produce ‘virtual’ enterprises whose duration would be restricted to the amount of time the products were on the market. (*Applause*)

Mr EDWARDS said in reply that he did not disagree. Universities must be involved in R&D, even if their principal task was fundamental research. The European Commission was undoubtedly the body most able to facilitate the networking of national systems.

Mr DOBINGER (Christian-Doppler-Forschungsgesellschaft, Vienna) presented the activities of the Christian-Doppler research company, which was in the business of promoting the dissemination of fundamental research results to industry. Initially it consisted of a network of five public enterprises, but they had now been joined by about ten others, most of them in the private sector, including manufacturers of spare parts for automobiles, semi-conductors and solar batteries. With help from universities, these enterprises had established 17 fundamental research laboratories in the form of joint ventures set up for seven years; this allowed them to focus on the long term without being exposed to excessively strong pressures. Naturally, this model as it stood was not necessarily applicable to all sectors, but it was entirely appropriate to engineering. Other countries might find inspiration here.

Mr EDWARDS pointed out that there were some interesting experiences of this type around the world, and that they should become better known and taken up more widely as a result.

Mr WIDMER (Vice-President, Commission of Science, Education and Culture, Swiss National Council) wondered if universities might continue to carry out their teaching task despite the development of related activities, and also provide a critical analysis of society instead of simply being a resonance chamber.

Mr EDWARDS gave an affirmative answer on the first point. As for critical analysis, he thought it was less the role of the institution than of university teachers as individuals and as citizens. It was all a question of whether they would be able to preserve their autonomy. What had happened in Serbia in recent years showed that the question was not a rhetorical one. Just the same, it was hardly realistic to imagine that all universities could fulfil all the functions that were theoretically theirs. They would have to choose, and do so on the basis of their competences.

THE CHAIR wondered, in these circumstances, whether they should be talking about a ‘multiversity’ rather than a ‘university’.

The points of view of scientists

Mr KORDON (President, Euroscience) introduced his association. It had 2000 members in 35 countries, and its aim was to promote science and technology in Europe, and in particular the debate between scientists and citizens.

The association stressed a cultural dimension of science that provided not only outcomes and benefits but also a representation of the world.

Euroscience organised public debates on controversial questions, worked with leading European bodies, organised debates in the European Parliament and the Council of Europe, and distributed documentation on request.

Mr Kordon addressed the issue of the ERA, both as a representative of his association's working group on scientific policy, and as a mouthpiece of the European Forum of Young Scientists that had just met in Gdansk.

The Committee's change of direction was to be welcomed, although it had not yet been implemented, and this was an area where parliamentarians could be of great assistance. Young people were the main driving-force behind scientific and technological progress, and there were many of them at CERN. To make further headway, these productive forces also needed guidance. At the same time, there was a need for strategic training programmes for upgrading researchers.

CERN was a large research body that also served as a focus for integrating researchers in physics and astronomy. There was no equivalent in fields such as chemistry and the social sciences. Europe did not take advantage of the potential of integration. Interaction was weak.

It was not just a question of funding: funding needed to be redeployed on the basis of strategic options. Too many paths were ill-defined. In the United States, the objective was clear: distribute knowledge among paths and sectors of activity; in Europe, these still too often left their authors in a siding while they carried on looking for a job in industry.

The European Union must learn how to welcome and train young people who would return to their countries in order to fulfil their potential. The brain drain was to be deplored, but arrangements must be made to provide researchers with a more attractive career. After completing their studies, researchers wanted to find a welcoming environment. Young people needed independence, and if they feel caged in, they would opt for exile. Europe had responsibility for young people from Central and East European countries: it must integrate them into its action in order to develop the human resources that were available throughout the continent, and at the same time help them to return to their own countries. Euroscience had suggestions on this point to put to the European Union.

We needed to organise a European labour market in order to establish a scientific and technological Europe. Only physics was organised on this model. As far as other disciplines were concerned, various national legal systems were not favourable to the setting up of such a single market.

We should look at the work of sociologists like Gibbons, author of *"The New Production of Knowledge"*: young people would go to the most welcoming countries, and their careers would no longer unfold according to the traditional model. It was up to lawmakers to adopt measures that give young people a welcome.

For example, we needed to introduce a five-year European young researcher statute, and guarantee minimum flexibility. Jobs would be lost otherwise.

There was currently a crisis in European scientific publishing. European multinationals were increasingly controlling the market. We needed to take advantage of the electronic revolution to win back market shares, or else Europe would depend on decisions taken in Washington in order to publish its own research.

There was a need to be more aggressive in our communications policy towards the public. Creating a continent was not the same thing as creating a market. It was not just a matter of ensuring the convergence of economic interests, but also, as Mr Bèkšta had underlined, of having

faith and a vision without which Europe would lose the economic competition, and would not had a say in the international arena.

The scientific community was keen to put this vision into practice. Interactions were more obvious if the basic conditions were there.

Science could be a pioneer in the matter of European integration. It was necessary to take decisions that would turn this vision into reality. (*Applause*)

Mr VAN DER MOLEN (Vice-President, Academia Europea) called for the establishment of clear rules to govern relations between politicians and scientists. Could the latter make their voices heard? Decisions were often made top-down, and were imposed without the views of individuals being taken into account, despite the fact that the source of all progress was the researcher as an individual. Although numerous organisations took part in scientific debate in Europe, few of them represented researchers. The debate was therefore dominated by interest groups instead of being founded on researchers' experience. They found it hard to identify a European research policy because national policies won the day, even under the 5th Framework Programme.

Yet researchers had all the skills to boost the competitiveness of Europe in a world that would soon had to feed 10 billion people.

Synergies could enable European research to be in the avant-garde in many fields. European added value involved a structural, co-ordinated approach using advice that was independent of national political or scientific priorities. The role of scientists needed to be strengthened through involvement in the organisations that represented them, and in the first instance through learned societies and academies, including the Academia Europea which was founded in 1998 on the initiative of European Science Ministers. The Academia Europea was a non-governmental association of researchers and university teachers; it had 2000 members from 33 European, and 5 non-European, countries and embraced a wide range of disciplines.

The Academia was ready to set up consultative advisory groups whose independent views would guarantee their credibility, as long as political leaders were prepared to listen to them.

To define a European science policy, it was necessary to collate scientists' views and clearly distribute responsibilities between national and European levels. There were four approaches:

- establishment of a European research policy by Ministers on the basis of recommendations provided by consultative groups;
- better use to be made of the FES as a multinational European research council with the transfer of national budgetary resources;
- close collaboration between the European Commission and administration, and European organisations of researchers;
- strengthening the evaluation of European research by using experts independent of any political or financial interest. (*Applause*)

Mr HALLIDAY (Particle Physics and Astronomy Research Council, United Kingdom) gave an example of an obstacle to researchers' mobility: that of an outstanding German researcher

he was unable to bring over because everything had been provided for – except the cost of his accommodation. It was this kind of stupid obstacle that Commissioner Busquin had asked to be brought to his attention. It was down to politicians, then, to act for the good of science.

Mr KORDON reverted to his suggestion: the setting up of a researcher's statute that enabled the holder to move from country to country, and attract independent grants that were the same all over Europe, and which would belong to the researcher concerned.

Mr VAN DER MOLEN said that there were national and international obstacles, and that it was necessary to operate at both levels.

Mrs JARLSKOG pointed out that mobility was impeded by the fact that researchers lost pension points if they did not stay in the same place for long. She herself had suffered as a result of this. There were also salary problems.

Mr ENGELBRECHT (President, Academy of Sciences, Estonia) said that attention should be drawn to the successes as well as the problems. Achievements in Ireland, Finland and Portugal were most impressive.

For 20 years now, Finland had been pursuing a coherent science policy that embraced flexible funding and the establishment of centres of excellence.

Mr Bèkšta had claimed that science in the former East European countries, having lost its military outlet, now needed co-operation. That did not apply to Estonia, which had negligible access to the military market. Linguistics and sociology were not linked to this market, and anyway co-operation was necessary to scientific development.

Mr MICHALOWSKI (OECD) had reservations: universities should not place themselves at the service of SMEs; their traditional role was to teach and provide researchers with an area of freedom. Reliance on enterprises for research funding meant there was a danger of a drop in public funding. It needed to be re-examined.

Mr Michalowski recalled that at the University of Stanford, where he had studied mechanical engineering, massive support from enterprises had not sought to sustain research and development, but to poach students when they left.

Mr EDWARDS (University of Leicester, President of the CRE) felt this painted a gloomy picture. Of course there was a need to take precautions, but a recent OECD meeting on entrepreneurial universities had highlighted the success of a British university in offloading surpluses in one subject and thereby funding other disciplines. The role of the service provider was no longer limited to industry, but also supported local authorities in combating social exclusion.

The danger lay in universities neglecting their traditional activities of teaching and research and of ceasing to publish at all. At the University of Trent, which was also an entrepreneurial university, the danger of fragmentation through multiplying activities was apparent. It was therefore necessary to take precautions, but Mr Michalowski had no grounds for painting so gloomy a picture.

Mr VAN DER MOLEN did not think it was a question of turning universities into para-enterprises, but of constructing an interface with SMEs, and preventing them from falling into the

traps described earlier. Distinctions needed to be drawn according to cycles and paths; in some paths, development was possible without harming universities' traditional functions.

Mr RAPSON (Member of Parliament, United Kingdom) introduced himself as a politician. He was now a Labour MP after working as an engineer in the aeronautical industry for 39 years. If there were problems with salaries, pensions and researcher exchanges, they must be resolved within the European family; otherwise, Europe would always lose out to the United States. Europe must regroup its creative forces. Today, even though they were good friends, the United Kingdom, France and Germany felt a degree of mutual distrust. It was to be hoped that one day the hall where the conference was being held would be filled with European citizens governed by common rules and respecting one another's individuality.

Mr BUDINICH referred to the work of a Chicago researcher who had calculated that two thirds of the US revenue was a direct consequence of fundamental research carried out 70 years ago, particularly following the work of Nils Bohr. The United States, Japan and Korea had clearly understood the importance of fundamental research. Science was born in Europe, and was nourished by the education system. Europe was losing ground because it no longer had an adequate education system, and because once upon a time Einstein and Fermi were forced to seek exile in the United States.

Why was there a brain drain? Because the best brains were attracted to the best schools, and Fermi's students were in the United States. An entire heritage had been lost in that way. In Europe, we needed to re-establish schools linked to a personality, those which in the past moved science forward.

Mr KUKLINSKI disputed the idea that Europe had no science policy: CERN, for example, was one of its components. Europe had trained students from all over the world during the first half of the 20th century, but it then lost its pre-eminent position, and its élites now went to the United States. Europe must re-discover its role as educator of the world's élites, but to do that it must renounce all demagoguery. Democratic university education was for the masses, not for an élite.

Mrs JARLSKOG, a Nobel Committee member of 12 years' standing, questioned the view that Nobel prize-winners had been trained in Europe but had found better working conditions in the United States. In the United States, it often happened that not one person, but a whole group of researchers, was taken on. It was equally true that the education delivered to researchers before they went off to the United States or Japan was very democratic, despite the fact that science itself was not democratic: science did not address everyone.

Today, Europe no longer gave stars the opportunity to shine. There was no doubt about that. However, we needed to prepare for the future, and that was what CERN had been aiming to achieve since its inception.

Mr ETHERINGTON (Member of Parliament, United Kingdom) replied that there had often been appeals for realism and pragmatism. Universities did an excellent job, but they were also governed by the needs of commerce and politics. Was it not contradictory to demand competitiveness and solidarity, and competition and co-operation?

The European Union could achieve much, hence the large number of candidate countries. However, the former Communist countries had been encouraged to stake all on the market economy and competition; that was not the same thing as co-operation.

We claimed that knowledge was power, but those who had the power would not want to give it up, and if they had the knowledge that procured power, they would refuse to share it.

How could we improve the situation in the universities and strengthen their co-operation if they were governed by the rigours of the market, particularly when the existence of some 40 languages did not help to reconcile their interests?

Mr Etherington did not wish to be seen as a cynic or a pessimist, but he felt that these problems were very hard to resolve.

Mr EDWARDS stressed the inequality between American universities: there was a wide gulf between the best and the rest. Stanford had succeeded in persuading firms to invest in research, and was earning money.

The USA did not neglect fundamental research because it knew that that was where the future lies, and therefore made every effort to attract the most brilliant researchers. American universities depended less than European universities on public funding. The latter had to be made more appealing to young researchers, but we must not forget that the American system was very élitist – a very taboo subject in Europe where we were more in favour of equality.

Mr KORDON pointed out that American universities were not only prestigious and competitive; they were also very open. They readily accepted teams of researchers and were prepared to co-operate.

However, the American university model did not match needs in Europe, where we had to invent a new model so as not to lag behind the United States. The world was entering the age of knowledge. It was up to political leaders to take the necessary measures in order to meet most effectively the needs of the science of the future.

The session ended at 6.35 pm

PROSPECTS FOR THE FUTURE

WEDNESDAY 11 OCTOBER 2000

CHAIR: Mr Luczak (Committee on Science and Technology, Parliamentary Assembly, Council of Europe)

The session opened at 9.10 am

The view of young scientists

Ms LEDOUX (President, Marie Curie Fellowship Association) set out the aims of her association: to advance the cause of science in Europe, to raise public awareness of science, to inform young scientists of vacant posts, to promote interdisciplinary meetings, and to involve young scientists in public debate.

The Association had taken part in the European Forum of Young Scientists that brought together 54 young people from 22 countries in Gdansk from 7 to 9 October.

Why must young scientists make their voices heard?

In the first place, they were affected by the decline in funding for R&D; moreover, the impending retirement of the present generation of researchers required exchange between the generations; careers in science were unappealing, and young people were turning their backs on the idea. This would impact on society as a whole. The change in approach to science would become easier as young people made their voices heard.

The present situation was as follows: investment, like salaries, was inadequate; the absence of a European research area was an obstacle to mobility; mobility was desirable, but it must not lead to a brain drain; there was a need to develop relationships between universities and industry; ongoing training was inadequate; and scientists must feel more answerable to the public for their research.

Proposals: raise salaries and investment; remove obstacles to mobility; achieve mutual recognition of degrees; had a database on vacant posts; funding 'return grants'; and, as Mr Kordon argued, make structures more flexible and the management of better targeted grants more autonomous.

Research structures must be more flexible: although there were very few permanent posts, rigid rules in many countries stood in the way of recruiting staff on fixed-term contracts. Euroscience had come up with the suggestion of a post-doctoral status outside national structures and backed up by a minimum salary.

However, young scientists were growing anxious, with those not re-entering the system running the risk of being totally excluded. That was the reason for the proposal to award fellowships lasting a period of four or five years, the time it took young researchers to prove themselves and settle into the host institution and research teams.

The following proposals were made to overcome the gulf between east and west: mutual recognition of degrees; harmonisation of doctorates (in the east, they were obtained round about the age of 35, that was to say later than in the west, and this caused problems with age-limits); the awarding of 'return grants'; and the speedier issue of visas.

Measures to be adopted in the short term included concessions with regard to age-limits and targeted fellowships in favour of young scientists from Eastern Europe, and disseminating information throughout Europe about fellowships available.

In conclusion, young scientists encountered particular problems that needed to be resolved in the interests of the whole scientific community. The Forum had drawn up concrete proposals in the hope that parliamentarians would respond as soon as they returned home and develop more flexible research structures, with a view to filling the gap between east and west, and enabling young people to be more involved in the scientific community.

