GIREP newsletter

Groupe international de recherche sur l'enseignement de la physique
International Research Group on Physics Teaching
Internationaler Arbeitskreis zur Förderung des Physikunterrichts

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Eugene P. Wigner " we owe to our teachers "

was born in Budapest in 1902 and died in Princeton on the 1st January 1995.

He received the Fermi Award in 1958, the Atoms for Peace Award in 1960 from President D. Eisenhower. He is honorary member of the Eötvös Society and the Hungarian Academy. He obtained the Nobel Prize in Physics as professor at the Princeton University in 1963 for understanding the role of symmetries in quantum mechanics, for the discovery of parity and for applying quantum mechanics to atomic nuclei. At his occasion he told in the City Hall of Stockholm:

I wish to say at this occasion a few words on a subject about which we think little when we are young but which we appreciate increasingly when we reflect on our intellectual development. I mean our indebtedness to our teachers. Man's knowledge has become mankind's knowledge because he has developed codes in which sound signals correspond to objects and actions and he can learn one of these codes early in life in some misterious way. Hence, people can communicate their knowledge and teach each other. Much of what we know, and most of the science which we know, was taught to us in this way. This process may be called manifest teaching-learning. Much can be said about this, in fact much has been said about it, but this is not my concern this evening. What I wish to draw attention to is how much of our interest in science, and how much of our attitude toward science, we owe to our teachers. My own history begins in the gymnasium in Hungary where my mathematics teacher, Rátz, gave me books to read and evoked in me a sense for the beauty of his subject. I can not mention all to whom I am indebted but I do wish to mention the inspiration received from Michael Polányi [*the Hungarian chemist and father of the to-be-Nobel-laureate John Polányi*]. He taught me, among other things, that science begins when a body of phenomena is available which shows some coherence and regularities, that science consists in assimilating these regularities and in creating concepts which permit expressing these regularities in a natural way. He also taught me that it is this method of science rather than the concepts themselves (such as energy) which should be applied to other fields of learning. We have not only teachers who are older than we, we learn also from contemporaries and younger colleagues. The contemporary from whom I learned most – in fact immensely much – was von Neumann but that was mostly mathematics.

International Council of Scientific Union
Committee on Capacity Building in Science

The Committee begun its deliberations under the guiding conviction that science and science-based technology are the driving engines for change in modern society. It concluded that, as a society we have arrived at a point in our history when there must be a major increase in the capability of people to cope with the sscientific and technological culture that is shaping their lives and the lives of their children, and that science-rich and science-poor sectors can no longer co-exist. It is now well accepted that science and technology are essential to economic development and this connection is of ever increasing concern to nations and regions. The benefits of science based development are many and include: better health and longevity, economic advances, improved quality of life, essen participation in the fight against environmental problems, democratic empowerment for national policies on science and technology and hopefully, participation in the deep cultural rewards of following the march of our understanding of the universe. It is in this context that we consider the importance of capacity building in science.

In designing a programme of capacity building in science we must acknowledge that we live in a world dominated by science and science based technology and to be scientifically illiterate is a terrifying and unacceptable situation.

But there are even more urgent issues that have impelled ICSU to address the issue of capacity building in science. To build capacity in science is to use all procedures to raise the capability of nations and regions to make use of science and technology for the well being and culture of their citizens. In a world whose questionable future is absolutely dependent on the advance of science and its wise application, the scientific illeteracy of the peoples of the world (and of so many of their leaders) presents a universal crisis which transcends North-South, developing and developed, rich and poor. (Ignorance of science is one condition that draws us all together!) Superimposed on this problem of general illiteracy is the wild discrepancy in science and technology prowes that maintains the North-South gap.

In the 20^{th} century, commercial and defense demands overwhelmingly shaped the technology and influenced the sciences in the developed countries. Assessment of the long term effects never seriously influenced the deployment of technologies. We now live in a world in which the fate of nations is welded together. Jet travel, televioson, e-mail and fax machines serve to knit the nations and regions of the world into the image of the global village. Events such as a war in the Balkans, starvation in sub-Sahara, riots in Los Angeles, volcanic eruptions in Alaska, a coup in Moscow, the reactor catastrophe in the Ukraine, oil-spill in the Mediterranean, (to alter the mood) the World Cup in Pasadena, and the discovery of a new gene in Birmingham or a quark in Chicago – such events are no longer local and the learning of these events by all the citizens of the planet reflects back to alter the course and the significance of our on-going history. Surely the changes in Eastern Europe were immeasurably influenced by the technology of communications and set in motion by the pace of change in science and technology. This pace continues to increase with consequences which are not understood by the people whose lives will continue to be molded by these changes.

