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Viewpoint

Crisis of confidence

Does physics face a crisis of public confidence ? Can equilibria in science policy be achieved ? How can physicists become more effective in research and development ? The Advisory Committee on Physics and Society has tackled these complex questions, and their conclusions are published in this issue. 'Improved communications with society ; a shift in emphasis towards society's problems ; more relevant organization and training' sum up the findings.

As the basis for discussion at a special session of the EPS General Conference in Wiesbaden on 3 October, the 'Physics and Society' paper should lead to many questions.

It would seem desirable to strengthen the recommendations with more explicit evidence in support of them. In stating that there were 'an almost bewildering number of facets of the subject "Science and Society", the Advisory Committee were fully aware that the subject of the interaction between physics, on one side, and social, economic and political forces, on the other, is very complex indeed. For the time being, EPS has no choice but to proceed on the basis of incomplete understanding and is now faced with the difficult task of persuading physicists that the recommendations in the paper will be effective. EPS must start somewhere, and the 'Physics and Society' paper is a beginning.

However, thorough, empirically-based studies are needed to establish the relationship between physics and social, economic and political systems. Amongst the useful results would be clear explanations of how science policies are formulated in different countries. These studies would require significant efforts, but once physicists had the results they might be better prepared to face crises of confidence.

Physics and Society - public policy and current prospects

Report by the Advisory Committee on Physics and Society

The Interrelation between Science and Society - particularly Communication between Physics and Society

The Committee observe that society-at-large holds science responsible for many of society's current problems and that public opinion fears that even worse may follow in the wake of further scientific advances. Scientists have been accused of remoteness from reality and of being concerned only with the pursuit of knowledge for its own sake, irrelevant to the world around them.

The Committee note, on the other hand and despite their apprehension, that the public recognize that modern life allows no alternative to an ultimate accommodation with science. They have no wish to abandon the material conveniences that science and technology have contributed to their daily lives ; they basically accept science as valuable to society and that there must be a permanent interrelationship.

The above-mentioned fears and charges by society are frequently expressed in statements of the following kind :

> Humanity is threatened by the vanity of those who believe that only good can come from satisfying scientific creativity.
>
> Too many scientists show only minimal interest in the uses of scientific knowledge and their consequences.
>
> Scientists prefer to be masters of highly specialized facts and to proclaim their over-riding importance, rather than to illuminate commonly shared truth.
>
> Academic scientists are detached from the harsh world in which we live and offer little or no contribution to vital problems confronting ordinary citizens.
>
> Scientists can be regarded as being, at best, curiously naive and, at worst, absent-minded professors ; they are single minded and as if not wholly complete in humanity and common sense.

The Committee believe that there is an urgent need to respond to such fears and charges.

Vice versa, non-scientists and society often are not fully aware of how much they owe to science and technology and to what extent our 'quality of life' depends on the results of scientific R & D. Transportation and communication, medical care, energy supply and other fields provide numerous examples. These tremendous services of R & D to society should be communicated to people outside science. Particular attention should be paid to this in education policies and curricula.

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In the Committee's view, the very existence of these charges and opportunities should induce the European Physical Society to promote science as a predominant element of human culture and general progress, no less than a practical or even an academic need.

The Committee believe that scientists, for their part, must not only recognize the interdependence of science and society, but also actively seek to increase the public's understanding of their scientific work. They should recognize and accept responsibility for informing society-at-large about the consequences of new technological advances, as far as can be foreseen. This includes the responsibility for ensuring that scientific or technological statements to the public are set in a proper perspective rather than in an exaggerated 'newsy' form for the popular press. Moreover, in certain situations, physicists may feel the responsibility to abandon or avoid such projects that they expect to lead to social disasters.

Against this background and in face of an almost bewildering number of facets of the subject 'Science and Society', the Committee believe that it is now necessary to select specific public apprehensions and to arrange for correspondingly specific comprehensive articles to be prepared in reply, by lecture or publication in appropriate fora.

Such articles should be set in the context of showing that the purpose of science and technology together is to create a better world and a better state of balance between man and his environment. On the other hand, in cases where reality and current trends are in contradiction to this purpose, this should be stated as well.