The young scientists who had met in Gdansk were grateful for the opportunity to express their concerns: they would like to do so more frequently in a permanent Forum of Young Scientists.
(*Applause*)

Science and society

Mr DIETRICH (Chairman, Institute for Modern Society, Poland) saw science both as scientific research seeking to develop knowledge and its application, and as the activity of scientists who created science and had an influence on the whole of society. Why did society take an interest in science and allocate such substantial resources to it? Because, by accumulating knowledge, science made it possible to get closer to truth. The desire to have a better understanding of the world was characteristic of human beings. Some people devoted themselves entirely to science, while others were content to have a better understanding of the phenomena they studied. They were not a majority in the population: there were also people who took no interest whatsoever in science, and then there were those who were excluded – prevented from participating in the cognitive process by their intellectual capacity, the poverty of their environments or the low quality of their education system.

Science always aimed at self-development, but scientific progress was only achieved on the basis of its practical application: one only had to think of the advances made in medicine, education and economics. Many citizens agreed to contribute to the massive funding of science if research outcomes were tangible.

Scientists must help to raise public awareness of the importance of science, and communicate with the general public with a view to making them accept science.

Science and technology had revolutionised the lives of individuals and society during the 20th century. But they had also globalised problems: life expectancy was not increasing everywhere, there was inequality in relation to death, and there was a gap between the living standards of the rich and the poor that science was helping to widen.

The progress made by science and technology had not prompted euphoria, but rather anxiety. People were afraid of economic, social and cultural development to such an extent that they forgot the positive sides and gave in to irrational reactions. For the first time, humankind had a chance to act like nature, with the capacity for total destruction at its disposal.

Who better than scientists could understand the issues of the present time? They must not lock themselves away in their ivory towers, but instead answer questions asked by members of the public and intervene in social life. Humanism and ethics did not follow the rhythm of scientific progress. Humans were unable to understand the world about us, and that encouraged individuals to take refuge in egoism, and to respect neither other people nor nature. People who did not understand the development of science grew hostile to it, and that explained such things as the success of alternative medicine.

Relationships between generations had changed. At one time, a person needed to have lived many years to attain wisdom, and young people had respect for their elders without necessarily always agreeing with them. Today, they immediately had usable knowledge, and fathers asked their sons to show them how to use the computer. The traditional values of society were being challenged.

Fine art and the humanities were now accompanied by an aspiration: that of individual development. That was possible through humanism. Access to education was a basic right, and human beings must take hold of the educational process to acquire knowledge and a philosophy of life. The education system must therefore transmit knowledge and values like a love of innovation, an aesthetic sense and an ethical sense – in order to distinguish good from evil.

To attain such a form of education, everybody from mathematicians and philosophers to historians and biologists must collaborate. There was a need for dialogue. It was necessary to humanise technology – not from the outside, but by introducing a human dimension into technology and science. It was possible to calculate technological risks; however, on a moral plane, was there such a thing as an acceptable risk? In reality, acceptable risk was determined by society itself as soon as it had the wherewithal to deal with the problem. In a totalitarian system where people did not have the right to speak out, the degree of risk was quite high. The same went for poor societies. The existence of technological risk had social consequences as it triggered an uneasy feeling that had not been brought about by technology itself.

In conclusion, Mr Dietrich regretted that Poland had not yet achieved the consensus that was so necessary in education, training, science and economics. Ideas articulated in academic circles were not enough; governments and parliaments needed to act to arouse people's interest in science. This conference was therefore welcome. (*Applause*)

Mr KUKLINSKI (Director, European Institute for Regional and Local Development, University of Warsaw) said that discussion on the European model came down to a contest between the 'Franciscan' model, that was to say the solidarity and cohesion model, and the 'Darwinian' model which focused on the survival of the fittest and the emergence of poles of excellence. It was possible to avoid this opposition by opting for a third scenario that sidestepped the Social Democratic vision as a neo-liberal vision, and relied on the emergence of a 'knowledge-based economy' by the year 2010.

Such an economy would be based on a re-interpretation of the interaction between science and society. The production of knowledge was so widespread that the process could no longer be described as linear, and it was therefore less important to create propitious material conditions than to understand the mechanisms at work. The dissemination of knowledge would be the second pillar of this economy as half of the production of affluence was already based on it, and the proportion would continue to rise. In the journal *Europolis*, Professor Foray provided an excellent interpretation of the American experience: it was simply a matter of knowing whether Europe would be able to define its own, more equitable path, closer to the spirit of St. Francis of Assisi than that chosen by the United States, and the extent to which the countries of Central and Eastern Europe would have a say.

The European research area had been the subject of a range of cartographic representations. DATAR's 1991 map of flows of itinerant workers was still strongly influenced by the Iron Curtain, which had only just come down, but things had changed only slowly since then with many more north-south than east-west movements. Professor Blatevogel's research tended to oppose the centre of the continent and its periphery; it was a way of looking at the world that was as old as the history of Europe, if not of the world itself. As for the geography of European science, we learnt from studies carried out by Danish researchers that in terms of publications, London led the way, followed by Paris, Moscow and the Dutch conurbations, and that the countries whose economies relied most on knowledge were Germany with 58%, and then the United States with 55%, Japan with 53%, Great Britain with 51%, and France, the Netherlands and Sweden with 50%. The OECD average was 51%, and the European Union average 48 %.

The challenges that Europe must meet were as follows: a spirit of enterprise, the influence of multinationals, educational reform, the management of knowledge, and a definition of the European model. Economic and monetary union was one of the first chapters of what was ultimately

inevitable: a future federal Europe. The knowledge-based economy was because of what its future held, a matter of the highest importance. (*Applause*)

Mr TIURI (President, Committee on the Future, Finnish Parliament) gave a brief presentation of the case of Finland. For some time now, his country had realised that science and technology were the keys to economic development, and had set up a national agency with responsibility for promoting innovation; the Parliament had also passed a law increasing university research funding by 10%. As a result, research expenditure had risen from 1.5% of GDP to 3% in the space of 15 years, while most European countries, with the exception of Sweden, had slowed down. The consequence was that Finnish exports of high-tech products had increased from 5% of GDP to 20%.

This example shows how crucial it was for governments and parliaments to be able to react to the new world order. The Finnish Parliament already had a 'Committee on the Future' whose 17 members had the task of thinking together about the future of the country and the world on a 15-year horizon, and free of electoral considerations. And, like many other countries, Finland had a unit that evaluated scientific and technological choices and helped parliamentarians to understand issues. Lastly, there was an association whose members included parliamentarians of all hues and a number of scientists representing some 200 disciplines, and which was a forum for fascinating discussions. These various bodies provided valuable assistance to political decision-making, and at the same time enabled scientists to had a better understanding of political issues. (*Applause*)

Mr KUKLINSKI pointed out that a European Commission study had shown that, unlike what had happened in Finland, the intensity of research and development in relation to GDP had fallen in Central and East European countries and in those of the former USSR.

Mrs NABHOLZ (Swiss Representative to the Council of Europe) wondered if Finland's progress was the result of political decisions or the expansion of Nokia.

Mr TIURI replied that Nokia's influence was obviously considerable, but was not the only factor. Scientific investment was increasing steadily throughout the Finnish economy.

Mr KUKLINSKI thought it was a thorny question, and it was also one that was asked in his own country, albeit in contrary terms. The question was whether the decline in research was the consequence of a negative attitude on the part of the government towards science and technology. Scientists had always tended to think they were unloved, but although those in the Central and East European countries received less funding, that was because these countries were less affluent. However, things should gradually improve – at least one could only hope so.

In fact, what the Central and East European countries, and Poland in particular, suffered from was structural political weakness, that was to say the absence of long-term thinking and an inability to see education, training and science as essential, long-term activities. That was largely explained by the fact that the influence of the scientific lobby was very much weaker than the lobby that represented farmers and miners, and there were major social problems to be resolved in those sectors. Moreover, R&D was not solely the business of the state but of the entire economy, and an enterprise that was vulnerable – as so many Polish enterprises were – could not afford to see any further than the short or medium term. Polish scientists who went to Budapest envied the good fortune enjoyed by their Hungarian colleagues, but the Hungarian state spent no more than the Polish State on research: 50 dollars per inhabitant per year.

Ethics and science

Mr HOTTOIS (Free University, Brussels, Rapporteur of the European Group on Ethics in Science and New Technologies, European Commission) said that since the Age of Enlightenment, the scientific community had served as a model or paradigm for the whole of society: this model generally valued science, and accorded it a normative function by making it an ideal for society. It also placed science outside culture – and, as one might say, outside society – by presenting society as a pre-scientific historical product. It presented science as a new culture, as a super-culture made up of universal knowledge and action, that must reach out to humanity to unify it or pacify it. The scientific community had instituted a way of peacefully and universally resolving problems and disputes; the mathematical, objective method presented science as disinterested and independent of private interests.

Science was conceived of as theory, as true knowledge, and technology as the application of resources that could be misused. One can only hope that scientific methodology and its technical application would help to resolve all the problems of humanity. Conceived in this way, science posed no ethical problems, and indeed resolved them all.

The ideal conception had been criticised over the last few decades: not only the evil use of technology and the hijacking of knowledge by self-centred and warlike interests, but science itself in its intrinsically technician mode, knowledge as power, the power to produce objects. This active dimension of science as techno-science concerned scientific research as much as it did the application. The power of the action of techno-science presented all that was given (ie matter, living and humankind) as transformable.

While in the traditional conception of science, the immutable, natural ‘given’ seemed to be susceptible of technical adaptation, with techno-science there emerged a range of ‘possibles’ that implied choice and responsibility.

Science had also become an economic, social and political business. Research and development were no longer outside society, but inside it, and depended on the components of society.

However, we must not exaggerate this dependence because, contrary to the claims of post-modernism, science possessed truth and objectivity. In techno-scientific operativity, there was a trans-cultural value that distinguished between scientific laws and judicial and moral laws: the latter relied on the support and belief of humankind; the working of an engine did not. There was an independent techno-physical operativeness that determined whether it worked or not. Epistemological discussion was often confused by psychological or anthropological considerations, suggesting that everything was subjective or inter-subjective, and that technology was no different from the institutions that relied on conventions. This fitted in with the war that rumbled beneath the surface between human and other sciences. There was a genuine debate to be had on the conception we had of humanity and its future.

Science exceeded every culture and historical society through its time-scale, which was out of all proportion to the historical scale; this prompted us to leave questions open, and not to terminate research on the basis of a given society.

The socio-constructivist conception of science, which immersed it in social inter-subjectivity, asserted itself as an exclusive, political desire demanding that research should be ever

more steeped in socio-politics. It had inspired a document published by the Commission in 1997, and entitled '*Science, the endless frontier*'. Chapter IV, '*Society, the endless frontier*' was a reference to Vannevar Bush's report '*Science: the endless frontier*'. Translating 'endless' as '*ultime*' in French was wrong because 'endless' meant that there was no '*ultimate frontier*'. Bush also saw unlimited scientific research as the driving-force of social transformation. Conversely, it was proposed that society should define the objectives of research.

The dependence of science and technology on society was not one-sided: we only had to think of the revolutionary consequences of PMA, genetic engineering and the Internet. Technology was shaping societies as much as the latter were guiding the former. The economic, social and moral consequences were non-predictive, just as the discoveries themselves were unpredictable. This stimulated reactions, particularly in the form of ethical problems. The multi-traditionalism of European societies complicated the problem further in that a new idea did not encounter a single morality but several moralities, and several religions, philosophies and other interests that might, or might not, be able to integrate it. Such diversity was riches: it prompted a range of responses from which one can select the best.

The problem was meta-moral. It was the problem of the least conflictual management possible of the diverse cultural and moral responses to techno-scientific progress. The meta-moral ethical problem for an ethics committee charged with clarifying political discussion ran as follows: Must one advise in favour of legislating, and of imposing a moral conception? It would be easy if Europe were homogeneous, like a country with a state religion or a single-party nation. But this was not the case in Europe, where we had moral pluralism and not moral monism. The large number of integrisms also demonstrated that monism was not one. The monist approach did not enable us to manage a plural world peacefully. At most, we could suggest broad outlines without, given the complexity of these cases, economising on good sense. The living source of ethics was not a morality imposed by a collective super-ego, but the ability to make judgements, to listen to objections, and to present one's reasons without which no principle had any value. Otherwise, the principle of individual autonomy became an instrument for exploiting people if one postulated that each individual was *ipso facto* autonomous, irrespective of his/her state, and therefore free, for example, to sell his/her organs. The principle of human dignity served to impose a morality and refuse PMA, experimentation on embryos, and xenotransplants. The principle of taking precautions could even become an instrument of immobilism, bearing in mind that there was no such thing as zero risk.

These principles were not necessarily dangerous. They must throw light on discussion by pinpointing certain problems and risks, but they did not permit us to do without pluralist discussion.

When talking about reports on science and society today, we thought of these new institutions, ethics committees, that had had remarkable success given their proliferation at all levels. What was the secret of their success? It was no longer the scientific community that constituted the normative model for society, but the ethics committee. The methodology for peacefully resolving disputes was no longer a matter for the scientific community, but for ethics committees.

An ethics committee was not a scientific committee or a morality committee: by its make-up, it was multi-disciplinary and pluralist (it welcomed all views), and it listened to arguments from a range of interest groups in society. It did not aim either to achieve a consensus, or simply to note down the opinions of those present. It promoted discussion, and asked for positions to be articulated and argued. In the course of debate, positions changed, ideas moved closer together, and disagreements became clearer.

The committee's conclusions were plural: they avoided both artificial consensus and lazy lack of consensus. The aim was to determine whether diversity was viable, and if there was a need to move towards a decisive political decision. The principle of subsidiarity that had been established in the European Union allowed for the incorporation of a range of specific cultural features. Post-modernist thinking was fruitful when it went hand in hand with the non-conflictual management of diversity (non-conflictual in the sense that inequalities and sources of suffering could be gradually corrected). Not all differences were good, but some of them impeded the flowering of what was different.

The success of ethics committees derived from the fact that they tried to resolve the problems of a techno-scientific, multi-cultural civilisation undergoing worldwide integration.

The Council of Europe's Steering Committee on Bioethics had published a Convention on Human Rights and Biomedicine.

The European Group on Ethics in Science and New Technology had issued an opinion on the ethical aspects of the 5th Framework Programme. As the only acceptable response, given that all of humanity was concerned, the UNESCO International Bioethics Committee had published an International Declaration on the Human Genome and Human Rights.

National committees shared the same approach. The bioethics consultative committee in Belgium had pushed hard for pluralism in its composition, in the way it functioned, and in the (always plural) opinions that it publishes. (*Applause*)

Mrs MALPÈDE (UNESCO) pointed out that UNESCO was a co-organiser of the Forum of Young Scientists that was attempting to construct the future in the present. Other key words at the Budapest conference included communication, dialogue, partnership and commitment.

On behalf of UNESCO, Mrs Malpède thanked the conference organisers for giving concrete content to these basic words. The process initiated in Budapest had been followed up. She hoped that the Forum of Young Scientists would not be a one-off event. (*Applause*)

Mr WIDMER congratulated Mr Hottois on his fascinating talk, the pluralist approach of which could serve as the model for a European ethics policy. However, it was open to question, he thought, whether all European societies were ready to go along with such a model. Some of these societies had been closed for decades, and this had left traces in the collective memory. In the event of failure, there could be a problem of the legitimacy of science in a twin-track Europe.

Mr HOTTOIS admitted that there was no easy answer to that question. The general framework that he had outlined seemed to him, as a philosopher, to be most appropriate to the kind of civilisation – that was to say a techno-scientific and multi-cultural civilisation – prevailing in Europe today. The objection that had just been made applied to all European nations: in Belgium, for instance, society was fundamentally divided by questions of ethics, and the debate on euthanasia, for example, had aroused strong feelings on all sides. All the same, it was self-evident that a pluralist conception of ethics had even less chance of developing in less economically and politically developed countries. At all events, it referred to a process that will take an enormous amount of time, and no doubt several generations. However, things moved forward when we addressed concrete issues such as euthanasia, abortion, GMOs, cloning and the new information and communication technology. This was an opportunity to explain the various possible approaches by

arguing them through. We then realised that there were not fools on one side and sensible people on the other: it was simply a matter of different presuppositions.

