International Workshop on the Future of Physics and Society
Debrecen, Hungary, 4–6 March, 1999

Workshop Summary

Raymond S. Mackintosh
Physics Department, The Open University
Milton Keynes, MK7 6AA, UK

Abstract  The Debrecen workshop was one of a number held in preparation for the UNESCO–ICSU World Conference on Science, which will take place in Budapest, June, 1999. A report representing the views of the workshop, prepared for that conference and containing a number of recommended actions, is included with this summary. The workshop affirmed the ongoing importance of physics for its own sake and as part of our culture, as a key element in increasingly unified science and as an essential contributor to the solution of environmental and energy problems. The problems faced by physics as an activity and as an educational subject were discussed and actions for both society as a whole and the physics community itself were put forward.
Introduction

A principal function of the workshop was to submit a report making recommendations to the UNESCO–ICSU World Conference on Science, to be held in Budapest, June, 1999. Nevertheless, a great many important points were raised which are addressed to the international physics community rather than to the World Conference.

This workshop summary is therefore in two parts: the first part is exactly the report finally submitted to UNESCO and the second is a summary of the other points raised at the conference which were agreed to be important.

Part I: Report to the World Conference on Science

Preface

The workshop affirmed three general conclusions:

1. The contribution of physics to all aspects of life, material and non-material, will be essential for the foreseeable future.

2. Physics currently faces serious problems in the world. Many of these problems affect science in general, but a number are specific to physics.

3. Actions are needed to assure the continued health of physics research, teaching and cultural influence. Some form of ‘contract’ between physicists and the rest of society will be required.

We emphasise that the problems physics faces are not related to the subject matter but to its relations with society and the perceptions of society. By ‘physics’ we include the physical sciences in general and we affirm the growth of interdisciplinary fields and the trend for areas such as astronomy, cosmology, environmental studies and biophysics to become ever more closely linked with all aspects of physics.

The workshop identified seven important actions. We recommend that the World Conference on Science organised by UNESCO and ICSU consider these for inclusion in its report “Science Agenda – Framework of Actions”. Many of them apply to other branches of science and hence ‘physics’ could be replaced in many places by ‘science’. Some actions, however, are specific to physics.

The list of recommended actions follows. We present in appendices some of the points which led us to make these recommendations. The workshop expressed the view that the experience of the many relevant professional bodies should be exploited in implementing the recommendations.

Recommended Actions

1. Promulgate a declaration affirming the vital importance of basic physical science and the need to protect and support curiosity-led physics.

2. Affirm the importance of making a substantial effort to educate and inform the public. A guideline should be established recommending that, say, 1% of money spent on research should be made available for public awareness.
3. Provide substantial support for the improvement of the teaching of physics throughout the world, at all levels from school to university. This should involve:

- establishing guidelines for what level of scientific understanding would be expected at particular stages of school education and how much time should be devoted to physics teaching at each level;
- monitoring these standards and defending them from external threat;
- encouraging both curricula and teaching methods to adapt to the changing social and scientific environment.

In addition, support is required for teachers, for example by enhancing their prestige and providing continuing education and personal development. UNESCO should promulgate the principle that physics should be taught by persons who have been trained to become physics teachers. Reliable information concerning curricula in different countries should be established and made widely accessible.

4. Explore ways of establishing a recognised authoritative and impartial international body, set up under the auspices of UN or UNESCO, to adjudicate damaging disputes involving scientific issues. Examples of such disputes are cold fusion and a wide range of environmental issues. The new body would investigate the extent to which claims are based upon established science or are simply ungrounded opinion, perhaps influenced by pressure groups. This will provide an authoritative scientific basis for important political decisions.

5. Establish means for supporting physics within the new democracies of Europe. This should be done by facilitating international collaboration and by encouraging the support of physicists within their own countries. Find ways to support and utilise for mutual benefit the reservoir of advanced expertise in the former Soviet Union.

6. Special measures should be taken to ensure the free movement of scientists. In particular, UNESCO should encourage governments to facilitate the issuing of visas for scientists if such are required.

7. The long-term health of physics requires the establishment of guidelines linking R&D expenditure to GNP at a level appropriate to the economic state of each country. In addition, there should be guidelines and standards for coherent and stable national science policies; these policies should be developed in close consultation with national scientific communities. UNESCO should establish a committee to make recommendations to governments.

In addition, the workshop agreed that there are a number of measures which the physics community itself should take. These will be publicised in due course.
Appendix 1: Why the contribution of physics will continue to be essential

1. Physics is a central part of our culture and will continue to inspire many people. Physics reveals important universal truths notwithstanding certain strands of post-modern thought.