We insist it is beyond debate that application of science and technology must increa-

singly be motivated by and dedicated to the amelioration of the human condition – to the solution of problems of environment, population, natural resources and to the creation of new resources which can alleviate povertry, hunger, disease, lessen the impact of natural disasters and provide, for all the inhabitans of the planet, the elements necessary for the fulfillments of human aspirations.

The UNESCO contribution to World Summit for Social Development (January 1994) noted: *"Sustainable social development is possible only through radically reoriented programme of human resource development, not in the narrow managerial sense of the term but on a broader sense of improvement on the quality of life: better education, better health, respect for human rights, democracy, rational use of resources through the application of recent advances in science and technology, and the commitment to the culture of peace and international solidarity."*

Just as environment degradation and natural disasters fail to recognise customs regulations, the resurgence of dogmatism, fear, greed, hatred and ingnorance knows no national borders, and together, create a major crisis for all regions in the ability of the human race to come to harmony with a physical and biological world in which it is embedded.

We stand at a crucial juncture at the end of the millenia: whether to apply our science with humanistic wisdom for the advance of mankind or to succumb to the base forces and epic tragedies that weave our histories. Whereas this is an age-old conflict, the science-created global village image raise the stakes enormously.

This is nothing less than a war to determine whether or not the 2000 year old commitment to rationality will endure. The world wide attention to global climate change is an example of the process in which we must engage if we are to progress in the war on ignorance.

Math "fobia" and fear of science are endemic and almost always traced to the indifferent or non-existent teaching of science and mathematics in the earliest grades - say beginning at age five or earlier. Cognitive research and practices show that new, revolutionary way of teaching science and mathematics can instill in children, excitement, play, enthusiasm and entry to the joy of all learning. This addition to the education process is in no way in conflict with the need for children to learn languages, the arts and humanities. Research, in fact, indicates that early science enriches the other studies. A massive programme of elementary school teaching is required and it is required as urgently in Chicago and Paris as in Dakar and the villages of Indonesia. Children who are well taught at the earliest levels in mathematics and science will not grow up innumerate and with a hopeless fear of science. They will grow to be empowered to exercise their democratic right to participate in the seminal issues of science, technology and public policy and to solve problems. Also, the effort to brng this new teaching to children must involve professional scientists in the elementary educational process with rich rewards to both activities.

Public awareness and understanding of science and technology have different values and emphases in the world multitude of cultures and political systems. However, there is no Chinese sience or Norvegian science; there is world science. The concepts, the processes and the way of thinking to achieve "literacy" will evolve and sooner or later override cultural and political differences.

(Leon Lederman, chairman of the Committee, USA

We Shell Meet in Udine

The GIREP Meeting will be held at the Udine Conference this year. Topics:

1) new election of the GIREP Comittee
   (please, send candidate's name to the outgoing secretary)
2) GIREP's coming conferences
   1996: committeed for Slovenia, see ICPE newsletters
   1997: informal application from Cambridge: electron centenary
   physics of toys? (Germany, this Newsletter)
   Finland ? (this Newsletter)

Both GIREP and ICPE will meet in Udine. Please, transmit formal applications for conference organizatons with details both to

Paul Black, chairman of ICPE
George Marx, president of GIREP

(G.M)

GIREP'95 **ICPE'95**

TEACHING THE SCIENCE OF CONDENSED MATTER AND NEW MATERIALS

international conference at the University of Udine, 24-30 August 1995

organized by the Groupe International de Recherche sur l'Enseigment de la Physique, the International Commission on Physics Education of the International Union for Pure and Applied Physics, the Office of External Activities at the International Centre for Theoretical Physics, and the University of Udine.

see details in the ICPE Newsletter

Mailing address: GIREP–ICPE–95, M. Michelini–S. Pugliese, Physics Department, University of Udine, via delle Scienze 208, I–33100 Udine, Italy. Phone 39–432–558208. Fax 39–432–558222. E–mails MICHELINIFISICA.UNIUD.IT and MC5940@MCLINK.IT.

