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INTERNATIONAL CENTRE FOR
THEORETICAL PHYSICS

INTERNATIONAL ATOMIC ENERGY AGENCY

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COVER - At the IAEA laboratory at Seibersdorf, Austria, rice plants are grown under permanent artificial daylight, for use in subsequent tests.

TRIESTE - A NOVEL VENTURE

A venture of a new kind in international collaboration has taken shape at Trieste. The International Centre for Theoretical Physics is the first scientific research institution to be set up under the aegis of the United Nations, freely accessible to all Member States.

There already exist theoretical physics centres of the highest standing – at Princeton, USA, for example, where Einstein occupied a chair, and at Copenhagen – but they have not this completely international character, which is already exemplified by the mingling of theoretical physicists from many parts of the world and from countries at different levels of development. The scientific staff comprised fifteen different nationalities in April, and the fellows twenty. Next year may well be a notable one in plasma physics, and two of the world's outstanding authorities in this field – M.N. Rosenbluth of USA, and R.Z. Sagdeev of USSR – will both be spending the year at the Centre.

The need for such an institution has been felt especially by scientists from developing countries who have already proved their capacity for original work of a high order. In such countries, theoretical physics is often one of the first subjects to be studied at an advanced level. After doing his early research at some centre in one of the scientifically advanced countries – and perhaps doing brilliantly – such a scientist would find himself confronted with the choice of leaving his country permanently, or of going home to virtual scientific isolation in which his work must infallibly deteriorate.

It was generally agreed, when the idea of the Centre was first raised, that this scientist ought to be able to return periodically to live and work at some centre where he would be in close contact with others of considerable standing. It was also agreed that theoretical physics – and especially high energy physics – offered the most fruitful field, since work of a high order has been done by men from a number of the developing countries, because fundamental physics is at present a most stimulating study in which some of the most basic concepts may well be modified by new discoveries, and because the methods used are finding applications elsewhere and are enriching other fields. There is also the practical advantage that in theoretical physics some progress can be made quickly, because it involves no large outlay for laboratories.

There was, however, difference of opinion on how this periodical return to the source could best be achieved. Some eminent scientists considered that it could best be done by providing fellowships to enable the scientist from a developing country to stay at some centre in one of the advanced countries. Such critics feared that the proposed international centre would be too artificial a creation, lacking necessary contacts with experimental physicists and with other subjects over a wide front. Nevertheless sufficient support was forthcoming to encourage the Agency to proceed. The Director General invited Dr R.E. Marshak (University of Rochester, USA), Prof. J. Tiomno (Centro Brasileiro de Pesquisas Fisica) and Dr L. van Hove (CERN)



Seminar at Trieste, May - June 1965. The Director of the Centre, Prof. Abdus Salam, and (right) the Mayor of Trieste, Mr. Franzil.

to study the proposal: "We feel this enterprise to deserve the greatest and most enthusiastic support," they reported.

The first formal move towards establishment of the Centre was a resolution put forward by Pakistan at the Agency General Conference in 1960, co-sponsored by Afghanistan, the German Federal Republic, Iran, Iraq, Japan, the Philippines, Portugal, Thailand, Turkey. Several Governments came forward with offers of accommodation and assistance, among them Italy, for a centre at Trieste, Denmark, at Copenhagen, Pakistan, at Lahore, and Turkey, at Ankara. In June 1963 the Agency accepted the Italian offer. Under this agreement, the Italian Government is providing a building for the needs of the Centre and staff housing, and is supplying staff services and \$28,000 a year for fellowships as well as an annual contribution of \$250,000 for five years. IAEA is also providing fellowships. The Centre works in close collaboration with CERN and Dubna.

THE CENTRE LAUNCHED

At the beginning of October 1964 the Centre started to function, with a charter at Trieste for four years. The present premises in the Piazza Oberdan in the centre of the city are provisional; a permanent headquarters is being built at Miramare a few kilometers away. A library of about 2,000 books and 70 periodicals has been built up, which is adequate for most everyday purposes, and it can be supplemented from the good resources of the Trieste



Temporary headquarters (Centre) of the Trieste Centre in the Piazza Oberdan.

