International Atomic Energy Agency

United Nations Educational, Scientific and Cultural Organization

International Centre for Theoretical Physics

News from ICTP

No. 74/75 September/October 1993

Mr. Micah Okwuchukwu Osilike (Nigeria), Mathematics Group, receiving the ICTP Diploma Certificate from Professor Luciano Bertocchi, Deputy Director, International Centre for Theoretical Physics.

Inside:

Diploma Course Awardees — New Members of the ICTP Family

On 24 September 1993 in a small ceremony, chaired by Professor Yu Lu, the ICTP Diploma was awarded to 25 young participants who had successfully completed the 1992-93 Diploma Programme. The awardees this year came from 17 developing countries.

The Deputy Director of the Centre, Professor Luciano Bertocchi addressed the Diploma awardees and those who had recently arrived for the 1993-94 Programme on behalf of Professor Abdus Salam, the Director of ICTP. He told them that he was very happy to welcome them as the youngest members of the ICTP "family", specially since they may be considered to represent the next generation of scientists and researchers who will carry on the peaceful exchange of scientific knowledge the world over — one of the main aims of the Centre itself over the past 30 years.

He recognized the hard work the 1992-93 awardees had done during the past twelve months for the intensive Diploma Programme whilst having to deal with day-to-day problems of living in a foreign country. He pointed out that the ICTP Diploma should, for them, mark not an end, but a beginning. They will face hard work in the next few years, whilst studying for a Ph.D., but their efforts will eventually find reward. He hoped they would keep in close contact with the Centre and that there would be an opportunity for them to visit the Centre again in the future. He reminded them that their ultimate aim should be to return to a developing country to offer the knowledge they gain as a benefit to their home countries and to others who choose a career in physics or mathematics, often under isolated conditions.

The individuals to be awarded the ICTP Diploma were then presented by their Coordinators, Prof. Vijay Kumar for Condensed Matter Physics, Prof. Faheem Hussain for High-Energy Physics, and Prof. Charles E. Chidume for Mathematics. They briefly described the past accomplishments and future plans of each participant.

Professor Yu Lu thanked Prof. Bertocchi and the Coordinators as well as those who had lectured during the Programme and/or acted as advisors to

1993-1994 ICTP Diploma Programme in Brief

1 September 1993 - 31 August 1994

First Term: 1 September – 23 December 1993; Second Term: 4 January – May 1994

Course of study: **Condensed Matter Physics**

Coordinator: Vijay Kumar (India/ICTP)

First term:

Lattice Dynamics (R. Prasad) - 15 hrs.
Many-Body Physics (G. Santoro) - 40 hrs.
Semiconductors & Superlattices (G. Goldoni) - 15 hrs.
Statistical Mechanics & Phase Transitions (M. Barma) - 45 hrs.
Symmetry & Bands (V. Kumar) - 27 hrs.

Second term:

Disordered Systems (N. Kumar) - 12 hrs.
Electron Gas (M. Tosi) - 12 hrs.
Magnetism (V.E. Kravtsov) - 10 hrs.
Non-linear Dynamical Systems (H. Cerdeira) - 18 hrs.
Quasi 1-dimensional Systems & Electron Correlations (Yu Lu) - 15 hrs.
Superconductivity (S. Shenoy) - 13 hrs.
Surface Physics (A. Levi) - 15 hrs.

Participants:

1. Adetayo Victor Adedeji (Nigeria)
2. Abdullah Ibrahim Al-Sharif (Jordan)
3. Orion Gjon Ciftja (Albania)
4. Isam Eldin H. Hagmusa (Sudan)
5. Dashdorjeen Jamyanaa (Mongolia)
6. Bijaya Bahadur Karki (Nepal)
7. Angela B. Klautau (Brazil)
8. George Musonda Lombé (Zambia)
9. Nguyen Hoa Hong Thi (Viet Nam)
10. Armando Villares Ferrer (Cuba)

Course of study: **High-Energy Physics**

Coordinator: Faheem Hussain (ICTP)

First term:

General Relativity (G. Ellis) - 30 hrs.
Introduction to Lie Groups & Lie Algebras (E. Gava) - 24 hrs.
Quarks & Leptons (G. Furlan) - 30 hrs.
Quantum Electrodynamics: Introduction to Quantum Field Theory (J.A. Strathdee) - 30 hrs.
Relativistic Quantum Mechanics (F. Hussain) - 22 hrs.

Second term:

Beyond the Standard Model (A. Masiero) - 33 hrs.
Lie Groups & Lie Algebras II (K.S. Narain) - 24 hrs.
Quantum Field Theory (S. Randjbar-Daemi) - 40 hrs.
Standard Model (C. Verzegnassi) - 30 hrs.

Participants:

1. Hanadi M. Abd El Salam (Sudan)
2. Tarig Mukhtar Abdalla (Sudan)
3. Adel M.M. Ahmed (Egypt)
4. Hilmiye Balkan (Turkey)
5. Jorge Castineiras (Cuba)
6. Luis Carlos Bassalo Crispino (Brazil)
7. Dambasuren Erdenebayar (Mongolia)
8. Petre Golumbeanu (Romania)
9. Mohammad Amin Kayali (Syria)
10. Soonok You (Korea, Rep. of)

Course of study: **Mathematics**

Coordinator: Charles E. Chidume (Nigeria/ICTP)

First term:

Introduction to Differential Geometry (E. Ciriza) - 30 hrs.
Abstract Algebra (M. Brundu/A. Logar) - 30 hrs.
Functional Analysis (C. Chidume) - 30 hrs.
Point-Set Topology (B. Zimmermann) - 24 hrs.

Second term:

Algebraic Topology (D. Repovs/B. Zimmermann) - 30 hrs.
Complex Analysis (G. de Souza) - 21 hrs.
Introduction to Algebraic Geometry (E. Mezzetti) - 30 hrs.
Measures & Integration (G. Dal Maso) - 30 hrs.
Partial Differential Equations, including Ritz & Galerkin Methods (P. Drábek/J. Francu) - 30 hrs.
Theory of Ordinary Differential Equations (F. Zanolin) - 30 hrs.

Participants:

1. Dawit Aberra (Ethiopia)
2. Trinh Tuan Anh (Viet Nam)
3. Mukta Bahadur Bhandari (Nepal)
4. Ayse Hacibekiroglu (Turkey)
5. Agashi Pius Nwogbaga (Nigeria)
6. Mahendra Prasad Panthee (Nepal)
7. Berhanu Bogale Tameru (Ethiopia)
8. Nguyen Chanh Tu (Viet Nam)

the participants while they were preparing their dissertations. He recognized the amount of work involved both for the faculty and the participants in the Programme, and was grateful to all those who contributed to its success. He ended the ceremony by expressing to the awardees his best wishes for their continuing studies.

The 12-month ICTP Diploma Programme is designed to provide young, promising graduates (mainly from developing countries), who hold a good degree at the level of a British B.Sc. (Honours) or equivalent, with post-graduate training suitable for pursuing teaching and research work in Condensed Matter Physics, High-Energy Physics, or Mathematics. It consists of 7-8 months of basic and advanced courses in each discipline, after which participants prepare a dissertation on a topic related to the courses under the supervision of scientists at the Centre or from nearby institutions. The participants orally defend their dissertation during the last month of the Programme. The ICTP Diploma is awarded only to those candidates who successfully complete all requirements of the Programme. The number of participants is kept small to allow close interaction between students and lecturers.

The Programme was instituted in October 1991, courses in the first academic year being offered in Condensed Matter Physics and High-Energy Physics. Many of the 17 awardees from that year are now in Ph.D. programmes in such places as Syracuse and Rochester Universities (USA), the University of Western Ontario (Canada), and Rochester Universities (USA), the University of Western Ontario (Canada), Brunel University (UK), the Scuola Normale Superiore (Pisa, Italy), the Josef Stephan Institute (Ljubljana, Slovenia), and the nearby International School of Advanced Studies (SISSA). Several have gone back to their countries to continue teaching and/or research, and some have also returned to take part in the Centre's scheduled activities or to carry out further research with scientists at the ICTP.

Mathematics was added as a course of study in the Diploma Programme commencing with October 1992. The third series of Courses in these three fields began at the Centre on 1 September 1993 and will run through 31 August 1994. To date, 81 promising young persons from 29 developing countries have come to Trieste to work towards the ICTP Diploma.

A brief description of the 1993-1994 Diploma Programme is given in the table on Page 2.

The fourth ICTP Diploma Programme is scheduled for the academic year 1 September 1994 – 31 August 1995. The deadline for applications is 31 December 1993. _♦

Nobel Prize in Physics and Chemistry

Professor Russell A. Hulse and Professor Joseph Taylor, both of Princeton University, New Jersey, USA, were awarded the Nobel Prize in Physics for the discovery of a new type of pulsar, a discovery that has opened up new possibilities for the study of gravitation. Professor Kary Muttis of California and Professor Michael Smith of University of British Columbia received the Chemistry Prize for developing a technique called PCR (polymerase chain reaction) and discovering how to cause mutations and specific sites on a strand of DNA.

Professor Russell A. Hulse was born on 28 November 1950 in New York. He is an American citizen. He got his Ph.D. in 1975 from the University of Massachusetts. He has been working as a research physicist, Plasma Physics Laboratory, at Princeton University. Hulse is a Member of the American Physical Society and American Astronomical Society.

Professor Joseph H. Taylor, Jr., was born on 29 March 1941 in Philadelphia. He is an American citizen. He got his Ph.D. in 1968 at Harvard University. He has been working as Professor in the Department of Physics, Princeton University, USA. Professor Taylor is a member of, among other bodies, the National Academy of Sciences, the American Physical Society, the American Astronomical Society and the International Union of Radio Science.

The discovery rewarded with this year's Nobel Prize in physics was made in 1974 by Russell A. Hulse and Joseph H. Taylor, Jr., using the 300-m radiotelescope at Arecibo, Puerto Rico, West Indies. The breakthrough came in the early 1970's as they searched the sky for pulsars, the superdense cinders left over when stars explode. Hulse and Taylor were first to find a double pulsar, a pair of objects whirling around each other in tight formation. Einstein's theory decreed that two such heavy bodies orbiting each other should give off gravity waves, which would drain off energy and cause the objects to come together eventually. Sure through, the pulsars are approaching each other at a rate of about 1 mm a year.

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Gravity Investigated with a Binary Pulsar

Courtesy of
The Royal Swedish Academy of Sciences

The discovery rewarded with this year's Nobel prize in Physics was made in 1974 by Russel A. Hulse and Joseph H. Taylor, Jr., using the 300-m radiotelescope at Arecibo, Puerto Rico, west Indies. Taylor, then Professor at the University of Massachusetts, Amherst, and his research student Hulse were searching systematically for pulsars — a kind of rapidly rotating cosmic beacon with a mass somewhat greater than that of the sun and a radius of about ten kilometers. (A human being on the surface of a pulsar would weigh some kilometers. (A human being on the surface of a pulsar would weigh some hundred thousand million times more than on Earth.) The pulsar's "beacon light" is often within the radio wave region.