2. Physics will continue to underpin all science and technology for the foreseeable future.

3. Physics is and will continue to be essential for analysing and solving urgent environmental and energy problems.

4. Physics plays a unique educational rôle:
   - **Secondary school**: It is recognised that other scientific disciplines more and more require knowledge of physics.
   - **Undergraduate**: Physics is becoming recognised as providing education of great value for many careers outside physics such as commerce, banking and medicine.
   - **Doctoral**: PhDs who go into industry are an indispensable byproduct of pure physics research.

5. Physics is global and constitutes our best ‘anti-Babel’. Generations of physicists of the most diverse political and cultural backgrounds have collaborated on the basis of shared understanding and shared ideals.

6. Physics sets standards of rational thought in the face of irrationality; it upholds the primacy of observation.

Appendix 2: Some general problems currently faced by science

1. Many people feel that science robs the world of meaning and this deeply affects their attitude to science. Science is felt by many people to be ‘cold’ and ‘alienating’.

2. Modern forms of irrationality are becoming widespread and sometimes involve outright opposition to scientific attitudes and even scientific knowledge. There is sometimes an unfortunate, even dangerous, political aspect.

3. There is a serious ‘authority problem’ in modern life with few people able to make rational judgements as to who or what to believe. This is reflected in a widespread relativism improperly invoking Einstein. Similarly, Heisenberg is improperly invoked in promoting the idea that everything is uncertain anyway. The widespread tendency to adopt conspiracy theories is a potentially dangerous aspect of this problem. There is a corresponding tendency in academe in the form of social constructivism; in extreme form this denies that science can progressively approach universal truth.

4. External pressures, sometimes commercial in nature and often exacerbated by funding problems, lead to damaging conflicts within subject areas. Damaging conflicts also arise between subject areas, particularly under pressure of inadequate funding.
5. In Europe and other places there is a squeeze on industrial research as a result of ‘short-termism’.

6. Science teaching and research face specific local problems, particularly in Eastern Europe and elsewhere.

It is precisely the nature of many of these items which makes greater support for science an urgent matter in the modern world. The workshop also identified a series of problems specific to physics and a report discussing these as well as some proposed measures will be published.

**Part II: Physics in the modern world: some problems and possible solutions**

The impact of the globalization on all our institutions and our value systems was a common element in many contributions. It is clear that physics will have a key role to play in studying and solving the global environmental and energy problems the world will face in the coming century. Globalization was felt in another way: while some of the problems listed below are particular to specific regions, there was nevertheless very much common ground in the identification of the general problems faced.

1. **Some problems we face**

   The workshop identified many difficulties faced by physics as an ‘institution’ and as a subject in schools and universities. These difficulties do not arise from its own subject matter and in particular the conference affirmed that the subject is certainly not ‘worked out.’ Nevertheless, physics as an activity and as an academic subject does face problems and some of the specific points raised were:

   1. For many students, physics can seem remote from their everyday concerns. This is true also for the general public. This is in great measure because physics is abstract and lacks visualizable elements (particularly modern microscopic physics, with astrophysics an exception). This presents a problem for teachers and those communicating with the public.

   2. The fact that physics is essentially mathematical also presents special problems. While the mathematical language is a main strength of physics as a discipline, it is a major obstacle in the way of communicating the meaning of physics to the general public.

   3. Many school science curriculums are relatively static and remote from exciting contemporary developments and unrelated to important contemporary issues such as medicine, energy and the environment. This is in spite of the direct relevance of physics to all these issues.

   4. Physicists have acquired a negative image in some parts of society, not least because of the association with nuclear weapons.
5. The public has no clear picture of how society has benefited from physics and how physics is essential for solving environmental and energy problems.

6. There is no ‘physics industry’ in the sense that, for example, there is a ‘chemical industry’ and a ‘biotechnology industry’. The following two problems are, in part, consequences of this.

7. Students in schools are unaware of the career possibilities enabled by education in physics which exist even in countries in which high-technology industry is not strong.

8. Physics faces problems in universities: in many places there are fewer students, and many appear to be less able. Sometimes, multi-disciplinary courses at undergraduate level add to the downward trend in the academic level of courses. This lowering of standards also occurs as a result of pressure to ‘satisfy customers’. The supply of students to do PhDs is highly susceptible to economic circumstances and many countries frequently face a serious shortage.

9. In Europe and other places there is a squeeze on industrial research as a result of ‘short-termism’.

10. In many countries there is a squeeze on pure research and a growing requirement for researchers to justify their work in terms of economic benefits.

