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International Centre for Theoretical Physics

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Professor Abdus Salam, Director ICTP and President TWAS, inaugurated the round table on Essential Role of Science in Technological Progress and Economic Development, on 22th April '92 at the Adriatico Guest House of the ICTP, Trieste, Italy. Prof. Louis Emmerij is on the left.

Contents

The Essential Role of Science in Technological Progress and Economic Development

The proposition that science and technology have something to do with

The proposition that science and technology have something to do with productivity, economic growth and international competitiveness is hardly a revolutionary idea. Already more than thirty years ago questions were being asked as to what the real place of fundamental research was in economic and social development and how fundamental research with its increasing volume and costs could contribute better to national and international interests while retaining the required freedom for researchers to follow creatively the lines of their own genius. It was evident that whilst scientific research is first and foremost a source of knowledge, it also constitutes an essential ingredient of the educational system — a long-term national investment and a stimulus to the process of innovation and change in

national investment and a stimulus to the process of innovation and change in society. In other words, 30 years ago it was clear that fundamental research is a determinant for the future of societies.

Unfortunately, there has been a lack of understanding and co-operation between scientists and economists. This problem stems partly from the nature of the responsibilities of the two parties. Whilst the economists, in particular those involved in governmental decision-making and operating in the business and financial world, live under the strong pressure of short-term, often crisis-wrought and profit-oriented conditions, the scientists are involved in more long-term activities searching for solutions to fundamental problems and

seem to live in an 'ivory tower'. There has been insufficient dialogue between seem to live in an 'ivory tower'. There has been insufficient dialogue between the two parties. Hence, in order to address this problem and initiate a dialogue between them, a round table on "The Essential Role of Science in Technological Progress and Economic Development" took place in the conference room of the Adriatico Guest House of the ICTP from 22 to 24 April 1992. The Nobel Laureate Prof. Abdus Salam — Director, International Centre for Theoretical Physics (ICTP) and President, Third World Academy of Sciences (TWAS) — inaugurated this three-day conference. He chaired a panel of 30 scientists, 15 economists and 10 eminent professionals from the Third World countries. The main aim of this

conference, therefore, was to narrow the gap between the scientists and the economists, between science and economics.

Professor Abdus Salam started his address saying "... Who is the guilty party so far as Science and Technology is concerned — Who keeps this activity back? We came to the conclusion that it must be our brother, the economist... The economist's influence was so great that when he did not choose to raise any segment of the society in a developing country, that segment remained completed depressed. This is the situation for Science and Technology and this had to be changed...". He then described three items which went wrong with Science and Technology in the developing countries. First, the number of scientists and technologists in the South is ten times smaller than that of the North. Second, Technology is confused with applied science. Third, economists did not keep in mind the distinction between primary and secondary education. Prof. Salam divides Science and Technology into four categories, i.e.: (1) the basic sciences: physics, chemistry, mathematics, biology and basic medical sciences. Developing countries have tended to neglect them on the ground that they could probably live of the scientific results obtained by others. (2) Science in application: agriculture, medicine and health, population, energy policies, environment and pollution, earth science. (3) Conventional low technology: bulk chemicals, iron, steel and other, metal fabrication, petroleum. And (4) science-based high technology: communications, informatics, micro-
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electronics, space technologies and new materials.

These are not areas of manufacturing technology in spite of the large technology content of these areas, but of applied science. Confusing it with technology has had unfortunate consequences in the Third World.

Prof. Salam then discussed the shortcomings of the educational system in the developing countries. Science and Technology literacy is introduced at too late a stage. Professional education is not encouraged as it should be and attracts only ten percent of the students in the secondary education against fifty percent in the North. He concluded: "The biggest enemies of Science and Technology as a factor of development are two types of communities among us: the planners and economists who are unduly worried by scientific expenditures, and the scientific and technological communities in the developing countries themselves who, though small in number, do not seem to approve that fact. They seldom agitate and, in general, tend to live within their ivory tower".

Dr. L. Emmerij, Director of the OECD Development Centre (Paris) said at the opening, "The newly industrialized Asian countries have brought a new message on the scene of development. The field of enquiry for this gathering is what late-comers can do in the light of the Asian example". He asked for a maximum of ideas and for a minimum of paper, and expressed his confidence in re-establishing a dialogue between economists and scientists.

The meeting turned out to be a long brain-storming session as the speakers were given a short time to present their papers.

Technology and development

The first speaker Mr. Qureshi, ex-Vice-President, World Bank, introducing the topic of the session, said that it is generally accepted that there is a strong linkage between technology and development. However, such technology of the North is proprietary and the North is becoming more and more aggressive. The globalization of economy will raise new issues and therefore one must find the key elements for a strategy and consider the respective roles of governments and of the private sector.
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Prof. Oldham, University of Sussex, UK, in his keynote paper, said that there is still a debate on the respective roles of governments and the private sector in development issues. Some economists have done considerable work on this problem, but introducing science and technology in economic theory is an arduous task. The problem consists in finding a correlation between investment in S&T and economic growth. Once this relationship is clarified and decided up, one may devise a policy. The issues are: (a) there is a close relationship between economic growth and S&T. Technology can be purchased or created but know-how must be accompanied by know-why. When one buys technology, one must also be involved in the making. (b) To create technology or make use of acquired technology, one must be able to make a choice, be able to use the technology, to change or increment it — this is done by engineers and scientists. Many of these aspects were neglected in the developing countries, while most of S&T work is done in the enterprises in the advanced countries, the same is carried out outside the productive sector in the developing countries. Economists can play an important role in these issues though it is true that many of them are unaware of the complexity of science.

The following are some of the comments made after the keynote speech of Prof. Oldham.

Prof. Cooper (Netherlands): Fundamental science cannot be justified by economic reasons only.

Prof. Parathasarathi (India): Development is not a question of market economy only.

Prof. Patel (India): The time required for the transition to industrialization is getting shorter. It was long for Japan, but much shorter for the newly industrialized countries. The developing countries must raise their level of investment (by reducing their defence budget) for the production of tools and equipment and for improving skills. They must build up their technological capacity and concentrate their efforts in a few sectors. He noted that the growth rate of the industrialized countries is 2% on average, i.e. rather low compared to 10% for some of the developing countries.

Ponnamperuma (Sri Lanka): Recalled that the creation of twenty international centres of excellence
Recalled that the creation of twenty international centres of excellence
proposed by Prof. Salam will be presented in June at the UNCED Conference in Rio de Janeiro. UNIDO is already financing a feasibility study for five of these centres. The proposal will also be discussed in Pakistan in a meeting which will be attended by heads of states in early 1993. Several countries have already expressed their desire to host such centres.

