Centre for the practice of theory

Next September, the International Centre for Theoretical Physics in Trieste will celebrate its tenth anniversary. In a decade it has become a major, but still unique, feature of the scientific world. Professor John Ziman, of the University of Bristol, describes its problems and successes.

THE International Centre for Theoretical Physics (ICTP) was inspired by Abdus Salam, professor of theoretical physics at Imperial College, London, who recognised, from personal experience, the need for a place where young and promising research workers from developing countries might come from time to time to "recharge their intellectual batteries". Salam persuaded the International Atomic Energy Agency (IAEA) to create such a centre, which came to Trieste at the invitation of the Italian government and of the City of Trieste.

After some years in temporary premises in the centre of the city, the ICTP moved in 1968 to an elegant building paid for by the regional government and the city. This building overlooks the Adriatic, about 8 km north of Trieste along the main coast road, and has offices and lecture rooms for about 100 physicists at a time. In the summer, naturally enough, the place is crowded, but the building is now in fairly constant use throughout the year. Unfortunately, domestic accommodation has to be found in hotels or lodgings in the city, which means a lot of bus travel; there are long term plans to provide a hostel nearby. The centre has its own excellent library, but the nearest computer facilities are in the University of Trieste. The material facilities are better designed for high-minded individual cerebration than for team research on dirty facts.

Noble laureates and brash young physicists

About 5,000 physicists from 90 different countries have visited the ICTP since it was founded. Of these, at least 1,000 have worked there for periods of several months or more. Visitors range from academicians and Nobel laureates, on courtesy calls of a few days or weeks, to brash young theoretical physicists from developing countries on nine-month fellowships or associateships. But the centre is not an 'institute' with a permanent academic staff committed to a long term research and teaching programme. By arrangement with Imperial College, Professor Salam, the director, spends two-thirds of his time at Trieste, and Paolo Budini, the deputy director, is also a professor at the University of Trieste. Other Trieste professors work regularly at the centre, but do not dominate its activities. In principle the scientific programme of the ICTP is guided by a Scientific Council, nominated by the various sponsoring agencies, which meets for a couple of days annually; in practice, the initiative rests almost entirely with Salam and Budini, in cooperation with various senior scientists who have become involved in the programme of the centre over the years. A small, hard working technical staff provides administrative, secretarial, library and printing services.

The precise constitution of the ICTP as an international organisation is not easy to explain. Legally it is a part of the IAEA and UNESCO, although the administration is mainly done by the IAEA. Financial support is shared in about equal proportions by the IAEA, UNESCO and the Italian government. Some matters have to be referred to the headquarters of the IAEA at Vienna and to UNESCO in Paris: others are dealt with by a 'consortium' of local Italian academics and officials. Funds for major activities at the centre also come from the United Nations Development Programme (UNDP), the Swedish International Development Agency (SIDA) and, until recently, from the Ford Foundation. Various overt or hidden subsidies come from such bodies as national scientific agencies. An income of about $1 million a year looks healthy but policy changes, earmarking, exchange fluctuations and other sources of variance or constraint make each year's budget a work of art. The best that can be said of this confused situation is that the centre itself is not burdened with detailed external controls or a heavy bureaucracy, and has been free to find an ecological niche for itself in the jungle of international organisations—who themselves have shown wisdom and restraint in not crushing this strange little beast underfoot.

Changes from experience

Originally, the main purpose of the centre was to provide shelter and intellectual companionship for a number of 'associates'—theoretical physicists of proven competence, taking temporary leave from their academic or government jobs in developing countries for a few months each year to undertake advanced research and to refresh their minds by contact with their peers. This research was to be directed and inspired by distinguished visiting scientists from more advanced nations, for example American professors on sabbatical leave. Naturally enough, opportunities for advanced seminars, small conferences and short study courses would also be exploited as the occasion arose.

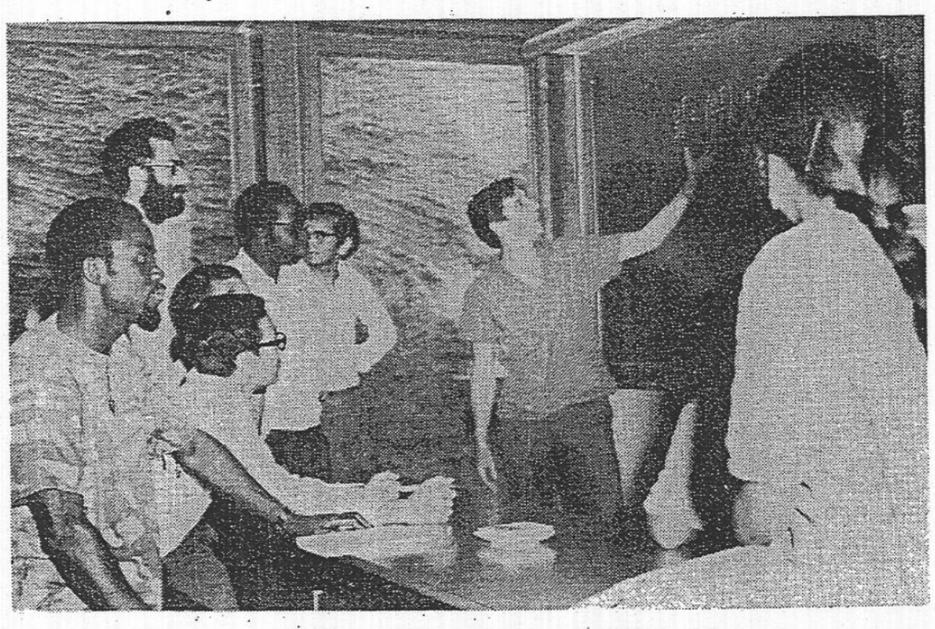
It must be admitted that this initial plan has been overshadowed and modified with experience. The quality of the research produced by associates at the centre was very uneven and their need for very close personal supervision could not always be met, simply because there were not enough senior people who could come to Trieste for long periods without financial support. Many of those chosen as associates were ill prepared for self-winding research in an atmosphere of scholarly independence. This defect is difficult to avoid when candidates must be selected on the basis of written applications from a distance and is particularly serious with applicants from small countries with very weak scientific traditions. In some fields of physics, therefore, the associate scheme is now being used mainly to help research workers whose ability has been confirmed by the part they have already taken in other ICTP activities.