Mr KUKLINSKI wanted to clear up what he thought was a misunderstanding. The scientific community in Poland, like its counterpart in Hungary, was not isolated from the rest of the world before 1989, as the East German scientific community had been for example. It had only been isolated on two occasions in its history: once, from 1939 to 1945 because of Hitler, and then from 1949 to 1955 because of Stalin. However, after October 1956, it renewed its links, and once more became a full member of the world scientific community: for Poland, de-Stalinisation was almost as great an upheaval as the fall of the Berlin Wall 33 years later.

Moreover, he was not in favour of the phrase 'production of knowledge' as it reduced knowledge to a material, marketable good. It was better to talk of the 'creation' of knowledge, as one talked of artistic creation, than to use the word 'production', which suggested the process as an end in itself.

Mr VAN DUINEN wanted the discussion to revert to proposals for action in order to know what politicians intended to do, for example harmonisation and recognition of degrees, researcher mobility, a European research area and the east-west divide. Would all these problems be addressed through legislation? Would they be left to market mechanisms or to other means?

Mr IACCARINO agreed with Mr Hottois that ethics must not be imposed by law, but he did not agree that ethics committees functioned as he had described. They consulted experts in order to formulate opinions to be sent to parliamentarians and governments.

According to its chairman, the French bioethics committee published such opinions in order to fuel public debate; the British committee collated the views of interested parties, and then published a statement summarising them and later forwarded a report to the government.

What did Mr Hottois think of that? What proposals should be made to parliamentarians?

Mr ROSETA (Member of Parliament, Portugal), also a member of the Portuguese ethics committee, was, like Mr Hottois, sure that the pluralist perspective was the only one that suited a continent as diverse as Europe.

There remained the problem of limits that were acceptable to all. The Committee on Science and Technology of the Council of Europe had played a major role in drafting the Convention on Human Rights and Biomedicine: the limits set were human rights. Article 15 stated that, generally speaking, scientific research in the field of biology and medicine must be carried out freely, subject to the provisions of this convention and the other legal provisions ensuring the protection of the human being. It was in fact the shared heritage of Europe and its civilisation: respect for human rights. The convention aimed to prevent certain abuses: Article 2, for example, stipulated that, the interests and welfare of the human being must prevail over the sole interest of society or science.

Mr Dietrich and Mr Kuklinski had spoken of people who took no interest in science or who were excluded from it. But there were also those who mistrust it, who believed that it was helping to destroy the environment, and who condemned such developments as genetic manipulation and GMOs. That was a problem for politicians because, without a knowledge-based society, Europe would end up being a museum with an elderly population, visited by well-off Americans and Japanese.

How were we to convince citizens that priority must be given to long-term investment, even though it was the short term that was exerting strong pressure? The contraction of the political arena was operating to the detriment of politicians. Who was to decide ultimately? Sometimes politicians, sometimes the European Court of Human Rights which interpreted the texts: but did it have sufficient scientific skills?

At all events, we must not ask too much of politicians.

Mrs NABHOLZ (Switzerland) returned to the questions raised in connection with such matters as the recognition of degrees and researcher mobility: there was an area of tensions here that complicated the task of politicians.

One could understand why young scientists were primarily worried about their careers, but this was a simplistic approach. It was not young people who posed questions about the world's future, but their elders. Moreover, one might ask, at the risk of sounding heretical, if ethics committees, this new way of making technology more acceptable by linking it to moral considerations, were not placing too heavy a burden on young people's shoulders.

Mrs Nabholz criticised her own country as a citizen of Switzerland, the land of chemistry. A bioethics committee had been set up there, and industrialists had realised that they needed to overcome the reservations of the general public. However, there was a choice: either ethics committees were a political G-string, a political concession enabling everything to carry on as before, or they were a way of initiating a fundamental debate on what humankind could do, and how far it could go.

At all events, political leaders needed help in reaching their decisions.

Mr TURINI explained to Mr Kuklinski that Europe had just broken free, both in the west and in the east, from the 'boss state'. The main challenge today was how to reconcile two antagonistic social systems in the context of the globalisation of the economy.

Mr DOLAZZA (Senator, Italy) wondered, after hearing so much about poor researchers, whether he should conclude that he was a rich politician.

Mr Dolazza admitted that he had become a politician after dreaming of doing so since childhood – just as scientists often dreamt of becoming scientists when they were children. The difference was that Mr Dolazza had previously had a job.

Although scientists complained about the problem of moving from one laboratory to another, this was not the fault of politicians: it was easy to blame them for everything.

So young researchers could not find jobs. Well, older ones couldn't either. And those who went in for philosophy should give up their places to young people. That would free up jobs and make more funding available.

Mr Dolazza apologised for appearing impolite, even though in the seven years he had been a parliamentarian he had had to learn how to be tactful.

University vice-chancellors and scientists themselves were the ones who must change the situation. Not all universities were of the same standard: politicians could pass laws, but it was up to university teachers to improve the quality of teaching.

In conclusion, Mr Dolazza said he had listened to some fine speeches, but he had heard nothing concrete.

Mr RAPSON did not share Mr Dolazza's philosophy, and said he thought he could influence his government, and that the government could in turn influence the Council of Europe. On the contrary, he invited those present to listen to young people and find out what they thought. No headway would be made without the impetus of youth.

As a political leader, he strove to construct a better world. He had learned much from these two days of discussion, and could take lessons from it back to his government. If everyone did the same, things would improve. Europe must be more united, and only politicians could tackle these problems.

Mr ETHERINGTON agreed that parliamentarians could wield a certain amount of influence, but the scientific lobby had little clout compared with other much more powerful lobbies. Parliamentarians could not blame the scientific community alone for the present situation. It was extraordinary that researchers who enabled humanity to advance should suffer from such a lack of respect from governments that despised them.

Mr Etherington was doing everything in his power to get things moving, but to succeed, everyone had to be united. (*Applause*)

Ms LEDOUX acknowledged that young scientists had to play their role to the full, and that political leaders could not do everything, but when one was confronted by recurrent problems, there was a real need to take decisions at European level, and that was the job of political leaders.

Young people had posed questions and proposed solutions that required money. Here, too, politicians had to take decisions.

Young people did not expect politicians to wave a magic wand. They wanted to tell them about their concerns. A little influence was better than none at all: if politicians could use it at national level, young people would be grateful to them for the small improvements they would enjoy.

Mr KUKLINSKI said that Europe was confronted at all levels by the same dilemma: efficiency or equality. Regions, for example, were in competition with one another. There were 16 of them in Poland: perhaps we needed to choose the five that would join the European bandwagon; one might well prefer harmonious growth to resolve the inequalities between them.

Twenty-five years ago, the Netherlands had wanted to reduce disparities between the east and the west of the country; today, they wanted to close the gap between their most successful regions and London or New York.

Europe wanted to resolve the dilemma at a continental level, but it was an impossible task because the world reality was Darwinian. Franciscan ideology influenced most European states, and efficiency was tempered by a desire to be equitable. The fact remained that it was necessary to reactivate the Welfare State which, contrary to what the neo-Liberals claimed, had produced outstanding results in the 20th century. The Netherlands had managed to do so by preserving the generous underlying idea but at the same time becoming more competitive.

Mr HOTTOIS said in reply to Mr Kuklinski that ‘production of knowledge’ should not be understood in a commercial sense: the formula identified the concrete (ie material, economic and political) conditions for developing science and technology. Knowledge was not like merchandise. It was true that there was a creative factor in science and technology, but philosophers rather tended to see them as instruments for controlling nature and humankind while forgetting the creative element.

Mr Iaccarino said he was well aware that the ideal and reality were some distance apart: while not all ethics committees might function as Mr Hottois described them, that was the direction in which they should nonetheless go. It was important to criticise those that resembled morality committees. Many national committees had been set up in the hope that they would function as morality committees; that was not what had happened in Belgium.

What was the political usefulness of these committees? Politicians sometimes expected them to come up with ready-made solutions that they would simply had to transpose into law, but it was not the committees’ role to relieve politicians of their responsibility to make decisions.

If an ethics committee said what had to be done, that was not the same as Parliament reaching a decision by majority vote following a debate. If a committee turned into a morality committee, it was as if truth and good had been proclaimed.

Ethics committees must try to explain whether it was advisable to legislate on this or that question.

Politicians put pressure on ethics committees to function consensually, but that had changed. And if opinions remained divided as to the end of life, for example, that was not a disaster: it was not as if there were fools on one side and those who possessed the truth on the other.

Mr Roseta was right to say that human rights were perhaps the only universal reference, even though it was questioned outside the west. They did not govern all ethical problems. Examples included: What was human life? When does it start? and What was human dignity all about?

What was more, factors like GMOs and PMA had not existed when human rights had first been proclaimed. During the debate that preceded the Universal Declaration of Human Rights, certain issues such as abortion and euthanasia had deliberately been left to one side. These ideas were not theologically or metaphysically based; those who supported these rights were free to found them as they please. In this sense, pluralism was inherent in the philosophy of human rights.

There were two extremes that ethics committees must avoid: on the one hand, ensuring acceptance of techno-scientific development, and becoming committees of rhetoric to foster this development; and on the other, by serving another rhetoric, countering the techno-scientific development of technophobic and scientophobic moral convictions.

Like all human creations, ethics committees were not perfect. Members must remain aware of the snares and pitfalls to which they were exposed.

Mr DIETRICH was sure that in order to establish a balance between science and technology on the one hand and ethics on the other, there was a need for a good education system to inculcate shared values. In Poland, an ethics module had been added to certain science programmes. Ethics would be assured when it was taught as part of all scientific disciplines, including mechanical and civil engineering.

Mr RAKHANSKY (Chairman, Committee on Science and Technology, Parliamentary Assembly, Council of Europe) was delighted with these two days of productive discussion. The Committee on Science and Technology was concerned about the difficulties encountered by researchers, especially young ones, and particularly in the countries in transition: it should not be forgotten that the former USSR accounted for 200 million people, that was to say half the population of the entire continent.

We needed to act to ensure that European standards did not slip. With less funding, the number of researchers would fall and people's needs would no longer be met. We needed to devote at least 2% of GDP to research, and 4% to education.

The Council of Europe must maintain its collaboration with Unesco and the ESF, and a constructive dialogue with all partners.

The press had got to stop dealing only in sensational events, and actually inform the public about the development of science.

How could government decisions be influenced?

The Committee on Science and Technology was hard at work, and the Parliamentary Assembly of the Council of Europe addressed recommendations to foreign parliaments: at its last session, the Assembly had adopted a recommendation on setting up a Euro-Mediterranean Hydro-Technical Institute. It had also adopted a resolution on patentability of the human genome.

As Mr Etherington had pointed out, politicians could achieve much, but they need to see eye to eye with scientists. Mr Rakhansky had raised these problems at the last session on 25 September when he had called for joint action at all levels (ie national, European and international) and for making use of all the machinery available (eg OECD, IMF and EBRD).

Mr Rakhansky said that his country, Ukraine, set store by its intellectual potential, and had set up a Fund for Intellectual Creativity in the 21st Century.

All in all, politicians took their role seriously because they were answerable to the electorate.

In conclusion, Mr Rakhansky read out the declaration that was to summarise the conference proceedings.

CLOSING SESSION

The session opened at 3.30 pm. It was chaired by Mr Anatoliy Rakhansky, Chairman of the Committee on Science and Technology, Parliamentary Assembly, Council of Europe.

Summing up by session rapporteurs and general debate

Mr PALUGYAI (Vice-Chairman, European Union of Science Journalists' Associations) reported on the proceedings of the first session 'Science and Technology in Europe'. There was agreement that despite the shortage of money, the collapse of research structures in

several countries, the continuing brain drain to the United States, and young people's disaffection with studying science, Europe continued to be a top-class scientific power, particularly in fields such as astronomy and the study of the universe (eg molecular biology), to quote but two examples. The task for decision-makers therefore involved identifying the positive and negative characteristics of the European system so as to preserve the former and remedy the latter, thereby affirming the old continent's position in the world.

European science had its strengths and its weaknesses. It was based on a network of public and private institutions with widely differing status and practices. Although pan-European institutions such as CERN, ESA, ESO and ESFR had been in existence since the 1950s, it was estimated that only about 15% of research expenditure was administered supra-nationally. Europe was the second biggest spender on research, behind North America and ahead of Asia; as for percentage of GDP, Europe managed only 1.8% while the United States spent 2.6%. With regard to publications, however, the European Union and the United States were neck-and-neck, and a long way ahead of Asia; the European proportion had continued to grow since 1990, but we should not forget that its population was 75% greater than that of North America. Lastly, the comparison was unfavourable in respect of innovation: Europe had lost a quarter of its market share, and was finding it hard to keep pace with the competitiveness and pace of investment of the United States.

What Europe lacked was an active and coherent research and technology policy designed to head off a 'twin-track' scientific Europe. This problem could not be ignored at a time when Central and East European countries were involved in negotiations to join the European Union.

Because research and technology were key elements of globalisation, European research could not cut itself off from the world context. Europe must adopt a joint position on the protection of intellectual property so as to guarantee the dissemination of scientific knowledge; this was under threat from the current practices of multinationals. The Council of Europe was a forum where these basic issues concerning the ethics of knowledge could be discussed.

Europe had also prepare itself for the fact that its population was going to decrease in relative and absolute terms between now and 2050. The ecological and economic disasters linked to the predictable demographic explosion in the Third World could only be avoided with the help of science and technology: this was one of the main messages to come out of the World Conference on Science organised last year in Budapest by Unesco and the ICSU. A consensus had emerged that developing countries should be urged to establish their own scientific networks, and that developed countries should help them through transfers of know-how rather than technology.

One of the most appropriate places for such co-operation was Trieste, where for several decades a number of scientific institutions including the Third World Academy of Sciences had been building bridges between the developed countries and those of the Third World and Central and Eastern Europe. Trieste would be host to the permanent secretariat of the Inter-Academic Panel (IAP) that was opening early next year; it would be able to call on the leading experts in the scientific community, with total independence from pressure groups, to collect reliable, objective data concerning the major problems on which planetary equilibrium depended.

The countries of Central and Eastern Europe had long been isolated from scientific and technical development in the western world, albeit to different degrees depending on the state, the time and the field of endeavour. The fall of the Berlin Wall had given scientists in these countries radically different perspectives, and the Budapest conference had stressed that regional and international co-operation was essential to help them to take advantage of the opportunities. It was regrettable, however, that the conference had focused insufficient attention on the social and human

sciences; they were of very considerable importance in enabling these countries to win back their identities and their self-confidence. (*Applause*)

Mrs DE PAOLI MARCHETTI (President, European Union of Science Journalists' Associations, Italy) summarised the proceedings of the second session, 'The Organisation of European R&D Co-operation'. A general introductory overview by Professor Banda described how scientific Europe was a complex place with its 40 countries, as many languages and cultures, and a widely shared reluctance to act collectively. Despite a number of voluntary initiatives since the 1950s, it had been difficult to build anything other than a 'variable geometry' Europe. If the outcomes of European research were to be optimised, the infrastructures would be neither fragmented nor limited to the European Union, and the definition of priorities would count for less, all told, than the introduction of mechanisms capable of avoiding duplication. Expenditure on research should not be judged by the GDP yardstick, but by the delay in catching up with the United States and Japan.

