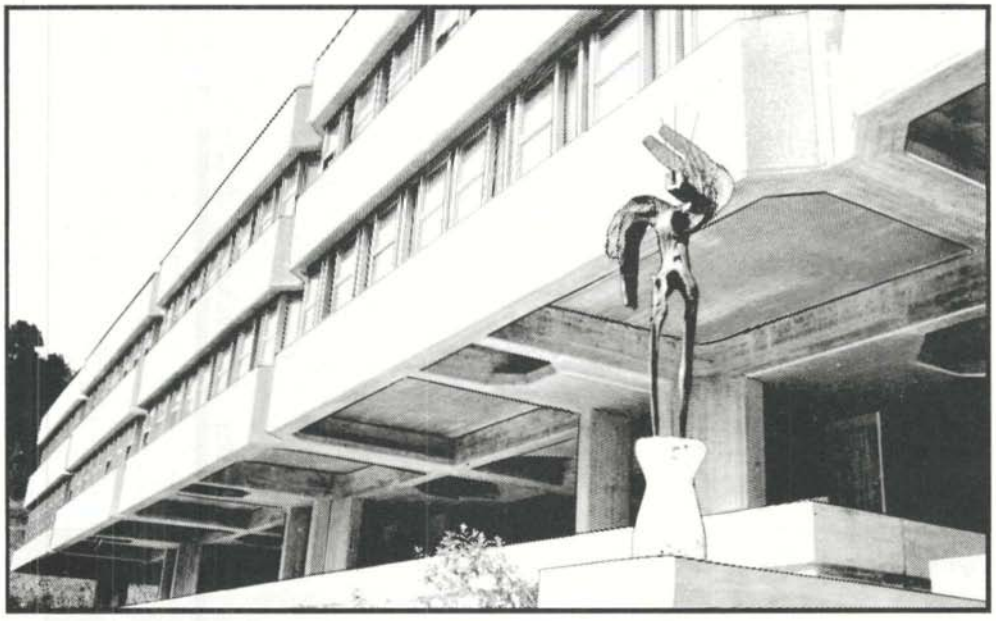

Exterior view of the International Centre for Theoretical Physics at Trieste.

International Centre for Theoretical Physics, Trieste, Italy

by Clarence R. O'Neal

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The ICTP is a unique institution. It is at one and the same time a centre of learning and research, an international point of focus for activities in theoretical physics in its host country, and a mecca for the physicist working in a developing country. It combines activities dealing with the frontiers of physics – such as astrophysics or the physics of fusion – with those of more immediate practical application – such as solid state physics. It is visited by a significant number of the world's physicists from some 90 different countries.

PURPOSE AND PHILOSOPHY OF THE CENTRE

The Centre was created as an integral, though physically separate, part of the International Atomic Energy Agency (IAEA) in 1964, following the generous offer of the Government of Italy to provide premises and an annual grant to cover part of the operational expenses. In 1970 the United Nations Educational, Scientific and Cultural Organization (UNESCO) became a full partner with the IAEA in the operation of the Centre, and these two bodies plus the Italian Government now represent the principal financial donors. Important contributions towards operational expenses have been received in recent years from the Swedish International Development Authority and the United Nations Development

Programme. The Ford Foundation has also contributed for two three-year periods, and contributions have also been received, from time to time, from various Member States.

Broadly speaking, the purpose of the Centre is to foster the development of physics, and, to a lesser extent, the related subject of mathematics, with particular reference to the developing countries. In carrying out its role, the Centre serves perhaps first and foremost as an international forum for personal contact between physicists of all countries. It is this continuing personal contact that has been the corner-stone of the Centre's activities. Through its ability to attract the acknowledged leaders in their fields, the Centre is in a position to maintain the highest scientific standards. Its director, Professor Abdus Salam of Pakistan, and its deputy director, Professor Paolo Budini of Italy, are continuing to maintain the high professional standards and are also finding new ways of strengthening the use of physics in developing countries. It is felt that the permanent scientific staff should remain at a low level and be augmented through the temporary recruitment of a substantial number of recognized specialists for the various specific activities carried out. It is this latter group which provides the broad range of expertise that is required.