Problems from Quantum

Spring jacket. A spring of length L_0 has a great number of identical open windings. If the spring is hung by one of its ends, its length increases by a factor of 1.5. What will the length of the spring be if it is placed in a tall vessel with smooth walls? To what level must water be poured to cover the spring completely? The density of the spring is r times that of water. (S. Krotov)

Disappearing fence. Watching tennis players thruogh a chain link fence, we can observe two phenomena: first, if we move further away we can see the players better; and second, if we walk quickly along the fence, the fence seems to dissappear. Explain why. (S. Krotov)

Toys in Physics Teaching

Proposal for GIREP Conference in Germany

Physics toys have a long tradition (gyroscopes, cartesian divers, soap bubbles, optical toys etc.) and modern aspects (Nitinol, holograms, liquid crystals, silly putty etc.). For all steps of experience (Kindergarten, school, university) there are appropriate physics toys that can create motivation and interest. There exists an extensive literature (books, publications, etc.) where you can find either the physics theory behind the toys or educational aspects. Teachers and even research physicists are interested in physics toys.

For the conference you can think of experimental and theoretical lectures, posters, video presentations, workshops, exhibition of literature and toys.

There is a possibility to organize the Conference in Germany. Prof. H.J. Schlichting (Lehrstuhl Didaktik der Physik, Fachbereich 7, Universität Essen, Universitätsstr., D-4300 Essen 1) has principally agreed in his co-operation.

(Christian Ucke, Germany)

Symposium for the Third Millenium

Proposal for GIREP Conference in Finnland

We are planning to organize an international symposium on physics education for the third millenium. The possible dates of the symposium are planned to be between 9th to 15th June 1997 and the actual meeting days could be from Tuesday to Friday evening. The symposium will take place in Helsinki. The number of the participants are planned to be restricted to one hundred. The main purpose of the Symposium is

to find new ideas for the improvement of physics education at all levels

to give a forum for of experiences on research and development projects.

Some of the themes could be such as:

The aims of physics education to non-physicists

Computers and teaching of physics

Interactive methods in teaching physics

History of physics

(Maija Achtee, Finnland)

2nd International Science and Technology Education Conference

Jerusalem January 8-11 1996

The conference will focus on the theory, policy and practice of technology education. The teaching and learning processes of technology-related knowledge and skills are as ancient as human culture itself. The impact of technology upon individual lives and society in the second half of the present century has been tremendous. It has brought about the need to review and redesign technology education to satisfy the requirements of a rapidly changing future on one hand and, on the other, to satisfy the needs and expectations of the learners, from kindergarten through high school.

Further information might be requested at fax: 972-3-512-4833
or e-mail: jistec@vax.trendline.co.il

(Arley Tamir, Conference Chairman)

Two rings on the screen...

– Learning structure of matter –

Educators have great problems selecting new teaching materials and new methods for the schools. Structure of matter offer a good opportunity for both fields.

Crystals

Pupils like crystals: they enjoy looking at them at exhibitions, growing them at home, cutting and melting them, and studying them through microscope.

Pupils can make cadmium single crystal by recrystallisation of a wire in a home made electrically heated furnace, and they can experience how dramatically is the heat-treated wire weaker than the polycristalline material. Pupils can hear a soft noise during streching the wire caused by the unvaried parts of the single crystal sliding on each other. And finally on the wire surface one can see the edges of the slipped, unchanged pieces, the packages of atomic layers. So pupils can learn by their own experiences a lot about the anisotropy, inhomogenity, and generally about the properties of crystals and about the connection between the properties and structure of matter.

Interaction of waves and periodic phenomena

After having studyed the macroscopic properties of matter pupils would like to learn about the real structure of them. We show the pupils rings on the electrondiffraction tube screen and two rings on the film used in a X-ray diffractometer (e.g. the TEL-X-OMETER, TEL580). After that we try to explain the origin of the rings. We try to understand how the wave properties of X-rays or of electron beams can be used in discovering how atom are arrenged in the solids. We build models from balls. We make model experiments with water waves and a two-dimensional lattice in a ripple tank, and with sound waves and a space lattice. Also we study microwe diffraction by a polystyrene ball crystalmodel. We are using the Bragg equation $n\lambda = 2d\sin\theta$ and varying λ, n and d in it.

Generally we lay great stress on the fact that pupils should experience first the reality, namely real examples from the outside world, from the real investigations, and only then should use models. Models are used only for the explanation of the observed behaviours of solids.

Problem solving, calculating problems

The analysis of the X-ray diffraction spectra of NaCl, KCl and RbCl give us an opportunity for thinking about the atomic size. The size of atom is of great importance in metallurgy at studying crystal cohesion and in the development of alloys having specific mechanical properties.

School experiences

We have good experiences teaching structure of matter at secondary school or at college level. So we can offer teaching of this field in the schools. One can learn more about teaching structure of matter at the Udine Conference "Teaching the Science of Condensed Matter and New Matcrials" 24 – 30 August 1995.