The first pulsar was discovered in 1967 at the radioastronomy laboratory in Cambridge, England (Nobel Prize 1974 to Antony Hewish). What was new about the Hulse-Taylor pulsar was that, from the behaviour of the beacon signal, it could be deduced that it was accompanied by an approximately equally heavy companion at a distance corresponding to only a few times the distance of the moon from the earth. The behaviour of this astronomical system deviates greatly from what can be

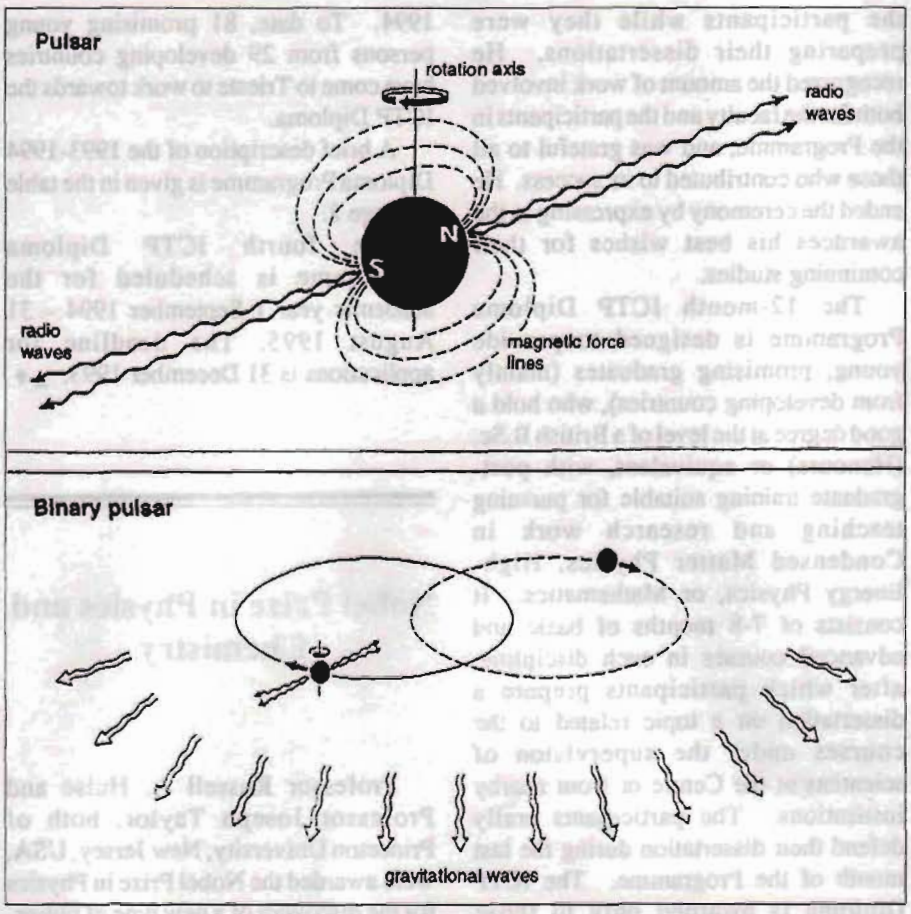
calculated for a pair of heavenly bodies using Newton's theory. Here a new, revolutionary 'space laboratory' has been obtained for testing Einstein's general theory of relativity and alternative theories of gravity. So far, Einstein's theory has passed the tests with flying colours. Of particular interest has been the possibility of verifying with great precision the theory's prediction that the system should lose energy by emitting gravitational waves in about the same way that a system of moving electrical charges emits electromagnetic waves.

The significance of the discovery of the binary pulsar

The discovery of the first binary pulsar is primarily of great significance for astrophysics and gravitational physics. Gravity is the oldest known natural force, the one we are most aware of in daily life. At the same time it is in one sense the force that is hardest to study since it is so much weaker than the other three natural forces: the electromagnetic force and the strong and the weak nuclear forces. The development of technology and science since the second World War with rockets, satellites, space voyages, radioastronomy, radar technology and the precise measurement of time using atomic clocks has led to a renaissance of the study of this earliest-known natural force. The discovery of the binary pulsar represents an important milestone in this historical development.

Relativity theory and gravitational physics

According to Albert Einstein's general theory of relativity, gravity is caused by changes in the geometry of space and time: space-time curves near masses. Einstein presented his theory in 1915 and became a world celebrity when in 1919 the English astrophysicist Arthur Eddington announced that one of the predictions of the theory, the deflection of starlight passing near the surface of the sun — "the light is drawn towards the sun" — had been verified during solar eclipse expeditions. This deflection of light, together with a small general-relativity contribution to the perihelion motion of Mercury (a slow rotation of Mercury's elliptical orbit round the sun), was for several decades the only, partly rather uncertain, support for Einstein's theory.



The radio waves from a pulsar are emitted in two bunches which sweep across space at the same rate as the pulsar rotates (upper figure). From a binary pulsar, gravitational waves are also emitted (lower figure).

(Illustration Hasse Nilsson)

For a long time the theory of relativity was considered aesthetically very beautiful and satisfying, probably correct, but of little practical significance to physics except in applications in cosmology, the study of the origin, development and structure of the universe.

Attitudes to the general theory of relativity changed, however, during the 1960s when both experimental and theoretical developments made gravitational physics a topical part of physics. New opportunities for precise experiments, based on satellite and radar technology, opened up. In particular, the research of the Americans R. Dicke and I. Shapiro contributed to this. Dicke performed precision experiments in which the sun's gravitational field on the earth was used for verifying what is termed the equivalence principle, the identity between gravitational and inertial mass — one of the basic principles of the general theory of relativity (and also of several alternative gravitation theories). Important contributions were also Shapiro's theoretical prediction and experimental verification, using radar echoes from Mercury, of a new consequence of the general theory of relativity — a time-delay effect for electromagnetic signals passing through gravitational fields.

All these experiments, however, were confined to our solar system with its very weak gravitational fields and consequently small deviations, hard to measure, from the Newtonian theory of gravity. Hence it was possible to test the general theory of relativity and other theories only in the first post-Newtonian approximation.

The discovery of the binary pulsar

Hulse's and Taylor's discovery in 1974 of the first binary pulsar, called PSR 1913 + 16 (PSR stands for pulsar, and

1913 + 16 specifies the pulsar's position in the sky) thus brought about a revolution in the field. We have here two very small astronomical bodies, each with a radius of some ten kilometres but with a mass comparable with that of the sun, and at a short distance from each other, only several times the moon's distance from the earth. Here the deviations from Newton's gravitational physics are large. As an example may be mentioned that the periastron shift, the rotation of the elliptical orbit that the pulsar (according to Kepler's first law from the beginning of the 17th century) follows in this system, is 4 degrees per year. The corresponding relativistic shift for the most favourable example in our solar system, the above-mentioned perihelion motion of Mercury, is 43 seconds of arc per century (this is less than a tenth of the very much larger contributions to the perihelion motion caused by perturbations from other planets, chiefly Venus and Jupiter). The difference in size between the shifts is partly due to the orbital speed in the binary pulsar, which is almost five times greater than Mercury's, and partly due to the pulsar performing about 250 times more orbits a year than Mercury. The orbiting time of the binary pulsar is less than eight hours, which can be compared with the one month our moon takes to orbit the earth.

A very important property of the new pulsar is that its pulse period, the time between two beacon sweeps (0.05903 sec) has proved to be extremely stable, as opposed to what applies to many other pulsars. The pulsar's pulse period increases by less than 5% during 1 million years. This means that the pulsar can be used as a clock which for precision can compete with the best atomic clocks. This is a very useful feature when studying the characteristics of the system.

The very stable pulse period is in fact a mean of the pulse period observed on earth over the time of one orbit of the pulsar system. The observed period actually varies by several tens of microseconds, i.e. by an amount that is much greater than the variation in the mean value. This is a Doppler effect, and led to the conclusion that the observed pulsar moves in a periodic orbit, meaning that it must have a companion. As the pulsar approaches the earth, the pulses reach the earth more frequently; as it recedes they arrive less frequently. From the variation in pulse period, conclusions can be drawn about the pulsar's speed in its orbit and other important features of the system.

Demonstration of gravitational waves

A very important observation was made when the system had been followed for some years. This followed theoretical predictions made shortly after the original discovery of the pulsar. It was found that the orbit period is declining: the two astronomical bodies are rotating faster and faster about each other in an increasingly tight orbit. The change is very small. It corresponds to a reduction of the orbit period by about 75 millionth of a second per year, but, through observation over sufficient time, it is nevertheless fully measurable. This change was presumed to occur because the system is emitting energy in the form of gravitational waves in accordance with what Einstein in 1916 predicted should happen to masses moving relatively to each other. According to the latest data, the theoretically calculated value from the relativity theory agrees to within about one half of a percent with the observed value. The first report of this effect was made by Taylor and co-workers at the end of 1978, four years after the discovery of the binary pulsar was reported.

The good agreement between the observed value and the theoretically calculated value of the orbital path can be seen as an indirect proof of the existence of gravitational waves. We will probably have to wait until next century for a direct demonstration of their existence. Many long-term projects have been started for making direct observations of gravitational waves impinging upon the earth. The radiation emitted by the binary pulsar is too weak to be observed on the earth with existing techniques. However, perhaps the violent perturbations of matter that take place when the two astronomical bodies in a binary star (or a binary pulsar) approach each other so closely that they fall into each other may give rise to gravitational waves that could be observed here. It is also hoped to be able to observe many other violent events in the universe. Gravitational wave astronomy is the latest, as yet unproven, branch of observational astronomy, where neutrino astronomy is the most direct predecessor. Gravitational wave astronomy would then be the first observational technique for which the basic principle was first tested in an astrophysical context. All earlier observational techniques in astronomy have been based on physical phenomena which first became known in a terrestrial connection. ♦

ICTP/TWAS Donation Programme Gets Considerable Cooperation from Institutions in the South

H.R. Dalafi
Liaison and Donation Programme Officer
ICTP

The ICTP/TWAS Donation Programme which was initiated some years ago with the aim of providing universities in developing countries with books, journals and proceedings in the fields of physics and mathematics, and later chemistry and biology, continues to distribute this literature with up to 40,000 volumes sent every year to libraries and institutions in 100 developing countries.

In recent years, in spite of the fact that such a large amount of material was sent, the donations and the continuous help from such sources as the American Institute of Physics, the American Physiological Society, the Elsevier Science Publishers, Editions Frontières, ICSU, International Union of Pure and Applied Physics, the Royal Society and the World Scientific Publishing Company, to mention but a few, has seen our warehouse accumulate somewhere in the order of 170,000 volumes. We would like the institutes in developing countries to receive this material in a relatively short time.

Therefore, earlier this year, due to our limited funds, we started out with the idea of making larger consignments of books to each library; thus saving on transportation costs. We contacted various institutes in developing

countries, offering them up to 1500 books, and proceedings, on the understanding that they would cover the shipping costs. A good many agreed to pay and they were all very anxious to cooperate with us. We will continue in this effort towards assisting more and more institutes in this way.

Encouraged by this response, we also sought the cooperation of embassies, national airlines, and shipping companies for the transportation problem. Once more the reaction was outstanding. Almost all the companies we spoke to, found some way of offering us free transportation, either by air (national carriers), or by sea.

Many airlines, such as Air Algérie, Biman Airlines of Bangladesh, Cuban Airlines, Air India, PIA, the Pakistani Airlines, Thai Airlines, are willing to offer free transportation or discounted rates. Also shipping companies are very cooperative; the Companhia Paulista de Comércio Marítimo of São Pãulo, Brazil, has offered us a whole container free! The Turkish Cargo Lines of Istanbul, Turkey, have also offered free transportation, along with others. As this method seems very fruitful we intend to continue in this direction to secure the cooperation of transportation companies in the future. Any cooperation from the institutes themselves, to get in touch with their own national airlines or shipping companies for this purpose would be a welcome effort.