The articles should make clear that:

The exploitation of new ideas to create wealth requires a climate in which the role of technology is understood and in which the risks of development are widely accepted as socially unavoidable and necessary.

Science is a necessary basic activity to create the reservoir of knowledge from which new technologies can draw.

If good general living conditions must be achieved, maintained or shared more evenly, this demands continuous qualitative growth ('quantity *with* quality'), including important contributions from education, science and technology.

In order to protect environment, and, in general, arrive at a sufficient level of human well-being, the aid of science is essential.

The public should thus be provided with convincing replies to their fears and worries, although part of their worries are of a political nature. The replies should be disseminated by organizing informal discussions on specific subjects, seminars, public symposia, private working groups on such matters as science policy and the total costs (including 'social' costs) of technological innovation. The findings of such meetings should be published to encourage still wider discussion, including discussion on a local scale.

The Committee recommend that the challenge posed by society's current reactions to science and technology should be accepted by the European Physical Society and that an enlightened response should now be organized along following lines:

Increase the consciousness of all individual physicists of this challenge and encourage a constructive response.

Encourage National Physical Societies or Institutes of Physics to improve the means and opportunities through which their work may be interpreted to society-at-large.

Arrange for the preparation of comprehensive articles of the kind suggested above for propagation by lecture or publication.

Stimulate the dissemination of scientific news by authoritative sources, from which mass-circulation newspapers could freely quote — for instance in the form of a rapidly appearing, easily printable and readable, 'scientific newspaper'.

Assist in the provision of lecturers, source material, films and work study projects.

Ensure that lectures or publications, or both, are directed at such audiences as teachers in schools, colleges, further education courses, university undergraduates and academic staff, educational administrators, youth generally, science journalists, the scientific community, including professional institutions and 'science policy' makers, government executives, parliamentarians and public groups generally.

Physics and Public Policy

Physics and other sciences no longer enjoy the almost unquestioned popular and political support they used to receive in past decades. There is an increasing pressure to increase the research effort on problems originating from society, at the expense of research on problems generated within science itself, and a belief that the demands for monetary, material and personal resources should be moderated accordingly.

Therefore, in addition to the need to overcome the communication problem between physicists (and scientists, in general) and society-at-large, modern science policy has to guarantee an optimum balance between :

objectives and problems arising and identified inside and outside science ;
disciplinary and interdisciplinary research ;
encouraging individual contributions and fostering big (collective) science ;
national and international activities and programmes ;
general, basic scientific research and specific research aiming at technical applications ;
educational programmes, teaching, research and application.

The interaction of scientific and social problems leads to new kinds of questions and challenges to the scientific world. These new questions in turn lead to new motivations for the research people. This motivation process has to be encouraged.

In seeking a coherent rationale for public support for science, scientists must show that the remedy for social ills is not to suppress science itself, but rather that science and technology are essential for the solution of those ills; society must exert its own mastery over the application of resulting technologies and even be willing to forego a new one, if deemed undesirable or unnecessary.

On the one hand, society-at-large must recognize and accept :

responsibility (for example, through its parliamentarians) for introducing legislative measures to deal with the obnoxious effects of technological inventions (that is, responsibility for the use or abuse of science and technology) ;

responsibility for balancing the drawbacks (such as paying the bill for solving problems like pollution) and the benefits of the fruits of new technological development.

On the other hand, scientists should :

anticipate shifts in emphasis in their work to meet the needs of society (for example, environmental problems — this is not to say that *all* scientists must henceforth devote their energy to 'pollution' problems) ;

have due regard to the social costs of industry and technology (where applicable) in terms of, for example, pollution, noise, and residues of pesticides in foodstuffs or the human body.

The Committee recommend that :

at top corporate and government levels, effective coordination functions

be established — to strengthen inter-departmental links — to set-up strategic capacities for problems analyses — to stimulate integrated planning and programming of R & D efforts — and to facilitate the implementation of scientific progress (innovation) ;

non-governmental R & D sponsoring organizations be made aware of the vital role science can and should play in contributing to the solution of public problems. A change in these organizations' policies should be induced from being just science-oriented to solving problems arising both outside and inside science.