Mrs Jarlskog's impulsive and poetic presentation of CERN had been such as to enable a large audience to understand the infinitely large and the infinitely public. CERN, which had been set up by Unesco in 1954, was an admirable example of European and international co-operation. It employed some 7000 researchers and technicians from 80 different countries, and its dazzling successes had been as striking as the challenges that had come its way. It had played a particularly notable role in the development of the particle accelerator, in the setting up of the World Wide Web, and in the use of liquid crystals in medical diagnosis equipment.

The point of view of industry had then been presented by Mr Horst Soboll, Director of Technology Policy at Daimler-Chrysler Germany, and by Mr Jakub Radulski, Chairman of Alstom Power Poland; the latter's paper was a good introduction to the visit to the Alston site at Elblag.

The role of universities had been set out by Mr Kenneth Edwards, President of the Association of European Universities. He had showed that although fundamental research was the main task of universities, they must not ignore R&D. He deplored the fact that they were coming under greater pressure as a result of globalisation, a sharp increase in student numbers, and the need to engage in profit-making activities to compensate for the lack of public subsidies, and to the detriment of research. In particular, he had advocated an increase in student and researcher exchanges, the setting up of a high-quality international electronic communications network, greater selectivity in the funding of fundamental research projects, and more co-operation between universities.

It was only at the end, to the speaker's amazement, that the point of view of scientists themselves had been discussed. Was this a reflection of a new social hierarchy of values? Mr Claude Kordon, President of Euroscience, thought that one of the main problems was that of young scientists, their mobility and their post-doctoral training, and that there was a more urgent need for new mechanisms than for additional funds. In particular, he had argued for greater integration of the Central and East European countries, for more attractive careers, and for a more 'friendly' labour market. Mr Henk van der Molen, Vice-President of Academia Europea, thought that the scientific Europe of the future would have to rely on co-ordinated research policies, and that the scientific community's recognised advisory role should not be restricted to defining these policies. Their authority would be all the greater if it preserved its independence on questions of medical ethics, patents, education policy, or even research evaluation.

A *leitmotiv* – the need to set up mechanisms facilitating better integration and better co-ordination of research activities – had recurred throughout the debate. The new information and

communication technology could help, provided that petty bureaucratic constraints did not destroy the benefit derived from this combined work. It had been pointed out that research relied on enthusiasm: if the enthusiasm was infectious, it would be the best guarantee for disseminating scientific culture in the era of globalisation. (*Applause*)

Mr GABOLDE pointed out that on 4 October, the European Commission, which had been on the receiving end of so many demands and suggestions during the conference, and would undoubtedly give most of them consideration, had adopted an important document that opened up opportunities for progressing towards the setting up of a European research area. This initiative was everyone's business – governments, parliaments, research bodies and associations of researchers – and here, as elsewhere, the principle of subsidiarity must prevail. The status of researcher was based on the tax and employment laws of each individual country, just as reception arrangements depended on national laws governing the entry and residence of foreigners. The pace at which the European research area was constructed would depend on the ability of the various partners to work together. It was important never to lose sight of the fact that Europe was not limited to the European Union. Indeed, had the Council of Europe not chosen to organise this conference in Gdansk?

Mr BEKSTA (Minister of Culture, Lithuania) reiterated how honoured and pleased he was to have been invited to the conference. He sensed that he now had a better understanding of the scientific community's problems, and was therefore better equipped to take decisions because he had a better understanding of the facts. He concluded by thanking the Polish authorities for their kind hospitality.

Closing addresses

Mr WISZNIEWSKI (Minister of Science and Chairman of the National Committee of Scientific Research, Poland) mentioned an idea that had come to him when visiting CERN's particle accelerator: the Commission in Brussels should, he thought, travel to Geneva to see how to accelerate new particle membership of the European Union. (*Smiles*)

About 14 centuries ago, Mohammed had said that the quest for knowledge would take us as far as China. When he had said that, he was the first statesman to refer publicly to the globalisation of knowledge, a process that was under way in medieval Europe as a result of widespread student mobility and the common use of Latin, a *lingua franca* that made the translation of books into all the continent's languages superfluous. However, the world had changed in the 18th century, and new nationalisms had brought science and education into national policies. It was only recently that Europe had undertaken to combat the consequences of these nationalisms and re-establish an international community of scientists.

The role of science had always been multifarious – the search for truth, the creation of new knowledge, and the dissemination of knowledge. This was even truer now that it had become an economic factor, and the 21st century would probably be the century of the economics of knowledge, with natural resources playing a declining role in prosperity. The turning-point had occurred during the Second World War when the role that science played in military operations had convinced politicians that it was worth investing in research. Since then, governments, and particularly enterprises, had invested massively, but they had demanded outcomes that can be applied within a short period of time, instead of abstract gains. On the one hand, scientists had seen their resources expand; on the other, they had lost much of their freedom. This had once prompted an American scholar to remark that if a scientist knew the end-use of what he was doing, he would stop immediately.

Research that did not start from a pre-conceived idea and did not have a precise aim is, at the end of the day, more productive than other research. The priorities of scientific policies these days were over-determined by economic considerations, and if we compared the content of European outline programmes with the list of Nobel prizes, we saw a very pronounced gap that was no doubt inevitable, but which could become dangerous if it got any worse.

The number of researchers had increased dramatically: for every 1000 workers, there were 5 researchers in the European Union, 7.4 in the United States and 8.5 in Japan. Half of those who worked in the sector received 70% of the resources. Total expenditure on research accounted for 1.8% of GDP in the European Union, 2.7% in the United States and 2.8% in Japan. Total world expenditure came to 50 billion dollars a year of which only a third came out of national budgets. Of the 700,000 patents registered each year, 30% were lodged in the United States, 30% in the European Union and 20% in the Asia-Pacific region. As far as publications were concerned, the distribution was almost even. Students had formed 5% of their generation 50 years ago, but they now accounted for 40%, or 4% of the total population. The positive effects of this were even more direct than those of patents and publications.

In Poland, there were 3.2 researchers for every 1000 workers, and expenditure on research came to no more than 0.75% of GDP, three fifths of it (ie 1.5 billion dollars) being funded by the state budget. Poland was 21st in the world for publications and 31st for patents. The student population had quadrupled in ten years and now represented a third of young people of student age. The National Committee of Scientific Research, which was personally chaired by the Minister responsible, examined all budgets and State-funded research projects line by line. The government had decided to double the percentage earmarked for research in stages, and to focus the priorities of the science policy on teaching at doctoral and post-doctoral level, on assistance with innovation, and on boosting international co-operation, particularly under the EU Framework Programme.

The role of science in the destiny of humankind must not be under-estimated. It had always played an essential role, but in the 21st century it would be of paramount importance, and this must prompt us to avoid complacency. As the proverb said, 'He who seeks the truth is a wise man; he who thinks he has found it is a fool.' (*Applause*)

Mr TUSK (Vice-Marshall of the Senate, Poland) said it was a great honour to have been asked to bring the conference to a conclusion. It had taken place in Gdansk, a city whose inhabitants were, as everyone knew, historically attached to freedom, and it was precisely the freedom of science, and not just funding, that had figured in the speeches delivered by the scientists, politicians and industrialists who had gathered together here over the past three days.

The 20th century was the century of utopias, but they had been disasters. Hopefully, this would not be the case in the 21st century. Political leaders must show themselves to be vigilant, and sensitive to the fundamental value of freedom, a value that must be cherished lovingly both by scientists and by themselves, because as far as freedom was concerned, their joint action constituted both the greatest opportunity and the greatest threat. In '*Brave New World*', Aldous Huxley described a totalitarian society in which an entirely enslaved population was artificially injected at regular intervals with doses of compulsory, artificial happiness. Let us hope that the author got it wrong, and that his prophecy did not come true. (*Applause*)

THE CHAIR stated in conclusion that the dialogue that had begun in Gdansk must be followed through, particularly in order to pressure governments to provide funding. Politicians were often accused of saying much and doing little, but the Council of Europe was to be congratulated on organising this meeting of politicians and scientists, particularly young ones. Everyone had come

with innovatory proposals, and the discussions had been stimulating. Out of the collision of ideas there came light. The speaker concluded by thanking the organisers, the interpreters and the précis writers, and declared the session closed. (*Applause*)

The session closed at 5.00 pm

Appendix I

PROGRAMME AND GENERAL INFORMATION

Participation:

By invitation only, limited to approximately 300 participants, including parliamentarians from the 41 Council of Europe member States, government representatives, leading experts from academia and industry, representatives from international and European organisations, non-governmental organisations, and the press.

Aim:

The aim of the Gdansk Conference is to bring together the main European partners in science and technology for a constructive dialogue between parliamentarians and representatives of research funding agencies, universities, scientists and industry.

Discussions will address the following :

“Science and Technology in Europe”

What is the present state of science and technology in Europe as a whole, taking into account global and historical perspectives? How can this analysis provide a base for future decision-making ?

“The organisation of European R&D co-operation”

To address the complex structure of R&D co-operation from a multiplicity of view-points in order to consider possible improvements.

“Prospects for the future”

This session is intended to provide a Forward Look, addressing key issues such as the place of research in society, responsibilities and ethical concerns. The views of the researchers of tomorrow will be an important element in the discussion.

Outcome:

It is hoped that this initiative will lead to a new impetus for the development of a European science and technology policy framework.

The findings and ideas for future action will be treated and developed by the Conference participants according to the special competence and scope of each.

The outcome of the Conference will be used in a report to be presented to the Parliamentary Assembly of the Council of Europe.

Format:

The sub-themes of each main session will be introduced by high-level presentations. Ample time will be provided for discussions between speakers, parliamentarians and other Conference participants. The Rapporteurs of the three working sessions will be eminent European science journalists.

Background

Science and Technology have always been of importance for development, culture and co-operation in Europe and in the 20th century perhaps more intensely than ever before. After the Second World War a number of European structures were created in order to facilitate and encourage European co-operation and integration particularly during the 1960s and 1970s. Some of these have been given a distinct scientific and/or technological character.

The ending of the artificial division of Europe in 1989 brought with it intense efforts to expand European co-operation by involving the entire continent.

The state of science and technology varies considerably among European countries. Particular concern has been voiced on several occasions regarding the intellectual capital in European economies in transition. European Research and Development co-operation has to a certain extent responded to this problem, but far more powerful action is needed to maintain and further develop these intellectual resources.

The situation of young researchers, the future of Europe's scientific and technological capacity, is particularly critical in some Central and East European Countries, but many West European Countries have also given increased attention to this issue.

Although European countries have their own science and technology policies, including policies for European and international co-operation, there has been little debate on those elements which might form part of a **European science and technology policy**. The presentation of a European Science and Technology "Map" during the present Conference should stimulate the first general debate on this issue at the continental level. This debate will also pay particular attention to co-operation with other parts of the world.

The global dimension of science was highlighted during the World Conference on Science, organised in Budapest (Hungary) in June 1999 by UNESCO in partnership with the International Council for Scientific Unions (ICSU). This important event as well as other debates on this issue represent valuable inputs to the European discussion.

A co-operative venture

The effort to stimulate a pan-European dialogue between policy-makers, the scientific community and its different representative organs as well as industry has been possible thanks to the co-operation of many organisations and individuals. The main organisers therefore wish to extend their gratitude and thanks to the hosts of this conference, to all speakers that accepted to animate the debates and to the many organisations that contributed to establish an interesting programme.

MONDAY 9 OCTOBER 2000

There will be a meeting of the Committee on Science and Technology of the Parliamentary Assembly of the Council of Europe from 10 am to 1 pm.

2.00 pm ***Registration***

3.-3.30 pm OPENING SESSION

Chair : **Mr Mikko Elo**, Vice-President, Parliamentary Assembly,
Council of Europe

Welcoming address

Mr Maciej Plazynski, Marshal of the Sejm, Poland

Opening addresses

Mr Edmund Wittbrodt, Minister of Education, Poland

Mr Aleksander Kolodziejczyk, Rector of the Technical University of
Gdansk

3.30-4.30 pm ***Introduction to the Conference topics***

Mr Reinder van Duinen, President, European Science Foundation (ESF)

4.30-5.00 pm ***Coffee break***

5.00-6.00 pm ***European space of research***

Mr Jean Gabolde, Director of International Co-operation, Directorate
General Research, European Commission

6.00 pm ***Highlights of Science and Technology in the History of Gdansk***

Mr Andrzej Januszajtis, former President of the City Council of Gdansk

8.00 pm Reception given by **Mr Maciej Plazynski**, Marshal of the Sejm,
and **Mrs Alicja Grzeskowiak**, Marshal of the Senate, Poland

TUESDAY 10 OCTOBER 2000

SESSION 1 SCIENCE AND TECHNOLOGY IN EUROPE

Chair: **Mr Claude Birraux**, First Vice-Chairman of the Committee on Science and
Technology, Parliamentary Assembly, Council of Europe

Rapporteur: **Mr Istvan Palugyai**, Vice-Chairman of the European Union of Science
Journalists' Associations, Hungary

9.00 am ***The pursuit of excellence in European science***

Mr Stefan Michalowski, Head of OECD Megascience Unit

9.20 am ***European science and technology in a global perspective***

Mr Pierre Papon, President, Science and Technology Observatory (OST),
France

Mr Maurizio Iaccarino, Secretary General of the World Conference on Science (UNESCO and the International Council for Science (ICSU))

Mr Paolo Budinich, Third World Academy of Sciences (TWAS), President, Trieste International Foundation for Sciences

Questions

10.20 am *Science as part of European culture and co-operation*

Mr Arunas Bėkšta, Minister of Culture, Lithuania

10.40 am *Coffee break*

11.00 am *General debate*

12.00 noon *Lunch break*

SESSION 2 THE ORGANISATION OF EUROPEAN R&D CO-OPERATION

Chair: **Mr Ivan Melnikov**, Committee on Science and Technology, Parliamentary Assembly, Council of Europe

Rapporteur: **Mrs Paola De Paoli**, European Union of Science Journalists' Associations

2.30 pm *An overview*

Mr Enric Banda, Secretary General, European Science Foundation

Questions

3.00 pm *CERN as an example of European and global co-operation*

Ms Cecilia Jarlskog, Advisor to the Director General of the European Laboratory for Particle Physics (CERN)

Questions

3.20 pm *The point of view of industry*

Mr Horst Soboll, Director of Technology Policy (FTT), Daimler Chrysler AG (Germany)

Mr Jakub Radulski, Country Organisation President ALSTOM Power Ltd. Poland

Questions

4.00 pm *The role of universities*

Mr Kenneth Edwards, Vice-Chancellor, Leicester University, President of the Association of European Universities (CRE)

Questions

4.20 pm *The points of view of scientists*

Mr Claude Kordon, President, Euroscience

Mr Henk van der Molen, Vice-President, Academia Europaea

Questions

4.50 pm *Coffee break*

5.-6.30 pm *General debate*

8.00 pm Organ Concert at the Oliwa Cathedral, and visit of the Cloister and the Museum ; reception given by **Mr Jan Zarebski**, Marshal of the Voivode Pomerania

WEDNESDAY 11 OCTOBER 2000

SESSION 3 PROSPECTS FOR THE FUTURE

Chair: **Mr Aleksander Luczak**, Committee on Science and Technology, Parliamentary Assembly, Council of Europe

Rapporteur: **Mr David Dickson**, News Editor, "Nature"

9.00 am *The view of young scientists*

Ms Laure Ledoux, President of the Marie Curie Fellowship Association (MCFA)

Questions

9.30 am *Science and global responsibility*

Mr Hubert Markl, President, Max Planck Gesellschaft

9.45 am *Science and society*

Mr Marek Dietrich, Chairman of the Institute for Modern Society (Poland)

The knowledge-based economy, the European challenges of the 21st Century

Mr Antoni Kuklinski, European Institute for Regional and Local Development – EUROREG, University of Warsaw

Questions

10.30 am ***Ethics in science***

Mr Gilbert Hottois, University Libre Bruxelles, Rapporteur of the European Group on Ethics in Science and new Technologies, European Commission

Questions

11.00 am ***Coffee break***

11.15 am ***General debate***

12.30 pm Buffet-lunch offered by **Mr Marcin Libicki**, Chairman of the Polish Delegation to the Parliamentary Assembly of the Council of Europe

CLOSING SESSION

Chair: **Mr Anatoliy Rakhansky**, Chairman of the Committee on Science and Technology, Parliamentary Assembly, Council of Europe

3.00 pm ***Summing up by the Session Rapporteurs and General debate***

4.30 pm ***Closing addresses***

Mr Andrej Wiszniewski, Minister, Chairman of the National Committee of Scientific Research, Poland

Mr Donald Tusk, Vice-Marshal of the Senate, Poland

5.00 pm ***End of Conference***

Press Conference

5.30-7.00 pm Reception given by **Mr Mikko Elo**, Vice-President of the Parliamentary Assembly

(Technical University of Gdansk)

THURSDAY 12 OCTOBER 2000

TECHNICAL VISIT

08.30 am Departure from Hotel to the City of Elblag

10.00 am Visit of the ALSTOM Power Company Ltd. (Turbines, machinery for the energy sector etc.)