Role and importance of a science base

Prof. Alexander King (United Kingdom): Warned that fundamental research may be patented in the future and therefore its results may not be available for everybody. He regretted

that little has been done in the past in relation with the ideas proposed by Prof. Abdus Salam. Sixty percent of the economic growth has been attributed to classic ideas. Quality explains the remaining 40%. He believes that a science basis is absolutely crucial for the growth of a society. S&T have changed quality, but the world is dominated by technology and not by science. To build up a science basis, education in science at all levels is required. Science is an excellent training ground also for those who will work in the applied sciences. It is also important for whoever is involved in policy-making in government and in industry. King cited the example of Japan. In poorer countries, scientists are not used, unfortunately, as they should be. In Latin America for instance, increasing scientific education has increased the brain-drain. In this connection, Prof. King acknowledged the role of ICTP in checking this brain-drain.

governments must act as catalysts. As there is much confusion on S&T matters in many countries, the help of economists is much needed to articulate the relation between scientists and government.

Minister Brunetti (Italy): mentioned the problem of migration from Eastern Europe and Northern Africa to the West and from Latin America to the United States and Canada are a threat to stability. She thinks that science will play an important role in the future. Science and economy must go together. She stressed the role of women in the developing countries and every effort should be made to improve their education. She reminded that the Italian Directorate for Co-operation to Development is helping developing countries in science if they ask for it. It also helps the developing countries to preserve their culture heritage.

The meeting in progress.

Science and Technology for development

Prof. C.N.R. Rao (India): Science and Technology must solve the problems of the people. Developing countries must create a suitable atmosphere for research. The quality of life must also be taken into account, though it does not necessarily increase the Gross National Product. For example, in India innovation did not increase as much as business did. Ninety percent of the resources for S&T in India come from the state. When budgets are cut, education and health are the first to be affected. Market forces are eroding the science basis in the USA and in UK, where creativity used to be very high. Though S&T are essential components of development, the demand for those is not very high in the developing countries. Scientists are not sure on how their results will be exploited. There is also the problem of maintenance of the scientific equipment. Prof. Rao believes that

suitable atmosphere for research. The quality of life must also be taken into

ask for it. It also helps the developing countries to preserve their culture

Prof. Durrani (Pakistan): Suggested that ICTP and TWAS should organize annual meetings where scientists and economists would teach each other.

Prof. Srinivasan (India) recalled the successful example of the Tata Institute created 20 years ago. He believes that the private sector should be involved, but it is not clear how it should. There must be a dialogue at the national and international levels.

Ambassador Ahmed (Sudan) recalled that one must find solutions to the financing of Science and Technology. He mentioned that the brain drain has struck Sudan heavily. Four billion dollars is the loss due to brain-drain of Sudanese to Saudi Arabia and of 8,000 Sudanese physicians and engineers to the UK.

Mr. Qureshi (Pakistan): There are two culprits: the scientists and economists. There is now a better diagnosis: development needs good science and good economics. To close the gap between the two, one should come up with good propositions and set priorities which may change ours. The role of governments is essential but that of the private sector is growingly important. How science and economy can join their efforts varies from one country to the other. But governments must play a role in promoting science. Governments must invest in human capital, in education in general, in scientific and technological education in particular. Women should be attracted in the systems and governments must reward the innovation efforts. Governments of the North should give more priority to the support of developing countries.

Conclusions

Professor Luis Emmerij summarized the debate at the end of the conference. He found that Professor Abdus Salam's opinion was too pessimistic. Not all economists should be blamed for the existing situation. On the contrary, many of them have made important contributions to the topics discussed in the conference. Some economists, however, are responsible for the emphasis in the eighties, on decreasing the role of the state in national economies. Newly industrialized countries provide a model for the other developing countries. The so-called late-comers, Indonesia and China, could perhaps be a better model than the other East Asian countries. The question of getting hold of technology is complex. One can make it or buy it. Between the

two, there is a continuum of possibilities. In all cases, an endogenous basis must be created and this entails a range of abilities from science and applied science, engineering and craftmanship skill is essential for incremental technology. The relation between Science and Technology very much depends on the firms. But also here there is a need for a science basis which implies and adequate education system. The twenty centres proposed by Prof. Abdus Salam would undoubtedly strengthen such a science basis.

Intellectual property rights could become a problem and it might be more and more difficult to keep access to the scientific information. Science drives technology and vice-versa. The science base must be part of culture and societies should be persuaded of this. There is also the question of the misuse of science and that of brain drain — on these points the signals received from the society are not easy to interpret. Fundamental science has never gotten its fair share of financing and this becomes even more obvious when one considers that much of this funding goes to defence. Science policy should be administered by scientists and not by bureaucrats and, in this regard, the role of towering individual scientists is extremely important. However, ideas have to be there otherwise funds will not come.

Prof. Emmerij believes that some measure of tension between scientists and economists is inevitable because the former are involved in the long-term, while the daily bread of the latter is to look at cost-benefit evaluation of investment in all kind of sectors, including science. Both communities should learn from each other's field and, in particular, economists should help scientists to articulate the link between science and the production process through technology.

The strategy for the future can be summarized in seven main points: (a) the role of technological progress in economic development studied in the sixties by Slow and Denyson should be updated. This is essential to convince decision-makers that R&D and education are a prerequisite for economic growth; (b) developing countries must move from alignment policies — which were essential in the eighties — to long-term policy. This involves investments in technology, science, innovations; (c) governments must commit themselves to these investments. The updating mentioned in (a) will help to produce a political will; (d) balanced policies are required. Countries should decide where to place themselves, given their oriented uses; (e) talents in the developing countries must be brought out: hence, the role of education, centres of excellence and skill formation; (f) those countries must adopt a fair income distribution policy. There are explosive situations in many parts of the world. Technologies must be designed to face these situations; (g) ten percent of the world lives in the twenty-first century, while ninety percent lives in the fourteenth. This situation must be taken into account when resources are allocated. ♦

Order and Disorder in Nature

Prof. P.G. de Gennes was awarded the 1991 Nobel Prize for Physics in October last year. Prof. de Gennes has visited ICTP several times and his work is well known to the Centre's scientists. We reproduce here the citation and description of his work.

Courtesy of
The Royal Swedish Academy of Sciences.

This year's* Laureate, the Frenchman Pierre-Gilles de Gennes, has described mathematically how e.g. magnetic dipoles, long molecules or molecule chains can under certain conditions form ordered states, and what happens when they pass from an ordered to a disordered state. Such changes of order occur when, for example, a heated magnet changes from a state in which all the small atomic magnets are lined up in parallel to a disordered state in which the magnets are randomly oriented. The transition from disorder to order always occurs at a well-defined temperature and sometimes also take place in jumps. There is a phase transition at a critical temperature, which in the case of ferromagnets is termed the Curie temperature.