For scientists from developing countries the opportunity to interact with their counterparts from the advanced countries is of paramount importance in maintaining their own enthusiasm for, and in increasing their understanding of, their subject. Since most physicists in developing countries are heavily involved in teaching, their enthusiasm – or lack of it – affects the quality of the future physicists being trained by them. Nor is the flow of benefits all in one direction: a number of cases of highly valuable contributions have been made by scientists from developing countries while collaborating with their colleagues from advanced institutions.

At the time of its creation, two considerations were paramount. The first of these was the need to alleviate the intellectual isolation of theoretical physicists working in a developing country; this factor has been perhaps the most important cause of the continuing brain drain. It was felt necessary to create an institution where physicists from the developing countries could come as a matter of right. Throughout its existence, it is fair to say that the Centre has played a significant role in reducing this sense of isolation, and has rekindled the spirit of creativity in a large number of physicists. The second factor of importance was the desirability of creating a meeting place for physicists of any nationality, regardless of political considerations.

THE CENTRE'S ACTIVITIES

In addition to sponsoring informal contacts between physicists of all continents, the Centre organizes meetings and workshops on specific subjects in various fields of physics. During the early years, the Centre's activities were largely concerned with the basic disciplines in which most of the physicists from the developing countries had been trained.

In recent years, however, greater emphasis has been placed on physics in relation to man's more immediate needs. This has been reflected in such activities as a recent course on physics of the oceans and atmosphere, the continuing support of work in solid state physics and in courses in applicable mathematics. The intent is to maintain a balance between those areas of physics more directly concerned with the frontiers of knowledge and the areas for which more immediate applications are apparent.

The Centre's programme for 1976 is a good example of this balanced approach and the following activities have either been carried out or are scheduled:

Winter College on the Interaction of Radiation with Condensed Matter	January–March (10 weeks)
Solid State Physics Research Workshop	April–June (12 weeks)
Topical Meeting on Symmetry Breaking	April (3 days)
Topical Meeting on the Physics of Tandem	April (4 days)
Nuclear Physics Workshop	May (4 days)
Topical Meeting on Particle Production in Interaction on Nuclei at Very High Energy	June (5 days)
Workshop on Weak Interactions with Very High Energy Beams	June (12 days)
Topical Meeting on Electromagnetic and Weak Interactions and the New Particles	July (6 days)
Summer College on the Teaching of Physics at the Tertiary Level	July–August (6 weeks)
Summer College on Physics and Contemporary Needs	August (3 weeks)
Meeting on Physics and Astrophysics from Spacelab	September (5 days)
Symposium on Geometry of Elliptic Operators	September (1 week)
Autumn Course on Applications of Analysis to Mechanics	September–December (10 weeks)
Research in High Energy Physics	Entire year

Also the second international course on atomic and molecular physics, with special emphasis on laser physics, will be held at the Centre from 23 February to 18 March 1977.

ASSOCIATE PROGRAMME AND FEDERATION AGREEMENTS

Two innovative programmes have been developed by the Centre in response to the requirements of scientists working in the developing areas of the world: the appointment of Associates and the award of Federation Agreements.

Selected physicists from developing countries, who are able to meet the high standards, are appointed Associates of the Centre for a five-year period, on the condition that they will remain and work in their own country during this period. Each is accorded the right to visit the Centre three times and for up to three months for each visit during the course of the appointment. The Centre pays the transportation costs and a modest *per diem*.

Federation Agreements are signed with institutes in developing countries. In these agreements, the Centre shares the cost of visits to Trieste of scientists selected by the institutes.

Informal discussions among physicists from around the world plays a significant part of the Centre's activities.

These arrangements were designed to assure continuing contact of the scientists involved with their counterparts from other areas of the world. The opportunities made available through these programmes have contributed substantially to the reduction of the brain drain of practising theoretical physicists. The opportunity for collaboration at the Centre with colleagues from other countries has often been of critical importance in rekindling enthusiasm for their work. Regional co-operation has also been stimulated and a number of collaborative efforts are directly attributable to contacts made at the Centre.