Departure for the City of Malbork

1.00 pm

Lunch

Visit of the Castle of the Teutonic Knights

Approx. 6.00 pm

Return to Gdansk

GENERAL INFORMATION

The Conference on Science and Technology in Europe – Prospects for the 21st Century will take place in Gdansk, Poland, on 9 – 11 October 2000.

1. Conference Venue

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Appendix II

European Forum of Young Scientists

INTRODUCTION TO THE CONFERENCE THEME

Reinder J. van Duinen

President European Science Foundation

Your excellencies, Ladies and gentlemen,

It is a great honor for me to introduce the theme of the conference “S&T in Europe, prospects for the 21st century”. The task presents a considerable challenge, with so many competent speakers in the coming days who will address various aspects in a much more solid and no doubt responsible manner.

Nevertheless I shall oblige to the request of the organizers. I have selected to discuss a number of issues that seem to me to be particularly relevant. To stimulate your thinking I include a dilemma each segment of my talk.

To introduce myself let me briefly describe my personal history:

I obtained my PhD in physics at the University of Groningen, The Netherlands, and switched to space astronomy as senior scientist and principal investigator in a number of international space projects. Around the age of 40 I switched fields again and went to industry, initially as head of the Space Division of the Fokker company, and later served for 7 years on the Board of Management of that company, responsible for design and production of aircraft. In January 1995 I was appointed to my present position at NWO; since January of this year I have the honour to also serve ESF as President.

SCIENCE AND TECHNOLOGY

This talk is not an attempt to predict the future, nor a scholarly or institutionally attempt to describe the present and the past. Rather it is meant to present an overview of science & technology and to introduce some issues for possible debate.

I shall first describe what Science and Technology is, then move on to the issue of the society/science relationship and from there to the position of science and the science system in Europe, the threats and opportunities and possible remedies for some of the present shortcomings. Throughout I shall do my best to keep the interest of this particular audience in view, as I will operate from the assumption that you Parliamentarians have come to Gdansk to prepare for political action, you science policy makers to make sense out of the effects of Europe on your work and you students will want to tell us oldies what we should and should not do.

Science then requires some definition. You would be surprised how many different images or notions are associated with the term *Science is about understanding the physical world and the relations between living organisms*. Understood in this way it is wider than the hard or natural sciences and in my talk I will use the term ‘Science’ including the social sciences and the humanities. Scientific knowledge is a description of our understanding of the world (in its expanded meaning). It is a comprehensive body of understanding that continuously evolves through research; new knowledge and new insight at least partially invalidates our previous understanding. It is a

body of statements of varying degrees of certainty, some most unsure, some nearly sure, none absolutely sure. The dynamics of science is caused by the progression which we call research. Professional researchers are those scientists and scholars who involve themselves with asking questions about the world and proceeding to try to get answers. These questions lead to a 'nearer' truth, sometimes even to 'paradigm shifts', which happen after cumulating small steps finally provide a new insight a new way of looking at a part of the world. In many instances insights in the hard sciences are encapsulated in technology, frequently in devices or methods. Such technologies enable new research which in turn leads to new insights. Science educators teach about our present understanding. Engineering scientists develop new products or services using existing technologies in new combinations.

Casimir called this dynamic progression the 'spiral of research and technology', research leads to technology and this technology enables research, often in completely unrelated fields, thus creating a spiral which is perfectly understandable in hindsight but nearly unpredictable in the future. Next to the research/technology spiral, there is science to science interaction. Today perhaps more than ever before we see the effect of one field of science feeding other sciences in an ever increasing interplay between previously completely separated domains of science. I need only to point to the effects of information technology on research: experimentation in silico, modeling. Or to modern molecular biology and technology on medical research.

Technology sometimes leads to completely unexpected new markets: the 747 aircraft resulted from the loss of a competitive bid for large transport aircraft for the US airforce. Its size far exceeded the market demand at the time of its introduction. One may safely say that this product enabled a completely new market: that of mass-travel and tourist business, with a turn-over of well over 750 B\$ per year, probably the world largest business sector..

Similarly, high density integrated circuits were initially developed for military purposes; the technology enabled the Personal Computer and the mobile telephone, which both have created a new business sector: the ICT industry.

The nature of the scientific pursuit

Research is about the pursuit of the 'nearer truth' in science. It differs fundamentally from the solution of a problem through the use of the 'scientific method'. This difference is often overlooked, especially by policy-makers and politicians without a background or experience in the actual performance of research. Laymen tend to equate the scientific endeavour with finding out what can be found on the WEB, in textbooks and the literature and using that knowledge to methodically analyse and subsequently solve the problem at hand. Research, however, goes beyond that. Research is about adventuring in uncharted territory, progress is typically by two steps forward and one step back, by getting trapped in dead allies, by having to restart from square one after a failed approach. Progress in research is often a matter of intuition, of being able to use - say - new mathematics in problems of physics, or physics in problems of biology. This adventurous nature of research is the main attraction to the perpetrators of research, it sometimes leads to great satisfaction when suddenly the breakthrough discovery is there, it more often leads to great frustration when a splendid idea turns out to lead nowhere at all. In this, conducting front-end research is not unlike the work of the creative artist. Such experiences are the reason why scientific research provides an excellent background for professional activities later in life, even outside of science.

Research adventures can only be successful when there is enough patience and perseverance on the side of the researcher or the team. But equally important is patience and perseverance in the funding

of research, to allow for the formation of scientific schools, which takes generations of PhD's to form and prosper. Such patience is generally not available through short-term funding which is specifically directed to solve a specific problem, preferably yesterday.

Universities and faculties would do well to maintain a healthy mix between long-term research primarily driven by curiosity and commissioned research, which is seen to serve society. I shall return to this topic later.

The future of science

I shall not attempt to give an overview of the challenges that lie ahead of us. There is no doubt in my mind that we are just at the beginning of understanding the physical world, that our understanding of life and of living systems, or I should say of complex systems, is still very fragmentary and primitive and we still have very little understanding about the nature and the dynamics of structures and processes that apply between groups of living organisms.

At the global level then I can see no major problems with the development of science. Despite Horgan's elegantly argued "End of Science"¹. There remains a lot to be done. No doubt that the Grand Challenges, such as the understanding of the (human) brain, the origin of life, the unification of fundamental interactions will continue to challenge the best brains to the pursuit of the boundaries of our knowledge. Societal problems require continuing efforts on the understanding of diseases and their elimination, especially those affecting the elderly and the poor, the understanding of our climate and the role of mankind in its evolution, the prediction of natural disasters and the control of pests, the issue of sustainable energy generation, the design of sustainable cities. With so many demands, so many questions still unanswered there will be a bright future for the business of science.

I do not believe that the science system is endangered by the apparent lack of interest in the younger generations to take up a career in the hard sciences and engineering.

While this issue does warrant serious study and firm action, I would argue that this tendency of young people to spurn science while typical for affluent societies, will not affect the other half of the world. The problem can and will be solved by migration. In fact, this immigration and re-migration of so many talented young people may be a blessing in disguise. The future intellectual elite travels and enjoys a first-hand experience of other places, other cultures. What could better serve the improvement of mutual understanding, the crossing of cultural bridges and ultimately world peace, than the ever increasing numbers of students studying and playing abroad?

The failure of the linear model

At this point I would like to make a detour and explain why I believe the popular model of the process of research leading to inventions and thereby to new economic activity is not only wrong but also dangerous.

The kind of interventions which government research policy-makers pursue, are often directed at the utilisation of science; I claim that often such interventions are based on a mistaken model of the interaction between science and the market. Such misdirected attempts are bound to fail, and if they do, as they will when based on the wrong model, science or academe or the universities will receive the blame. Such undeserved blame is damaging for the cause of science. The linear model attempts to capture the evolution of scientific ideas to business in the simplistic notion of fundamental

¹ John Horgan, "The end of science", 1998, Tunbridge Wells 1998

research, which leads to inventions, which in turn lead to profitable products and services in the market. It fails because in reality the interaction is not simply as described, but as often completely the other way around. Many important scientific discoveries were made because a problem needed a solution and perhaps even more because an accidental coincidence led to the discovery of a new phenomenon. The accidental invention of sterilisation by Pasteur is an example of a serendipity discovery; the discovery of prions the result of an effort to understand certain transmittable diseases.

A superior whilst not perfect model is to speak of loosely forward and backward interacting cycles, i.e. the *knowledge* cycle which leads to fundamental knowledge embedded in products or procedures, and the *innovation* cycle which packages technologies to generate or serve markets. Interventions to promote the utilisation of science and technology must therefore be directed towards the promotion of innovation, which requires much more than finding a good idea as every entrepreneur knows. Categorisation of science in *fundamental* and *applied* based on the linear model is as meaningless as it is useless. In stimulating and promoting the knowledge cycle quality must be the judge, irrespective of the origin of the scientific problem or question. Reliance on the community of science to make such judgements is essential, outside interference must not and cannot be tolerated. Research cannot and must not pretend to be able to solve societal problems on its own, what it can do and must do is to show the way, to analyse the options. The solutions require political decisions, which are outside the scientific domain.

With this I have alluded to the second theme of my talk: the interaction of science and politics.

But before I discuss this, I should like to return to the main line of my argument: science is a source of great value to us all and must be allowed to prosper and grow. There is however, an interesting dilemma here which may be worth discussing.

I would phrase it as follows: How much S&T is enough?

GDP percentages are frequently used to inter-compare national statistics, but there are some important limitations to its use. For one, it represents a ratio which would tend to decrease when GDP growth is high. Also it is a number representing a snapshot value, while more often than not the performance of the science system is as much the result of accumulating past investments in physical and human capital as it is the result of instantaneous input. Growth should not be such that it outstrips supply of scientists and engineers, perhaps a growth rate over 15% cannot be sustained for long. Finally it concerns an input number; it seems as important to track the output of the science system.

Science and society

Science is of great value to us all. Society expects a lot from science, in some instances the pressures from society, be it the government or single-issue movements, are such that some scientists individually or in groups, promise more than they can deliver, or state scientific certainty which cannot be upheld. Indeed science (including the social sciences and the humanities), through the technology that it enables and the insights in societal structures and dynamics it provides, changes our lives and shapes the future of mankind. Science and technology are seen as the very engine of economic progress, and lately, even as the source of the emerging “new economy” which is supposedly characterised by extraordinary robustness against economic cycles. Be that as it may, the role of the sciences is overwhelming and puts great responsibility on the shoulders of its perpetrators.

Yet, all this science and technology, however beneficial for mankind, leads to a variety of concerns in the general public and also in the scientific community itself. I need not remind you of the sobering effect the actual use of the atomic bomb had on the physicists who helped to create this ultimate weapon of destruction. At the time, many of those involved in its development, hoped and expected it would never have to be put to use². The continuous threat of world-wide destruction during the period of the cold war seems almost forgotten, despite the effect it had on our every-day lives. Today, in the wake of public concerns about the application of nuclear technology, we may not any more be able to use nuclear fission as a source of clean, carbon-free energy, despite our concerns about climatic change. Likewise, one may question whether the concerns in the public about the application of GMO's in the food-chain may lead us to being unable to adequately feed the present six, soon eight billion inhabitants of this planet.

We need only to be reminded of the accidents of Bopal, Chernobyl, Three-Mile Island, Challenger, and recently Tokaimura to realise the threats and failures of science and technology. But apart from these large scale accidents, we also perceive - increasingly- the negative effects resulting from the relentless application of new technologies in our everyday lives. These run from the irritating use of cellular telephones in public places, to the inability to play old versions of sound recordings, the forced use of automatic tellers and of low quality mass-produced food products, the omnipresence of surveillance cameras, the breach of privacy through data-mining, to the removal of the old-fashioned ten-cow farms from our villages. And in the spiritual sphere, science seems to steal from us the mysteries of life and of creation. The tremendous progress of molecular biology, the ever better and rational underpinning of the molecular basis of genetics, of life and ultimately of creation itself, is a source of intellectual delight for some and emotional disaster for others.

Science is a source of great value to us all. It is the source of material wealth, the reason why we do not all have to toil long hours every day, why nowadays we enjoy lots of free time to spend as we choose. It is also the source of immaterial wealth for those who make an effort to better understand our world. Science is at the basis of our ever longer life expectancy, of our better health and well-being. But at the same time, science is a threat. It destroys our traditional values and belief systems, it removes our children and grand children to far-away places, it kills animal and plant species, destroys nature, and leaves us with dementia as the last phase of our existence. It provides the basis for solutions to life threatening problems of our planet, but it is at the same time also the source of these problems. It progresses unchecked, at its own pace, with nobody in control, nobody apparently accountable. We live in democracies and thus decide over our destiny as a society and yet the very engine that drives societal evolution appears essentially beyond our control. And when we need science to help improve our lives, to come up with cures for nasty diseases, to give us a source of non-contaminating, safe energy, to predict natural disasters, we get no answers, or at best partial ones and vague promises.

Science and society then, are closely interrelated, but the relationship is not anymore a happy one. There are tensions. It would seem that, increasingly, the perceived role of science and technology turns from beneficial to problematic. Which in turn could remove the political and popular basis for its sustenance and support. The relations between science and society are complex, the dynamics badly understood.

Here I will touch upon two aspects of this relation that seem to me are particularly relevant for the future of science. One concerns the change in the political attitude towards science, perhaps best described as the tendency to require science "to deliver the goods". The other concerns the politicisation of science and the scientification of policy.

² Robert Jungk, "Heller als tausend Sonnen", 1956

I will first discuss the increasing pressure on science to deliver.

Relevance and accountability of science

Let me take a position: It seems to me that there is nothing principally wrong about the recent pressure on accountability of the science system. After all, science is part of society, on average some 40% of the total research and development effort is funded through the public hand. The period of almost unbounded affluence and freedom of the science system up until the seventies, both in the East and in the West, which seems to find its beginnings during and after WW II, is in retrospect perhaps more of an anomaly than the return to accountability which we witness today. This is not to say there are no problems. Certainly many scientists, especially in the East, are alarmed by the dramatic decrease of funding for research. Scientists and research administrators are demanding more money to maintain the science system and to remain competitive. While I am fully conscious of the differences in conditions in the East as compared to the West, there are pressures on the availability of public funds for research. In the West they arise from the reduction of national budget deficits on the one hand, and through the competing demands on public funding by education, health care and social security on the other. In the East the material situation is still so bad generally that research and the maintenance of the science system has a low priority. Under these circumstances it is entirely justified for the science system to keep pointing to the benefits of science to society, if only to prevent the decay of a system that has taken ages to build.