Pierre-Gilles de Gennes began by working on magnetic phase transitions, but during the 1960s and 1970s studied other, more complicated, order phenomena. The transition to a superconducting state in certain materials, from an ordered state to a disordered state in liquid crystals; regularities in the geometrical arrangement and movement of polymer chains; conditions of stability in micro-emulsions, and other phenomena: all these have been objects of de Gennes' interest. Some of these systems are so complicated that physicists had earlier been unable to discern general rules for how they behave during the transition from order to disorder. De Gennes has in many cases succeeded in doing this, in particular for *liquid crystals* and *polymers*. In addition, he has shown that phase transitions in such apparently widely-differing physical systems as magnets, superconductors, liquid crystals and polymer solutions can be described in mathematical terms of surprisingly broad generality.

Some examples of the laureate's contributions

Liquid crystals have been known for over a century and their hydrodynamics, that is, how they flow, were studied as early as the 1920s by Professor Wilhelm Oseen of Uppsala. But it was not until the 1960s that the development of liquid crystals gathered impetus with the technical exploitation of their optical properties for showing numbers in pocket calculators, wristwatches, etc. Liquid crystals have been called

* 1991.

"nature's delicate phase of matter" because the molecules can be arranged in many different, characteristic ways, and because the arrangement is also easily affected by weak electrical or magnetic fields. One of the ordered phases is the "nematic" phase, in which the molecules move as if in an ordinary three-dimensional liquid, but with their axes mainly pointing the same way. Other phases are termed "smectic" (i.e. soap-like), where the molecules can also flow, but only in two dimensions, in parallel layers. In industry, these properties have led to the optical applications mentioned, since liquid crystals are also optically active and alter the polarisation of light or scatter light strongly when it passes through thin layers of the crystals. Recently, "flat" TV screens have been described. These are based on the electro-optical properties of liquid crystals. In physics, on the other hand, liquid crystals are often seen mainly as an exciting "playground" where the arrangements which they assume can easily be modified and studied. In these case liquid crystals can act as model systems for experiments to test more general theories.

At the end of the 1960s de Gennes formed the liquid crystal group in Orsay. This research team consisted of both experimenters and theorists. It quickly became one of the leading groups in the field. De Gennes himself made his chief contributions to our knowledge of liquid crystals when he explained what is termed anomalous light scattering from nematic liquid crystals. This light scattering depends in a complicated manner on fluctuations in the orientational order. Another important contribution was his description of the conditions for one of the transition points that occur when a weak alternating electric field is applied. In addition, de Gennes demonstrated important similarities between the behaviour of liquid crystals and that of superconductors. Published in 1974, his book "The Physics of Liquid Crystals" has become a standard work.

Somewhat later de Gennes began to be interested in the conformation and dynamics of the *polymers*. Polymers are formed out of very long chains of simpler links, termed monomers. The links may be about 10 Ångström (i.e. 10^{-7} cm) long, and the chains consist of tens of thousands of similar links. Polymer molecules in dilute solutions form loops, or "tangles", rather like spaghetti. When followed from end to end the winding-about appears like an (almost) random movement in three dimensions. Attempts had been made earlier to describe in mathematical-statistical terms the various possibilities for the spatial disposition of the molecules, also taking into account the fact that a chain cannot have more than one link in the same place at the same time. The Englishman S.F. Edwards made important contributions in this area by introducing a technique of calculation taken from theoretical particle physics. De Gennes' important discovery was that there were far more similarities than had hitherto been suspected between this "order in disorder" in the arrangement of polymers and the conditions that apply when a system of magnetic moments moves from order to disorder. With this, de Gennes opened the way for new descriptions of complicated order phenomena in polymers, which are based on general physical principles of phase transition. In the "Orsay group", the descriptions were soon developed to apply also to polymers in more concentrated solutions, in which the various chains can partly "entangle" themselves, and in high concentrations in pure melts of polymers.

For the latter cases, de Gennes has also established a number of predictions regarding how polymer chains and their individual parts can move, i.e. what physicists call polymer dynamics. These predictions often have the character of "scaling laws": they say that conditions shall be similar for certain combinations of the starting variables (such as polymer concentration in a solution, and temperature). These are properties that can sometimes be controlled experimentally, and many works on polymer dynamics have been performed using neutron-scattering techniques. In experiments of this kind, it is possible to distinguish how individual parts of a polymer chain move by noting how an oscillation of a selected wavelength initiated by the neutron collision is damped during a certain measurable time. Such measurements have helped to confirm de Gennes' models for polymer-chain motion. One of these models, the "blob" model, states that a certain typical segment of a chain can move as if it were free, even in more concentrated solutions. Another is the "reptation" model, which describes the serpentine motion of a polymer chain within a "tangle" of surrounding polymer chains.

De Gennes formed a school for polymer studies as well, and gathered around him a large number of co-workers in STRASACOL, a joint project with physicists and chemists from Strasbourg, Saclay and the Collège de France (to which de Gennes had then been appointed). His work in this field is described in his "Scaling Concepts in Polymer Physics", which came out in 1979. De Gennes has since contributed new viewpoints in many fields unconventional for physicists such as gels, porous media and other so-called soft systems.

Pierre-Gilles de Gennes — a coordinator in physics

Pierre-Gilles de Gennes has by some judges been called "the Isaac Newton of our time". The reason for this highly appreciative epithet is probably that de Gennes has succeeded in perceiving common features in order phenomena in very widely differing physical systems, and has been able to formulate rules for how such systems move from order to disorder. Some of the systems de Gennes has treated have been so complicated that few physicists had earlier thought it possible to incorporate them at all in a general physical description. Physicists often take pride in dealing with systems that are as simple and "pure" as possible, but de Gennes' work has shown that even "untidy" physical systems can successfully be described in general terms. In this way he has opened new fields in physics and stimulated a great deal of theoretical and experimental work in these fields. While this is pure research, it has also meant the laying of a more solid foundation for the technical exploitation of the materials mentioned here: liquid crystals and polymers. ♦

Eugene Paul Wigner (USA), 1963
"for his contributions to the theory of atomic nuclei elementary particles, especially for his discovery and application of fundamental principles of symmetry".
Dates of visits:
1968 – June
1970 – July
1983 – September

Thirty-five Nobel Laureates have visited the ICTP since 1964. The citations for the Prize and dates of their visits are given for five of them in this issue. More will be published in future ICTP newsletters.

Sheldon Lee Glashow (USA), 1979
(shared the 1979 Nobel Prize with Abdus Salam and S. Weinberg)
"for contributions to the theory of the unified weak and electromagnetic interaction between elementary particles, including inter alia the prediction of the weak neutral current".
Dates of visits:
1965 – May
1986 – July

Murray Gell-Mann (USA), 1969
"for his contributions and discoveries concerning the classification of elementary particles and their interactions".
Date of visit:
1965 – June

Carlo Rubbia (Italy), 1984
"for decisive contributions to the large project which led to the discovery of the field particles W and Z, communicators of the weak interaction".
Dates of visits:
1966 – February
1969 – June
1984 – April
1986 – February
1987 – June

Julian Seymour Schwinger (USA), 1965
"for fundamental work in quantum electrodynamics which involves profound consequences for elementary particle physics".
Dates of visits:
1965 – June
1968 – June

The Role of ICTP for Strengthening Science in Third World Countries

The International Centre for Theoretical Physics (ICTP) is the long-awaited dream of Prof. Abdus Salam which came into reality as a result of his untiring perseverance and dedication for developing the scientific footings of the Third World countries. Prof. Abdus Salam believes it profoundly that there is no alternative for the Third World countries to ensure the welfare of their people without boosting up the scientific and technological advancement properly. Having been brought up and spent the early part of his career in a Third World country, he knows the problems and drawbacks of the Third World countries better than anybody of his stature in the field of science and technology of the time. He dedicated himself to uplift the condition of Third World countries providing them with scientific and technological support through an international organisation, so that the scientists and technologists of the developing parts of the world do not feel themselves deprived of a guardian to stand by their side.