In order to facilitate the redistribution of the literature in each single country, and due to the fact that in most cases the airlines or shipping companies reach only one or two international airports or only a few ports, we have written to some institutes in these key cities to deal with the formalities of retrieving the material and sending it to other universities in their own country, which are not in direct contact with international routes of transportation. We have in fact already contacted the Scientific and Technical Research Council of Turkey who are willing to act as a redistribution point, through the Marmara Research Centre, and pay for the local transportation expenses. We have also had a similar offer from India. The University Grants Commission has offered to redistribute the material to other institutions in the country. Similar offers have come from Brazil and Algeria. In this sense it would be extremely helpful and very efficient if we could establish a continuous cooperation with one institute in each country to act as the focal point of redistribution.

As we continue to receive donations from publishing companies and other sources in the industrialised world, we will be in a position to go further in our task of helping more and more institutes in developing countries and with their cooperation as well, we will be able to distribute the literature in the most efficient way possible.

We have been helped in our job of automating the Donation Programme with a very generous contribution made by UNESCO. With the computerisation of the Programme it will be possible to keep an updated track of all the material sent to the developing countries and all the material arriving in Trieste.

The ICTP/TWAS Donation Programme is also part of the International Network of the Availability of Scientific Publications (INASP). This is an organisation supported also by UNESCO and the European Community working under the aegis of ICSU Press. It is a network of donors and representatives of recipient institutions.

We would like to thank all those institutions, organisations companies and individuals who have collaborated with our Donation Programme and we hope that others will join us to make the Donation Programme even more successful. ♦

International Centre for Science and High Technology (ICS)

After 20 years of existence, in 1984, the training and research activities at ICTP expanded so much as to cover all branches of physics and mathematics. During that phase, it was clear that we had to include also experimental and applied physics in our programmes.

The first practical demonstrations and experimental activities with the involvement of the participants of the ICTP activities were organized in 1985 on the occasion of a course on microprocessors and a college on lasers. The interest shown by the participants was so strong that it was decided to set up laboratories in order to offer training opportunities to the participants of several other courses.

In 1985, Professor Abdus Salam, Director of the International Centre for Theoretical Physics (ICTP) and President of the Third World Academy of Sciences (TWAS), proposed, to the Italian Government, to support a project aimed at establishing three new international institutes on the model and with the purposes of ICTP, with a stronger orientation towards applied sciences and technologies.

They are:

- International Institute for High Technology and New Materials (IITM)
- International Institute for Pure and Applied Chemistry (IIC)
- International Institute for Earth, Environmental and Marine Sciences and Technologies (IIEM)

which are the components of the International Centre for Science and High Technology (ICS). The proposal was accepted and the ICS became a UNIDO Project sponsored by the Italian Government.

In order to identify the scientific strategy and the main research and training lines of the ICS institutions, international steering committees for each of the three institutes were appointed. The Committees were able to give the general suggestions, while the first pilot activities started in 1989, in cooperation with ICTP.

In 1990 the first official conference was organized entirely by ICS: "Conference on Lasers in Chemistry". This was followed by an intensive programme of conferences and

workshops within the three institutes.

Activities

The activities of ICS are made up of several components: research, training, networks and advisory services.

The programme of activities of ICS is designed in accordance with the recommendations made by the Steering Committees during the Feasibility Study phase and in close collaboration with the International Centre for Theoretical Physics, at least in the disciplines which are dealt with in both institutions.

The training programmes jointly organized by ICS and ICTP, for instance, reflect the main orientation of the two Centres: emphasis on the fundamental point of view of the phenomena at ICTP and focus on applications at ICS. In a course on lasers, for example, there are lectures on the fundamentals of lasers, on holography and Fourier optics, etc., but there are also lectures on optical data storage, on optical communication systems, on fibre technology and others which are the necessary basis not only for the practical exercises of the course but also for the participants wishing to join the Photonics Laboratory for a research period.

Another point taken into consideration in the elaboration of the programme is its coherence and its synergy both in research and in training, within each institute and within ICS as a whole. This affinity serves a dual purpose: on one hand, courses offer ICS research leaders possibilities for identifying suitable candidates for research in the institutes and trainees in the laboratories to widen their background through attendance in the courses and workshops, and, on the other hand, participants in the training programmes do have an opportunity to visit the ICS laboratories and decide whether these meet their necessities.

It should also be noted that the research lines have many facets. Catalysis, for instance, is important from the industrial point of view but it is also intimately related to environment issues like automotive emission control, which is the province of IIEM, to the synthesis of pharmaceuticals which is a competence of medicinal chemistry — another research line of IIC — and even to the Composite Materials (IITM) Laboratory where a new material for catalyst support is being developed.

Last but not least, synergy between environment, chemistry and high technology is operating in a context of very high economic interest.

Research

Research is carried out in all three Institutes throughout the year under the guidance of full university professors. Trainees from developing countries working in the laboratories are given an opportunity to execute projects which have a relevance to the needs of their countries of origin and to get acquainted with scientific instrumentation and techniques which will be of benefit not only to themselves but also to the institutions where they come from. The projects undertaken by the trainees may vary in scope and in duration depending on the nature of the problems they are addressed to. Some may last from six to twelve months or even longer while others are designed for a duration of a few months only. As a rule, trainees already have some research experience and an M.Sc. degree. In practice, the majority of them have obtained their Ph.D.

Training for Research

In addition to the training done in the laboratories through participants in the research projects, ICS organizes: courses at the post-doctoral level (they last several weeks); hands-on experiments and computer work are emphasized whenever relevant; workshops lasting for a few weeks for small groups to work on well-defined projects; conferences on topical subjects.

Network of Affiliated Research

Network of Affiliated Research Centres

All research lines have already set up collaboration links with many research institutions in the developing countries. ICS is in the process of creating a network with ten to fifteen institutions of excellence already operating in the developing countries which will be named Affiliated Research Centres. These Centres will serve as institutions which can undertake training programmes. They will also conduct joint research projects with ICS with joint financial support.

Advisory Services

For institutions in developing countries which need them, ICS will provide free advisory services like training specialists of computer centres and instrumentation technicians.

The Scientific Staff

Each Institute of the ICS is envisaged to include:

- a core Scientific Staff employed on a long-term basis, part-time consultants from the University of Trieste and from other Italian or foreign institutions;
- Associates or distinguished scientists from developing countries who have the opportunity of paying three research visits to ICS in six years, each lasting a maximum of three months;
- Research Fellows appointed for periods ranging from six months to two years;
- Trainees appointed for relatively long periods.

Statistical data

Ninety-five countries were represented, last year, in the ICS programmes: seventy-five from the developing world and twenty from the industrialized areas.

Altogether, 1005 scientists took part in the research and training activities for a total of 854 person/months, with an overall average duration of stay at ICS of 0.85 months or 26 days. While this average was of the order of 18 days or 3 weeks approximately in the training activity, it reached 6.5 months in the research component.

Scientists from developing countries account for 63% and 65% of the total participants expressed in number of persons attending and in person/months, respectively.

It should be noted that the majority of scientists from the industrialized countries are lecturers or course directors in the training activities. Participants from the same group of countries are not financially supported by the ICS. ___ ♦

Statistical Data on Activities at ICTP in 1992

The following tables deal with all activities combined, therefore they show the *actual* number of visitors, i.e. those scientists who participated in more than one activity are counted only once.

Summary of Participation

Table 1.a
1992 vs. 1991

	Visitors		Person/months (P/M)		Total		Percentage (Dev. vs. total)	
	Dev.	Adv.	Dev.	Adv.	Visitors	P/M	Visitors	P/M
1992	1885	1700	3136.82	1053.49	3585	4190.31	52.58	74.86
1991	2066	1918	3162.77	1059.11	3984	4221.88	51.86	74.91
1992 vs. 1991 Increase/ Decrease	-9.60%	-12.82%	-0.83%	-0.53%	-11.13%	-0.75%		
The above figures for **1992** include:								
Outside activities	107	4	684.09	0.26	111	684.35	96.40	99.96
Co-sponsored activities	2	14	0.26	1.70	16	1.96	12.50	13.27
The above figures for **1991** include:								
Outside activities	124	3	724.10	1.41	127	725.51	97.64	99.81
Co-sponsored activities	23	112	19.64	56.25	135	75.89	17.04	82.96

Table 1.b
Participation by geographical area

Table 1.b
Participation by geographical area

in the research and training-for-research activities of the ICTP from 1 January to 31 December 1992

Geographical area	Visitors		Person/months		Total for Area	
	Dev.	Adv.	Dev.	Adv.	Visitors	P/Months
Africa	254	1	465.76	0.23	255	466.01
Asia	799	51	1527.94	35.36	850	1563.30
Europe	497	1185	647.27	603.38	1682	1250.65
Indonesia and Oceania	6	4	6.64	2.63	10	9.27
North and Central America	73	355	90.57	259.55	428	350.12
South America	256	–	398.64	–	256	398.64
International Organizations	–	104	–	152.34	104	152.34
TOTAL	**1885**	**1700**	**3136.82**	**1053.49**	**3585**	**4190.31**
% Developing vs. Total					**52.58**	**74.86**

Breakdown of the number of scientists January to 31 December 1992 and of person/months by scientific field

Previous tables show that the total number of scientists who came to the ICTP is 3585 while the total number of person/months is 4190.31. In the tables which follow the number of scientists will be higher since several of them took part in more than one activity (visits).

Table 2.a shows a summary of the breakdown while Table 2.b shows the details. Percentages refer to the total participation in the field vs. the grand total.

Table 2.a
Breakdown by field of activity

Activity	Number of Visits				Number of P/months			
	Dev.	Adv.	Total	%	Dev.	Adv.	Total	%
1. Fundamental Physics	357	367	724	16.76	512.61	379.49	892.10	21.29
2. Condensed Matter	665	539	1204	27.88	770.35	249.82	1020.17	24.35
3. Mathematics	360	244	604	13.98	424.34	180.89	605.23	14.44
4. Physics & Energy	92	62	154	3.57	100.58	27.49	128.07	3.06
5. Physics & Environment	203	135	338	7.83	117.31	50.18	167.49	4.00
6. Living State	232	153	385	8.91	143.13	42.51	185.64	4.43
7. Applied Physics	213	110	323	7.48	258.83	68.16	326.99	7.80
8. Adriatico Conferences	82	230	312	7.22	24.02	38.80	62.82	1.50
9. Miscellaneous	90	58	148	3.43	101.30	14.19	115.49	2.76
Total	2294	1898	4192	97.06	2452.47	1051.53	3504.00	83.63
Outside activities	107	4	111	2.57	684.09	0.26	684.35	16.33
Co-sponsored activities	2	14	16	0.37	0.26	1.70	1.96	0.05
GRAND TOTAL	**2403**	**1916**	**4319**		**3136.82**	**1053.49**	**4190.31**	

Hosted activities

1. Convegno Nazionale "Continente Europa: Formazione e Professione", 18-19 January.

1. Convegno Nazionale "Continente Europa: Formazione e Professione", 18-19 January.
2. UNESCO-TWAS Business Session, 23 January.
3. Scuola INFN di studi avanzati in fisica nucleare e subnucleare, 15-21 March.
4. Theoretical Course on Research and Biotechnology Applications to the Problems Related to Development, 23 March-10 April.
5. European Advanced School on Structural Geology and Tectonics, 23 March-11 April.
6. Theoretical Course on RNA Structure and Function, 8-10 April.
7. Theoretical Course on Yeast Molecular Genetics, 12-15 April.
8. Convegno "Leibniz e la Questione della Soggettività", 11-14 May.
9. International Summer School of Theoretical Geodesy, 25 May-5 June.
10. Meeting of the Interim Executive Committee of the Third World Organization for Women in Science (TWOWS), 25-27 September.
11. IITM-ICS "Advanced Workshop on Whiskers and Particles", 5-9 October.
12. Meeting on Perception, 28-30 October.
13. IIC-ICS Second Workshop on Catalyst Design, 10-14 November.
14. First Annual Users Meeting–Sincrotrone Trieste, 23-24 November.