But there are limits. It seems increasingly problematic to demand from the fundamental research to justify itself through the connection with all kinds of beneficial applications, real or imaginary. The very nature of fundamental or curiosity driven research is that we cannot and must not attempt to predict when and where it leads to societal benefits. It is perverse to pressure the science system in general and the university system in particular to justify the spending on curiosity driven research by demanding an ex-ante demonstration of its utility. It leads to false rhetoric and a mistaken concept of the scientific endeavour.

Universities

At the university level, the outside pressures on accountability and justification have led to the introduction of a variety of quality assurance systems and other management concepts to introduce outside review of the quality of staff and work performed. Universities are increasingly aware of the importance of human resource management to maintain and enhance the quality of the research staff. Certainly, pressures on “relevance” have led to a reorientation towards problem driven research, as opposed to curiosity driven research.

However, both research funding organisations and the performers of research have, I believe, benefited from this re-orientation. Problem oriented research requires by nature the contribution of a variety of disciplines to contribute to the study of the issue at hand. Whilst multi- and inter-disciplinary research is not without its difficulties in the assessment of research proposals and in the extra effort required in the design and management of research projects, again, I believe that the overall effects have been beneficial. The traditional disciplinary boundaries have to be and are being melted away, traditional research attitudes changed, resulting in benefits not only with respect to the research problem itself, but also, and more importantly perhaps to curiosity driven research. Why? It seems to me that the tendency towards the **atomisation of science**, which I do not have time to discuss, needs a countervailing integrating force, which prevents the science system to lose its ability to take a synthetic, if you want holistic view. The pressure on relevance seems to provide that force.

All this is not to say there are no problems with the pursuit of “relevance” of science to society. There are the risks of perversion of the university system by the introduction of unbounded reliance on “the market” to guide the development of the university and of its research portfolio. Earlier I mentioned the pressures on fundamental research which, because of its very nature cannot and must not be required to justify its existence through possible utilisation in some unknowable future. Every attempt to do so, puts us in the position of the astrophysicist who has to show why it is relevant for mankind to pursue the nature and origin of Gamma-Ray Bursters, which produce enough energy in a few seconds to keep the Sun going for millions of year. Perhaps more important, who is to judge “relevance”? Astronomy was a particularly relevant science in the 16th and 17th century when it provided the basis for navigation of merchant fleets of Holland, England and Portugal. Nowadays we would all classify astronomy in the curiosity driven, rather than problem driven domain.

Politicisation of science and scientification of policy

The other issue which I would like to discuss in the context of science/society relations concerns what I would call the politicisation of science and the scientification of policy. In a recent special issue of *Science and Public Policy*, Peter Weingart discusses this theme³. He begins by showing that a remarkable change has occurred in the last fifty years; it used to be that science and policy were well separated domains, since the days of Leonardo da Vinci scientific advice was limited to the military application of science and technology, which let Eisenhower to warn that “public policy might become the captive of the scientific-military establishment”. In fact this association became the source of strong controversy, you may remember the bombing of the Wisconsin University computer centre in the late sixties, the centre being seen as a symbol of undesirable association of university science with the military establishment. Still following Weigart, conflicts of interest in the advisory role were identified among others by C.P Snow and Don Price in the sixties: how to avoid that scientists while giving advice were not at the same time pursuing their own interests, or at least the interests of research?

This concern is still valid. The process of the involvement of science in policy design is increasingly problematic. First there is the not too uncommon phenomenon that scientists and scholars are being recruited by government officials to analyse policy options and to advise on the “best” course to take. Even in the ideal situation of a “clear” separation of *political problem definition*, value free *scientific advice* and *policy decision* by politicians, there is always the danger that the scientist is not and cannot claim to be totally impartial. But the fact of the matter is that quite often the political problem definition *itself* is in fact motivated by science. Examples are DDT in the food-chain, the ozone depletion through CFC’s, mad-cow disease. The risk of science and technology is *itself* a rich source of research into these risks, and scientists are responsible for the political concerns which in turn feeds more probing research on such risks. Second, scientists cannot claim the value freedom that comes with objectivity of knowledge. More often than not results of research require carefully selected wording and usually limit the scientific claims to specific circumstances or domains. Such qualifications are not very practical in the political arena, as a result of which claims are “translated” in wording which may take on a different meaning than intended in the context of science. Third, scientists are not as impartial as one would tend to assume in idealised models of science-policy interaction. Weigart quotes Edward Shils⁴

“Advisors are too frequently chosen not so much because the legislators and officials want advice as because they want apparently authoritative support for the politics they propose to

³ Peter Weingart, *Science and Public Policy*, June 1999, page 151-161

⁴ E. Shills, “Science and scientists in the public arena”, *The American Scholar*, 35, 85-202

follow. It is obvious that in complying with these desires, the legislators and officials are in collusion with the scientists to exploit the prestige that scientists have acquired for objectivity and disinterestedness."

It is in this connection that scientists are sometimes tempted to promise more than they can deliver or to claim certainty where none exists.

Weigart sees the close coupling of science and politics as a novel aspect of scientific expertise (*loc. cit.*). With the legitimating role of scientific knowledge in policy making on the increase, politicians develop a keen interest in the most recent research results. As these are to be found on the frontiers of research, it is not unusual that such recent insights have not yet reached the status of accepted "truth", through the method of vigorous peer review prior to the publication of results. This very fact creates a phenomenon which we can witness almost weekly, in which one "expert" lays claims, which are promptly disputed by another "expert". The debate, which in scientific circles is essential for our progression to deeper understanding, is now conducted in the open arena, with the ensuing effect that the public is asked to believe this position one day and another the next. Such playing of scientific expertise leads to the belief that experts can be bought, at the cost of the respect for science as a "body of statements of varying degrees of certainty, some nearly certain...." Indeed, why "believe" in science as pontificated by scientists: there are other sources of so-called scientific truth, alternative medicine and astrology for instance. Recent cases of fraud in biomedical research have been widely publicised. No wonder that science is losing its authority in the eye of the general public. Paradoxically, while politicians increasingly tend to turn to science as a legitimating "truth", science itself is losing the lustre of objectivity. Weigart goes even further and exposes the drive of scientists into the political arena as a case of self-serving interest, whereby catastrophes are being construed to capture public attention and support for an expansion of research in particular fields. Must the recent asteroid scare be categorised in that domain? Or the possible contamination of the natural environment through genetically modified food?

Scientists have responded to these trends by evolving from the scholar and the scientist of old - recognisable by a distinct habits, dress and attitude - to the new entrepreneurial type, sociable, communicative, well-dressed. This new scientist is continuously on the look-out for funding opportunities, whether in his own university, with the national research council, in EU programmes, or wherever. This is further stimulated by the tendency to stimulate science-business interaction; "earning power" of university staff is increasingly seen as an important element in the selection of newly appointed university professors.

In searching for the model to describe science and societal interaction some scholars⁵ use the concept of the "Public Sphere" as a common place where members of society meet to discuss matters of mutual interest. This public sphere operates under the influence of the media, and it is to be expected that scientists not only participate in agenda setting but also make use of the media to further their normative stands and their own interests. All too frequently we can observe to which height or rather abyss, media hypes can take the debate, when for some reason an issue captures wide-spread media attention and the ensuing simplification and amplification destroys the quality of what started as an argument between scholars. Also in the recent history of science, these hypes

⁵ e.g. Arthur Edwards, *Science and Public Policy*, page 163 and references quoted therein.

have taken on an almost unbelievable dimension as the cases of high-temperature superconductivity and cold fusion attest.

This is not the place and neither do I have the competence to recommend another or better model to describe the evolution of the science and society interaction. But I tend to agree with Weigart (loc.cit.) that “the (over-)supply of knowledge and its politicisation leads to de-legitimisation of politics and loss of authority on the part of science”.

This analysis leads to the following dilemma: “Can and must the independence of science be restored?”

My own answer to this is a clear: YES! But what to do? Solutions to the problem of the demise of the prestige and independence of science are not easily found. Restoration may not be achievable and, I might add, in the eyes of some, is not even desirable. But it is clear that solutions must come from the science system itself. Perhaps the most sensitive issue concerns the setting of the research agenda. At the level of government science policy and agenda setting, nowadays the prevailing, though not the only approach, is the foresight mechanism, which operates at the national level. If well conducted, it is an open and transparent system, in which the process of confrontation and debate is perhaps as important as the final outcome. In the European Union research policy used to be set and subsequently implemented through the Framework Programme, a mechanism which has been criticised as ‘murky and rigid’ for its lack of transparency and flexibility. While the framework mechanism has no doubt had and still has a beneficial effect on the science system in Europe, additional measures are required to support curiosity driven research; I will come back to this. In the national setting the more or less independent research funding organisations play a major role; in some countries the support for “fundamental or basic” research is separated from that of “applied” research, in others it is mixed. But more and more the research funding organisations take account of real or perceived national priorities as expressed in the results of foresight-like processes. This is need not be a problem, provided all awards are made on the basis of rigorous merit-based peer review. In such a way funding decisions on research can remain to be seen as impartial and based on quality.

At the level of university departments, institutes and individual professors and staff, the pressures to combine the pursuit of “truth” in the university setting with some form of external funding are increasing. And with this also the pressures to deliver the right answers at the right time. While this emphasis on relevance is not necessarily detrimental to the quality of the work, it is absolutely necessary for the universities to maintain rigorous standards in quality assessment and review of its staff and of the research conducted. Career advancements, including tenure, must be based on the assessment of academic qualities and not just on the basis of earning power alone or life-time job security.

Taken together, improvements in the way awards for both research funding and careers are made and transparency and visibility of research policy decision making, can help to prevent a further deterioration of the position of science which results from the increasing interaction between science and policy. Added to this must be education and training on ‘being a good scientist’, which must include the ethics of science.

Science in Europe

Turning now to this continent one cannot avoid the issue of comparison of success in the science enterprise between Europe and the rest of the world. Where does Europe stand on the international scale of performance in the sciences? On this, the present overall state of affairs for Europe must be

judged negative. Historically, Europe's science has been extremely successful, but in the last decades Europe seems to have lost its leadership in the research enterprise and with it the education of the global scientific elite has transferred from Europe to the USA. With some notable exceptions: whenever European countries have joined forces on a substantial scale, as they have done in the case of CERN, ESO and EMBL we have been able to keep up or even outperform the USA. But on the whole, research in Europe suffers from a lack of coherence and scale, as compared to the US and perhaps also - though less obvious - Japan. European science can be characterised as 20 or so national science systems, each with their own national research policy, complemented with a small application orientated European element, run by the EU. CERN, EMBL, ESA, ESO and some other European ventures stand out, but other than that Europe lacks an overall science system driving the research and engineering enterprise forward and challenging its constituency to compete and to collaborate on a truly European scale. The EU Framework programme, however successful it has been and still is, because of its utilitarian character and its modest scale compared to the sum-total of national research spending, cannot be seen as the equivalent of the national efforts by NSF, NIH, NASA, DOT, DOD and DOE. In monetary terms: the total budget of these organisations, which support basic research as well as some strategic research in the USA, far outruns the budgets of CERN, EMBL, ESA, ESO and the EU Framework Programme put together. The budget is certainly not the only factor, but such vast differences should be cause for concern, especially now that it is evident that research and technology are the very basis for economic prosperity and well-being. Europe has lost the battle on the information sciences and subsequently on IT and the businesses based on this technology. I need not to substantiate this in numbers. In microbiology and biotechnology the threat is very real that the outcome will be the same, although Europe and European businesses still have a chance. But it is to be noted that European enterprises in the life-sciences almost without exception have started to spend increasing proportions of their research budgets in the US. In communication technologies Europe is in the lead, owing to a number of successful business enterprises and a focused research and technology policy in some Nordic countries. Nano-technology is most probably the next battleground and if the early warning signals are not false, here again is a great risk for Europe. In the empirical sciences areas such as industrial organisation and marketing are solidly in US hands. Social security structures and education are domains of European superiority, as is agricultural research. Citation and impact analyses, in most fields, point to the superiority of US research over Europe.

At this point I should like to point out that the sketch I have just given must not be taken to imply that everything must be seen in competitive terms. This of course cannot be, certainly not for science. Science is essentially an open system, there is no national science, nor is there European science, as much as there are no national multiplication tables. Science progresses through interaction and collaboration and competition on a world scale. What is at stake is the ability to apply and use science and technology in new products and services and to use science for setting policies. The ability to absorb and use the results of research depends on one's ability to understand and correctly gauge possibilities and opportunities. These can only be seen by those who have been trained at the forefront of research. This is not only a question of money. What is at stake here is the issue of scale. Once a country covers the whole of science and maintains three or four centres that compete at world class, there is no obvious reason to do more. In Europe *each* nation state needs to cover a substantial portion if not the whole of the science spectrum in its research portfolio, if only because the national higher education system requires this. Such a distributed system carries an enormous overhead in initial costs and is inherently inefficient as compared to a single large system. In other words the cost of non-Europe is enormous. There is another disadvantage as well. As a result of the distributed nature of the research system in Europe, most countries - there are exceptions - seem unable to provide for institutes that are of a scale to be clearly visible internationally and are able to cater for the kind of attractive research environment that draws and keeps top-researchers.

With this I have touched upon another aspect of European science: the apparent inability to successfully compete for top-talent. To attract and maintain top-talent requires an attractive research environment. Such an environment should minimally provide for top-of-the-line equipment, easy access to support facilities, a collegial and competitive atmosphere, motivated students and staff, liberal administration, minimal bureaucracy. Increasingly, proximity of a metropolitan centre with a choice of cultural events, attractive housing and availability of jobs for spouses become additional factors. Such an environment requires scale. It is inconceivable that such centres will be found in all disciplines in all provinces of Europe. To achieve the necessary concentration mechanisms we need to develop new concepts in research management about which I will speak later.

A factor which cannot be easily overlooked is the existence of private institutes of higher learning, which especially in the US function as the ultimate target for the competition. These institutions are exceptionally well endowed, the competition for entry is fierce and the conditions for staff excellent. In Europe we have only a few places which compete in the same league.

An additional comment needs to be made at this point. Contrary to the US system which can be described as “open”, the European academic community is essentially a “closed” system. The dynamics of US research owes a lot to all the foreigners that come there to work on a thesis or on a postdoctoral project, of which some remain and obtain tenured positions and some return to their country of origin, later to become ambassadors of the country in which they have enjoyed productive years. The enrichment of the structure with young talent often of a different cultural background is no doubt a source of success. Europe, in contrast, seems to attract relatively fewer foreign students and staff. Apart from the language problem there are other structural reasons, among them subtle and sometimes not so subtle mechanisms of in- and exclusion, promotion and tenure in the university system, which are disadvantageous to non-nationals.

Comparative advantages of Europe

Yet not everything points to disadvantages on the European side of the comparison. While it is quite some time ago that the last European research institute was formed, we owe a lot to the movers and shakers that convinced politicians to pay for CERN, to start ELDO which later became ESA, to start ESO. Clearly, such initiatives required the coincidence of both new research adventures and some form of political relevance. Today, such institutional arrangements may take on a different form. First because research in Europe has grown up and second because other modes of operation that compensate for scale disadvantages are presently available. One would think that the need for such new forms of institutional arrangements can be found easily in the large portfolio of scientific questions that need urgent answers. Such as the problem of climatic change and human behaviour, the issue of functional genomics, geriatric diseases, European history.