SCIENTIFIC GUIDANCE AND EVALUATION

Scientific guidance for the Centre's activities is provided by the Scientific Council which is convened once each year to advise on programme activities covering the following two to three years. The present composition of the Council is: Chairman: A. Kastler of the University of Paris, France, A. Kaddoura of the University of Damascus, Syria (currently serving as Assistant Director General for Science at UNESCO), Malu wa Kalenga of the Commissariat des Sciences nucléaires, Zaire, V. Latorre of the Universidad Nacional de Ingeniería, Peru, M.A. Markov of the Academy of Sciences of the USSR, B.D. Nag Chaudhuri of the Jawaharlal Nehru University, India, M.N. Rosenbluth of the Institute for Advanced Study, Princeton, USA, and J.M. Ziman of the University of Bristol, UK. Specialized

guidance in major subject areas is provided by Advisory Committees composed of eminent specialists in the field.

A panel of internationally recognized experts was convened in 1974, under the chairmanship of Prof. L. Van Hove of Belgium, to review the activities of the Centre. This group reported that they were "deeply impressed by the way in which the Centre – successful from its very beginning – has grown in stature, in scope of subjects and number of alumni. By helping developing countries to attain competence in advanced theoretical physics, and by showing that their scientists can hold their own in an international institute that is making outstanding contributions to one of the most profound realms of human thought – a worthy goal in itself – it has helped to raise the whole scientific level and to provide much needed background for work in applied science and engineering and even in management and government administration."

COST-EFFECTIVENESS OF THE CENTRE

The budget of the Centre is modest. To carry out its current annual programme, including the financing of visits of Associates and the partial financing of visits of staff members of Federation Institutes, the Centre must manage on a total budget of some $1.5 million, much of which comes from sources other than the three principal donors (IAEA, UNESCO, and the Italian Government).

The number of scientist man/months per year spent at the Centre divided into the total annual budget of the Centre for that year is a crude but indicative measure of effectiveness. At the Centre during the years 1971–75 the cost per man/month was as follows:

Year	Cost per Scientist per month
1971	$1 259
1972	$ 779
1973	$ 789
1974	$1 167
1975	$1 152

The figures demonstrate the continuing cost-conscious attitude of the Centre. Certain other cost figures might also be noted. Given the existence of the Centre and its staff, a three-month course for 50 participants from the developing countries (as an example) can be carried out for a cash increment of about $170 000. This works out to some $2 670 per day of instruction for the group or to some $53 per man per day (including the costs of tuition, intercontinental travel and payment of *per diem*). This is clearly a low cost means of providing advanced training for a substantial group of scientists.

THE FUTURE OF THE CENTRE

Because the IAEA and UNESCO have a strong obligation to assist the developing countries, and actively explore new possibilities for doing so, it is sometimes suggested that the Centre's efforts should be concentrated on those areas of physics which have immediate, practical applications, and that other areas which might be considered more basic should be

excluded. This view of course fails to recognize the inter-relatedness of the various disciplines in physics, the weakness of both basic and applied science in most developing countries, and the fact that the Centre must maintain its competence in theoretical science in order to set a high standard.

In brief, the Centre has established itself as a meeting place for physicists from all countries and has earned a high scientific reputation. It has contributed directly to the reduction of the brain drain in developing countries, and continues to provide valuable post-doctoral training at very low cost for scientists in these countries. It has developed strong links with a number of scientific institutions in both developing and advanced countries, and maintains a continuing contact with a significant number of scientists in most of the developing countries. In carrying out its programme, the Centre has consistently taken new initiatives designed to enhance the utility of physics to the developing world or, in many cases, to promote activities which might extend our basic understanding of the science itself.

It is likely that the "programme mix" will vary from time to time in accordance with the requirements perceived in relation to the resources available and in relation to new developments in physics, particularly its application to the needs of society. It is also possible that further attention may be given to the organization of selected activities to be carried out in various regions. Whatever the modality or the topic, however, the ultimate goal will remain the development of science in the service of man.