Table 2.b
Activities held at and outside the ICTP

Figures on research include long- and short-term scientists as well as Associate Members, some scientists from Federated Institutes and seminar lecturers.

Activity	Number of Visits			Number of Person/months		
	Dev.	Adv.	Total	Dev.	Adv.	Total
1. At the ICTP						
(a) Research:						
Fundamental Physics	109	90	199	214.18	205.84	420.02
Condensed Matter	127	32	159	222.97	57.92	280.89
Mathematics	98	28	126	260.22	90.92	351.14
Plasma Physics	12	6	18	35.27	7.88	43.15
Microprocessors Lab.	8	5	13	30.26	22.78	53.04
High T_c Superc. Lab.	12	5	17	38.44	13.68	52.12
Laser Lab.	11	24	35	26.90	2.79	29.69
Atmospheric Physics and Radioprop. Lab.	12	1	13	15.69	0.43	16.12
Science, High Tech. & Dev.	2	8	10	5.39	2.40	7.79
Other	70	17	87	93.45	8.01	101.46
Total	461	216	677	942.77	412.65	1355.42
% Total vs. Grand Total	19.18	11.27	15.67	30.05	39.17	32.35
(b) Training for Research (Courses, Workshops and Conferences)						
Total	1833	1682	3515	1509.70	638.88	2148.58
% Total vs. Grand Total	76.28	87.79	81.38	48.13	60.64	51.27
2. Outside activities						
Italian Laboratories	107	4	111	684.09	0.26	684.35
% Total vs. Grand Total	4.45	0.21	2.57	21.81	0.02	16.33
3. Co-sponsored activities						
Pacem in Maribus XX	2	14	16	0.26	1.70	1.96
% Total vs. Grand Total	0.08	0.73	0.37	0.01	0.16	0.05
GRAND TOTAL	**2403**	**1916**	**4319**	**3136.82**	**1053.49**	**4190.31**

Table 2.c
Participation in the research and training-for-research activities

Activity (short titles)	Dates 1 Jan/31 Dec.	No. of Visits Dev.	Adv.	Total	No. of Person/months Dev.	Adv.	Total
Fundamental Physics							
High Energy-Astrophysics/Research	All year	109	90	199	214.18	205.84	420.02
Diploma High Energy/Course*	1 Jan–30 Sep	11	9	20	68.34	47.34	115.68
String Theory/ School-Workshop	30 Mar–10 Apr	28	83	111	13.84	27.22	41.06
New Elementary Particles /Workshop	20–22 May	11	30	41	1.10	4.07	5.17
High Energy and Cosmology/School	15 Jun–31 Jul	145	96	241	163.51	63.62	227.13
Diploma High Energy/Course*	1 Oct–31 Dec	12	7	19	36.33	20.04	56.37
Phenomenology/Conference	19–23 Oct	41	52	93	15.31	11.36	26.67
TOTAL		**357**	**367**	**724**	**512.61**	**379.49**	**892.10**
% vs. Grand Total				16.76			21.29
Condensed Matter, Atomic and Molecular Physics							
Solide State/Research	All year	127	32	159	222.97	57.92	280.89
Diploma Condensed Matter/Course*	1 Jan–30 Sep	15	12	27	86.90	5.09	91.99
Atom-Radiation/Workshop	24 Feb–6 Mar	44	28	72	19.12	6.21	25.33
Superconductivity/College and HTS Advanced Activities	27Apr–19 Jun	85	47	132	128.88	31.60	160.48
7th Semiconductor/Symposium	8-12 Jun	9	133	142	4.21	26.53	30.74
Electron Systems IV/Miniworkshop	15 Jun–10 Jul	25	42	67	12.27	17.08	29.35
Condensed Matter/Workshop and 25th Anniv. Symp. in Cond. Matter	22 Jun–31 Aug	208	93	301	199.40	53.50	252.90
Non-Linearity/Miniworkshop	13–24 Jul	18	30	48	7.54	8.65	16.19
Electronic Structure/Miniworkshop	10–21 Aug	41	28	69	20.85	9.39	30.24
Quantum Field Theory/Course	24 –31 Aug	45	60	105	20.04	23.42	43.46
Chemical Evolution/Conference	26–30 Oct	34	32	66	6.96	6.15	13.11
Diploma Condensed Matter/Course*	1 Oct–31 Dec	14	2	16	41.21	4.28	45.49
TOTAL		**665**	**539**	**1204**	**770.35**	**249.82**	**1020.17**
% vs. Grand Total				27.88			24.35
Mathematics							
Mathematics/Research	All year	98	28	126	260.22	90.92	351.14
Dynamical Systems/School	25 May–5 Jun	54	39	93	25.70	16.81	42.51
Dynamical Systems/School	25 May–5 Jun	54	39	93	25.70	16.81	42.51
Dynamical Systems/Workshop	8–19 Jun	63	42	105	31.45	16.15	47.60
Algebraic Geometry/Adv. Workshop	31 Aug–11 Sep	75	63	138	44.91	26.70	71.61
Commutative Algebra/Workshop	14–25 Sep	58	69	127	32.40	23.64	56.04
Diploma Mathematics/Course*	1 Oct–31 Dec	12	3	15	29.66	6.67	36.33
TOTAL		**360**	**244**	**604**	**424.34**	**180.89**	**605.23**
% vs. Grand Total				13.98			14.44
Physics and Energy							
Plasma Physics/Research	All year	12	6	18	35.27	7.88	43.15
Nuclear Energy/Workshop	10 Feb–13 Mar	39	25	64	44.38	12.59	56.97
Energy Systems Dev./Workshop	21 Apr–8 May	41	31	72	20.93	7.02	27.95
TOTAL		**92**	**62**	**154**	**100.58**	**27.49**	**128.07**
% vs. Grand Total				3.57			3.06

* Figures refer to the Statistical year (Jan./Dec.) and not to the Academic Year.

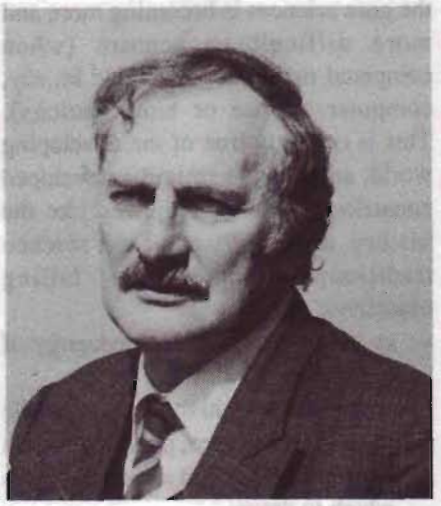
Continued

Activity (short titles)	Dates 1 Jan/31 Dec	No. of Visits Dev.	Adv.	Total	No. of Person/months Dev.	Adv.	Total
Physics and Environment							
Earthquake Project	7 May–31 Dec	3	4	7	2.52	5.50	8.02
Cyclones Studies/Workshop	18–22 May	25	15	40	5.65	2.96	8.61
Climate Variability/Workshop	17–21 Aug	16	20	36	5.71	4.00	9.71
Atmosphere System	26 Oct–6 Nov	59	16	75	26.46	5.02	31.48
Atmospheric Phys. and Radiop. Lab.	1 Sep–31 Dec	12	1	13	15.69	0.43	16.12
Mathematical Ecology	2–20 Nov	56	45	101	45.42	17.83	63.25
Seismic Waves	30 Nov–11 Dec	32	34	66	15.86	14.44	30.30
TOTAL		**203**	**135**	**338**	**117.31**	**50.18**	**167.49**
% vs. Grand Total				7.83			4.00
Physics of the Living State							
Neurophysics/College	2–27 Mar	39	28	67	34.86	9.61	44.47
Medical Physics/College	31 Aug–18 Sep	62	27	89	43.71	11.56	55.27
Medicine and Biology/Conference	21–25 Sep	70	78	148	11.64	12.55	24.19
Biophysics/College	28 Sep–23 Oct	61	20	81	52.92	8.79	61.71
TOTAL		**232**	**153**	**385**	**143.13**	**42.51**	**185.64**
% vs. Grand Total				8.91			4.43
Applied Physics and High Technology							
Microprocessors Lab/Research	All year	8	3	13	30.26	22.78	53.04
HTS Experimental Lab/Research	All year	12	5	17	38.44	13.68	52.12
Laser Lab/Research	All year	11	24	35	26.90	2.79	26.69
Lasers and Optical Fibers/College	27 Jan–21 Feb	70	37	107	62.96	10.81	73.77
Computer Network/Workshop	30 Mar–18 Apr	58	28	86	48.52	11.23	59.75
Microprocessor/College	5–30 Oct	54	11	65	51.75	6.87	58.62
TOTAL		**213**	**108**	**323**	**258.83**	**68.16**	**2326.99**
% vs. Grand Total				7.48			7.80
Adriatico Research Conferences							
Polarization Dynamics	7–10 Jan	10	59	69	2.51	11.46	13.97
Clusters & Fullerenes	23–26 Jun	22	79	101	5.39	13.98	19.37
Wrinkling of Surfaces	21–24 Jul	26	40	66	6.05	4.14	10.19
Synergetics	4–7 Aug	7	19	26	2.90	2.80	5.70
Hydrogen Atoms	18–21 Aug	17	33	50	7.17	6.42	13.59
TOTAL		**82**	**230**	**312**	**24.02**	**38.80**	**62.82**
% vs. Grand Total				7.22			1.50
Miscellaneous							
Miscellaneous/Research	All year	70	17	87	93.45	8.01	101.46
Science, High Tech. and Develop.	All year	2	8	10	5.39	2.40	7.79
Economic Development/Meeting	22–24 Apr	18	33	51	2.46	3.78	6.24
TOTAL		**90**	**58**	**148**	**101.30**	**14.19**	**115.49**
% vs. Grand Total				3.43			2.76

Continued

Activity (short titles)	Dates 1 Jan/31 Dec	No. of Visits Dev.	Adv.	Total	No. of Person/months Dev.	Adv.	Total
Outside activities							
Training and Research at Italian Labs.	All year	107	4	111	684.09	0.26	684.35
TOTAL		**107**	**4**	**111**	**684.09**	**0.26**	**684.35**
% vs. Grand Total				2.57			16.33
Co-sponsored activities							
Pacem in Maribus XX/Prep. Workshop	10–12 Sep	2	14	16	0.26	1.70	1.96
TOTAL		**2**	**14**	**16**	**0.26**	**1.70**	**1.96**
% vs. Grand Total				0.37			0.05
GRAND TOTAL		**2403**	**1916**	**4319**	**3136.82**	**1053.49**	**4190.31**

Award to Professor Luciano Fonda



Professor Luciano Fonda, a consultant of the ICTP, has been awarded the 1993 "San Giusto d'oro" prize. Every year, the journalists from Trieste reward in this way a fellow citizen who has made Trieste famous both at the national and international level. This year, they unanimously chose to award the prestigious prize to the promoter of the "ELETTRA" synchrotron light machine. "By choosing Prof. Fonda, the Triestino journalists mean to reward Trieste City of Science", read the communiqué from the local press. The award had already been awarded to eminent local scientists — among them, Prof. Paolo Budinich, former Deputy Director of the ICTP.

Prof. Luciano Fonda was born in Trieste on 12 December 1931. He obtained his degree in physics with honors at the local university in 1955. He worked in the United States as a Research Associate in Bloomington (Indiana), Rochester (New York), and at the Institute for Advanced Study in Princeton (New Jersey) upon invitation by Robert Oppenheimer. He became Professor and then Full Professor of theoretical physics at the University of Trieste in 1960 and 1963, respectively.