University which lends books to the Centre. However, it will take some years to bring the collection of back numbers of periodicals and books to the desired level. An IBM computer is also available at the University, but to date there has been no request from the Centre for its use.

The Centre has been conceived not as a post-graduate school, or institution to award higher degrees, nor even as a place designed to help in the acquisition of formal qualifications. It has been founded primarily, but not solely, to help the graduate from developing countries to make better use of the qualifications which he already possesses by keeping in touch with the main streams. Such a man can come to the Centre as a fellow, for one year or two, and there meet in an intimate and informal way some of the most eminent minds in his field and other people whose work impinges on his own. Returning home, he will impart something of what he has acquired to students and colleagues in his own country. If he lives in a developing country, he may be accorded an Associateship of the Centre, which entitles him to return from one to four months every year, with no other formality than that of notifying the Centre of his arrival.

The Centre receives guidance from a Scientific Council, composed of the president, Prof. M. Sandoval-Vallarta (Nuclear Energy Commission of Mexico), Prof. A. Matveyev (Unesco), Prof. A.N. Bohr (Denmark), Prof. R. Oppenheimer (Institute for Advanced Studies, Princeton, USA), Dr. V. Soloviev (Dubna, USSR), Prof. V.F. Weisskopf (Director General, CERN), Prof. Abdus Salam (Imperial College, London), Prof. P. Budini (University of Trieste) and (secretary) Prof. A. Sanielevici (IAEA).

STAFF AND FELLOWS

The Director of the Centre, Prof. Salam, is from Pakistan. He was educated at Cambridge where he took his Ph.D. and then worked at Princeton. He returned to Lahore to teach, but quickly realised that unless he could somehow be assured of regular contact with physicists in the advanced countries he would become fatally out of touch. Hence while he is Professor of Theoretical Physics at the Imperial College of Science and Technology, University of London, he also works ardently to solve this problem of isolation for others.

The Deputy Director, Prof. Budini, is also Director of the Institute for Nuclear Physics of Trieste University. He too has been a keen advocate of the Centre and has worked hard for its establishment.

The senior scientific staff, of about 25 – representing some 15 nationalities – has been constituted by inviting visitors who spend from a few months to a year at the Centre. It has been a good augury for the future, that men of outstanding reputation in their fields have been willing to come and to assist in this way. It will be necessary to recruit a nucleus of permanent staff, but the aim is always to establish and maintain an institution of the first rank, and hence a place which the good physicists would want to visit. "This was the hardest challenge", the Director remarks.

There were 27 fellows at the Centre in April, from 20 countries – Austria, Bulgaria, Chile, China, Czechoslovakia, Denmark, the Federal Republic of Germany, Ghana, Greece, Italy, Iran, Iraq, Japan, Mexico, the Netherlands, Pakistan, Poland, Romania, Yugoslavia and the United Kingdom. Most are sponsored by IAEA, some by UNESCO. Most have had some previous research experience, and they come normally for one academic year. They vary in age and experience; coming as they do from countries at different levels of scientific advancement they include some who need advanced instruction in order to undertake research. This is provided at the Advanced School of Theoretical Physics of the University of Trieste. It is a post-graduate school, open to students from other places, but has close links with the Centre, whose staff members give lectures and courses at the School from time to time. The UN Educational, Cultural and Scientific Organization is also a party to these arrangements, and is sending fellows to the School for training. Twelve fellows from the Centre are attending the school this year. A few of the fellows who are already engaged on research find it advantageous to attend some of the courses at the School at the same time.

METHODS OF WORK

The subjects of study chosen initially for the Centre are:

- * elementary particle and high energy physics, which is fundamental to all else, and has at present great research possibilities. It has the advantage also that many physicists from the developing countries have worked in this field, and some have achieved high distinction.
- * low energy physics. This is needed for reactor programmes, but low energy

physicists with capacity for leadership are lacking in the developing countries.

