The International Centre for Theoretical Physics - Physics and the Developing Countries

by A. Hamende

Introduction

One of the chief needs of working scientists is contact with their peers for criticism and intellectual stimulation. In advanced countries with well-established and closely connected universities, adequately funded research programmes, ample libraries and quick communications this need can easily be met In developing countries where these elements are often lacking it cannot, with the result that scientists are isolated in their work, cut off from the main stream of ideas. One consequence of this is the movement of scientists from developing to advanced countries, the "brain drain".

It was largely to help remedy this situation that the International Centre for Theoretical Physics was established in 1964. To some, the connection may be obscure and a natural question would be "Why theoretical physics? " The answer to this question was well phrased by a committee of renowned scientists reviewing the work of the ICTP:

1. "Theoretical physics does not need an extensive infrastructure or expensive equipment. Pens and paper and quick access to the scientific literature are all the tools it requires."
2. "In most of these developing countries, the communities of men with advanced competence in theoretical physics and applicable mathematics are likely to remain very small in the foreseeable future. But these groups of men — some dozens of them — are a national capital of extreme importance. These are the men who set the teaching standards and also advise the Governments and the society in highly technological fields "
3. "In fundamental physics there is a close relation between theory and experiment ... Theory provides a unifying point of view for the whole of physics, for many other sciences and for many branches of engineering ... Many branches of modern engineering — the whole of electrical, electronics and telecommunications engineering, the whole of nuclear engineering — originated from new ideas in fundamental physics. Even industries that started out in a more empirical way (thermal engines, aeronautics) are now highly dependent on theoretical analysis."
4. "Theoretical physicists have shown again and again that their discipline, their being trained in the highest realms of theory, enables them to deal with a large variety of problems ... Nobel prizes for economics and medicine were awarded to Tinbergen and Delbruck, who both started as theoretical physicists ..."

Mr. Hamende is a staff member of the International Centre for Theoretical Physics in Trieste, Italy.

5. "... all countries will learn to recognize the impact of high-level theoretical competence, whereas neglect of the really advanced domains will lead to mediocrity also in these fields that are more obviously needed today."

Objectives and Scope of Work

Although the Centre aims in general to further the development of physics and to a lesser extent, the related subject of applicable mathematics, it has four specific objectives:

- to encourage the growth of advanced studies in the physical and mathematical sciences, especially in the developing countries;
- to provide a forum where scientists from all countries can meet and make personal contacts among their peers;
- to help train young scientists from developing countries for research;
- to conduct original research.

The Centre's activities deal with a range of topics covering broad aspects of physics:

Physics and the frontiers of knowledge
Physics and energy
Physics and technology
Physics of the environment and of natural resources
Applicable mathematics and planning models
Physics teaching.

This range reflects the deliberate intention of dealing with contemporary problems of science and society from a multidisciplinary point of view. All the Centre's work is carried out at the post-doctoral level.

In order to make a contribution towards the further development of physics and applicable mathematics as well as to be of greatest benefit to scientists from developing countries, the Centre maintains the highest academic standards. It is able to attract scientists who are acknowledged leaders in their fields to participate in its work. The intermingling of scientists from both developing countries and the most advanced institutions has resulted in some highly fruitful collaboration.

The Programme

The ICTP directs its efforts along four main lines:

(a) **Associate Members** are selected from among distinguished scientists working and living in developing countries. They are normally entitled to spend from six weeks to three months at the Centre at times of their own choosing, three times in a period of six years. Their fare to Trieste and their living expenses are met by the Centre.

(b) **Federation Agreements** are in place between the Centre and a number of institutions in developing countries. Such an agreement allows an institution to send physicists to the Centre for a total of 40 to 120 man-days per year

(c) **Courses, Workshops and Seminars** are held at Trieste throughout the year. The 1978 and 1979 schedules are typical of work in recent years.

1978: Physics and the Frontiers of Knowledge:

Sixth Trieste Conference on Particle Physics (Topical Meeting)
Fourth Colloquium on High Resolution Spectrometry (Topical Meeting)
High Energy Physics Research (Throughout the year).

Physics and Energy:

Nuclear Physics and Reactors:
Part I — Nuclear Theory for Applications
Part II — Reactor Theory and Power Reactors (Extended Course)
Few-Body Problems in Nuclear Physics (Workshop)
Recent Progress in Many-Body Theories (Topical Meeting)
Drift Waves in High Temperature Plasmas (Workshop)
First Seminar on Solar Energy Storage: Thermal Storage (Extended Seminar)
Séminaire sur l'Energie Solaire (Extended Course in French)

Physics and Technology:

Physics of Modern Materials (Extended Course)
Classical Fluids (Symposium)
Electromagnetic Phenomena near Metal Surfaces (Topical Meeting)
Second Latin-American Workshop on Self-Consistent Theories of Condensed Matter
Condensed Matter Physics (Workshop)
Solid State Physics Research (Throughout the year).