Contribution

The research output of the centre (about 100 papers a year, of which half are by physicists from developing countries) is, in fact, quite substantial. In certain specialised fields of elementary particle theory, such as group theoretical methods, the use of non-compact groups and the connections with the theory of gravitation, it is the leading place in the world. In other fields the preprints circulated from the centre often represent important preliminary stages in investigations that are continued and completed elsewhere.

But the contribution of the ICTP to physics should not

be judged from the research actually done there. In recent years, much more emphasis has been given to 'extended seminars', 'winter colleges' and so on, where whole fields of advanced physics are systematically expounded by invited lecturers of the highest international reputation. For each such course, scholarships are given for 30–50 participants from developing countries to come to Trieste for 2–3 months. These courses are open, without fee, to appropriately qualified scientists from all countries and are well patronised by physicists from West Europe. Trieste is geographically well placed to receive physicists from East European countries, whose participation in the ICTP would be even greater if it were not severely limited by exchange controls and other administrative restrictions on travel. The Soviet contribution to the scientific programme has not been as great as was originally hoped but there have been long periods of collaboration at the centre between teams of plasma physicists from the Soviet Union and the United States.



A group of physicists at the ICTP, Trieste.

Many of the best physicists in the world, senior and junior, may be found talking together in the seminars, 'congressini', and 'research workshops' that arise spontaneously during or after each extended course. The centre has thus become a major forum, or market place for the international physics community. Personal contacts are established, ideas are exchanged and new developments communicated in a more leisurely and relaxed environment than the conventional scientific conference or summer school. The general atmosphere is serious and business-like; discussion ranges from the technical problems of mathematical physics to the role of the scientist in a developing country. The typical participant is about 30, has his PhD and several published papers to his credit, and is already carrying responsibility as a university teacher or in a newly formed research group in his own country. But the name on the office door speaks of Nigeria or Brazil, of Pakistan or Korea, rather than the United States, Europe, the Soviet Union or Japan. This is one of the few international scientific institutions in the world that is not dominated by people from economically advanced nations—and that is not just a political talking shop.

In founding the centre, Salam naturally concentrated on his own field of research, the theory of elementary particles. This remains a major component in a scientific programme which now includes regular activities on the physics of nuclei, atoms, molecules, plasmas, condensed matter, living organisms and the Universe, and on mathematical topics such as computational methods, global analysis, and fluid dynamics.

Highbrow theoretical meetings such as an International Symposium on Contemporary Physics are balanced by courses that get down to hard experimental facts, such as the 1974 Winter College on 'Surface Science'. The centre now caters for the experimental physicist who wants a simple explanation of the theoretical background of his research as well as for the 'theoretician' with his abstract mathematical models. The proportions of the mix are mainly determined by the relative enthusiasms of various individuals who are willing to organise various activities, but would not perhaps be very different if there were a long term plan, based on firm financial guarantees, thought out carefully by a representative committee.

The facilities and programme of the ICTP are now much valued by the world physics community. It is well known as a good place to work at for short periods and the high standard of the extended seminars is coming to be appreciated both by potential lecturers and by their audience. But it still suffers from a shortage of active personal support and practical commitment over long periods from those leading physicists who could help so much in the scientific direction of its activities. Labour is an essential component of the fine ideal of international scientific collaboration.

Serving interests

Does this programme serve the genuine interests of the developing countries? The argument that the real need is for engineers, doctors, technicians and other practical experts is valid on the whole, but ignores the contribution that quite small numbers of well informed and competent academic research workers can make to the solution of technical problems, to educational standards and to cultural life.

Over the years, the activities of the centre have slowly shifted towards the more applicable branches of physics, in response to the political demand for greater 'relevance' to social needs. Indeed, this shift has not been altogether passive: physicists from developing countries meeting together in Trieste as a distinctive group begin to realise for themselves that the pursuit of pure science should not be regarded as an end to itself. In the extended seminar programmes, the intellectual continuity is emphasised between, say, the theory of elementary excitations in covalent solids and the technology of semiconductor devices. This provides a bridge over which the young scientist may move from the academicism of the old-fashioned physics curriculum to the more practical territories of engineering and industry.

A natural extension of the programme of the centre is to support similar activities in other regions of the world. This can only be done on a very limited scale, without permanent facilities, but should eventually strengthen the social and intellectual links established between physicists of various countries when they meet at Trieste. The ICTP cannot, of course, replace the great centres of physics research that exist in advanced countries and that are growing up in many developing countries, and can only supplement the specialist conferences, travel scholarships, regional summer schools and so on that already bind together the world scientific community. But because it is a place where the scientist from a developing country feels he comes as of right, and where people work hard together, on an equal footing, to the highest intellectual standards, it makes a unique contribution to international cooperation and national development. It thus represents a sound prototype for similar institutions in other fields of science and scholarship.