(László Kovács, Hungary)

Many faces of water – proposal for the workshop, GIREP 1995

The main objective of the proposed workshop is to prepare kind of basis for the next eventual GIREP conference, or workshop. To discuss some proposals and valuable results in one, or more years in advance of future conference. This eventually should help to better synchronisation of future presentations, should help in better comparison of achievements and presented aproaches.

During conference **Condensed Matter and New Materials** water is in opposition to them. It is most common substance and in some sense best known for people. But from the other hand has unexpected properties. So new materials against the oldest one.

The topic **WATER** is so broad that whole conference can be devoted to it. During the next GIREP I propose only pilot workshop – which can serve as a staring point for the one of the nexts.

Why **water**?

- it has interdisciplinary aspects in general and in physics itself
- it can be tought on any level, for every age of children
- many different kind of experiments, starting from extremely simple to more sofisticated experiments are possible
- environmental importance
- human body importance
- topic open for local teachers initiatives
- it should be possible to get financial support from many different producers, industries, institutions.

Interdisciplinary aspects: physics, chemistry, agriculture, biology, geology, medicine, cosmology, astronomy, technology.

In physics: hydromechanics, phase transitions, surface tension, osmotic pressure, solutions, electricity, water in cosmos, optics, methereology – weather, pharmacology and so on.

In theory: from Archimedes Principle till hydrogen atom, water moleculae, fractals. From general questions to such as eg. "why sequoyas trees can be so high?".

Problem is rather in selection of problems.

For this conference can be proposed only some of them eg. Are there other states of water in addition to that we know: gas, liquid, ice? What means substance hydrophobe, hydrophile, hydroscopic?

Secrets of snow, secrets of water solutions, water without gravity

It is easy to write – more difficult is to have ready school proposals, I myself, personaly do not have. What I can do – ask teachers, scan books. Few monthes which remain, when school program is ready in not sufficient time to prepare some new ideas. It is why. I propose to discuss it more in advance.

(Zofia Golab-Meyer, Poland)

GENERAL INFORMATION

GIREP COMMITTEE

President: *George Marx*, Dept. Atomic Physics, Eötvös University, Puskin u. 5., 1088, Budapest, Hungary (telex 225459, tel 361–266-79-02, fax 361–266-02-06)

Vice-presidents: *Joseph Depireux*, Institute de Physique, 4000 Sart-Tilman (Liege 1), Belgium (tel 3241-563-612, fax 3241-562-355) *Silvia Pugliese Jona*, via San Nazario 22, 10015, Ivrea (Torino), Italy (tel 39–125-436-37, fax 39–125-631-872)

Secretary: *Esther Tóth*, Logodi u. 48, 1012 Budapest, Hungary (tel 36–36-476-180, fax 361-266-02-06)

Treasurer: *Brian Davies*, The Institute of Physics, 47 Belgrave Sq, London SW1X 8QX, UK (tel 44–71-235-6111, fax 44–71-259-6002)

FEES

The accounting year runs from January 1 to January 1, Fees paid after September in any year will be credited on the following year, unless the applicant specifies otherwise. – The current fee (1992) is 10 £st, **preferably paid into one of the two London accounts** or, if that is not possible, the equivalent of 10 £st in the currencies and into the accounts indicated application for (or renewal of) membership, with members paying their own bank charges and mailing costs. It is possible and advisable, in order to reduce bank expenses, to pay several years together in advance. – In cases of real difficulty of payment, please contact the Secretary who is ready to advise whether special arrangements can be made.

London accounts:

a) GIRO: Fees in £st should be made out to "Brian Davies re GIREP" GIRO Account n° 53 889 4806. This number must be quoted and the money sent to GIROBANK, c/o The Post Office, Eccleston Street BO LONDON SW11 9LS, UK. At the same time, please send a note to the Treasurer confirming how much money you sent and when and for what years. b) Non GIRO: made out to "GIREP ACCOUNT N° 90301248" and sent to the Treasurer.

Italian Account: Equivalent of 10 £st can be paid, in Italian Lire only, made out to "Marisa Michelini" and sent to: Dr Marisa Michelini, Dipartimento di Fisica dell'Universita', via delle Scienze 208, 33100 Udine, Italy, fax: 39–432-558-222.

APPLICATIONS AND NEW MEMBERS

Applicants for membership should, please require the Application Form from the Treasurer

INQUIRIES – CHANGES OF ADDRESS

Please, address inquiries concerning fees to the Treasurer. Other inquiries may be addressed to the Secretary or to any other member of the Committee. Please, send notice of changes of address to the Secretary.

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