The ICTP is the outcome of Prof. Abdus Salam's dream and untiring endeavour to extend advanced facilities to the scientists and technologists of the Third World countries. For the last 26 years the Centre has been providing these noble services for developing and improving the scientific and technological backbone of the Third World countries.
World countries.

At present there are modern and sophisticated laboratories at ICTP including the Microprocessor Laboratory, Superconductivity Laboratory, Laser Laboratory etc. Wide scope facilities for scientific research, experiments and studies are available in these laboratories. Besides, the ICTP has also established working links with 270 laboratories in Italy. In addition to the ICTP's own laboratories, the Third World's scientists and technologists are availing the opportunities of working in these laboratories for one year with the financial support of ICTP.

The ICTP library has an up-to-date collection of books, journals, papers etc. on all disciplines. Photocopies of journals and papers are supplied to the scientists on request.

Scientists from the Third World countries join the various scientific programmes, courses and activities of ICTP. Nearly 5000 scientists of these countries participate each year in different courses, programmes and activities of ICTP, their visits lasting from one month to a year. They meet here with the visiting scholars and leading scientists of the developed countries and exchange views on their subjects of interest.

The ICTP's assistance programmes for the Third World countries also include providing with the sophisticated scientific equipment. The Third World countries are besieged with the problems of procuring the costly but necessary equipment for scientific research for their budget constraints. The ICTP tries to meet up these requirements as far as possible.

With a view to creating a congenial atmosphere of scientific activities in Third World countries, ICTP extends all sorts of co-operation and financial assistance for arranging symposia, seminars etc. locally in those countries.

The next important step of Prof. Abdus Salam is the creation of the Third World Acadmy of Sciences (TWAS) which is working as one of the sister organisations of ICTP with almost similar programmes.

The Third World Academy of

The Third World Academy of Sciences (TWAS) is a non-governmental, non-political and non-profit making organization whose objectives are to recognize and promote high-calibre scientific research carried out by scientists from developing countries, to facilitate their mutual contacts, strengthen their scientific research work and foster it for the development of the Third World and in the service of mankind.

At present, there are 143 Fellows, coming from 52 developing countries, 56 Associate Fellows, 71 Corresponding Fellows and 3 Corresponding Associate Fellows. These 273 Members include the 10 living Nobel Laureates of Third World origin.

The Founding President of the Academy is Prof. Abdus Salam of Pakistan and also Founding Director of the International Centre for Theoretical Physics (ICTP) and Nobel Laureate in Physics 1979.

On 5 July, 1985, the Third World Academy of Sciences (TWAS) was officially inaugurated by the Secretary General of the United Nations, Mr. J. Perez de Cuellar, in Trieste, Italy.

The principal objectives of the Academy are:
(a) To recognize and support excellence in scientific research performed by individual scientists from the Third World;
(b) To provide promising scientists in the developing countries of the South with the conditions necessary for the advancement of their work;
(c) To promote contacts between research workers in developing countries of the South among themselves and with the world scientific community;
(d) To provide information on and support for scientific awareness and understanding in the Third World;
(e) To encourage scientific research on major Third World problems.

What TWAS does in and around the world:

TWAS awards five prizes each year for the individual scientists from developing countries; TWAS Research Grants, up to US$ 5,000 for Experimental Physics, Mathematics, Experimental Physics, Mathematics, Biochemistry, Molecular Biology and Chemistry; Spare Parts for Scientific Equipment up to US$ 500 for Third World institutions; Provision of Books and Journals; South-South Fellowships; TWAS/CAS Fellowship Programme for Research and Training in Chinese Institutes; TWAS/ICIPE Associateship Scheme; Support for International Scientific Meetings; and Joint Lectureship Programme.

For the best interest of the Third World countries, Prof. Salam has also initiated some other programmes, viz. Science and High Technology, Earth and Environment, Pure and Applied

continued on Page 9

The Wheatley Award

The International Physics Group has been working for several years to create The Wheatley Award, a $2,000 award of the American Physical Society, to honour those who have contributed to the advance of physics in developing countries. The first recipient of the Award will be named in 1992.

The International Physics Groups plans to organize a special session at the 1993 March Meeting. The session will both be an occasion to honour John Wheatley with presentations on scientific themes in the areas of his interest and the occasion of the presentation of The Wheatley Award to the first recipient.

The International Physics Group is now collecting nominations, at the following address: International Physics Group of American Physical Society, c/o Materials Research Laboratory, University of Illinois, 104 South Goodwin Avenue, Urbana, IL 61801, USA.

John Wheatley (1927-1986) was a distinguished condensed matter physicist who worked on low temperature techniques and low temperature properties of matter. He studied at the University of Colorado and the University of Pittsburgh; he worked at the University of Illinois, the University of California (San Diego), Los Alamos National Laboratories and the University of California at Los Angeles. He developed low temperature cryostats using adiabatic demagnetization and also dilution refrigerators. He and his team used these systems to make measurements of specific heat, thermal conductivity, viscosities etc. of He^3 and mixtures of He^3 and He^4.

In the period 1962-1963, Wheatley spent 18 months in Bariloche, Argentina. The research institute at Bariloche had been founded in 1955, but when Wheatley arrived the infrastructure was still very poor ad research programmes were hardly beginning. Wheatley was largely responsible for changing that situation and converting the laboratory in Bariloche into a serious, world-level centre for research in condensed matter physics. At the University of Illinois many people still remember this period because of the way Wheatley used short-wave radio to continue to work with his students there. In Bariloche he is remembered for much more — in a letter to *Physics Today* after John Wheatley's death, F. de la Cruz of Bariloche wrote: "Wheatley taught us how to solve problems, how to feel proud of scientific experimental work. Wheatley's outstanding work capacity and his personal approach toward the local people made possible what even today seems an impossible dream." _____ ♦

Conferences and Lectures

• We have recently learned that one of ICTP's former post doctoral students, Dr. Duong Minh Duc from Viet Nam, has been awarded a fellowship by the prestigious Alexander von Humboldt Foundation. Dr. Duc is the second of ICTP's Mathematics post-doctoral students to receive this honour — Dr. Carlos Olmos (Argentina) was awarded one about a year ago.

