INTERACTION AT TRIESTE

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In its very first year of existence the International Centre for Theoretical Physics in Trieste has achieved a success surpassing the best hopes of its organizers. Besides bringing together physicists of East and West, and of rich and poor countries, it has been able to make important contributions to knowledge

The idea of creating, under the aegis of the United Nations, an international centre for theoretical physics took shape five years ago. Some three years of hard persuasion at the forum of the International Atomic Energy Agency (IAEA) in Vienna were needed to get it accepted and a further one year to prepare for its inception in October 1964. The Centre has now completed its first academic year and it is time, perhaps, to assess how far the ideals which went into its creation have actually been realized.

The International Centre for Theoretical Physics was conceived with two distinct ideals in view. First, as a contribution to international collaboration in science; second as a contribution to physics in developing countries through the help it might particularly give to the work of senior physicists there. Theoretical physics happens to be one of those relatively advanced disciplines where decisive advances in recent times have come not only from the physicists from the West and the East, but also those from some of the developing countries like Brazil, China, India, Korea, Lebanon, Pakistan, Turkey, and others. One could hope that a successful theoretical physics institute might set a pattern possibly for a United Nations University at some time in the future.

The first occasion when the Centre was discussed was at a high-energy physics conference in September 1960. In his banquet address Mr J. A. McCone, who was then the Chairman of the US Atomic Energy Commission, mentioned with approval a suggestion that nations of East and West might collaborate in setting up a joint high-energy accelerator. Some of us—including Hans Bethe, Robert Sachs and Nicholas Kemmer—who assembled afterwards wondered how practical the suggestion might be and whether one might not perhaps start on a smaller scale with a modest truly international centre for theoretical physics—financed by one of the United Nations' family of organizations.

The same month I had the privilege of being able to voice, on behalf of the Pakistan government, this visionary ideal in the form of a resolution at the annual conference of the International Atomic Energy Agency at Vienna. We were fortunate to receive co-sponsorship of the resolution from the governments of Afghanistan, the Federal Republic of Germany, Iran, Iraq, Japan, the Philippines, Portugal, Thailand and Turkey. As the list of sponsors indicates, the setting up of such a centre was of interest not only to the developed countries, but also to some of the less privileged ones. I myself found it impossible, when teaching at Lahore some years ago, to remain sufficiently in touch with the physicists of the advanced centres. My hope for the proposed centre was that, besides providing a venue for collaborative research, it might also resolve this frustrating problem of isolation for other active scientists in poorer countries. Such men could come fairly frequently to the Centre to renew their contacts and engage in active research in fields like nuclear theory, high-energy physics, theory of plasma and solid state physics.

Right from the beginning we received enthusiastic support from the IAEA's directorate and from the physics community. Niels Bohr, before his death, expressed his whole-hearted support for it; scientific panels convened in 1961 and again in 1963 by the Agency's director-general, Dr S. Eklund, forcefully recommended its creation. Unfortunately there was not the same unanimous response from all atomic energy commissions around the world. At the 1962 annual conference of the IAEA (where these commissions are represented), even though the creation of a centre was accepted in principle, the feeling in the IAEA's decision-making group, the Board of Governors, was that they could not recommend the committing of purely IAEA funds towards it, at least to start with.

Additional offers of financial assistance from interested member states were solicited; of the four received (from Italy, for a centre to be located in Trieste, from Denmark for Copenhagen, from Pakistan for Lahore, and from Turkey for Ankara), the most generous was the Italian government's offer, with P. Budini, professor of physics at the University of Trieste, as the moving spirit behind it. This was accepted in June 1963 and the Centre started functioning from 1 October 1964 with a charter for four years.

The first year's activity at the Centre covered two disciplines in theoretical physics: the physics of elementary particles associated with the experimental work of the big particle accelerators; and plasma physics, crucial to the ultimate exploration of controlled thermonuclear fusion as a source of power, but also relevant to processes in stars. The Centre had a staff of 52, made up of 28 nationalities. This included 25 post-graduate and post-doctoral Fellows, sponsored by the IAEA and UNESCO, most with previous research experience, the majority coming from countries in South America, Eastern Europe, Africa and Asia.

In addition to a normal research programme the Centre organized two *extended* seminars, for both of the disciplines covered, particularly directed for those who had lived away from active centres for long periods: on plasma physics in October 1964, and on high-energy physics during May and June 1965. The plasma physics seminar lasted for four weeks, with 21 lecturers and 80 other participants. It was co-directed by M. N. Rosenbluth (USA), B. B. Kadomtsev (USSR) and W. B. Thompson (UK). This must be the first occasion when all three major schools of plasma physics—the US, the Soviet and the European—collaborated in running an extended joint advanced course. The seminar on high-energy physics brought together for eight weeks 33 lecturers and 120 other participants—altogether from 29 countries. Again we were exceedingly fortunate in that some of the world's most active physicists could come to stay and lecture in Trieste.

A particular focus for research at the Institute during the past year has been the symmetries recently discovered among the "strongly interacting" sub-nuclear particles. The discovery of the omega-minus particle last year, predicted by the so-called SU(3) symmetry theory, gave a great boost to these studies, and at Trieste we explored the possibility of there existing still higher symmetries in nature compatible with relativity theory. We were able to make a general attack on the problem of "dynamical" symmetries; for this one had to forge and use new theoretical tools like non-compact groups. One hopes we reached new levels

Top *The present home of the International Centre for Theoretical Physics in Trieste*

Bottom *The Seminar on High-Energy Physics (May-June 1965) brought together (for eight weeks) 33 lecturers and 120 participants, from 29 countries*

Appreciations of the Centre by leading theoreticians.