He keeps close contacts with his colleagues in the US, through research and teaching periods at the universities of California (Irvine, Los Angeles, Santa Barbara, CalTech), in Bloomington, Cincinnati, and at the laboratories in Berkeley, Brookhaven and Stanford with a special aim at promoting the "ELETTRA" synchrotron machine of Trieste.

Prof. Fonda is the author of about a hundred articles on elementary particle, nuclear, atomic and molecular physics which have been published in journals of international repute. He has written also many papers on synchrotron light for the public at large.

He directed the UNESCO-IAEA-INFN Advanced School of Physics from 1965 to 1980, and has directed the Inter-University Consortium of Physics Institutes since 1980, and the Scientific Division of the company "Sincrotrone Trieste" since 1987.

Although Prof. Fonda is a theoretical physicist, he has been one of the first advocates for building a synchrotron light machine in Trieste. To this end, he contacted many internationally-known scientific and non-scientific personalities ever since 1970s.

Currently, Prof. Fonda is Vice-President of the company "Sincrotrone Trieste". Prof. Carlo Rubbia himself (Nobel Laureate 1984) proposed him for the post.

The presentation ceremony of the "San Giusto d'oro" award shall take place, as is customary, in the City Council Hall of Trieste in December.

The prize is named after the patron saint of Trieste. ♦

Where the History of Science Informs Science Policy: An Indian *Fin-de-siècle* Scenario on the "New Knowledge" and Development

by Dhruv Raina,
National Institute of Science, Technology and Development Studies,
New Delhi, India.

This is the summary text of a lecture delivered at the International Centre for Theoretical Physics, Trieste, on 13th May 1993. The lecture is based on the following papers: Dhruv Raina, S. Irfan Habib, "The Unfolding of an Engagement. The Dawn on Science, Technical Education and Industrialization: India 1896-1912", Studies in History, Jan.-June 1993; and Dhruv Raina, S. Irfan Habib: "Institutional Proliferation Embodying Bhadralok Perceptions of Science, Technology and Cultural Nationalism: The NCE/BNC-SPTE/IBTI Divide (1905-1912)", NISTADS Preprint-HPSS/920820.

The distinctions between science and technology becoming increasingly blurred, it would appear that the community of scientific researchers should not be facing the kind of legitimation crisis it is facing today: particularly when money for research in the pure sciences is becoming more and more difficult to acquire (when compared to funding available in, say, computer science or biotechnology). This is certainly true of the developing world, and may be so in the developed countries as well. Disciplines like the history and philosophy of science traditionally served the falling objectives:

- as heuristic aids in the pedagogy of science teaching,
- fulfilling a cognitive role within the practice of sciences, providing both a lineage of ideas and a resource upon which to draw,
- contributed at the cultural level inasmuch as they located the history of science within the broader history of ideas.

In the present context such disciplines may acquire another kind of significance. This has to do with historical and philosophical inquiry into science, or historical inquiry in the philosophical mode, that could inform contemporary issues of science policy and planning by disclosing the affinities and elisions characterizing discourses on science and technology.

As the French philosopher of science, Gaston Bachelard once pointed out, the history of science, as different from other kinds of history, given the nature of scientific knowledge, will have to be written afresh in every age. In the process he stands our conception of history on its head, for the perspective on history stands reversed: the present now guides the past, and not as conventionally understood, the other way around.

We are presently witnessing processes at the global level that partially eclipse the Enlightenment ideal (and we hope only temporarily), which in developing country contexts calls into question the on going processes of modernization as well as development. Are the models of technological development and industrialization adopted in the developing world commensurate with the goals of these civilizations and cultures ? We shall take up of an important discussion organized at the turn of the century among a small community of Western-educated Bengali thinkers in India, from whose ranks would spring forth the future generations of Indian scientists and institute builders. The period we have chosen is important, in that 1870-1914, could well be considered the beginning of India's graduation into the age of modernity. The discourse characterizing this community is relevant since it raises issues on modern scientific and technological knowledge, as well as industrialization at a time when questions of opting for a particular model were being discussed. These issues continue to be burning issues in India, and have acquired urgency in the post-1970s period, which policy experts consider the crisis in developmentalism period. Such historical investigations are thus undertaken with an end in mind, that of revealing unresolved problematics concealed under accumulated experience, overlooked by time, either on account of the immediacy of politics, or on account of the inability to act on resolutions in the past.

In India the years 1890-1920 are years of heated debate on industrial policy, and naturally matters of industrial policy would also be related to the bank of technologies and technological skills available in a society. And while the imperial government was weighing these issues, a group of Indian intellectuals was attempting to visualize a future scenario for the industrial development of India and the transformation of the social base of this society. From the perspective of the sociology of science, a discipline that has grown with the growth of scientific institutions, funding for science and technology, and the exponential expansion of scientific knowledge, it is absolutely essential to distinguish between the self-image of a community and its practices: while they may symbiotically shape each other, they are also in many ways distinct. A point that Andrew Pickering makes in his book, *Constructing Quarks*: that the scientist's account of his work is not the account of his work.

This distance separating the discourse from the discursive practice, while at important points appearing to be in conjunction, could be observed, in the exchanges of this group between 1896 and 1905. In 1906 they commenced setting up institutes to give flesh to their vision. And here it is possible to reveal, *post facto* naturally — and as is often done in history, the limitations within the discourse and how this was manifest in the institutions they set up. Disciplines like the sociology of science make it their business to gauge the distance separating the self-image from the practice, for it is in this interregnum that the complexity of social processes and historicity make themselves manifest.

This story begins in *fin-de-siècle* Calcutta: the Bengal of the period 1890-

1915. The forty years 1870-1910, as mentioned earlier could be considered the years of India's reckoning with the age of modernity, the years when India embarked slowly but gradually on processes of modernization — putting it rather loosely, this could well mark a phase transition. In this milieu, there is building up in India resistance to British rule, there is a mobilization of thinkers within the freedom struggle. And here we would like to take a look at how members of the Bengali Bhadralok community (Western educated Bengali professional class) constructed a world premised on the ideology of science. As is well known, the origins of modern scientific research in India are traceable back to Calcutta: it is here that scientific research traditions came to be founded and subsequently dispersed throughout the country.

In the last decade of the nineteenth century, Satish Chandra Mukherjee set up a journal called *The Dawn Magazine*, and which in 1902 was upgraded into *The Dawn Society Magazine*. This journal served as the forum for *cultural redefinition* in the light of the burgeoning freedom struggle. Every body who was anybody in the cultural constellation of Bengal during these years wrote in the journal. There are three distinct phases in the history of the journal. The first phase spans the years 1896-1902. The articles during these years predominantly reflect the Bengali fascination with the notion of history, and its relation to culture. History, as the political theorist Sudipto Kaviraj informs us, at this time, is imbued with a dual significance, being both the name of hope as well as that of despair. In a sense then these years are witness to the recreation of a modern cultural consciousness in opposition to the colonial definition of Indian culture. The second phase extends from 1902 to 1907. These are the years when the deliberations on history and culture, having reached a point 3 of saturation, now guides interest to the domain of social action. Focus now shifts to India's natural resource endowment, to the rich tradition of artisanal skills, the slowly eroding handloom and textile industries in the face of the onslaught of mass-produced goods. And it is at this juncture that the discussion immediately shifts to that of technical education and pedagogy. This could well be the *assimilative phase* of the discourse: assessing what should be kept alive from the past and what should be assimilated from the traditions of the West. And finally the last phase covers the years 1907 to 1913. In this phase, both the logic of the evolution of ideas as well as political contingencies co-produce a discourse of science, technology and culture interwoven with that of politics. It is the commencement of the full-fledged political phase of the nationalist struggle: in other words the discourse on historical consciousness is substantially transformed in to a *theory of political action*, via a politico-economic understanding of colonialism.

Without going into the details of the debate, we shall summarize some of the essential features that are representative of their thinking on science, technical education and the sort of model of industrialization that they wished to opt for. The group as a whole hardly questioned the relevance of scientific and technological knowledge in the Indian environment. A fundamental postulate, contested in today's context, was then taken as axiomatically given, namely that science and technology are important agents of social and economic development. Presently, with years of exposure to developmental philosophies, we naturally are forced into asking as to how processes related to the generation of scientific knowledge and technological artifacts, intermesh with the cultural, social and other spheres of a nation's life cycle.

Commencing with this axiom they then had to contend with exigencies as historical subjects, which in effect meant recognizing that scientific knowledge activates different sorts of processes in different environments. This entailed the domestication of this *knowledge form* in the Indian environment. The uneasiness with the Western model of industrialization found voice in the critique of the reigning paradigm of industrialism. They were two essential features of this critique. One was the conjunction with the Victorian repulsion concerning industrialization. This repulsion arose from the perception of the dehumanization that seems to have been ushered by the new lifestyles engendered by industrial life in the cities. The processes of industrialization had also produced the squalor, congestion and the pollution of cities, so aptly narrated in the literature of the nineteenth-century Dickensian underworld. And finally, in terms of technology itself, the mass-produced commodity appeared to have ushered in a new era of the depersonalized artefact, where the artefact was divested of the signature of the producer of the artefact. In addition to this Victorian critique, was a nationalist one, and this had to do with the finding that Western industrialism was highly insensitive to the artisanal base of the country, and that it was ushering in a programme in which the artisan conceived as the country's capital was being further immiserized. And secondly, it was also felt that in the process such large-scale production was unsuited to India's civilizational charter — that such large-scale production, distribution and consumption of goods did not mesh with the nation's trajectory of development, or if it did it would disturb the system sufficiently.

There were two essential ways out of the deadlock. One *institutional* and the other *paradigmatic*. The institutional changes suggested required a greater deal of intervention from the state. As has been suggested by historians of economic thought, if the nineteenth century was one of *laissez-faire* economics, the twentieth century was one of state intervention or state protection of the interests of finance capital. The *Dawn* interlocutors suggested that to begin with it was essential that technical institutes be set up that would upgrade the skills of Indian artisans in the light of developments of modern technology, so that they could be brought into the mainstream of industrialization, as well as exposed to the products of the markets abroad and in India. These institutes could be set up by the state, as had been done in the native states of India or through public donations. However, it was duty of the state nevertheless, to set up two kinds of institutions in order to be able to

moderate a more benign and profitable industrial environment. The first had to do with establishing a system of commercial intelligence, that would keep the manufacturer informed of trends in the market as well as to suggest which products would go down well with which set of consumers. In addition the state was requested to institute fiscal measures that would pull the artisan out of his state of misery. It was in the state's own interests to do so, for a neglect of the artisans state, it was felt could in turn create an insurrectionary situation as Europe had witnessed earlier.

At the paradigmatic level, there appeared to have been three options to chose from. One was the already reigning paradigm of Western industrialism. Counterposed to this was the Tolstoyan vision of some sort of pastoral Utopia, the ideal of autarchic self-sustaining communities. The Gandhian ideal was close to, but yet different from this, in so far as it visualized the entire edifice of Indian society to be built from these self-sustaining units. But what our interlocutors were talking about was of a third alternative. And this alternative considered the possibility of deploying scientific and technological knowledge to work at scales smaller than those at which large-scale technologies were seen to be profitable with the then prevalent model of industrialization. It postulated that there existed lower scales of production where technological knowledge could be deployed to produce economies of scale. This in turn would also require a different kind of regime of skills, wherein it would be possible to locate the Indian artisan, with his upgraded knowledge, at the centre of the industrialization process.