• Prof. Alberto Verjovsky, Mathematics Research Co-ordinator at ICTP, spent three weeks at various institutes in China in December 1991. He gave lectures on different topics at the University of Beijing, Academia Sinica in Beijing, Anhui University, University of Science and Technology in Hefei, Mathematics Institute in Hangzhou, and Fudan University in Shanghai. He was most impressed by the high standard of mathematics in China. And he remarked on the high esteem the Chinese mathematicians have of the ICTP's Mathematics Section. _____ ♦

Visits to ICTP

Prime Minister of Mongolia

The Prime Minister of Mongolia, S. E. Dashiin Byambasuren, visited the ICTP on 6 March 1992.

He met Professor Abdus Salam, Director of the International Centre for Theoretical Physics (ICTP) and President of the Third World Academy of Sciences (TWAS), and discussed the possibility of strengthening future scientific exchanges between Mongolia and ICTP. He also met Professor G. Denardo, Head of the Office of External Activities of the ICTP. During the afternoon he visited the Library.

President Eltsin's Adviser

The Round Table on "The Essential Role of Science in Technological Progress and Economic Development" was held at the Adriatico Guest House on 22-24 April 1992. During the afternoon session of 24 April 1992, President B. Eltsin's personal adviser and State Counsellor of Russia on Public Policy Affairs and first Vice-Chairman of the Moscow City Council, Mr. Serguei B. Stankevich, attended the round table. He made a short speech expressing his government's willingness to co-operate at all levels with the ICTP.

Pro Senectute

On Tuesday, 28 April, about thirty members of the Trieste's association of senior citizens ("Pro Senectute") were senior citizens ("Pro Senectute") were introduced to the general aims and scope of ICTP by Prof. G. Denardo. They were then shown the equipment at the Laboratory directed by Prof. Denardo — the one for Lasers and Fibre Optics — and had a guided tour of the Library.

Director of Colciencias, Colombia

Prof. Clemente Forero Pineda, Director of Colciencias, the Colombian Government Agency for Science and Technology, and President of the Council of Basic Sciences, Social and Human Sciences and Biotechnology of the Colombian S&T System, visited the Centre on 30th April, 1992. He had a meeting with the Director Prof. Abdus

Salam and Deputy Director Prof. L. Bertocchi to discuss matters of research related to technical co-operation and further collaboration between Colombia and ICTP and TWAS. Prof. Forero Pineda also visited the Microprocessor and Laser laboratories and the Library of the ICTP.

Minister A. Vattani

Minister Alessandro Vattani, Director General for Cultural Relations of the Italian Foreign Ministry, visited ICS, ICTP, TWAS and the ICGEB on 10 April 1992. He was accompanied by Counsellor Gerardo Carante. In his address to a group of participants in a course on biotechnology organized by the ICGEB, Minister Vattani recalled the message of Abdus Salam: "There will be no real independence for the countries which do not take achievements in science and technology seriously. If one does not close the scientific gap, the social and economic gap will remain". He encouraged scientists from the developing countries and from Eastern Europe to continue their collaboration among themselves and with their colleagues from Italy and other industrialized countries after their return at home. In this respect, he strongly advised them to avail themselves of the services offered by the Scientific Attachés in the Italian Embassies and by the Italian Cultural Institutes (there are eighty of them all over the world). Minister Vattani also invited the participants to join their efforts for contributing to the creation of scientific centres of excellence in their regions.

contributing to the creation of scientific centres of excellence in their regions, similar to the "Trieste model".

Counsellor Carante drew the attention to other initiatives of the General Directorate in other cities of Italy, like the international courses on scientific management, health problems, AIDS and many others. Both speakers expressed the continuing interest of the Government of Italy for the work done in Trieste for the benefit of the international cooperation with the developing countries and with Eastern Europe. _ ♦

Professor Abdus Salam, Director ICTP, and Minister Alessandro Vattani, Director General for Cultural Relations of the Italian Foreign Ministry.

ICTP Prizes 1993, 1994, 1995

The International Centre for Theoretical Physics announces the following three prizes for the years 1993, 1994 and 1995.

The 1993 Prize (in honour of Professor J. Robert Schrieffer): in the fields of Solid State, Atomic and Molecular Physics.

The 1994 Prize (in honour of Sir Michael Atiyah): in the fields of Mathematics, Nuclear Physics, Plasma Physics and other fields of Physics.

The 1995 Prize (in honour of Professor Steven Weinberg): in the field of High Energy Physics.

The prizes will be awarded for outstanding and original contributions within the above fields. Candidates for the prizes must be nationals of developing countries, working and living in developing countries. Any leave of absence due to sabbaticals or studies abroad would not disqualify candidates. Each prize will consist of the sum of US$ 1,000, payable in US dollars or in local currency.

The winner of each prize will be selected by an international committee, from among the most outstanding scientists in the above mentioned fields.

In order to be considered for any of these prizes, a candidate must submit a review of his work and attach a brief curriculum, a list of publications and any relevant published work.

The age of the candidate must not exceed 40 years at the time the submission is made. Submissions for each prize must reach the ICTP before 31 May of the relevant year.

Submissions should be sent to the ICTP Prize Committee, ICTP, P.O. Box 586, 34100 Trieste, Italy. _____ ♦

continued from Page 7

Chemistry, and High Technology and

Chemistry, and High Technology and New Materials. All these programmes have been planned to improve the condition of scientific infrastructure of the Third World countries.

The responsibility of ICTP and its siter organisations and related programmes are perhaps going to be increased because of the recent changes in the socialist countries of Eastern Europe. Many of these countries would like to take advantage of ICTP for a better participation in scientific research and the goal dreamt by Prof. Salam would be extended to them too in a larger scale.