11. In many countries there is a serious lack of competent and enthusiastic physics teachers.

12. Physics is particularly subject to competition from pseudo-science. This is an aspect of the authority problem: the public is confused as it is confronted with a mixture of information and misinformation through the media, including the Internet.

2. **Hopeful factors we should find ways to exploit**

The workshop discussed solutions to these problems and also identified some hopeful signs. Among the positive points were:

1. Politicians at the highest levels are beginning to find that the prestige arising from national success in pure science is of value in international negotiations. A related fact is that, in many countries, it is success in science (along with sport) which most arouses national pride.

2. In some countries, and potentially everywhere, there is a higher than ever interest in popular science. This point has been emphasized by professionals in the popular science business, and is also clear from the number of books published. (The simultaneously existing problems remind us that the ‘public’ is not a single undifferentiated body.)

Our defence of physics, as well as science in general, must find ways of exploiting these hopeful points. It was pointed out that ‘The resource of the 21st century is knowledge...’ and certainly physical knowledge will be an important part of this.
3. Recommendations to the physics community

The workshop identified a number of areas where action by the physics community and its friends, including those involved in teaching physics, could be of great benefit:

1. Physicists should present a united front; suppress factional fighting; show respect for different subject areas. (We are vulnerable to ‘divide and rule’.)

2. Physicists must deal responsibly with the public, avoid exaggeration, be honest and should not infringe conventions relating to peer review and publication. (‘Going public’ prior to peer review has been very damaging to biology, and physics has also been harmed by it.)

3. Physicists should assume more responsibility in the issues of the global environment, sustainable growth or equilibrium and the energy problem. Physics will have a key role to play in finding an acceptable solution to these problems. Particular presentations to the workshop made very clear the seriousness of the situation and exemplified the contribution of physics.

4. Facilitate improved means for scientists to advise (and enter into dialogue with) government and other public organisations. (Interaction should be both ways and involve the grass roots scientists.)

5. We should find ways of using the expertise of sociologists to explore in greater depth the cause and nature or anti-scientific feeling; this could even lead to entente between physics and some part, at least, of the world of sociology. This could be of great benefit. An urgent problem requiring study is the way the media treat pseudo-science in modern pluralistic societies.

6. We should find ways to encourage industry to support long term and curiosity-led research. Governments should be persuaded to encourage, facilitate or enforce this (through tax laws, etc.).

7. Research should be carried out, with the participation of both scientists and economists, which shows the long term influence of scientific research on GNP. This should be done in a way which includes such things as the contribution of the training which is an important byproduct of pure research at PhD level.

8. Many points relating to teaching physics were mentioned, and some appear in the ‘action’ statements to UNESCO. Particular points are:

   • Physics teaching must respond to changing social and also scientific circumstances.
   • There is much value in courses which relate the important findings and perspectives of cosmology etc. to common human needs and aspirations. This was demonstrated to the workshop by an account of a general course at undergraduate level.
• Teachers should recognise the value of relating physics teaching to matters of everyday importance, including environmental and energy issues. Teachers should emphasise that it is everybody’s moral duty to have an elementary understanding of the physics of the threatened global environment. The abstract aspects of physics should be moderated at the introductory level.

• There are many ‘modern physics’ topics which can be made very accessible with imaginative teaching methods involving pupil activity. A case was put that they can be made more accessible and more relevant than some traditional topics if they are presented with appropriate explanations.

Evidently there is a need for continuing debate concerning the teaching of physics in schools. There is no accepted general solution to the apparently contradictory requirements of, on the one hand, attracting talented young people into physics and preparing them for university level studies, and, on the other hand, teaching physics in a way that does not repel and alienate future citizens.

9. Various points were put forward concerning means to educate and inform the public, (the subject of a recommended UNESCO action). Points mentioned include: the need to professionalize interaction with the media; the need for humour; demonstrating the openness of science by letting scientific disputes be public; the virtue of science laboratories, travelling exhibitions, science&technology weeks; the importance of the personal and biographical elements in presentations, etc.

10. Investigate and seek remedies for the anomalously low women’s participation in physics in some countries compared to others. We should do this in the first place because of the human fulfilment and beneficial productivity which is currently being lost. There is further potential benefit: the remedy may substantially improve the public status of physics in general.

Acknowledgements

I am deeply grateful to Herwig Schopper and Rezső Lovas for their thorough critique of this summary and for saving me from embarrassing omissions. The first section, the report for UNESCO, was a joint submission of the three of us on behalf of the workshop. The conference was supported by the UNESCO-Physics Action Council, the European Physical Society, OMFB, OTKA, MTA and MALÉV. I am personally very grateful to the Lovases for hospitality.