Report from Trieste: ICTP on the march

Why have more than 22 000 scientists studied at the International Centre for Theoretical Physics?

by Akhtar Mahmud Faruqui

A small Roman town under the Caesars, an independent municipality in the Middle Ages, a flourishing international port and trading centre between the West and East after 1700, and an Italian entity since 1918, Trieste is a city of entrancing scenic attractions. Tucked away in the northeast of Italy on the Adriatic Sea, the city stands on tree-dotted hills resembling a sunlit sea-washed amphitheatre, with the surrounding Carso plateau rated as one of the most enchanting landscapes in Europe.

But Trieste is now known not just for its scenic splendours or past grandeurs. It is identified increasingly as a meeting place of bright scientific minds from the West and the East, from the North and the South. It has come to play a leading role in a new enterprise: the promotion of physics, of the scientific ethos, in the science-deficient developing world. Year after year, eager young physicists dash to the International Centre for Theoretical Physics (ICTP) to re-establish their bearings in the fast developing world of contemporary physics. The last few years have been among the most exciting period — they have witnessed the most fundamental breakthroughs in understanding — since the early days of quantum mechanics. More than 22 000 researchers from developed and developing countries have made their pilgrimage to ICTP since its inception and have contributed to the mainstream of physics, besides enriching their own scientific communities at home. The ICTP's Director Abdus Salam shared the 1979 Nobel Prize in Physics for his unifying theory of the electro-weak force.

Physics and development

The discipline of physics, according to Salam, "is an incredibly rich discipline ... a science of wealth creation par excellence" because of its implicit connection with high technology and materials exploitation. The view is widely shared. "As perhaps the most truly international of all the sciences, physics has the opportunity and the responsibility to continue this flow of benefits to society and, most important, to extend them to the very large fraction of the world's burgeoning populations that have thus far — for whatever reason — been denied them," D. Allan Bromley has noted.* The report, *Physics in Perspective*, strengthens Salam and Bromley's view: "Science is knowing. What man knows about inanimate nature is physics, or rather the most lasting and universal things that he knows make up physics. As he gains more knowledge, what would have appeared complicated or capricious can be seen as essentially simple and in a deep sense orderly. And, to understand how things work is to see how, within environmental constraints and the limitations of wisdom, better to accommodate nature to man and man to nature."**

The early years

But the ICTP was conceived by Salam, a gifted Pakistani physicist, not so much to create economic wealth in developing countries as to enrich their intellectual stock. "Salam's strength is that he believes miracles are possible provided one goes out and helps them on their way," Nigel Calder has stated.*** Thus, Salam remained unruffled when his proposal for the creation of an international centre for theoretical physics got a polite rebuff in UN circles. Some comments were particularly harsh and stinging: "Theoretical physics is the Rolls-Royce of sciences — the developing countries need only bullock carts." Salam recalls: "People took it (proposal for ICTP) half-jokingly and many delegations abstained on the vote when it was approved for a preliminary study. I found out that the idea interested the poor countries. What I wanted to do was to give the poor a place of their own where they would not have to beg anybody. Why should not a bright youngster in Pakistan have the right to receive the same stimulating atmosphere as an Englishman or an American, provided he deserves it?"

Why should a developing country scientist be confronted with the cruel choice of either giving up physics

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* Bromley, Allan D., "The frontiers of physics and their roles in society", *Physica Scripta*, Vol. 19, pp. 204-229 (1979).

** *Physics in perspective*, US National Academy of Sciences, Washington, DC (1972).

***Calder, Nigel, "A man of science — Abdus Salam", *Science year: The World Book Science Annual* (1967).

In May 1986, the IAEA Board of Governors visited the Centre.

or his country? Salam's unrelenting campaign, later ably supported by Italian professor Budinich, was eventually crowned with success. In 1962, the General Conference of the IAEA approved the creation of the ICTP. "That was the most momentous day of my life," Salam exuberantly declares. "I seldom smoke, but I must have smoked 50 cigarettes that day and I went through a kilo of grapes. At the end of the debate, 60 hands went up in favour — and we had won."

The doors open

In 1964, the ICTP opened its doors at Trieste. It is now jointly sponsored by the IAEA and United Nations Educational, Scientific, and Cultural Organization (UNESCO), and generously supported by the Italian Government and the hospitable Triestines. Today, the ICTP serves as an important point of convergence, a meeting place, for physicists of all nationalities. It welcomes scientists from Africa, Asia, North and South America, Europe, and Australia. For East European physicists, ICTP is one of the only places in the world for effective collaboration with the West. Salam has vividly demonstrated that various interactions of nations and cultures are no obstacle to the brotherhood of man in science. In the words of Prof. John Ziman of Bristol University, he has acted as "a sort of one-man multinational corporation, busily transferring intellectual technology to the less developed countries of the world".