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1992 New Regular Associates

Name	*Member State*	*Field*
ABDEL-RAHMAN ABDEL-MALIK,M.	SUDAN	RELATIVITY
ADIBE, E.C.	NIGERIA	ENVIRONMENTAL SCIENCES
AJAYI, G.O.	NIGERIA	COMMUNICATIONS PHYSICS
ALAMNEH FEKADU, K.	ETHIOPIA	GEOPHYSICS
ALEMU, Y.	ETHIOPIA	MATHEMATICS
ALIEV TAKHMASSIBB, M.	RUSSIAN FEDERATION	HIGH ENERGY PHYSICS
ALIGIA, A.A.	ARGENTINA	CONDENSED MATTER PHYSICS
ALPAR, A.M.	TURKEY	CONDENSED MATTER PHYSICS
AYUB, M.	PAKISTAN	HIGH ENERGY PHYSICS
BARRACHINA, R.O.	ARGENTINA	CONDENSED MATTER PHYSICS
BASHAR, S.A.M.K.	BANGLADESH	BIOPHYSICS
BETAK, E.	CZECHOSLOVAKIA	NUCLEAR PHYSICS
CARPIO-BERNIDO, Maria V.	PHILIPPINES	MATHEMATICS (Math Physics)
CHOUDHURY, D.K.	INDIA	HIGH ENERGY PHYSICS
DABBOUR, A.	EGYPT	MATHEMATICS
DASGUPTA, B.	INDIA	PLASMA PHYSICS
DE LA FUENTE CALVO, F.	CUBA	MEDICAL PHYSICS
DESQUITH, E.	IVORY COAST	MATHEMATICS
DEY, M.	INDIA	HIGH ENERGY PHYSICS
DHAR, D.	INDIA	CONDENSED MATTER PHYSICS
DUC NGUYEN HUU	VIET NAM	MATHEMATICS
ERZAN, A.	TURKEY	CONDENSED MATTER PHYSICS
EZE, M.	NIGERIA	BIOPHYSICS
FAM LE KIEN	VIET NAM	CONDENSED MATTER PHYSICS
FERREIRA LUIZ, A.	BRAZIL	HIGH ENERGY PHYSICS
FOLORUNSO, O.A.	NIGERIA	SOIL PHYSICS
FREZ, J.	MEXICO	GEOPHYSICS
FREZ, J.	MEXICO	GEOPHYSICS
GNAVI, G.	ARGENTINA	PLASMA PHYSICS
GUNDUC, Y.	TURKEY	HIGH ENERGY PHYSICS
GUPTA, B.D.	INDIA	BIOPHYSICS
GURSES, A.C.	TURKEY	NONCONVENTIONAL ENERGY
HERNANDEZ, D.B.	MEXICO	MATHEMATICS (Appl. Math)
HONG, J.	KOREA REP.	CONDENSED MATTER PHYSICS
HSU, Hou Tse	CHINA P.R.	GEOPHYSICS
ISLAM, G.S.	BANGLADESH	ENVIRONMENTAL SCIENCES
JAYANNAVAR, A.M.	INDIA	CONDENSED MATTER PHYSICS
KUKU, T.A.	NIGERIA	NONCONVENTIONAL ENERGY
KUMAR, A.	INDIA	HIGH ENERGY PHYSICS
KUNDAELI, H.N.	TANZANIA	ATOMIC/LASER PHYSICS
LUBUMA, M.S.	ZAIRE	MATHEMATICS

Name	*Member State*	*Field*
MAKHDOOM, M.D.	PAKISTAN	ATOMIC/LASER PHYSICS
MARONE, E.	BRAZIL	ENVIRONMENTAL SCIENCES
MBAGWU, J.S.C.	NIGERIA	SOIL PHYSICS
MILI, A.	TUNISIA	COMMUNICATIONS PHYSICS
MODARRES, M.	IRAN	HIGH ENERGY PHYSICS
MUSTAFA, A.A.	KUWAIT	MEDICAL PHYSICS
NATALE, A.	BRAZIL	HIGH ENERGY PHYSICS
ODUNDUN, O.A.A.	NIGERIA	MATHEMATICS
OKEYO, A.E.	KENYA	ENVIRONMENTAL SCIENCES
OLIVEIRA, L.E.M.	BRAZIL	CONDENSED MATTER PHYSICS
ONWUAGBA BENIAH, N.	NIGERIA	CONDENSED MATTER PHYSICS
OULD JIDOUMOU, A.	MAURITANIA	MATHEMATICS
PADMANABHAN, T.	INDIA	RELATIVITY
PASCUAL-MARQUI, R.D.	CUBA	BIOPHYSICS
PEREZ-ROJAS, H.C.	CUBA	HIGH ENERGY PHYSICS
PIETRUSZKO, S.M.	POLAND	NONCONVENTIONAL ENERGY
PRASAD, R.	INDIA	CONDENSED MATTER PHYSICS
QUANG DOAN NHAT	VIET NAM	CONDENSED MATTER PHYSICS
RABAH, K.V.O.	KENYA	NONCONVENTIONAL ENERGY
SALEHI, A.A.	IRAN	HIGH ENERGY PHYSICS
SAN JUAN, B.C.	PHILIPPINES	MEDICAL PHYSICS
SARIKOV, N.A.	RUSSIAN FEDERATION	HIGH ENERGY PHYSICS
SEDLACEK, Z.	CZECHOSLOVAKIA	PLASMA PHYSICS
SEN, D.	INDIA	HIGH ENERGY PHYSICS
SHASTRY ANANT, R.	INDIA	MATHEMATICS
SHNIRMANN, M.	RUSSIAN FEDERATION	GEOPHYSICS
SHYAM, R.	INDIA	NUCLEAR PHYSICS
SIMON, S.	HUNGARY	BIOPHYSICS
SUBHASH, N.	INDIA	ATOMIC/LASER PHYSICS
[illegible]	[illegible]	[illegible]
SUBRAMANIAN, S.	INDIA	MATHEMATICS
TRAN QUANG	VIET NAM	ATOMIC/LASER PHYSICS
URBAN, L.	CZECHOSLOVAKIA	GEOPHYSICS
WIAFE-AKENTEN, J.	GHANA	ATOMIC/LASER PHYSICS
WIO, H.S.	ARGENTINA	NUCLEAR PHYSICS
YAN, Mu-Lin	CHINA P.R.	HIGH ENERGY PHYSICS
YANG, Zhan-Ru	CHINA P.R.	CONDENSED MATTER PHYSICS
YIN, Weiping	CHINA P.R.	MATHEMATICS
ZAKKARI, M.	MOROCCO	HIGH ENERGY PHYSICS
ZHU, Bang-Fen	CHINA P.R.	CONDENSED MATTER PHYSICS
ZHU, Huanliang	CHINA P.R.	NONCONVENTIONAL ENERGY

Activities at ICTP in March/April 1992

Title: COLLEGE ON NEUROPHYSICS: "OBJECT RECOGNITION BY MAN AND MACHINE: METHODS AND TESTS OF COGNITIVE NEUROPSYCHOLOGY AND NEURAL COMPUTATIONS", 2 – 27 March.

Organizers: Professors A. Borsellino (International School for Advanced Studies, SISSA, Trieste, Italy), J. Chela-Flores (Instituto Internacional de Estudios Avanzados, Caracas, Venezuela, and ICTP), J.H. Kaas (Vanderbilt University, Nashville, USA) and O. Siddiqui (Tata Institute of Fundamental Research, Bombay, India).