As the debate proceeded, certain historical contingencies accelerated the rate at which our interlocutors were forced into creating the institutions where they would give concrete form to the developmental scenario they were working out. To mention some of these contingencies: the first was the production of a large intellectual proletariat who were finding it difficult to obtain a niche within the imperial dispensation; and secondly the partition of Bengal was to come as a major blow to the notion of Bengali self-hood. In addition to stoking the raging nationalist movement in several modes, it also gave rise to the founding of an alternate pedagogic movement, founded in 1906 and called the National Council of Education. Those involved in the founding of the movement belonged to the cream of Bengal's cultural renaissance. Other than Satish Chandra Mukherjee, there was Aurobindo Ghosh before his seditionary writing landed him in prison, Rabindranath Tagore — the poet laureate, Radha Kumud Mukherjee — the sociologist, Benoy Kumar Sarkar — sociologist, and leading physicists and chemists of the time, P.C.Ray — the founder of the tradition of modern chemistry in India, J.C.Bose — the physicist, P.N.Bose — the geologist and instrumental in the founding of the Tata Iron and Steel Works, Ramendra Trivedi and others.

Already one could see the emergence of a certain kind of professionalization. When the matter of founding an institution came up, this community was split down the line. At stake were different conceptions of scientific and technical education. Those with a liberal arts background, felt that what was essential was to instil a sense of nationalism and consciousness of Indian civilization in the students if science and the processes of industrialization were to be domesticated to the needs of Indian civilization. On the other hand, those trained in the sciences, and the few engineers who happened to be present in the debate, felt that the task of technical capability building did not necessitate a background in the liberal arts. They saw the task as proceeding directly to the sciences, and spending as much time exposing the students to as much of science and technology during the course schedule.

These contesting viewpoints saw realization thus in the split of the group and the founding of two separate centers. There followed four years of what is now referred to as *Kultur Kampf*; at the end of which the two sides decided to patch up, and come under the umbrella of the National Council of Education. But, however, they retained their distinction to reconfigure their pedagogic in contradistinction to that of the Calcutta University. Leading scientists like J.C.Bose and P.C.Ray, in those years, while still employed by the Calcutta University, maintained a clandestine relation with the newly-founded institutes — in fact playing an important role in shaping their future. By the mid-1920s, the institutes set up by the Council came to be amalgamated under one university, today known as Jadavpur University.

However, from the point of view of policy, as well as contemporary concerns: the resolution of the differences between the two camps, and the answers sought to the fundamental problems they had raised are rather tame. In fact, on such a fundamental issue of distinct technological or industrial alternatives, it appears an important opportunity was missed. In nineteenth-century Europe, both the capitalists as well as the Marxists appear to have shared a frame of industrialization. The distinct concern that the Marxists raised was, who would own the means of production. But, say, on an issue such as Taylorism, their views were not very distinct. Amongst our Indian interlocutors, as amongst the Owenites in industrial England, the possibility of another alternative was discussed. Nevertheless, the immediacy of political intervention in nationalist struggle, and a number of push factors from India's newly emerging industrial class, appears to have sealed both the fate of the debate, and in the process decided the principal frame for the industrialization of India for the next six decades. ♦

Conferences and Lectures

Prof. S.J. Abbasi from Karachi, a Post-doctoral student in the ICTP Mathematics Research Group, was invited to present the talk "Matrix near-rings" at the Mathematics Institute of Johannes Kepler Universität in Linz, Austria, on 6 October 1993. ♦

Activities at ICTP in September-October

Title: RESEARCH WORKSHOP ON CONDENSED MATTER PHYSICS, 21 June – 3 September.

Organizers: Professors A. Aronov (A.F. Ioffe Physical-Technical Institute, Academy of Science, St. Petersburg, Russia), G. Baskaran (Institute of Mathematical Sciences, Madras, India), E. Burstein (University of Pennsylvania, Philadelphia, USA), P.N. Butcher (University of Warwick, Coventry, UK), H. Cerdeira (Universidade Estadual de Campinas, UNICAMP, Campinas, Brazil, and ICTP), F. Garcia-Moliner (Instituto de Ciencias de Materiales, Madrid, Spain), F. Gautier (Université Louis Pasteur, Strasbourg, France), V. Kumar (Indira Gandhi Centre for Atomic Research, Kalpakkam, India, and ICTP), A. Levi (Università di Genova, Italy), S. Lundqvist (Chalmers University of Technology, Gothenburg, Sweden, and ICTP), Chi Wei Lung (Institute of Metal Research, Academia Sinica, Shenyang, P.R. China), N.H. March (University of Oxford, UK), A. Mookerjee (S.N. Bose National Centre for Basic Sciences, Calcutta, India), F.S. Persico (Università di Palermo, Italy), E. Tosatti (International School for Advanced Studies, SISSA, Trieste, Italy, and ICTP), M.P. Tosi (Scuola Normale Superiore, Pisa, Italy) and Yu Lu (Academia Sinica, Beijing, P.R. China, and ICTP).

Plenary Seminars: The heavy

Plenary Seminars: The heavy fermion enigma. Molecular pump: active transport. Exact diagonalization calculations of spectral weight functions. Gauge properties of the interactions of charged particles with surface electronic excitations. Interplay of self-similarity and local symmetry on the vibrational dynamics of a Vicsek fractal. Electrons in contact with stochastic baths. Melting at the surface of ice. Topological magnetic solitons in the two-dimensional Mott-Hubbard gap. Communications at single quantum level. Preferred path migration of alkali ions and mixed alkali effect. AC conductivity and dielectric function in complex metallic systems. Fluctuations in quantum chaos: preliminary results. Quantum statistical effects in electron and photon transport in small wave guides. Stochastic systems and quantum spin models: jamming, non-ergodicity and slow dynamics. Nonlocal, nonequilibrium and contact properties in quantum Hall effect. Structure instability and superconductivity in high T_c cuprates. Surprising elasticity: materials with negative Poisson's ratio. Photoinduced carriers in insulating cuprates: Fermi-glass state, metal-insulator transition and superconductivity. Quantum statistical effects in electron and photon transport in small wave guides.

Group Activities:

Nonlinear dynamics: Micro-workshop on nonlinear dynamics. Wavelength doubling bifurcations in spatio-temporal systems. Topological quantum numbers in chaotic systems.

Classical and quantum liquids: Plasmon damping in a two-dimensional electron gas. Hartree-Fock method posed as a density-functional theory.

Correlated electron systems: Field theory of a frustrated Heisenberg antiferromagnet.

Strongly correlated electron systems: Hole in a quantum antiferromagnet. Anomalous behaviour of $U = \infty$ Hubbard model. Gauge theory of normal state transport of the flux finding phase in the t-J model. Evaluation of quantum partition function in the Hubbard model.

Semiconductor physics: Polaron localization versus Mott-Hubbard transition at GaAs (110) with alkali-metal adsorbates. Electron-phonon interaction in Al As/Ga As quantum wells. Linear Boltzmann equation without linearization. Dynamic fractional stark ladder in time-periodic electric fields. Nonlinear optical properties of CuCl and CdSSe quantum dots. Valence band structure in superlattice with δ-like potential.

Electronic structure: Oxygen ordering in $YbA_2Cu_3O_{6+x}$. Fermi surface studies of Li-Mg alloys. Electronic structure of random alloys — some outstanding problems. Short ranged order in alloys (group discussion). Superconductivity in the disordered Hubbard model. Hierarchical structure of the electronic localization for 1D quasilattices. Study of hydrogen, oxygen and nitrogen bonding in a-Si by FTIR and thermal effusion spectroscopies. Rigorous approach to the construction of pseudopotential from crystalline environment.

Defects of mechanical properties: Analytical solution to a model meant to explain jump in creeps. On the propagation of helicons in interfaces. Surface segregation of hydrogen isotopes in transition metal hydrides. Dynamic strain ageing (DSA) and grain boundaries — some interesting results of Hall-Petch analysis in DSA regime. Interatomic potentials for the computer simulation of defects in metals.

Highlight activity on "Scattering from surfaces" (5–16 July):

Lectures: Introduction to atom-surface scattering. Introduction to electron-surface scattering. Microscopic mechanisms of desorption induced by electronic transitions, or how to squeeze atoms out of a solid surface. Real space Green's functions method applied to surface problems.

Informal Seminars: Ab-initio surface calculations. Experimental results. Optical properties of surfaces: molecular dynamics surface simulations. Interplay of reconstruction and roughening.

Working Group on atom-radiation interaction" (20 July – 10 August):

Lectures: Fundamentals of atomic dynamics in intense laser fields. Introduction and overview of intense field laser-atom interaction physics. Multiphonon processes, higher order perturbation theory, diagrammatic method. Strongly perturbed quantum systems in laser fields above threshold systems in laser fields, above threshold ionization and detachment (ATI ATD), the Volkov-solution and the KFR model. The Floquet theory; ionization and stability in intense fields. Threshold structures; inverse Bremsstrahlung and 'capture-escape' resonances, multi-harmonic emission.

Working party of small semiconductor structures (2–13 August):

Lectures: Resonant tunneling through a double-barrier structure: the effects of electron-phonon interaction, magnetic field, high-frequency AC bias and electron-electron interaction. Magnetotunneling and chaos. Optical

non-linearities in n-i-p-i doping superlattices. Dielectric response of the inhomogeneous quasi-2D electron gas. Impurity bands in two-dimensional systems. Non-equilibrium persistent current in a ballistic quantum dot. Electronic structure of semiconductor superlattices. Polar optical modes in semiconductor heterostructures. Acoustic mode confinement within low-dimensional electron gas due to electron-phonon interactions. On the possibility of spontaneous currents in mesoscopic systems. Excitons in low-dimensional systems. Stochastic approach to the theory of shot noises in double barrier resonant tunneling structures. Optical spectroscopy of type I and type II superlattices. Modulation doped heterostructures. Quenching of the integer quantum Hall effect in an electron wave guide. Magnetotransport in thin films and strips. Shallow impurity states in GaAs-(Ga,Al)As quantum wells and quantum-well-wires. The total absorption of infra-red radiation in a thin slab of small metallic particles. Frequency dependent current partition. Theory of mesoscopic semiconductor-superconductor interfaces. Universality in the random-matrix theory of quantum transport. Nonideal contacts in ballistic transport and quantum Hall effect — microscopic model for a metal/2DEG contact. Disorder-induced flicker noise in resonant-tunneling structures. Transient effects and the tunneling time problem. Single impurity in a ballistic microjunction. Finite-frequency shot noises in a correlated tunneling current. Persistent current of a Wigner crystal-ring. Mesoscopic fluctuations in the shot noise power of metals. Bistability, traversal time and shot noise in DBRTS and 1D random structures. Electric field effects on finite length superlattices. Electromagnetic absorption of mesoscopic rings. ac-conductance of a quantum wire with an electron-phonon interaction (effects from the longitudinal inhomogeneity). Ferroelectric phase transitions in molecular-like array of quantum dots.

Round Table: Small semiconductor structures: state-of-the-art and perspectives.

Highlight activity on "Magnetic multilayers" (9–13 August):

Lectures: Magnetic metallic multilayers. Magnetic domains in ultra-thin films: an overview. Interfacial and interlayer magnetic coupling in metallic superlattices. Experimental observation of interlayer exchange coupling in Co/Cu, Fe/Cr and Fe/Mn. Theory of interlayer exchange coupling. Theoretical description of transport in magnetic multilayers. Magnetic domains in ultra-thin films: the role of anisotropies. Electronic properties of random magnetic surfaces. Segregation effects on the magnetic properties of bimetallic multilayers. The magnetoresistance in exchange biased permalloy/Cu/permalloy systems. Theory of negative magnetoresistance in magnetic metallic multilayers.