Applicable Mathematics and Planning Models:

Mathematical Economics (Extended Course)
Systems Analysis: Theory, Methods and Applications (Extended Course)
Recent Advances in Differential Equations (Topical Meeting)

1979: Physics and the Frontiers of Knowledge:

Second Marcel Grossmann Meeting on the Recent Developments of General Relativity (Topical Meeting)
Theoretical Physics (Workshop)
Solitons, Partial Differential Equations and Spectral Methods (Workshop)
High Energy Physics Research (Throughout the year)

Physics and Energy:

Non-Conventional Energy (Extended Course)
Plasma Physics (Extended Course)

Physics and Technology:

Atomic and Molecular Physics and Quantum Optics (Extended Course)
Condensed Matter Physics (Workshop)
Core and Surface Processes in Condensed Matter (Topical Meeting)
Solid State Physics Research (Throughout the year)

Applicable Mathematics and Planning Models:

Recent Advances on the Theory of Evolution Equations (Workshop)

(d) The ICTP also participates in a number of **regional activities.**

During 1978, for example, the Centre contributed to the:

Third International Summer School on Physics and Contemporary Needs, Pakistan
International Symposium-Workshop on Solar Energy, Egypt
Fifth Course on Solar Energy Conversion, Canada
International Meeting on the Frontiers of Physics, Singapore
First National Summer School in Physics, Indonesia.

Additional activities will be hosted at the Centre in 1979 and various outside activities will be co-sponsored.

Operation and Administration

The job of designing and carrying out the Centre's programmes rests on Prof. Salam and the Centre's small permanent scientific staff. A hard-working support staff (also small) makes maximum use for scientific activities of the limited funds available. Considerable accomplishments can be attributed to the Centre's staff, accomplishments that have been praised by the Directors-General of both sponsoring organizations, the IAEA and UNESCO.

Scientific guidance is given to the Centre's work through the Scientific Council and eight Advisory Committees. At present, the members of the Scientific Council are:

Professor A Kastler, Ecole Normale Supérieure, Paris, France (**Chairman** of the Scientific Council);
Professor A R. Kaddoura, Assistant Director General for Science, UNESCO;
Professor V. Latorre, Universidad Nacional de Ingeniería, Lima, Peru;
Professor Malu wa Kalenga, National Atomic Energy Commission, Kinshasa, Zaire;
Academician M.A. Markov, Academy of Sciences of the USSR, Moscow;
Professor B D. Nagchaudhuri, Jawaharlal Nehru University, New Delhi, India;
Professor M.N. Rosenbluth, Institute for Advances Study, Princeton, USA;
Professor J.M Ziman, University of Bristol, UK.

In the past, members of the Council have included Professors A. Bohr, B.B. Kadomtsev, D.S. Kothari, R.E. Marshak, A. Matveev, R. Oppenheimer, M Sandoval Vallarta, V Soloviev, L.Van Hove, V. Weisskopf, and H. Yukawa.

The eight Advisory Committees deal with the subjects of astrophysics; atomic physics; geophysics and environment; seismology; applicable mathematics and mathematical physics; plasma physics; nuclear physics; and physics of condensed matter.

The Centre receives the bulk of its funds from three sources: the IAEA, UNESCO and the Italian Government. (The Italian Government also provides the Centre's buildings and the IAEA provides administrative support for the Centre). Additional contributions are received from other international, national and private organizations.

International Links

Between 1970 and 1978, 114 countries were represented at the Centre and over 3000 addresses have been entered on its mailing lists since the Centre opened its doors in 1964. These include large and well-funded research institutes in the advanced countries as well

as departments of physics and mathematics at isolated universities in developing countries. The Centre also maintains contact with about 600 Corresponding Members, chosen from among former Associate Members, Course Directors, Lecturers and participants.

The Federation Agreements scheme is being pursued and institutes in 26 countries are now associated with the Centre.

At the individual level, many of the scientists who come to work at the Centre maintain their contacts with Trieste when they return home. A total of 8326 scientists visited the Centre between 1970 and 1978.

Impact of the Centre

Through the ICTP, physicists of many disciplines working in all areas of the world are linked with their counterparts in other institutes. Direct personal contact at the Centre has created an extensive network that is highly active in passing ideas, information, comments, criticism and advice back and forth among groups of scientists. Such contact is vital in maintaining those scientists' individual creativity.

An example of the impact of the Centre is in the field of solid state physics. Some ten years ago there were very few physicists in any of the developing countries who were directly concerned with the physics of condensed matter, a branch of physics on which many of our modern industries are founded. Today, largely as a result of initiatives taken by the Centre, a substancial corps of highly trained solid state physicists now exists in a number of countries in Latin America, the Far East, and to a limited extent, in Africa.

The work of the Centre inspired Latin American physicists to set up a regional centre for theoretical physics at Rio de Janeiro and, more recently, it served as a model for the Regional Centre of Physics in South-East Asia, to be established in Singapore.