To compensate for the two elements of competitive disadvantage that I described before - scale and institutional- , we note a lot of political support for concepts such as ‘Espace European de la Science’, ‘centres of excellence’, ‘national research centres’, ‘co-laboratories’ and the like. Can such structures and initiatives effectively compensate the structural disadvantages? Especially the integration of Eastern and Western research systems must be one of the goals of these new concepts and policies. The answer must necessarily be cautious. Perhaps, I would say. No doubt that the US system also has its problems, excessive red-tape being one of them, congressional meddling and pork barrel spillage another. Therefore, when and where necessary to achieve scale advantages in research, these must be obtained through international collaboration between research organisations such as research councils, academies and national groups of large laboratories and institutes. But note: “where and when necessary”. Most progress in research is made in groups and teams, not

necessarily in massive institutes. Collaboration carries hidden costs and some not so hidden. One must therefore carefully weigh the need. But there cannot be any doubt that some form of direction and co-ordination is needed in order to tackle some of the research challenges facing us. A prerequisite for such collaboration to be effective is that research organisations accept some form of co-ordination and sharing responsibility for the assignment of funds. I believe the launch of such collaborative programs through the European Science Foundation EUROCORES mechanism is urgent. We need to rapidly develop this type of research collaboration to prevent a widening of the gap with the US, to assist the process of East-West integration and also to provide a venue for effective world-wide collaboration between Europe and other parts of the world.

The resolution of the institutional problem lies first with the scientific community itself and second with politics. There is need for initiatives from the scientific community and subsequently for decisions by politicians to support and to stimulate collaboration. Again, the onus is very much on research councils and science itself to achieve the stated goal: where and when necessary strive for and achieve the creation of new forms of institutional collaboration for the advancement of research.

Once this goal has been achieved, the disadvantages of Europe will turn into a considerable advantage. The nature of the scientific pursuit that I described earlier implies that progress is made in unexpected corners and through serendipity as often as by design. The diversity of Europe, the differences in research traditions, approaches, reasoning are together a rich source of the kind of inspirational variety which research and technology requires to progress.

The dilemma here is: "Can we overcome the barriers of national research policies?"

My answer would be: we must and we can. It is realistic to assume that national research policies are not going to go away. Just like the nation states are not going to disappear. Therefore national research policy setting and execution is here to stay. Science policy is very much in the domain of competition and posturing and there is nothing inherently wrong with that. However, such a distributed system requires effective mechanisms that provide the necessary scale and critical mass, when and where needed. Such mechanisms necessarily operate below the level of governments and above the level of individual scientists and research groups; at the European Science Foundation we use the term interagency collaboration. In this, we see an important contribution to the creation of the Espace Européenne de la Science, which we and our member organisations wholeheartedly subscribe. The main advantage of collaboration of research organisations in the pursuit of research problems lies in their relative independence from central government policy setting. If and when they see the advantages of collaboration in the execution of a joint research programme to outweigh the disadvantages of additional co-ordination, the scale disadvantages can be overcome, while at the same time exposing scientists in the respective countries to international competition, without having to invoke government level agreements. The same holds for collaboration in the investment in expensive infrastructure for research and technology. We will hear more about these concepts in the days ahead. The challenge on the research and technology is before us and I strongly believe we can find the ways and means to overcome it.

Excellencies, ladies and gentlemen. I have briefly described for you what science and technology is about. I have attempted to paint the science/society relationship and concluded that a new attitude is needed to overcome the threats which result from too much intimacy in the relation between science and politics. Finally I have attempted to convince you that interagency collaboration is a vital element in the creation of the Espace Européenne de la Science. This is especially true for the issue of East-west integration.

Appendix III

Minutes

of the meeting held in Gdansk (Poland) from 9 to 12 October 2000

Members present:

MM.	Rakhansky, Chair	Ukraine
	Birraux, Vice-Chair	France
	Tiuri, Vice-Chair	Finland
	Brunhart	Liechtenstein
	Etherington (for Mr Cunliffe)	United Kingdom
	Martelli (for Mr Cioni)	Italy
	Daly	Ireland
	Dolazza	Italy
	Von der Esch	Sweden
	Fernández Aguilar (for Ms Fernández-Capel)	Spain
	Guardans	Spain
	Siebert (for Mr Maass)	Germany
	Monteiro	Portugal
Ms	Nabholz-Haidegger	Switzerland
MM.	Luczak (for Mr Pawlak)	Poland
	Rapson	United Kingdom
	Roseta	Portugal
	Turini	Italy
	Wittbrodt	Poland

Also present:

Mr	Elo	Finland
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Guests:

Mr Hanife Akar, Middle East Technical University, Department of Educational Sciences, 06531 Ankara, Turkey

Mr Giorgio Andrian, University of Padova, Department of Land Use and Agroforestry Systems, Section of Economics AGRIPOLIS, Via Romea, 16, 35020 Legnaro (Pd) Italy

Mr Vasile Julian Antoniac, AMCSIT – Polytechnica Spaliul Independentei, 313, 77206 Bucharest Romania

Mr Dumitru Giani Apostol, Polytechnical University Polizu, 1, 78126 Bucharest, Romania

Ms Daniya Asanova, Al-Farabi Kazakh State National University, 71, Al-Farabi Avenue, 480 078 Almaty Kazakhstan

Mr Elchin Babayev, Azerbaidjan Academy of Sciences, 10, Istiglaliyyat 370001 Baku, Azerbaijan

Ms Zlatina Bakratheva, Institute for Art Studies at the Bulgarian Academy of Sciences 1, November 15th str. 1000 Sofia Bulgaria

Mr Petr Baldrian, Institute of Microbiology AS CR Videnska 1083, 14220 Prague 4, Czech Republic

Mr Jack Bokaris, Imperial College, 125 Greemhill Hampstead, NW3 5 TY, London, United Kingdom

Ms Maria-Cristina Bunda, National Agency for Science, Mendeleev 21-25, 70168 Bucharest Romania

Mr Lionel Camus, Akvamilo Mekjarvik 12, N-4070 Randaberg, Norway

Mr Vincent Corruble, University Paris 6, 4 place Jussieu, 75252 Paris Cedex O5, France

Mr Gela Dumbadze, Ministry of Foreign Affairs of Georgia, Chitadze 4, Tbilisi Georgia 380018

Mr Domenico Gallipoli, Universitat Politecnica de Catalunya, Departamento de Ingenieria del Terreno, Gran Capitan s/n, Edificio D-2, 08034 Barcelona, Spain

M. Theofanis Georgopoulos, University of Lund, Getingevägen 60, 22100 Lund, Sweden

Mr Devrim Göktepe, METU Science and Technology Policies, İnönü Bulvari, MM Merkez Mühendislik Binasi, TEKPOL, 06531, Ankara, Turkey

Mr Francisco Javier Gomes Rincon, BEST Barcelona Modul A3 – S105, Campus Nord, C/Gran capita S/N 08034 Barcelona, Spain

Mr Dimitri Gvindadze, Ministry of Foreign Affairs, Georgia

Ms Christine Heller del Riego, Universidad Pontificia Comillas, Escuela Tecnica Superior de Ingenieria Martires de Alcala, 11, 28015 Madrid, Spain

Mr Jose Antonio Herrera-Cervera, Aarhus University Gustav Wieds VEJ 10, 8000 C Aarhus, Denmark

Mrs Gudrun Hilgerloh, Fulfsweg 20, D – 26386 Wilhelmshaven, Germany

Ms Irene Katsipi Ionna, - GRIVA - National Technical University of Athens, Dimokratias 55, 151-21 Athens, Greece

Mr Thomas Jestadt, Mittermayrstr. 18, D-80796 München, Germany

Mrs Janina Jozwiak, Instytut Statystyki I Demografii w Warszawie, Poland

Mr Claude Kordon, President, Euroscience

Ms Sabine Kroener, Universitaet Bremen, TZI Postfach 330440, 28334 Bremen, Germany

Mr Pierre Lasserre, Director of the UNESCO Venice Office, 1262. A Dorsoduro, Venice, Italy

Ms Laure Ledoux, President “Marie Curie Fellowship Association”, 1 A, rue du Champs de Mars, B – 1050 Brussels / School of Environmental Sciences, University of East Anglia NR4 7TJ Norwich, United Kingdom

Mrs Margarita Leon, Flat 12 A. 29 Macaulay Rd, SW4 9AJ London, United Kingdom

Mrs Heather Mackinnon, Canadian Commission for UNESCO, 350 Albert Str. P.O. Box 1047, K1P 5V8 Ottawa, Canada

Mrs Diana Malpede, UNESCO

Mr Sloboda Markiyan, UNESCO Student Association in Lviv, 19/23 Konotopska Street, 79044 Lviv Ukraine

Mr Howard Moore, UNESCO, 7 place de Fontenoy, F – 75352 Paris 07 SP

Mr Shailendra Mudgal, Ineris DRC, Parc Technologique ALATA, F – 60 550 Verneuil-en-halatte

Mr Valerii Ivanovych Muntian, Kiev, Ukraine

Mr Bruno Muratori, National University of Ireland, Department of Mathematical Physics, Logic House Maynooth, Co. Kildare, Ireland

Ms Nuria Navarro, Centre for Coastal and Marine Sciences, Dunstaffnage Marine Laboratory P.O. Box 3 PA34 4AD Oban, United Kingdom

Mr Baurjan Nurahmetov, Technological University of Almaty Tole-bi street corner Cosmonavtov street, 480023 Almaty Kazakhstan

Ms Maria Öhman, K93 – Odmdarsvagen 14, 167 37 Bromma Stockholm, Sweden

Mr Chingis Omarov, Astrophysical Institute Observatory 20-21, 480020 Almaty Kazakhstan

Mr Costas Papadopoulos, Institute of Nuclear Phycis, NCSR 15310 Athens, Greece

Mr Marko Pavic, University of Zagreb, Faculty of Physics, A.T. Mimare 30, 10 000 Zagreb, Croatia

Ms Irina Petkova, Institute of Organic Chemistry, Bulgarian Academy of Sciences 1, November 15th Str. 1000 Sofia, Bulgaria

Ms Barbara Pillon, University of Bologna, G.D. Coletti N° 8, 31046 Oderzo (TV) Italy

Mr Ancuta Plaesu, Socio-Behavioral and Geopolitics Studies Institute 17-19 Nerva Traian, B1.M70, Sc. 3, Ap. 71, Sector 3, 7000 Bucharest, Romania

Mr Cristian Preda, Romanian Presidency Geniului, 2-5 Sector 5 Bucharest, Romania

Ms Nadja Mag. Preinl, Institute of Ecology and Conservation Biology Althanstrasse 14, 1091 Vienna, Austria

Mr Javier Rodriguez, Universitat Politecnica de Catalunya, Av/Lluís Companys 10, 08970 Sant Joan Despi (Barcelona) Spain

Ms Izabela Sabala, Aarhus University, Gustav Wieds vej 10, 8000 Aarhus Denmark

Ms Hanna Salo, Institute of Biotechnology, Viikinkaari 9, 00014 Helsinki, Finland

Mr Alain Sarkissian, Service d'Aéronomie du CNRS, Route des Gatines, BP3 Verrieres-le-Buisson, France

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Mr Radu Stefanoiu, AMCSIT, Polytechnica Splaiul Independentei, 313, 77206 Bucharest, Romania

Mr Fer Svedic Zeljko, Unska 3, 10000 Zagreb, Croatia

Mr Rob Tinch, University of East Anglia n/a NR4 7TJ Norwich, United Kingdom

Mr Dino Tonti, Hahn-Meitner-Institut Berlin GmbH, Glienicke Str. 100, D-14109 Berlin, Germany

Mr Ilker Usta, Hacettepe University, 06532, Beytepe Ankara, Turkey

Mr Brian Ward, Nansen Environmental and Remote Sensing Centre Edv. Griegvei 3A, N-5059 Bergen Norway

Dr Oxana Yaremchuk, ENARECO c/o, Ukrainian State University of Forestry and Wood Technology Bul. Gen Suprenko, 103, 290057 Lviv, Ukraine

1. OPENING OF THE MEETING

The Chair opened the meeting on 9 October at 10.40 am and welcomed Mr Wittbrodt, Minister for Education and member of the Committee, and the members of the European Forum of Young Scientists.

He congratulated UNESCO and the Marie Curie Fellowship Association for having taken the initiative of organising the “Conference on Science and Technology in Europe –Prospects for the 21st century”.

2. MINUTES

The Chair said that the minutes of the meeting held in Strasbourg on 25 and 28 September 2000 would be submitted for approval at the next meeting.

3. PREPARATION OF THE “CONFERENCE ON SCIENCE AND TECHNOLOGY IN EUROPE – PROSPECTS FOR THE 21st CENTURY”

Mr Moore pointed out that an international forum of young scientists had been held as a satellite event of the World Conference on “Science for the 21st century: a new commitment”, held

in Budapest from 26 June to 1 July 1999. Some 150 young scientists from 57 countries had attended the forum. The European Forum of Young Scientists, a satellite event of the Gdansk Conference, had brought together 54 young scientists from 22 European countries.

Mr Andrian, general rapporteur of the forum, reported on the results, emphasising the practical proposals for political action. Parliamentarians were being called upon to take action to ensure that these proposals were put into effect (Appendix 1: “European Forum of Young Scientists – Executive Summary”).

Ms Yaremchuk raised a number of specific points with regard to the situation of young scientists in the European countries in transition (Appendix 2: An overview of the current science and education situation in the countries of eastern Europe).

Mr Muntian provided information on the science situation in Ukraine. Ukraine had been one of the pillars of scientific development in the former USSR. Today, Europe was finding it difficult to know how to exploit the existing scientific potential. The countries of central and eastern Europe were experiencing a significant brain drain at a time of transition when intellectual ability was most required. The European Union should set up a body to draw up not only science strategies in Europe, but also science financing strategies in central and eastern Europe so that those countries could become competitive on the European science market. Advantage had to be taken of the end of the East-West confrontation: it should not be too difficult to refocus defence research on civilian fields.

The Chair presented the book “Economic security in Ukraine”, written by Mr Muntian.

Mr Dumbadze stressed that very often studies on the problems of science development in Europe were limited to western Europe, while the problems facing the countries of central and eastern Europe were different in nature. He suggested that a conference be held in the former Soviet Union to encourage widespread debate on pan-European science problems.

Mr Von der Esch suggested that clear priorities be determined among the list of forum proposals.

Mr Andrian pointed out that all the proposals were a priority.

Ms Mackinnon stressed the need for greater communication at European level between university and research institutes. There should be more scholarships for scientists from central and eastern Europe.

Mr Dolazza highlighted a paradox in co-operation between academies and industry: researchers wanted greater freedom in their work, whereas industry was looking for concrete results. He also referred to the negative impact of certain cases of research results being expropriated: two Italian scientists had just left Italy for the United States because the results of their research had been published under the name of the son of the director of the laboratory where they had been working.

Mr Etherington stressed that scientists were not directly accountable to public opinion whereas politicians were. Scientists could not be both judges and parties: they had to relinquish some of their independence if they wished to be given public funding.

Ms Nabholz Haidegger pointed to the enormous competition in western Europe among researchers in the same field, between different scientific fields and between different countries. There was also competition between research in universities and industry. She emphasised the difficulties faced by countries wishing to import scientists from central and eastern Europe to work on national projects and by scientists themselves who sometimes had to overcome formidable obstacles to be able to take part in such projects abroad.

The Chair compared the percentage of GDP allocated to science in Ukraine (0.3%) and Switzerland (3%).

Ms Mackinnon said that scholarships awarded to young scientists from central and eastern Europe did not by any means make it possible to improve the scientific infrastructure in their own countries so as to halt the brain drain in the future.

Mr Tinch acknowledged that scientists did not listen attentively enough to opinions from outside, but he also thought that there was a lack of comprehension on the part of politicians. Communication needed to be improved in both directions.