Organizing and Training for Effective R & D

In the past couple of decades the performance of the R & D community has been raised and maintained essentially by continuous, quantitative, growth, but in the near future this community must probably concentrate primarily on efforts to increase the quality and efficiency of the *existing* R & D units, with respect to programming, budgeting and manpower strategies.

Where necessary and where possible, the sciences should develop new modes of interactions and concerted actions. If scientists learn to co-operate in terms of multi- and interdisciplinary strategies, a number of present innovation obstacles would be removed and the rate of innovation increased. Since physical principles penetrate nearly all branches of R & D, physics has excellent opportunities to take the lead in enhancing interdisciplinary communication links. Therefore, in academic and industrial environments, the effort of interdisciplinary research may be enhanced where possible — staffed on a part-time basis by the manpower of the classical disciplinary structure. If needed, new interdisciplinary centres should be set up.

Furthermore, special manpower on R & D staffs should be provided for, to act as observers and co-ordinators, able and free to communicate with other fields of study ('lookout' manpower). The mobility of trained scientists between functions in industry, in academic institutions, in education and in government should be fostered.

There is a need for a reconsideration and rationalization of our terminology to indicate various categories of physical research. Adjectives like 'pure', 'basic', or 'free' often mask the real issue, objective or motivation.

The curricula of science and engineering training should be adapted to the future needs and performances of the R & D community. Physicists should be given opportunity for science policy training and teamwork experience, in addition to disciplinary training. To this end, science policy units and public policy seminars should be organized in universities.

The most practical and effective way of control being the budgeting and the corresponding allocation of manpower and material means, the following measures are recommended :

University and government institutions should reserve a sizable fraction (say 10 %) of the budget for promoting the work of talented individual scientists.

An equal fraction of the budget should be reserved for interdisciplinary activities and science policy chairs.

Letters to the Editor

Claim for priority in holography

Sir,

I read with interest the article 'Dennis Gabor-Winner of the 1971 Physics Nobel Prize' by E. Ingelstam.[1]

I feel it is my elementary duty to make a small comment. The precursor of holography was a Pole, Mieczyslaw Wolfke, the late Professor of Physics of the Technical University, Warsaw. We find the first mention of holography in his paper 'Über die Möglichkeit der optischen Abbildung von Molekulargittern'.[2] (See also Reference 3.) In his paper, Wolfke writes 'Bei monochromatischer parallel senkrechter Beleuchtung is das Beugungsbild eines Beugungsbildes eines symmetrischen Objektes ohne Phasenstruktur identish mit dem Abbild dieses Objektes.' One can find the full explanation of this statement in his previous papers.[4]

I would like to mention that the problem of holography has been studied carefully for many years by the Russian Professor D.F. Schuschurin of Moscow. In 1971, he published '*History of Holography*' in Russian.[5]

Schuschurin drew the attention of D. Gabor to the publications of M. Wolfke, and Gabor (in a letter dated 19 January 1968 to Schuschurin) wrote 'I have now read Wolfke's paper and see that priority for the "double Fourier transformation" must go to him, not to W.L. Bragg.'

J. Mazur,
Polish Academy of Sciences,
Institute for Low Temperature and Structure Research,
Wroclaw,
ulica Próchnika 95,
Poland.

Sir,

I knew of the contents of the paper[2] to which Professor Mazur refers when I wrote my very short article,[1] which by no means claimed to contain full references. A priority to Wolfke for the double Fourier transformation seems to be clear. Professor Gabor also mentioned this priority in his Nobel Lecture, which will appear in 'Le Prix Nobel 1971'.

E. Ingelstam,
Kungliga Tekniska Hogskolan,
Stockholm 70,
Sweden.

Sir,

Thank your for your letter of June 1, with copy of the letter from J. Mazur. It will be good if wider circles become acquainted with the merits of Mieczyslaw Wolfke. From my side, I wish to add that I have duly mentioned Wolfke in my Nobel Lecture, but I mentioned also that neither I nor Sir Lawrence Bragg knew anything of his paper.

D. Gabor,
Imperial College of Science and Technology,
London SW7.

Editor's note :

Professor Mazur wrote a similar letter to *Physics Bulletin,* **23** *3* (1972) 175.

He also pointed out that D.F. Schuschurin drew the attention of Polish readers to two German references [6, 7] in his supplementary remarks to the article [5] translated into Polish [8].

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