

Nurturing science in developing countries

High standards in scientific education and research should not be the privilege of those who can afford to attend prestigious universities. Physicists in Trieste are trying to remedy the isolation of scholars from developing countries and involve them in the worldwide scientific community.

Tucked between the Istrian and the Italian coasts on the Adriatic Sea, Trieste has become an important hub of scientific activities, especially for physicists. Despite its peripheral location, at the border with Slovenia, and its undistinguished academic traditions compared with other Italian cities (such as Pisa, Padova or Bologna) Trieste is the home of the International School for Advanced Studies (SISSA). This is the postgraduate institution that this year ranked first in physics and mathematics and second best in biology, according to the first official evaluation of academic research institutes in Italy, and is 17th according to the worldwide Shanghai ranking scheme (weighted for size).

But more impressive still, is the fact that in Trieste scientific excellence is coupled with the mission to build the scientific capacity of developing countries and involve their scientists at an international level. Next door to SISSA, the International Centre for Theoretical Physics (ICTP) provides rich and well-attended programmes to help the work of scientists from developing countries at different career stages. These are not top-down programmes based on political lobbying and provision of funds. Virtually everyone working at ICTP gets up close and personal with scientists from developing countries to teach, advise or collaborate with them. SISSA is involved in this as well, being larger than ICTP, which has only 28 permanent staff. In fact, SISSA provides many of the lecturers, tutors, professors and researchers to carry out activities organized by ICTP.

It is perhaps not surprising then that Erio Tosatti, a theoretical condensed matter physicist at SISSA, was awarded the 2006 Tate medal by the American Institute of Physics for his persistent effort in helping scientists from developing countries and working with them to elevate their research programmes to international standards. Tosatti received the award in Washington, DC in May 2006.

In July, *Nature Materials* went to Trieste to hear his experiences and find out just how Trieste's scientists instil scholars from developing countries, who sometimes lack the most basic facilities of modern life, with the desire to pursue world-class standards.

Tosatti served as acting director of ICTP between 2002 and 2003, during a transition period. We asked him if that might have been the reason why he received the award. "The Tate medal was quite an unexpected honour. It goes to a non-American for helping keep together the international community. I have been part of SISSA and ICTP for over 25 years, and almost everyone in physics has visited here once. The American Institute of Physics committees encompass scientists from the US and other developed and developing countries who clearly value the Trieste system as a home away from home. The condensed matter physics community, in particular, is a huge group of people (one third of the global physics community) who tend have ICTP and SISSA as their reference point. This makes all of us working here relatively important in that respect."

In the mid 1960s, when Tosatti started his career in Rome in one of the best Italian physics departments, particle physicists Abdus Salam and Paolo Budinich were setting up ICTP in Trieste. They started off as a theoretical high-energy physics institute and they aimed at gradually expanding to cover other areas, primarily condensed matter theory. They were looking for enthusiastic faculty members to build a high-profile physics centre. In 1974, when he was first offered a position, Tosatti declined bluntly. "There was nothing in my area and so it meant having to build everything from scratch. I knew a colleague from the US had tried before me. But he had been given no secretary, no budget, no group: no wonder he left after one year. Moreover, in Rome I was in the best place for science; coming to Trieste then was like moving to a desert. But the

Erio Tossatti, professor of physics at SISSA and former acting director of ICTP.



people who started this place had a very international outlook and were very convincing. They wanted me and I persuaded them to bring a whole group of scientists along, to give us a budget and a secretary. The desert was in fact a very fertile place, where things could grow. With hindsight, I think that, had I not found a place like this in Italy, I would have left the country.”

ICTP was a unique experiment right from the start. Salam wished for ICTP to have a strong impact on scientists from developing countries. Forty two years on, this mission hasn't changed and the result can be seen in the sheer number of scientists (of the order of 100,000) who have visited and worked in ICTP and SISSA, throughout the years.

ICTP director, Katapalli Sreenivasan, explained how the programs work. “We have diploma programmes for young students who have already got a bachelor's degree in their countries but they still benefit from very rigorous training (for nine months) to enable them to think analytically about scientific problems. We also take PhD students for six months of the year. They are registered for a degree in their country and they also have an advisor here. In this way they get the benefit of working and making connections in Trieste but they remain linked to their country and then stay there. Then, we have a programme for associates. These are researchers who do not have much time or resources to do research in their country. They can come to Trieste every year and stay for up to 40 days to use our facilities and be stimulated by a more international environment. Sometimes people apply for yearly fellowships but we cannot afford to take them. So we arrange to send them to SISSA or other Italian universities who can help with the funding. On top of these, we run a number of conferences, workshops and schools. Some are pedagogical, others have a front end which is pedagogical and a back end which is more research oriented, some are indeed very advanced research conferences, like the ‘Lundqvist’ series for example.”