The Centre today

Starting with an annual budget of US $0.5 million, the ICTP's funds have risen to US $8.7 million in 1985, reflecting the increase in its activities and the growing multiplicity of its programme. Gradually coverage has broadened from fundamental physics to encompass physics that may be more relevant to the needs of the developing countries: for example, physics of materials and microprocessors, physics of energy, physics of fusion, physics of reactors, physics of solar and non-conventional energy, geophysics, biophysics, neurophysics, laser physics, physics of oceans and deserts, and systems analysis. But the Centre has not committed the blunder (which is all too often committed in less-developed countries) of neglecting basic frontier physics, such as high-energy physics, astrophysics, quantum gravity, cosmology, atomic and nuclear physics, and mathematics. Such a broadening of the programme was made simply because there was not, and still is not, as Salam explains, any other international institute responding to the scientific hunger of developing country physicists.

Growth in programmes

The year 1985 has been rated the "best" — most productive — in the Centre's 21 years of life. During that year, 2720 scientists visited the ICTP marking an increase of 30.6% over 1984. In terms of man-months, this marked an increase of 42.7%. The developing country share registered an increase from 1424 to 2178 physicists, a growth of 52.9% (with a similar increase for man-months). "Training for research" courses also went up from 23 in 1984 to 30 in 1985. Three hundred and thirteen research papers were published in 1985, as against the average of around 200 for the past years. The number of associates — high-level physicists who can come to the Centre when they choose for periods of up to 9 months in 6 years (provided they continue to work in their own countries) — climbed up from 206 to 378. The number of federated institutes grew from 106 to 195. The number of external activities supported by the Centre also rose from 12 to 39, and are expected to approach 70 in 1986. The expenditure on these activities has correspondingly increased from US $0.4 million to US $1.3 million.

On the experimental side, the ICTP's training programme for experimental physicists (from developing countries who work in Italian laboratories) registered an increase from 30 to 74 trainee-physicists. As against the US $0.35 million spent on this

The ICTP in Trieste, Italy.

programme in 1983 and 1984, an amount of US $1.15 million was spent during 1985 alone. The Centre's first training laboratory in microprocessors was also commissioned during this period with the help of the United Nations University. (A training laboratory on fibre optics is expected to be in operation in 1987. There are also plans for setting up training laboratories for laser physics, neurophysics, and for solar physics and silicon physics at a later stage.) During 1985, half a million dollars worth of books and US $1.5 million worth of equipment were distributed among Third World institutions.

"Just because we exist, we serve as a nucleation and distribution centre," Salam explains.

The increased level of activity has been possible "by the extraordinary and generous benefaction of the Italian Government", he says. Due to the "zero-growth" situation prevailing in UN organizations, contributions from the IAEA and UNESCO are proportionally getting smaller as the Italian Government (Ministry of Foreign Affairs and Department of Co-operation in Development) increases its participation in the Centre. However, the fact that the Centre belongs to the United Nations family is extraordinarily important for its international character, and is a precondition of the contribution the Italian Government makes to the Centre, Salam says. The Third World thus owes its gratitude both to Salam who has conceived and successfully run the ICTP, and to the science-sponsoring Italians who willingly and generously support it.

Besides various programmes aimed at enhancing the individual capabilities of physicists from developing countries, the ICTP supported developing country science by extending financial grants to seminars and symposia held outside Trieste. The Centre also holds full-fledged sessions for training and research outside Trieste, such as courses on condensed matter physics (Ghana), monsoon dynamics (Bangladesh), physics of energy (Colombia), and microprocessors (Sri Lanka, Colombia, and China). In addition, the ICTP helps initiatives of local spring or summer colleges in Nathiagali in Pakistan, Petra in Jordan, Khartoum in Sudan, and Cuzco in Peru, as well as regional networks, such as ASPEN in Southeast Asia and SAMSA in Southern Africa.

Positions for scientists

Since its inception, the ICTP has produced results of outstanding merit. Its contributions are highly rated. To ensure the continuity of this effort the creation of 20 positions for "long-term" scientists was recommended "urgently and without fail" by a committee appointed by the IAEA, UNESCO, and the Italian Government and chaired by Professor P.T. Matthews. These positions are to be supported by the three agencies responsible for running the Centre — 10 jointly by the IAEA and UNESCO and 10 by the Italian Government. The IAEA has already made available four positions. The Italian Government has not been able to meet this obligation, not because it lacks the will to undertake the responsibility, but because the modalities are harder. A way out, according to Italian Government representatives, could be to make extra funds available for the Agency to take care of all 20 positions.