Lectures: The organization of processing systems in the human brain. Basic neuron structure and function. The organization of human somatosensory and motor system. Perception of motion in biological and artificial visual system. The role of the 'environment' in the development and maintenance of neuron systems (networks). The organization of the human visual system in the human brain. Olfactory reception. Primate somatosensory system. Auditory system. Plasticity of adult sensory systems. Digital versus analogue handling of information. Development of sensory systems. Consciousness in modern neuroscience. Attention for location. Cellular mechanism of memory and learning. Plasticity of developing systems. Lateral masking — attentive obscurement. The hippocampus: a model to study plasticity during development. Central representation of odours. Cerebellum. Task-determined visual strategies. Parallel processing model, architectures and technologies. Artificial visual perception — problems and applications. Introduction to natural language processing. A view of natural language-based human machine interaction. Object recognition of motor system. Location of objects in space of motor system. Blind sight. A traditional view of brain-language relations. Hemispheric differences: neural basis. Psycholinguistic challenges to the traditional view. The theoretical relevance of aphasic syndromes. The language structure and the language acquisition. PET technology and experimental applications. Clinical usefulness of PET. Neuropsychological correlates of speech and learning disorders. Extroversion, introversion and the Muller-Lyer illusion. Neural information processing. Associative memories in neural networks. Neurotransmitter mechanism of primary visual relay of the frog. Theoretical analysis of the EEG states. Making sense out of words and faces — an event-related potential study. Machine face recognition. Navigation with learning. Network for invariant recognition.

The College was attended by 63 lecturers and participants (39 from developing countries).

Title: SPRING SCHOOL ON STRING THEORY AND QUANTUM GRAVITY AND WORKSHOP ON STRING THEORY, 30 March – 10 April.

Organizers: Professors J.A. Harvey (University of Chicago, USA), R. Iengo (International School for Advanced Studies, SISSA, Trieste, Italy), K.S. Narain (ICTP), S. Randjbar-Daemi (ICTP) and H. Verlinde (Princeton University, USA), in collaboration with the International School for Advanced Studies (SISSA, Trieste, Italy) and the Italian Institute for Nuclear Physics (INFN).

Lectures: *Spring School, 30 March – 7 April:* Quantum aspects of black holes. N = 2 superconformal field theory. High

College on neurophysics: "Object recognition by man and machine: methods and tests of cognitive neuropsychology and neural computations", 2 – 27 March.

energy scattering in 4-d gravity. C = 1 quantum gravity and 2-dimensional string theory. Black holes and black strings in string theory. Dynamical applications of topological field theories. Recent developments in closed string field theory. Quantum aspects of black holes. Mirror symmetry.

Workshop, 8 – 10 April: A_n-W-geometry. Quantum Fermi liquid at C=1. Continuum approach to 2d gravity (physical states and ring structures). Physical states in minimal CFT coupled to 2d gravity. Renormalisation of gravity-dilaton in two dimensions. Ring structure of BRST cohomology in 2d gravity coupled to minimal model. Scalar-tensor quantum gravity and the fate of the 2d black hole. Progress in the construction of strings for D larger than one. Topological strings in two dimensions. Simplicial quantum gravity in four, three and two dimensions. Quantization of the conformal factor in 4d gravity. Gravitational collisions at Planckian energies: the eikonal and beyond. The gravitational field of the string matter. On the classical solution of string field theory. Physical states in G/G models and 2d gravity. Topological correlators in first order systems with L G interactions. Geometry and integrability of 2d topological field theories. Piccard-Fuchs equations in special geometry. Moduli dependence of gauge and gravitational couplings from string loops. N=2 strings and quantum self-dual Yang Mills. The mirror of the z_3 orbifolds.

The School and Workshop were attended by 125 lecturers and participants (48 from developing attended by 125 lecturers and participants (48 from developing countries).

Title: COMPUTER NETWORK PROJECT, 30 March – 16 April.

Organizers: Professors F. Liello (Italian National Institute of Nuclear Physics, INFN, Trieste Section) and A. Nobile (International School for Advanced Studies, SISSA, and ICTP, Trieste).

Lectures: OSI Physical Layer; Transmission media.Telephone network. Error control, MNP protocols. Modems. Synchronous and asynchronous links. Interface standards. Computer networking through radio/ wireless networks (multiple access). Operational procedures. Networks of the future: ATM technology, wideband networks etc. Architecture. Low levels, CNLS. Special problems with satellite channels. Addressing. VSATS and their application in computer networking. Experiences in Brazil: from Bitnet to Internet. HEPNET. Routing. DECNET Phase V transition. X.25. Ethernet. Overview of TCP/IP. Low levels: IP, ICMP, TCP, UDP etc. RIPE. IP security. Mail. High levels (FTP, telnet etc.). DNS. High levels (programming). Dialup IP. Low cost communications. Cooperative computing. SNMP. INRIA Copernicus (EARN on TCP-IP). Polish national network. X 500. User services. Security issues. Fidonet and other low-cost PC-based solutions. Internet. Case study in net.man: Internet experience. DEC networking solutions. EUNET. NJE protocols; EARN. UUCP. The news system. Internetworking solutions. Internationalization (character sets).

Laboratory exercises.

The Workshop was attended by 83 lecturers and participants (57 from developing countries).

Title: WORKSHOP AND CONFERENCE ON "GLOBAL CHANGE AND ENVIRONMENTAL CONSIDERATIONS FOR ENERGY SYSTEM DEVELOPMENT", 21 April – 8 May.

Organizers: Professors G. Furlan (University of Trieste and ICTP), A.M. Khan (Pakistan Atomic Energy Commission, Islamabad, Pakistan), N. Nakicenovic (International Institute for Applied Systems Analysis, IIASA, Laxenburg, Austria), H.H. Rogner (University of Victoria, Canada) and T.A. Siddiqi (East-West Center. (University of Victoria, Canada) and T.A. Siddiqi (East-West Center, Honolulu, USA), in collaboration with the International Centre for Science an High Technology (ICS, Trieste, Italy) and with the co-sponsorship of the East-West Center, IIASA and the Fridtjof Nansen Institute (Lysaker, Norway).

Lectures: *Workshop, 21 April – 5 May:* General definitions. Basics of climate modelling. Modelling CO_2's role in climate. Linking energy and climate. Energy systems: supply and demand. Energy systems: end uses. Review of energy modelling. Introduction to the concept of energy chain analysis and to CO_2DB, the IIASA CO_2 technology data bank system. Formulation and application of large-scale linear programming energy optimization models with special consideration of pollutant emissions. Daily up to seasonal operation planning of electricity and district heat production systems with mixed integer modelling. A review of tools available to develop new linear and mixed integer modelling applications discussion session. Energy modelling and planning in India. Energy modelling and planning in China. Strategies to control CO_2 emissions. National and international environmental considerations in energy policies. Efficient uses of energy in industry, building and transportation. Equity issues in GHG reduction. Environmental change and perception of energy system dynamics. Carbon-free technologies. Energy and lifestyle. CO_2 mitigation: model studies for the FRG and the European community. Safety criteria for nuclear power plants. Overview and end-use demand models and example of MEDEE. Experience in US end-use models: data scenario issues. Integrated assessment of transboundary air pollution. Presentation of RAINS: application to Europe. Presentation MARKAL: evolution of an energy/ environment modelling system. ETSAP network activities. MARKAL: model description. MARKAL: model usage. PC-MARKAL/MUSS: overview; data management and hands-on computer training; analysis of results and hands-on computer training.