This assortment of programs caters for the variable level of scientific proficiency of what are still collectively called ‘third world’ countries. For example, China, Mexico, Brazil and India have made strides and are much better off than sub-Saharan

countries, which are seriously lagging behind. For this reason, a course on string theory would be too esoteric for students from the latter, whereas a course on internet connectivity is likely to be more relevant. Moreover, there are issues that have strong geographical dependence. Earthquakes, for example, are a particular concern of Sreenivasan. “Because I am Indian by birth, I am sensitive to the problems of that region. I worry about a big fault line that runs from Iran all the way to Vietnam. If an earthquake happened near a main city along this fault it would kill hundreds of thousands. So we are organizing a meeting of geoscientists from all these countries at ICTP. They come to discuss science first of all, but also how to respond to these huge, devastating events. These kinds of events sometimes bring together people from neighbouring countries between which there is political friction. But when they come to Trieste they have the same objectives and meetings generally work very well.”

Sreenivasan is a strong supporter of the original mission to alleviate the isolation of third world scientists. However, he also acknowledges the changing circumstances and wants to adapt the functions of ICTP to the current situation. He has rejuvenated the ties with UNESCO and CERN to gain more support for ICTP's activities. He recognized that the progress of countries like Brazil, China and India could be harnessed for South-South cooperation. Therefore, he has established partnership with Brazilian, Chinese and Indian institutions to co-sponsor scientific schools and workshops held in these countries. There are several advantages to this. The most obvious one is financial. The same amount of money can bring in more participants than if they had to travel to Trieste. Attendees have less mobility problems caused by unpleasant visa procedures and solidarity builds up between developing countries. From a scientific standpoint, Sreenivasan is also trying to expand the scope of the programmes. “I try to emphasize the theme of sustainable development, things like climate change, earthquakes, Earth-related science. We now have an Earth-systems physics diploma course, and more of these projects are in the pipeline. I believe that if the world at large aspires to develop in the same way the western world did (by accident of history), there are no resources on earth that can sustain it.”

Another example of South-South cooperation is found in the activities of the Academy of Science for the Developing World (TWAS), also created by Salam, which seeks to build the capacity of both individual scientists and scientific institutions. The Academy extends a helping hand to scientists by providing, for example, research grants and prizes, and it works closely with policy makers to raise the level of funding and the profile of science throughout the developing world. In recent years, the Academy has signed agreements with the governments of Brazil, China and India to host talented students from other developing countries, similar to what ICTP does in Trieste. Mohamed H. A. Hassan, executive director of TWAS, talks about this new venture. “It's a win-win situation. The work of the

students enriches scientific activities at the host institutions, and scientists find opportunities to forge new contacts that will likely be maintained once they return to their country.”

In their roles, Hassan and Sreenivasan try to influence the decisions of ministers and policy makers of developing countries. The priority for both is to improve basic scientific education. “Concentrating on highly specialized topics is dangerous because these can change with time,” says Sreenivasan, “We try to tailor our approach to the specific needs of a country, but the bottom line is that to build scientific capacity, one needs to impart rigor in the training of educators as well as policy makers, and those who are responsible for raising scientific awareness in their country.”

Hassan believes that concentrating on cutting-edge science and technologies is the way forward for developing countries “I advise decision makers to focus on frontier scientific and technological fields and to explore and invest in areas that can really make a difference to development. They should, for example, pursue research and development opportunities in material science, especially nanotechnology, communication and information technologies, biotechnology and space research, because if they fail to develop these cutting-edge fields they will forever remain behind in today’s fast-paced global environment for science and technology. Yet, these nations must continue to develop their capacity in the basic sciences: a nation simply cannot

do without physicists, mathematicians, biologists and chemists as they are the ones who enable these cutting-edge technologies.”

Another thing that should not be overlooked is the innate desire for knowledge. This is an issue Sreenivasan feels very strongly about. “Sometimes I ask myself: what is the motivation for people living in such a difficult environment to do science? Would I still do science if I were there? But who am I to tell a student from Congo, for instance, that string theory is too esoteric for him or her? Why should string theory be a privilege of people who can go to Princeton, or similar places? I believe there should be a place in the world where clever people can pursue their scientific interests if they are willing to work hard to develop the competence needed. I regard what we do here as part of that goal.”

“Most of us do physics out of a form of delusion,” says Tosatti, “Our guests from developing countries are extremely capable people and they could do well for themselves under any circumstances. But a desire, typically in their young age, to do something intellectually and spiritually challenging, drives them into this difficult, low-paid profession. If you add to this a general sense of isolation that these scientists have (because they are not valued by their society and they feel apart from the international science community), their level of frustration must be overwhelming. That’s why personal care and some connection are relatively cheap but crucial ingredients. It is our mission to provide them.”