* plasma physics. Although the long-range implications of thermonuclear power are of wide interest, this topic has not been included for the benefit of the developing countries. It has been adopted because of the unique position of the Centre as an international forum where ideas can be discussed and exchanged between scientists from the three or four countries, East and West, which are the leaders in this field.

* theoretical solid state physics - a field on which transistors and electronic equipment depend.

Methods of work at the Centre are informal. A fellow attends advanced courses on specialised topics - weekly seminars are conducted by guest scientists or staff of the Centre - and he undertakes a research project under the guidance of a senior staff member. Fellows meet two or three times a week, either to describe their own research work, or to make a survey of some particular point of theoretical physics. The emphasis is on informality and free discussion. With 50 or 60 physicists at the Centre, each is able to find others having common interests, and they group themselves naturally in this fashion.

The other main form of activity is the holding of extended seminars, of which there have been two in the 1964-65 academic year. The first, on theoretical aspects of Plasma Physics, was held from 5 to 31 October 1964, and some 80 participants attended. This seminar was directed by M.N. Rosenbluth (USA), B.B. Kadomtsev (USSR), and W.B. Thompson (UK). It was a notable occasion, with all three schools of plasma physics collaborating in this way for the first time. The second seminar, on the Physics of Elementary Particles, took place from 2 May to 30 June. About 120 applicants were accepted, and these were of a calibre which ensured a high level of discussion. These larger seminars have elicited enthusiastic comments from the participants. They are, in total, in session over a good proportion of the academic year. Together with the constant coming and going of short-term visitors, they provide a remedy against the lapse into sterile isolation which some have feared would be the fate of the Centre.

Nor does the absence of an experimental centre appear to have been a handicap. Links with such establishments do exist; experimentalists from places like CERN visit the centre and discuss their work. Many of the physicists at the Centre, too, have personal contacts with experimentalists in other places, and may on occasion ask their friends for information on a specific point. The Director of the Centre points out that neither of the notable institutions at Princeton and Copenhagen are great experimental centres. The essential, he maintains, is to have the right intellectual climate, which can be provided by a good university or similar centre of ideas.

THE FUTURE

It is perhaps rather soon to assess the results of the Centre, but the progress up to date has been encouraging. By May, some 65 scientific papers had been issued and a number of them have attracted quite wide interest. In particular, the work of A. Barut, C. Fronsdal, R. Delbourgo, M.A. Rashid,



Seminar on the Physics of Elementary Particles, Trieste

A. Salam and J. Strathdee described in several papers on strong interaction symmetries, and particularly on $U(12)$ symmetry, has been hailed as an important advance in the theory of fundamental particles.

In order to estimate the benefits to the developing countries it will be necessary to wait until the fellows have returned to their home countries and settled in to their normal work of teaching or research, which work should certainly gain from their contacts with some of the leading physicists of the day. The most promising feature of all, has been the success of the Centre in attracting such gifted people. This success has been the result of a conscious effort, which has involved expenditure on a higher scale than had been envisaged for the Centre.

For 1964, the Centre received the Italian Government's contribution of \$278,000, together with \$55,000 from the Agency's regular Budget, making a total of \$333,000 (there were also a few contributions from other Governments for special purposes such as the purchase of books). Because operations began fairly late in the year, \$152,000 remained to be carried forward into 1965; together with the annual allocation of \$333,000 this made a total of about \$485,000 available in the current year.

By a deliberate policy decision, the whole of the \$485,000 is being spent in order to launch the Centre at once on a series of worth-while activities, and to make its potentialities well known to the scientific world. This object is already in a fair way to having been achieved, but a large question-mark is left hanging over the future. To carry on with activities

on the current scale would require a Budget of \$550,000 to \$600,000 a year – nearly twice the present allocation. Further, to keep up the standard of the scientific staff, it is not possible to rely on continuation of the short-term visits by distinguished scientists who have been willing to lend a hand in order to get the Centre under way. Permanent appointments must be made, but this is not possible while the Centre remains in a trial period, ostensibly for four years. All this will involve important policy decisions, but there is now accumulating some solid experience on which they can be based.