Computer demonstrations.

Conference, 6 – 8 May: Goals of the Conference. Global energy overview. Energy policy responses to climate change: Eastern Europe; Africa; Asia. Norwegian climate policy in an change: Eastern Europe; Africa; Asia. Norwegian climate policy in an international context: challenges and options. Energy policies and climate change: Bangladesh; USA; Brazil; China; Pakistan; Italy. Overview of the EEC energy policy response to climate change. Scientific uncertainty as a challenge to greenhouse policy-makers. Costs of reducing greenhouse gases: preliminary results from a UNEP study. Transport, energy and environment. Greenhouse gases and equity issues.

The Workshop and Conference were attended by 64 lecturers and participants (47 from developing countries). ____ ♦

Calendar of Activities at ICTP

1992

ICS/ICTP/WMO International Workshop on Mediterranean cyclones studies ..... 18 – 22 May

Trieste Workshop on the search for new elementary particles: status and prospects ..... 20 – 22 May

School on dynamical systems ..... 25 May – 5 June

Seventh Trieste Semiconductor Symposium on: "Wide-band gap semiconductors" ..... 8 – 12 June

Workshop on dynamical systems ..... 8 – 19 June

Miniworkshop on strongly correlated electron systems IV ..... 15 June – 10 July

Summer School on high energy physics and cosmology ..... 15 June – 31 July

Research Workshop in condensed matter, atomic and molecular physics ..... 22 June – 11 September

Adriatico Research Conference on clusters and Fullerenes ..... 23 – 26 June

Miniworkshop on non-linearity: dynamics and surfaces in nonlinear physics ..... 13 – 24 July

Adriatico Research Conference on wrinkling of surfaces in nonlinear systems ..... 21 – 24 July

Adriatico Research Conference on synergetics in condensed matter ..... 4 – 7 August

Miniworkshop on methods of electronic structure calculations ..... 10 – 21 August

Workshop on tropical climate variability and regional impacts ..... 17 – 21 August

Adriatico Research Conference on hydrogen atoms in intense electromagnetic fields ..... 18 – 21 August

Course on low-dimensional quantum field theory for condensed matter physicists ..... 24 August – 4 September

Advanced Workshop on arithmetic algebraic geometry ..... 31 August – 11 September

College on medical physics: imaging and radiation protection ..... 31 August – 18 September

Workshop on commutative algebra ..... 14 – 25 September

Workshop on commutative algebra ..... 14 – 25 September

Fourth International Conference on applications of physics in medicine and biology:
advanced detectors for medical imaging ..... 21 – 25 September

WMO Workshop on limited area modelling ..... 28 September – 2 October

College on methods and experimental techniques in biophysics ..... 28 September – 23 October

Second College on microprocessor-based real-time control — Principles and applications in physics ..... 5 – 30 October

Second Trieste Conference on recent developments in the phenomenology of particle physics ..... 19 – 23 October

Conference on chemical evolution and the origin of life ..... 26 – 30 October

School on physical methods for the study of the upper and lower atmosphere system ..... 26 October – 6 November

Second Autumn Workshop on mathematical ecology ..... 2 – 20 November

Third Workshop on basic VLSI design techniques ..... 2 – 27 November

Workshop on three-dimensional modelling of seismic waves generation, propagation and their inversion ..... 30 November – 11 December

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1993

Sixth International Workshop on computational condensed matter physics ..... 11 – 13 January

Experimental Workshop on high temperature superconductors and related materials (advanced activities), San Carlos de Bariloche, Argentina ..... 11 – 29 January

Fourth Training College on physics and technology of lasers and optical fibres ..... 18 January – 5 February

Second Workshop on functional-analytic methods in complex analysis and applications to partial differential equations ..... 25 – 29 January

Third ICTP-URSI College on theoretical and experimental radiopropagation physics ..... 1 – 26 February

Winter college on optics ..... 8 – 26 February

Workshop on scientific aspects of the rural communications in developing countries ..... 1 – 5 March

Third College on computer networks ..... 1 – 26 March

Adriatico Research Conference on quantum interferometry ..... 2 – 5 March

Conference on "Highlights of particle and condensed matter physics" ..... 8 – 12 March

Workshop on representation theory of Lie groups ..... 15 March – 2 April

Workshop on air pollution for environmental impact assessment ..... 22 March – 2 April

Spring School and Workshop on superstrings ..... 19 – 30 April

Meeting on "Intracellular channels, organelles and cell function" ..... 21 – 23 April

Sixth Workshop on perspectives in nuclear physics at intermediate energies ..... 3 – 7 May

Sixth Workshop on perspectives in nuclear physics at intermediate energies ..... 3 – 7 May

Workshop on qualitative aspects and applications of nonlinear evolution equations ..... 3 – 14 May

Workshop on middle-upper atmosphere interactions ..... 10 – 21 May

College on computational physics ..... 17 May – 11 June

Spring College on plasma physics ..... 17 May – 11 June

Summer School in high energy physics ..... 14 June – 13 August

including

Third School on non-accelerator particle astrophysics ..... 14 June – 1 August

Miniworkshop on strongly correlated electron systems ..... 21 June – 9 July

Research Workshop in condensed matter, atomic and molecular physics ..... 21 June – 3 September

Adriatico Research Conference on Fermi liquids vs. non-Fermi liquids ..... 22 – 25 June

Adriatico Research Conference on scattering from surfaces ..... **6 – 9 July**

Miniworkshop on non-linearity: mesoscopic system and chaos, a novel approach ..... **19 – 30 July**

Miniworkshop on the liquid state of matter: opportunities from new radiation sources ..... **19 – 30 July**

Adriatico Research Conference on mesoscopic systems and chaos ..... **27 – 30 July**

Adriatico Research Conference on vortex fluctuations in high T_c superconductors ..... **10 – 13 August**

Conference on variational problems in differential geometry and partial differential equations ..... **16 – 20 August**

Working Party on mechanical properties ..... **23 August – 3 September**

Workshop on materials science and physics of non-conventional energy sources ..... **30 August – 17 September**

Course on geometrical phases ..... **6 – 17 September**

College on soil physics ..... **6 – 24 September**

Second Workshop on composite media and homogenization ..... **20 September – 1 October**

Workshop on telematics ..... **27 September – 22 October**

Workshop on radioecology: mechanisms of transfer of radionuclides to the environment ..... **11 – 29 October**

Conference on the origin of life ..... **25 – 29 October**

Second School on the use of synchrotron radiation in science and technology:

"John Fuggle Memorial" ..... **25 October – 19 November**

Trieste Conference in high energy physics ..... **8 – 12 November**

Second Workshop on non-linear dynamics and earthquake prediction ..... **8 – 26 November**

Workshop on VLSI technology ..... **22 November – 3 December**

For information and applications to courses, kindly write to the Scientific Programme Office.

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