During the first week (21–25 June), the participants in the Research Workshop attended the lectures of the Miniworkshop on strongly correlated electron systems V and of the Adriatico Research Conference on "Strong correlation phenomena at low carrier densities".

The Workshop was attended by 254 lecturers and participants (180 from developing countries).

Title: WORKSHOP ON MATERIALS SCIENCE AND PHYSICS OF NON-CONVENTIONAL ENERGY SOURCES, 30 August – 17 September.

Organizers: Professors G. Furlan (University of Trieste and ICTP, Italy), C.G. Granqvist (Chalmers University of Technology, Gothenburg, and Uppsala University, Sweden), D. Nobili (Istituto di chimica e tecnologia dei materiali e dei componenti per l'elettronica, LAMEL-CNR, Bologna, Italy) and A. Sayigh (University of Reading, UK).

Lectures: Transparent insulation materials for active and passive solar energy applications. Principles of P.V. materials and devices. Recent progress of amorphous silicon solar cells: device physics and technology. Module design and testing. Status and future of photovoltaic technologies. High efficiency solar cells with concentration. Standard evaluation of photovoltaic performance: cells and modules. Activities on alternative P.V. materials and devices at the Portici (Italy) Research Center. P.V. systems simulation. Calibration of reference cells. Optics of solar cells and batteries. Surface coatings with spectral and angular-dependent selectivity. Passive and low energy cooling systems. Field monitoring of P.V. generators: an overview of the European Solar Test Installation. Chromogenic thin films for energy-efficient windows. Combined P.V. and thermal solar design. Energy education. Energy for a sustainable world. The technology P.V. issue for industrial applications. Advances in materials for P.V. conversion. The DELPHOS Project: results and developments. Environmental and health effects of different energy systems. The Stuttgart Centre for Solar and Hydrogen Research (ZSW). P.V. systems. An overview of passive uses of solar energy. Power conditioning in large grid-connected P.V. installations. Egyptian-Italian Renewable Energy Project in the South-West desert in Egypt. Wind energy: national programmes and international perspectives. Electricity production by the P.V. source. Overview of the ENEL (Italy) activities in renewable energies. System sizing. Perspectives for renewable energies in Romania. Metal grid failures in microelectronic devices. P.V. perspective of a-Ge:H. Solar village. Batteries. Fuel cells: present status and future perspectives. Fuel cells R&D and applications: world programmes. Adsorptive refrigeration. Perspectives on agricultural biomass production. Solar hydrogen: why, potential, when? Photoelectrochemical energy conversion and storage. An overview of passive uses of solar energy.

Seminar and discussion sessions. National programmes.

Field trip to Helios Technology National programmes.

Field trip to Helios Technology (Padua, Italy). Visit to the Trieste Research Area (science park).

The Workshop was attended by 123 lecturers and participants (95 from developing countries).

Title: COURSE ON GEOMETRIC PHASES, 6 – 17 September.

Organizers: Professors M. Berry (University of Bristol, UK) and H. Cerdeira (Universidade Estadual de Campinas, UNICAMP, Campinas, Brazil, and ICTP).

Lectures: Introductory lectures: some geometric phases. Optical manifestations of the geometric phase:

theory and experiment. The geometric phase in molecular systems. Classical holonomy geometry. Anyons. The Kubo formula as a topological invariant. Topological phases and fractional statistics. Hierarchy theory of the fractional quantum Hall effect. Geometry of Hilbert space and quantum reality. NMR, with lots of quanta. The 'fractional exclusion principle' in the fractional quantum Hall effect. Gauge kinematics of self-propulsions: the geometry of swimming and diving. Classical and quantum anholonomy and chaos. Berry's phases and fractional statistics? Post-mortem on anyon superconductivity. Gauge kinematics of spins and cats. From ICOSAHEDRA to SQUIDS.

Short communications: Berry's phase in conducting rings. Fractional spin in a group theoretical context. Phase space geometry and phase space path integrals. Many anyon wave functions on a plane. Asymptotic Berry phase for flows on 3-manifolds. On the geodesic rule in filtering measurements. Geometrical phase and dynamical symmetries of quantum systems. Non-zero curvature in elementary classical mechanics. On geometric phase for mixed states. Geometric phases in resonance systems and laser models. Geometric phase for all quantum evolution and other geometric structures. Topological phase and the quantum Hall effect. Semi-classical born Oppenheimer approximation in the hyperspherical adiabatic channel approach for helium doubly excited states. Geometric phases and Mielnik's evolution loops. The optical Berry phase and the Gauss-Bonnet theorem. Energy levels and three optical Berry phase and the Gauss-Bonnet theorem. Energy levels and three anyons in an harmonic potential.

The Course was attended by 56 lecturers and participants (28 from developing countries).

Title: COLLEGE ON SOIL PHYSICS, 6 – 24 September.

Organizers: Professors D.M. Gabriels (State University of Ghent, Belgium), GC. Ghirardi (University of Trieste and ICTP, Italy), D.R. Nielsen (University of California, Davis, CA, USA), I. Pla Sentis (Universidad Central de Venezuela, Maracay, Venezuela) and E.L. Skidmore (U.S. Department of Agriculture, Kansas State University, Manhattan, Kansas, USA).

Lectures: Soils of the world. Soil composition, aggregation, porosity. Soil structure degradation. Soil surface sealing and crusting. Water erosion. Revised universal soil loss equation. Hydrodynamic dispersion of a solution in porous media. Monitoring of soil moisture through microwave remote sensing. Modification of soil structure under different fallow systems in the moist savanna zone of Nigeria. Modelling study of the soil-atmosphere-vegetation coupled system. Wind erosion. Soil conservation. Soil water determinations. Soil water potential. Nuclear techniques in soil physics studies. Water balance. Soil salinity. Salt and water balance in irrigated soils. Soil temperature. Heat transfer in soils. Effect of tillage and nitrogen levels on the yield attributes and yield of rain-fed rice. Equipment for soil moisture measure using microwave attenuation technique. Application of SLEMSA and USLE erosion models for potential erosion hazard mapping in South-Eastern Nigeria. Changes in soil bulk density and total porosity following conversion of rain forest into tree plantations. Calibration of field methodology to evaluate soil physical constraints. Effects of erosion on soil properties and crop yields in Venezuelan Andean soils — Influence of top soil removal, manure and fertilizer applications. Some aspects of using microcomputer systems for estimation of soil-plant-atmosphere properties in the field. Soil moisture studies in Jordan. Soil physics problems in Peru. Influence of cattle trampling on soil porosity under alternative dry and ponded conditions. Sustaining crop soil porosity under alternative dry and ponded conditions. Sustaining crop production and soil productivity under intensive cropping in the Central Hills of Nepal. Concepts of soil hydrology — pores to landscape scales. Flow of water in soils (steady state). Solute and water movement (observations and theory; theory and applications). Concepts of spatial variability (field observations). Influence of the acacia on the physical and chemical properties under the experimental plantation of plateau of Kinzono. Experimental and modelling studies on the process of land-surface evaporation as it relates to soil moisture. Water movement across plant bed and water use of Chinese cabbage *(brassica campestris L. ssp. pekinensis)*. Flow of water in soils (unsteady state) — The 'key' of boundary conditions. Water use by maize. Assessment of soil-conditioning capacity of tree gums via hydraulic conductivity measurements. Infiltration — Neuman boundary conditions versus Dirichlet boundary conditions. Redistribution and evaporation — Applications in the field. Spatially analyzing soils and crops. Integrating field concepts. A new beginning.

Presentations by participants.

Excursion to Grotta Gigante (Trieste).

The College was attended by 50 lecturers and participants (47 from developing countries).

Title: SECOND WORKSHOP ON COMPOSITE MEDIA AND HOMOGENIZATION, 20 September – 1 October.

Co-sponsored by The International School for Advanced Studies (SISSA, Trieste, Italy), Interdisciplinary Laboratory (SISSA), EEC Project "EUR Homogenization", CNR (Italian National Research Council) Project "Irregular Variational Problems".

Organizers: Professors G. Dal Maso (SISSA) and G.F. Dell'Antonio (Università "La Sapienza", Rome, Italy).

Lectures: BMO fields and bounds for nonlinear composite response. Relaxation for certain optimal control problems and application to shape optimization. Homogenization of a spectral problem arising in fluid-solid structures. Homogenization and polyconvexity. Composite media with a periodic microstructure: a new calculational method and some new periodic microstructure: a new calculational method and some new physical phenomena in magneto-transport and optical bistability. Relaxation of a general optimal design problem: reducing to minimization of the sum of energies. Lavrentiev phenomenon and homogenization for some variational problems. Homogenization on BV for integral functionals with linear growth defined on vector-valued functions. Continuum percolation models. Homeopathic cylinders: strange behaviour at the boundary of ellipticity. Composite materials with imperfect interface. Homogenization in locally periodic perforated domains. Homogenization of the Laplace equations in a partially

perforated domain. H^1-estimate of oscillating functions. Using asymptotic methods and homogenization to study scattering of an electromagnetic wave by a body coated with a composite medium. Limits of strongly nonlinear problems. Existence, uniqueness homogenization and correctors of renormalized solutions of elliptic equations. Control in thermoelasticity. Homogenization of stratified structures with low and high conductivity inclusions. Asymptotic behaviour of a frame-type antenna. Homogenization of nonlinear parabolic boundary value problems in perforated domains. Variational principles for the media with complex moduli. The homogenization of the Stokes equation in random porous media. On the relation between Young measures and H-measures, and application to bounds of effective coefficients. Alternative geometries in homogenization. On the prediction of extremal material properties for the optimal design of topology, shape and material. Low concentration limit for the Dirichlet homogenization problem. Propagation of waves in periodic and random elastic media with small compressibility. Modelling of chemical processes in porous media on micro- and macro-scales. On propagation of waves in periodic and random media with small viscosity and small heat conductivity. A relaxation approach to Hencky's plasticity. Some estimates for homogenization error for second order operators with random coefficients. Some issues on magnetostriction. Shape memory polycrystals. A saddle point theorem with application to problems in optimal structural design. G-convergence of nonlinear elliptic operators with varying domain of definition. Second order elliptic equations with rapidly alternating boundary conditions. Direct relaxation of material layout problems. On homogenization problems for second order elliptic equations in a partially perforated domain.

EURHomogenization Meeting.