The "floating" scientists contribution

Ambassadors of various countries who drove from Vienna to Trieste in May 1986 were pleasantly surprised at the effusive enthusiasm and exuding confidence among scientists working at the ICTP. Some gleefully acknowledged their easy access to current literature (scientific journals and books, a prime requirement for research, are sadly lacking in many developing countries). Others spoke of the fruitful and intellectually rewarding discussions they shared with co-researchers, while some mentioned a feeling of exhilaration in interacting with "top-notchers" in their field. A surprised ambassador exclaimed, "We are used to listening to pessimists and egocentrics when it comes to a dialogue with the scientific community. The ICTP mood is certainly very different."

Lecture in session at the ICTP.

Dr Julian Cehla-Flores, a biophysicist from Venezuela, feels the Centre demonstrates "a successful model of international co-operation not tried before", one which should be emulated in other fields of science, but on a regional basis, particularly in Third World settings. The transfer of information at ICTP, he affirms, is quick, a false start in a research undertaking is timely corrected, and the preprints of papers sent to thousands of research centres all over the world are a signal contribution to global research. The floating population of scientists that passes through the ICTP produces results "comparable with the best centres of research in frontier sciences particularly in high-energy physics, condensed matter physics, nuclear physics and plasma physics", he says. He is convinced the developing world has also contributed to the developed world in the ICTP association. Some course directors from developing countries, brilliant academicians and men of erudition, have often sharpened the perception of participants from developed countries. The ICTP, he sums up, "has exceeded the expectations of its founding fathers".

Dr Anis Alam, a physicist from Pakistan, regards the ICTP as "a second home for physicists" where developing country scientists meet their peers from the developed world with "the minimum of restrictions". To him the Centre is the "only place in the world" where the universal nature of science transcends geographical and ideological frontiers.

Dr Peter Mbaeyi, a Nigerian mathematician, finds that "information exchange, focusing particularly on overviews of major thrust lines of scientific theories, novel developments, and new areas of concentration" are of especially high quality. Trieste, he acknowledges, has been "the biggest boost to my endeavour to generate self-consistent fields for biological phenomena".

Dr Thomas W. Kephart, a physicist from the USA, regards the ICTP as "a visionary enterprise now attaining many of its goals. The research performance at the Centre and the conferences held there are making a substantial contribution to international physics, he says. Since the number of visitors is large, the chance of meeting a colleague with similar interests is also great, thus enhancing the probability of collaboration, he adds. Dr Kephart is convinced that the scientist who visits the Centre "gains from both the scientific and cultural experience independently of whether he or she is from the East or West, North or South, or from a developed or developing country". In his view, the effectiveness of interactions between scientists in the developed and developing countries, as with any other human interaction, demands effort by individuals. This effort is so apparent at the Centre and has resulted in many rewards for all. Its congenial and intellectual atmosphere provides opportunity, and "the scientists who come from all parts of the world are making the most of it", he says.

Looking to the future

The ICTP is on the march. It has certainly created a stir, both in the developing and the developed world. In years to come, as the "visionary enterprise's" laudable undertakings ramify, the physics of developing countries will gradually be rescued and rejuvenated. The following proposals could perhaps figure in a futuristic perspective of the Centre's programme:

- The Centre could encourage and find innovative projects aimed at improving the *teaching* of physics in developing countries. The Centre could locate individuals/groups who are doing something on their own already. A group of teachers in Delhi is said to have undertaken fabrication of teaching aids using local expertise and indigenous material. They were reported to be very successful. In Pakistan, a research group at the Pakistan Institute of Nuclear Science and Technology has developed computer simulation of several dynamical phenomena.

- The Centre may try to locate good physicists/writers in developing countries and "commission" them to write text-book style monographs on different topics from the perspective of less-developed countries. These could supplement the woefully inadequate school/college texts being used in many developing countries.

- The Centre has so far laid emphasis on nurturing individual research works. Perhaps the time has come to consolidate this effort and to try to develop groups of productive researchers. Again, this is a question of locating prospective active groups and supporting them *in situ* so to speak.

- The Centre may consider instituting "South-South Associateships" to enable scientists of a developing country to spend some time with an active group in a neighbouring/regional country (rather than at the ICTP). This would be cheaper than normal associateships and have the advantage of helping two developing countries in one go.