Mr Lasserre raised the problem of the need for more intellectual and scientific exchanges between generations. The scientific community had grown tremendously over the last three decades. Narrower specialisation had led to the isolation of young scientists in one field who did not communicate enough with those in other fields. Fresh thought therefore needed to be given not only to scientific contacts between generations but also between different fields. The UNESCO Venice office was organising “European advanced seminars for young scientists” with the specific aim of bringing together eminent senior scientists in key fields of contemporary science and young scientists with proven talent for research in order to develop an exchange of ideas on the major challenges of science and society.

Mr Kordon said that the gap between investment levels in R&D in Europe and the US was becoming ever wider and this in turn led to a differential in the quantity of research results. The young scientists attending the forum had produced a list of priorities and it was up to parliamentarians to take action to ensure that the money available was used more effectively. There should be a European research area along the lines of the American model, and legislation should be enacted to achieve this. Furthermore, young people should be given more responsibilities, as in the US. There should be strategic programmes to unify European research.

Mr Roseta expressed his concern at the brain drain between Europe and the US. To overcome this, companies and foundations had to be made more aware of the importance of R&D, individuals encouraged (through tax incentives) to sponsor R&D and the problem of the way R&D was perceived by electors had to be addressed. For their part, scientists could take effective action with regard to this latter point. They must help make the public more aware of R&D and its impact on society. Europe must continue to invest in science, otherwise it would become the most beautiful museum in the world. The Council of Europe was acting in the right direction. It had decided to lay the foundations of a Euro-Mediterranean hydrotechnical institute (water management and technology) in Murcia, Spain.

Mr Rapson agreed that there was a need to take political measures to make Europe more attractive for scientists. If this were not done, the brain drain to the US could not be halted.

Ms Heller del Riego emphasised the need to overcome the public’s suspicion of science.

Mr Luczak said that research had today neglected its training role. Senior scientists were obliged to waste time solving administrative or financial problems. The transmission of knowledge seemed to be in jeopardy.

Ms Mackinnon said that researchers who had qualified abroad were generally no better thought of on their return. Accordingly, there needed to be a system in certain countries whereby greater recognition was given for the knowledge and skills acquired.

Mr Daly said that his own country, Ireland, had suffered significantly from the brain drain to the US and had now chosen to invest in high technology. He would be drawing the conclusions of the European Forum of Young Scientists to the attention of the Irish authorities.

Mr Wittbrodt said that he would include the conclusions of the report on young scientists in the paper he was currently drafting on young scientists in Europe. He wondered about the relative weighting of the role of politicians and industry in solving problems specific to young scientists and those relating to R&D in general.

Figures showing European averages revealed significant differences between countries. Even within the same country, there were considerable differences: one example of this was access to higher education in the various regions of Poland. Generalised data on 41 countries had to be used with care.

Thorough consideration had to be given to the dividing line between co-operation and competition. The parameters of co-operation needed to be carefully defined so as to identify the point beyond which competition began. One means of setting up a European research area would be to lay the foundations for “European laboratories”.

4. CONFERENCE ON SCIENCE AND TECHNOLOGY IN EUROPE – PROSPECTS FOR THE 21st CENTURY

The report of the Conference would be published as a separate document and distributed at a later date.

5. STUDY VISIT

On 12 October, the Committee **visited** the Alstom Power company which manufactured turbines for the energy industry.

6. OTHER BUSINESS

Mr **Tiuri** was **appointed** Committee representative to the 6th Conference of Parties to the Kyoto Protocol (COP 6) to be held in The Hague from 13 to 24 November 2000.

7. DATE AND PLACE OF THE NEXT MEETING

The Committee decided to hold its next meeting in Strasbourg on 29 November 2000.

The meeting rose on 12 October at 6 pm.

Annex 1 to the Minutes

European Forum of Young Scientists Gdansk 7-9 October 2000

*Report to Council of Europe Parliamentary Assembly
Committee on Science and Technology*

Executive Summary

The Forum of 54 young scientists from 22 countries held lively discussions about the problems and opportunities facing science, and young scientists in particular, in Europe. Several key themes were identified. These included: the need to make European research careers more attractive; the importance of more flexible research, funding and career structures, in particular greater autonomy for scientists earlier in their careers; the need to recognise and address the particular problems of Eastern European research mobility and funding; and the requirement for greater public involvement in, and appropriation of, science.

Six policy proposals were developed, of which the two main priorities are:

Develop more flexible research structures and funding schemes: A European postdoctoral status, and accompanying incentives for institutions to participate, funded at European level.

Address the particular problems of Eastern European research mobility:

Shorter PhD degrees and mutual recognition of degrees, with transitional concessions for Eastern European scientists, and assistance with setting up new infrastructure.

European Forum of Young Scientists, Gdansk 7-9 October 2000

The European Forum of Young Scientists met for two days prior to the Council of Europe Parliamentary Assembly Committee on Science and Technology Conference on Science and Technology in Europe: Prospects for the 21st Century. The Forum was organised by UNESCO and the Made Curie Fellowship Association, in association with the Parliamentary Assembly of the Council of Europe, the Technical University of Gdansk, and AIESEC Poland.

The Forum involved 54 participants from 22 countries. Interesting presentations from invited speakers were followed by lively debate among the young scientists present. Several key themes were recurrent through the sessions. This brief report summarises these themes and the policy implications, and concludes with a short list of policy priorities.

Summary of Key Themes

Poor attractiveness of research careers and insufficient opportunities offered by Europe to its young scientists represent a potential risk for the future of research and development in Europe. Independently of the financial effort need to overcome the increasing gap in European research budgets with respect to the US a few practical measures could improve the integration of young scientists and make them more adapted to the changing science and technology labour market.

Science careers in Europe need to be made more attractive. This is partly a question of funding and salaries, but also connected to the level of autonomy experienced by young researchers.

Researchers need to become independent at an earlier stage in their careers in order to take advantage of their creativity and productivity.

There are great differences among areas, in terms of training and in terms of opportunities for individuals and requirements of industry: there is significant unemployment in some areas and major skill shortages in others. Mobility is still limited in Europe today: it is encouraged by EU programmes, but is driven primarily by job seekers rather than by industry, except for a select few. More information about jobs and opportunities and about the range of individual skills and qualifications available within Europe could help to reduce rigidities in the system on both sides.

Although greater mobility is clearly potentially beneficial for individual researchers, for home institutions and states mobility can mean a brain drain if scientists do not return home - this is particularly acute in Eastern Europe. To combat brain drain, incentives are needed to encourage mobile researchers to return to their home countries. Greater assistance for individual researchers to cover the transitional costs of returning should be considered, and incentives are vital to encourage home countries and institutions to welcome returning scholars and ease the transition between different research cultures and systems. Linking fellowships to assistance with establishing research facilities on return, particularly to countries with less developed research infrastructure, should form a key part of this policy.

Greater knowledge exchange is required between academia and industry, at all levels. Academia should be producing graduates and postgraduates with the skills required for industry and research, but for this to happen it is vital that industry be engaged in informing academia of its rapidly evolving needs. Creating national and European industry advisory boards for universities should be considered; and greater involvement of industrial representatives at the individual university level should be encouraged, especially with respect to curriculum development and audit. Greater flexibility in academic career structures and evaluation should be introduced in order to allow academics to collaborate with industry and government, to mutual benefit, without jeopardising their positions.

There is also need for greater individual awareness of the requirement for wider skills and lifelong learning, as well as a greater willingness on the part of universities to train undergraduate and doctoral students in these skills, such as teamwork, leadership, and project management. Knowledge may be key, but personal and business skills are also essential. The ability to adopt a multidisciplinary approach will become increasingly valuable and the training offered by universities should enable this.

There is an increasing tendency towards public mistrust of science and of political decision making related to science and technology development. This must be addressed through greater appropriation of science by the public, and through scientists becoming more accountable to society. Developments in biotechnology give a clear example both of the need for greater public integration into scientific decision-making and of the need for education about risks and tradeoffs. It also illustrates the misuse of information technology for propaganda on both sides of a debate and the influence of economic power in shaping the research agenda. Scientists must no longer allow themselves, or be allowed, to be used in the service of economic or military power independent of ethical and environmental considerations, but must rather serve the society. For this to occur, society must be empowered to cope with high volumes of often conflicting information and must be given fora to make public views heard. This can be achieved through increased emphasis on basic science education to enhance public understanding of science, and through establishing structures for informed public participation in scientific agenda setting and decision-

making. Scientists must form better public communication structures to disseminate information about cutting-edge research and its implications.

Proposed Action Points

There was a general view that policy needs to be more focussed on particular problems such as those identified above. The following concrete proposals arose from the Forum discussions.

Develop more flexible research structures and funding schemes. Scientists should have more control over the financial planning of their projects. A postdoctoral status defined at a European level, superseding national structures, would allow employment of mobile postdocs in countries where the currently rigid national system prevents this. Incentives for institutions to participate will be required and enable access to certain networks or funding opportunities. These advantages should be funded at European level.

Address the particular problems of Eastern European research mobility. Better harmonization, and in particular shorter PhD degrees and mutual recognition of degrees, is a priority. A European database of science and technology opportunities for young scientists, including fellowships and academic and industrial positions should be established. Obstacles to mobility should be removed, such as delays in providing visas. There should be short-term transitional concessions for Eastern European scientists, for example where average age of graduation is higher, or infrastructure weaker, than in the West. These inequalities should be taken into consideration in awarding grants and some should be earmarked for Eastern European scientists. It is also important to encourage Western European countries to participate fully in existing schemes (such as INTAS) with Eastern European countries.

Give scientists more independence earlier in their careers through funding targeted to excellent young scientists, awarded on merit, to create research leaders. This requires funding for networking and training and further support to set up labs, in particular in Eastern Europe.

Return grants should be introduced, paid partly to the institution and partly to individuals, provide additional incentives for mobility, help avoid "brain drain"), and fund new research facilities.

Encourage effective promotion of a European research area open to scientists of all origins, by removing the administrative and statutory barriers that make transnational careers very difficult (for instance, in terms of insurance or pension schemes, or of equivalence of diplomas for certain countries). An overall increase in the percentage of GDP invested in research is also required, part of which should be devoted to improve salaries to be competitive with industry and scientific salaries in other nations, so as to attract the best scientists to research careers.

Support wider skills training in postgraduate degrees to ensure that doctoral candidates are fully equipped to meet the needs of career building for consulting and industry. Additional funding will be crucial, but minimum requirements for training provided by host institutions for accessing existing mobility grants should also be considered.

Main Priorities

The Forum is aware of the need to prioritise objectives for political purposes. The general consensus is that the most urgent changes are:

- 1) **Developing more flexible research structures and funding schemes:** A European postdoctoral status, and accompanying incentives for institutions to participate funded at European level.
- 2) **Addressing the particular problems of Eastern European research mobility:** Shorter PhD degrees and mutual recognition of degrees, with transitional concessions in funding criteria for Eastern European scientists, and assistance with setting up new infrastructure.

In conclusion, the participants in the Forum valued greatly the opportunity to meet to discuss these important issues and to present this document to the Council of Europe Parliamentary Assembly Committee on Science and Technology. The Forum feels that mechanisms for input by young scientists into policy nationally, and at European level, should be reinforced and their development supported.

Annex 2 to the Minutes

EUROPEAN FORUM OF YOUNG SCIENTISTS

(Conference of Science and Technology in Europe - Prospects for the 21st Century)
Technical University of Gdansk, Poland, 7-9 October 2000

Introductory key-note

THE VIEW TO THE PRESENT SITUATION OF SCIENCE AND EDUCATION IN EASTERN COUNTRIES BLOCK

*by Oksana YAREMCHUK,
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Ukrainian State University of Forestry and Wood Technology,
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ECONomics Master course)*

Dear Mr. President,
Mr. Chairman,
Colleagues,
Ladies and gentlemen.

I feel honoured to participate in the European Young Scientists Forum in the occasion the Pan-European Conference on Science and Technology – Prospects for the 21st Century.

The Forum gave young scientists the opportunity to discuss present and future issues concerning science and technology in Europe, in particular the situation and role of young scientists with regard to changes which 90s brought about scientific achievements, structural changes in many European countries and new perspectives in different fields of scientific cooperation. One of the objectives was to address future-oriented recommendations to decision-makers and scientific institutions.

The major conclusions of the Forum were already presented by Dr. Giorgio Andrian and I would like to mention some additional issues that should be taken into special consideration.

Firstly, I intend to stress the importance to continue organizing similar fora which are essential both for young scientists and for policy decision-takers.

In particular, I would like to rise some key points reflecting the existing situation in European countries with economies in transition.

1. The insufficient level of information about the existing educational programs, research facilities, enterprises activities in Europe.
2. Return grants. The efficiency and the qualification level of the scientists who were studying, training and working abroad are dramatically reduced upon their turning to home institutions, mainly due to the strong restriction in budget and technical equipment available for their activities, as well as the burocratic and administrative limitations.
3. The importance to support the creation of modem laboratories and research facilities, to create an attractive working environment for foreigner researchers. One key point is to further increase the level of foreign investments into the creation of potential systems of research institutions, which will be able to self-perpetuate their activities after the halt of external support.
4. The mutual recognition of the academic titles and degrees between Eastern and Western institutions has to be improved.
5. The strategic need to encourage and support the talented scientists by creating attractive working conditions. In fact, the majority of scientists in Eastern countries can only count on their own enthusiasm and personal resources, being forced to work in unsatisfactory conditions.

I find important to mention the recent Ukrainian State approach to protect and develop the scientific, technical and intellectual potential in our country and to involve the talented generation in academic institutions and organisations. On March the 10th, 2000 a specific Ukrainian Presidential Decree was issued, to encourage young scientists of the Ukrainian National Academy of Sciences for their exclusive achievements in the natural, technical and humanitarian scientific trends, by launching 10 annual premium (5000 UAH each).

6. Scientists are not completely prepared to compete or to cooperate, either with the country institutions or with external institutions. The initial point is to develop tight relationship between educational and scientific institutions and industries.
7. The need to integrate into industrial technologies the latest innovations developed by scientists.

Without such decisive factors of human progress as strong financial system, intellectual potential, appropriate stage of science and education development and spiritual culture, it is impossible to reach a sustainable development in our countries.

Appendix IV

DECLARATION

We, the signatories to this declaration, took part in or took note of the results of the “Conference on Science and Technology in Europe – Prospects for the 21st Century”, which was held in Gdansk from 9 to 12 October 2000 by the Committee on Science and Technology of the Parliamentary Assembly of the Council of Europe in collaboration with the European Science Foundation and UNESCO, at the invitation of the Polish Parliament, and attended by over a hundred parliamentarians, government representatives, scientists from the academic world and industry, and representatives of international and European organisations and of non-governmental and press organisations.

We also took note of the outcome of the debates held at the European Forum of Young Scientists organised by Unesco and the Marie Curie Fellowship Association, in association with the Parliamentary Assembly of the Council of Europe, Gdansk Technical University and the International Association of Students in Economics and Management. The Forum, which coincided with the Conference, was attended by over fifty young scientists under 35 years of age from 22 European countries.

After discussing the current state of science and technology in Europe and prospects in this case, in particular young scientists’ situation and role in the light of the far-reaching changes that took place in the nineteen nineties, the participants in the Forum concluded that in many European countries (especially but not only those whose economies are in a period of transition) the funding of scientific research has decreased. They expressed great concern about the future of scientific and technological potential in these countries.

History has shown that, in countries which neglect scientific development, economic growth suffers, social problems emerge and the independence of some countries is jeopardised. We therefore agree with the young scientists that science – in particular pure research – should be one of the priorities of national policies in all European countries and that political decision-makers should ensure that national budgets reflect the important role that science and technology plays in the economic development of European countries.

Appendix V

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