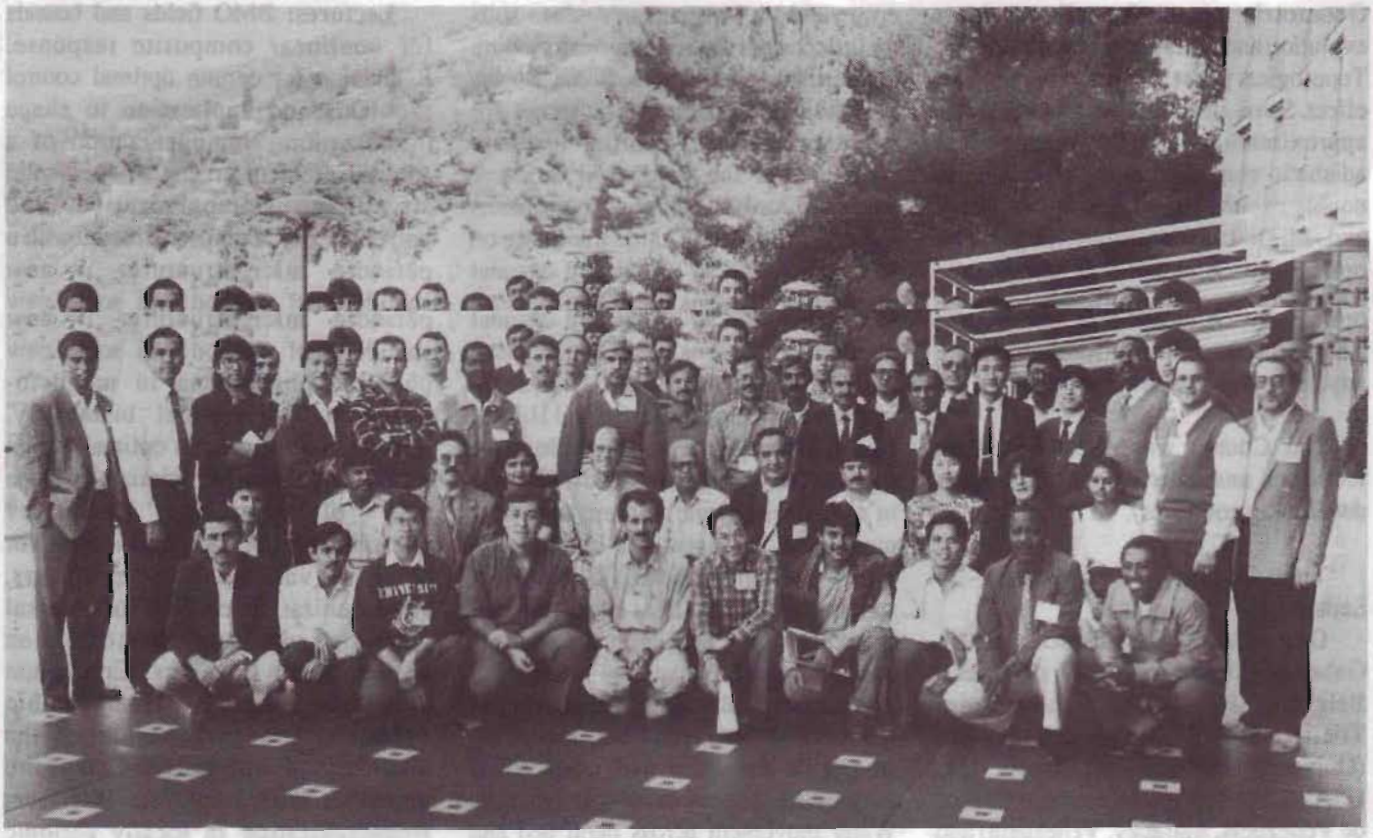
The Workshop was attended by 114 lecturers and participants (45 from developing countries).

Title: WORKSHOP ON TELEMATICS, 27 September – 22 October.

Sponsored by Direzione generale per la cooperazione allo sviluppo (Ministry of Foreign Affairs, Rome, Italy).

Organizer: Professor M.V. Pitke (Tata Institute of Fundamental Research, Bombay, India).

Lectures: Basic telephony. Telecom switching. Practical switching architecture. Computer networks. Packet switching. Data communication principles. Digital signal processing. Optical fibre communication. Satellite network project. Computer vision. High speed switching. Telematics services. Campus networks. Protocol engineering. VLSI design. Signaling system 7. Photonic switching architecture. Development of telematics technology. Intelligent network. Rural communications — issues and options. B-ISDN technology. Multiple access techniques. Multimedia in telecom networks. Speech recognition technology. Communication software engineering. Voice servers in public networks. Satellite networks. Multiple access techniques for mobile radio systems. Overview of cordless and cellular systems. Fixed channel allocation and outage probability evaluation in cellular mobile radio systems. Real-time design. Parallel computers for applications.



Workshop on telematics, 27 September – 22 October.

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

Programming with C++. From narrow band to broad band ISDN-strategic analysis. Involving high speed data networks towards B-ISDN. Message handling systems. Multi-network services. System design implementation techniques.

Laboratory sessions.

Visit to the ICTP Microprocessor Laboratory and Laser and Optical Fibres Laboratory.

The Workshop was attended by 73 lecturers and participants (60 from developing countries).

The Workshop was attended by 73 lecturers and participants (60 from developing countries).

Title: CONFERENCE ON THE ORIGIN OF LIFE (in honour of Prof. C. Ponnamperuma), 25 – 29 October.

Co-sponsors: International Centre for Science and High Technology (ICS), Commission of the European Communities, and UNESCO.

Organizers: Professors C. Ponnamperuma (University of Maryland at College Park, USA), and J. Chela-Flores (Instituto Internacional de Estudios Avanzados, Caracas, Venezuela, and ICTP).

Opening Ceremony: Presentations by representatives of sponsoring agencies. Award of a plaque to Prof. C. Ponnamperuma. Comments on research on chemical evolution in India, Mexico, Japan and P.R. China.

Lectures: Comets as "sowers" of prebiotic molecules in the galaxy. Role of nitrites and other reactive molecules in chemical evolution. Formation of amino acid precursors by cosmic radiation in primitive terrestrial and extraterrestrial environments. Hydrogen cyanide polymers: prebiotic agents for the origin and self-organization of proteins and nucleic acids. A plausible route for the synthesis of bio-organic compounds in the primitive Earth form mineral salts — an overview. Energy, matter and self-organization in the early molecular evolution of bioenergetic systems. Exploring errors and spatial self-structuring in mathematical models of early stages in the origin of life. Computational support for origins of life research. On attempts to create life-mimicking cells. Some evolutionary aspects of biochemistry polyphosphates. Membrane phase separations, asymmetry, and implications in the origin of life. Co-evolution of peptides and nucleic acids via self-assembly into inter-helical structures. General crystals in prebiotic context. Self-organization and polymerization in biological macromolecules and symmetry breakdown. Archaebacteria: key organisms for the study of the early evolution of life. RNA: genotype and phenotype. Gradual rise of cellular translation. Molecular relics from chemical evolution and the origin of life. Aspects of ecopoiesis. Unexpected in vitro intron splicing of common bean chloroplast trnL(UAA) gene and pseudogene by T7 RNA polymerase. Fluorescence imaging of replicating RNA in capillaries. On Dyson's model of the origin of life and possible experimental verification. Randomness, determinism, thermodynamics, and evolution. Role of information processing in the evolution of complex life forms. The initiation of biological processes on Earth: summary of empirical evidence.

The Conference was attended by 69 lecturers and participants (23 from developing countries). ♦

Getting Information on ICTP Activities via Computers

Information on the various ICTP activities throughout the year can be retrieved via electronic mail or using the Internet Gopher. The procedure is as follows.

Using Electronic Mail

(1) Scientific Program of ICTP Activities

The complete Scientific Program can be obtained by sending an e-mail to

smr@ictp.trieste.it

using as `Subject:` **`get calendar`**

Note: The Scientific Program is constantly updated. So, please check the issue date.

To each activity listed in the Scientific Program there is an assigned **smr-*number*** from which you can obtain more detailed information, when available.

(2) Information on a specific ICTP activity

To receive a list with the names of documents available for a particular activity, you should first identify the `smr###` code as indicated above. Then send an e-mail to

smr###@ictp.trieste.it

using as `Subject:` **`get index`**

If you send another mail to

smr###@ictp.trieste.it

using as `Subject:` **`get`** *`document_name`* (e.g., **announcement**, etc.)

you will receive detailed information on the topic *`document_name`*

Note: If you wish more than one document of an activity then use

`Subject:` **`get`** *`doc1 doc2`*... etc.

Using Internet Gopher

The ICTP Gopher server (*hostname:* `gopher.ictp.trieste.it`) allows you to explore, search and retrieve general information regarding the many scientific activities carried out at ICTP. It is also possible to obtain information on the in-house scientific publications, diploma courses, scientists present at ICTP as well as the services offered by the

- ICS-International Centre for Science and High Technology and
- TWAS-Third World Academy of Sciences.
- TWAS-Third World Academy of Sciences.

When issuing the **`gopher`** command, you will be connected automatically to your default local Gopher server. Then it is possible to access the Gopher space by exploring the branch *"Other Gopher servers in the world"* pointing to the geographical region: `Europe→Italy→ICTP`.

To access directly to the ICTP server, you can issue the command:

`gopher gopher.ictp.trieste.it`

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For further information please write to
SCS-Scientific Computing Section, International Centre for Theoretical Physics,
P.O. Box 586, 34100 Trieste, Italy
or send e-mail to: **admin@ictp.trieste.it**

Calendar of Activities at ICTP

1993

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

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

Second Workshop on non-linear dynamics and earthquake prediction ..... 22 November – 10 December

1994

SMR

751 Follow-up to the Workshop on preparation of radiomaritime master plans for English-speaking African countries ..... 7-18 February

752 Winter College on quantum optics ..... 14 February – 4 March

753 Workshop on study of atmospheric interactions by remote sensing ..... 21 February – 4 March

755 Workshop on fluid mechanics ..... 7 – 25 March

754 Workshop on science and technology of thin films ..... 7 – 25 March

803 Training Course on dosimetry and dose reduction techniques in diagnostic radiology ..... 16 – 25 March

756 Spring School and Workshop on string theory, gauge theory and quantum gravity ..... 11 – 22 April

757 Workshop on nuclear reactors — physics, design and safety ..... 11 April – 13 May

758 Spring College on quantum phases ..... 3 May – 10 June

759 International Monsoon Conference ..... 9 – 13 May

761 Workshop on commutative algebra and its relation to combinatorics and computer algebra ..... 16 – 27 May

760 College on atmospheric boundary layer and air pollution modelling ..... 16 May – 3 June

762 Summer School in high energy physics and cosmology ..... 13 June – 29 July

including

Workshop on perspectives in theoretical and experimental particle physics ..... 7 – 8 July

Workshop on strings, gravity and related topics ..... 28 – 29 July

764 Research Workshop on condensed matter physics ..... 13 June – 19 August

766 Workshop on submicron quantum dynamics ..... 13 June – 1 July

765 Quantum transport in nanostructures (Adriatico Research Conference) ..... 20 – 24 June

767 Miniworkshop on strong correlations and quantum critical phenomena ..... 4 – 22 July

768 Cooperative phenomena in many-electron systems and their response to external fields (Adriatico Research Conference) ..... 26 – 29 July

769	Workshop on: non-linear electromagnetic interactions in semiconductors	1 – 10 August
806	Lasers in surface science (Adriatico Research Conference)	9 – 12 August
770	Advanced Workshop on algebraic geometry	15 – 26 August
771	Conference on the structure and model of the first cell	29 August – 2 September
773	College on medical physics: Radiation protection and imaging techniques	5 – 23 September
772	International Workshop on parallel processing and its applications in physics, chemistry and materials science	5 – 23 September
775	College in biophysics: experimental and theoretical aspects of biomolecules	26 September – 14 October
774	Third College on microprocessor-based real-time control — principles and applications in physics	26 September – 21 October
777	3rd Trieste Conference on recent developments in the phenomenology of particle physics	3 – 7 October
779	Workshop on variational and local methods in the study of Hamiltonian systems	10 – 28 October
750	College on physics of archaeometry and preservation of work of art	17 – 28 October
780	Fourth Autumn Course on mathematical ecology	24 October – 11 November
781	Suivi de l'atelier sur la préparation des plans directeurs radio-maritimes pour les pays africains francophones	31 October – 11 November
782	Second Workshop on three-dimensional modelling of seismic waves generation, propagation and their inversion	7 – 18 November
783	International Conference on mathematical ecology	14 – 18 November
749	5th Training College on physics and applications of lasers and optical fibres	21 November – 9 December
748	ICTP-UNU-Microprocessor Lab: Third Course on basic VLSI techniques	21 November – 16 December
804	Ultrafast phenomena and applications (Adriatico Research Conference)	6 – 9 December

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

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