"The contributions were right away of such importance that it has become very natural for scientists from all over the world to pass through Trieste when they are travelling, or to come to Trieste whenever some opportunity offers itself. One should realize what this means for the Fellows, the young people who are here. Although the place is very new and in its period build-up, most of them have had the opportunity to meet leading scientists in the field, to listen to lectures, to discuss points in these lectures and the literature with the best specialists and one can, I think, regard the Seminar on Elementary Particle Physics which is going on now, as some kind of brilliant culmination of this period of activity."

L. Van Hove

"It seems to me that the Centre has been successful in these eight or nine months of operation in three important ways. It has cultivated and produced admirable theoretical physics, making it one of the great foci for the development of fundamental understanding of the nature of matter. The Centre has obviously encouraged, stimulated and helped talented visitors from developing countries who, after rather long periods of silence, have begun to write and publish during their visit to the Centre in Trieste. This is true of physicists whom I know from Latin America, from the Middle East, from Eastern Europe, and from Asia. It is doubtless true of others. The Centre has become a focus for the most fruitful and serious collaboration between experts from the United States and those from the Soviet Union on the fundamental problems of the instability of plasmas, and of means for controlling it. Without the Centre in Trieste, it seems to me doubtful that this collaboration would have been initiated or continued. In all the work at the Centre of which I know, very high standards prevail. In less than a year it has become one of the leading institutions in an important, difficult and fundamental field."

J. R. Oppenheimer

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of insight, depth and understanding in this quest.

In a different field a paper that perhaps deserves special mention is one by D. A. Akyeampony of Ghana on electrodynamics at high energies which is significant as it marks an African entry into advanced theoretical physics.

It is not for me to speak of the *quality* of research contributions from the Centre, although others have done so in most generous terms (see previous page). All I can say is, we were very fortunate. One can never budget for high quality; perhaps the men who had lived away from active centres for two or three years were bottling up ideas which they feverishly poured forth and developed at the earliest opportunity that came to them.

We can take pride in that the Centre succeeded during its first academic year in three crucial ways.

(1) It encouraged good physics, not in just one field of theoretical physics, but in an inter-disciplinary manner. To maintain this inter-disciplinary tradition the plans for 1967 include an extended seminar ranging over the *entire* spectrum of theoretical physics—to try to recapture its essential unity—something which has not been attempted on this scale for a long time.

(2) We could, here, lay foundations of an active, a lasting and a prolonged co-operation between physicists from the East and West. During 1964–65 a total of 18 physicists—senior and junior, working for periods from two months to a full year—came to the Centre from Eastern Europe. During 1965–66 the collaboration is taking a still sharper form with two groups of plasma physicists, the Soviet and the American (some 25 senior men), meeting and working together *for a full year*. This type of collaboration is impossible, at present, to achieve elsewhere.

(3) The Centre has helped physicists from developing countries, who, after long periods of silence, have begun to write and publish during their visits to Trieste. Specifically for them, the Centre has instituted a new scheme of Associateships. The idea is to give selected active men from developing countries the opportunity of coming to the Centre for one to four months every year. The Centre pays for their travel and living expenses in Trieste. The times (and indeed the frequency of the visits) are left completely to the Associates. So far eight Associates have been elected. The plan is to extend the privilege to some 40 more leaders of research in developing countries. This may cover nearly all the first-rate men. One may hope that this financially-guaranteed possibility of remaining in touch (even while they are permanently located in their own countries) might persuade some of the best physicists from less privileged countries not to exile themselves permanently abroad. There is no claim that this is the only way to halt the brain-drain, but this is one way and it is worth trying.

Although high-energy physics and plasma physics have been emphasized in the first year, the programme also provides for study of low-energy nuclear physics, which is the basis for the current practical exploitation of nuclear energy, and theoretical solid-state physics, which has assumed such great importance in electronics and materials science.

As I said earlier, the Centre was created for a period of four years. The decision as to whether it should continue at all—and where—will be taken at the IAEA's Board of Governors' meeting next year. In the final analysis then, its continued existence depends on the atomic energy commissions of the IAEA's member states. Basically the problem as always, is financial.

At present nearly two-thirds of the Centre's normal annual budget of $400 000 comes from just one source—the host government, contributing through the IAEA. The rest comes from the IAEA itself, with a smaller share from UNESCO. The Centre's present mandate (and its sources of finance) run out in 1968. We must find new sponsors, within the IAEA, within the Atomic Energy Commissions of the world, and among foundations outside, if the initiative taken in creating the first faculty of a future UN university is to endure.

The Centre is fortunate in having a Scientific Council consisting of Professors S. Vallarta, J. R. Oppenheimer, V. Weisskopf, A. Bohr, V. G. Soloviev and A. Matveyev. It could never have come into existence or run as it does with no administrative difficulties, but for the warm, consistent and enthusiastic support of IAEA's Director General, Dr S. Eklund. Among the institutions which have actively helped with the Centre one must mention Imperial College, London, with gratitude for so generously seconding part of its staff to it. The Centre's inception and its organization mark it as a new type of venture—an assay in collaboration between the East and the West, and the developing nations; an assay in collaboration for pure science organized under the aegis of the United Nations. The idea is the embodiment of the international ideal; it must succeed.

Below. *The author* (standing) *at the inauguration ceremony of the High Energy Physics seminar. Seated* (left to right) *Professors C. Fronsdal, G. Gerin and P. Budini, deputy director*