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International Science Programme
Uppsala University
1961–2001

Historical Review
and Participants' Experiences

Editor: Torsten Lindqvist

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ABSTRACT

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On the 1st of September, 1961, an international fellowship programme started at the Institute of Physics, Uppsala University. Fifteen fellows from 14 developing countries were invited to spend one academic year in Sweden to be trained in research work. The programme was at that time called the International Seminar for Research and Education in Physics. Today, 40 years later, the programme has developed from a fellowship programme into a worldwide research project programme, not only in physics but also in chemistry, and has given long-term support to the building up of viable research teams in the Third World. Host laboratories in the northern hemisphere, mainly in Sweden but also in other countries, cooperate with the research groups in the Third World. The programme changed its name in 1987 to the International Science Programme.

The programme has been financially supported by the Swedish Government through its agencies for aid to developing countries. Uppsala University, UNESCO and IAEA have also contributed.

The development of the programme is described. In his introduction the Vice Chancellor of Uppsala University points out the importance for the entire university to be engaged in cooperation with the Third World. Ideas about the future of the programme are presented. Some of the research groups in the Third World have been engaged in the programme for nearly twenty years. Their experience is presented in a number of short articles.

Key words: Developing countries, Research, Basic Sciences, Projects, Regional cooperation, Networks.

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Editor's Preface

This book is written in order to document the 40 years of cooperation between the International Seminars in Physics and Chemistry (from 1987 named the International Science Programme) and developing countries in order to build research capacity in physics and chemistry in the Third World. The programme started in a modest way on September 1, 1961, with the invitation of 15 fellows from developing countries to spend one year at the Institute of Physics, Uppsala University, for research work. At that time, the programme was unique and attracted international attention. During these 40 years of activity, the programme has developed into a large project programme, not only in physics but also in chemistry. The results in the supported developing countries in terms of sustainable research groups, trained scientists, PhD and MSc theses, and networks within the regions of developing countries, are impressive.

It is hoped that this book, aside from giving the history of the programme, will also inspire and inform scientists all over the world, university authorities, donor agencies in all countries and politicians in developing countries, so that the programme can continue to develop and so that new programmes can be started by other countries and within other scientific disciplines.

One chapter of this book deals with the historical review, to a great extent based on annual reports. Regarding the first ten years, the editor's personal experience has been an important source. For the period 1970–80, two former directors of the Physics Seminar, Olov Bergman och Anders Marelius, jointly wrote a report intended to be published at the 30th anniversary of the International Seminar in Physics. For various reasons this report was not published, but it has been used as a source for this historical review.

Many other publications have been consulted (see list of references), such as reports on supported research groups. The Director of the Chemistry programme 1970–1997, Rune Liminga, has related his experience in a very extensive publication, with the subtitle "1970–1995, Summing up – Looking into the future". The Director of the Physics programme, Lennart Hasselgren, who has been involved in the activity since 1975 and is still active, has of course been indispensable to the production of this book. The head of administration, Åsa Bergengren, was engaged already in 1968 and is thus the veteran of the

programme. She has given valuable contributions as a result of her experience of the non-scientific matters of this programme. The new Director of the Chemistry programme, Malin Åkerblom, has contributed with the latest development on that side. The appendices in the form of maps showing the locations of projects and host laboratories have been produced by staff member Johan Wennerberg. The figures have been put in digital form by Teddy Thörnlund, Department of Radiation Sciences.

An informal reference group, consisting of actual directors, the head of administration and a board member, professor Claes-Göran Granqvist, have on various occasions discussed the progress of the work with the editor.

The book also contains reports from certain funded research groups in the developing countries. The guidelines for their texts were, on purpose, minimal. The authors were requested to choose themselves the way of presenting the cooperation with the programme. Some editing has taken place. Their articles are not only very interesting but also serve as evidence that the programme has been worth while. As a special token of gratitude, one of the participants of the first course, 1961–62, has made a much appreciated donation to the ISP in connection with its 40 years anniversary.

This book's production has been made possible thanks to a generous financial contribution by the Wenner-Gren Foundations. The International Science Programme wishes to take the opportunity to express its gratitude.

Uppsala, September 2001

Torsten Lindqvist

Assistant Professor of Physics emeritus

Introduction

By Professor Bo Sundqvist
Vice Chancellor of Uppsala University
Uppsala, Sweden

A great global challenge for higher education is to contribute to the development of tertiary education in developing countries. This challenge was recently emphasized by a special task force at the initiative of the World Bank. The title of the report is 'Higher Education in Developing Countries – Peril and Promise'. The task force was headed by the former president of the University of Cape Town, Mamphela Ramphele, as chair and the renowned Harvard dean and economist Henry Rosovsky as vice-chair.

First of all, the task force established that the world economy changes when knowledge replaces physical capital as the source of wealth. This change has already taken place to a certain extent and it is expected to be even more pronounced in the future. As knowledge grows in importance, so does the need for higher education. More and more, well-educated citizens, and the successful generation of new knowledge through research, constitute factors for the success of a nation.

The gap that exists between industrialized and developing countries as regards the capacity to educate their citizens and employ new knowledge for economic growth is increasing rapidly at present.

The cornerstone for knowledge-based economies is the systematically developed foundation of basic knowledge that leads to technological development. Today, and even more so tomorrow, new technologies like biotechnology, materials technology, and information and communication technology are rooted in basic knowledge straight from pure research at the biomolecular level, from the crafting of materials at the atomic level, and on quantum mechanical phenomena. This circumstance means that the gap mentioned earlier, between industrialized and developing countries, will widen more rapidly than ever before.

How can our world go about creating conditions that at least make it feasible to decrease this gap? Half of all undergraduate students are in developing countries. Today more than 100 million people, mostly in developing countries, are eligible for higher education but cannot access it. The burgeoning need for expanded capacity in academic education has led to desperate measures, such as those in Mexico and Argentina involving so-called mega-universities with more than 500,000 students. Other countries are rife with 'for-profit'

solutions which in many cases lead to so-called 'garage universities' of dubious quality. Rosovsky, who is an economist himself and largely penned the report, states in one of the conclusions that the market alone will not be able to solve these problems.

Universities in the industrialized world, as the prime creators and conveyors of knowledge, must take the lead when it comes to efforts to diminish the developmental gap between industrialized and developing nations.

Two thirds of the world's population live in low-income countries that possess about 6% of the purchasing power of the remaining one third, that is, high-income countries like ours. These differences continue to grow apace with the widening of the knowledge gap. One consequence of these developments is the so-called 'brain drain' that has affected the developing countries. It is obvious, and it has been pointed out for many years, that what is needed is infrastructure, improved leadership, health measures, and development of the financial systems in developing countries, but what is new is the accelerating need for higher education. As the English author H. G. Wells writes in The Outline of History: "Human history becomes more and more a race between education and catastrophe".

Uppsala University continues to reinforce its role as an international research university by systematically benchmarking itself vis-a-vis the best in the world. In regard to developing countries, Uppsala University already has a relatively strong profile. However, it can develop further toward a greater emphasis on mentorship for universities that are coming into their own in the Third World. It is in order to support this work that, in the future, a larger share of Sweden's developmental assistance will be earmarked for support to higher education in the developing countries. Sweden and Uppsala University have made major contributions in this respect, cementing a tradition of support for higher education that does not lead to brain drain. This can be further elaborated and strengthened, though.

Another aspect of the collaboration with the Third World, that perhaps has not received sufficient attention, is that it allows us to offer a better education to our Swedish students by exposing them to a broader cultural spectrum than would have been possible with fewer non-Swedish students and guest researchers.

Higher education is facing many formidable challenges in the new millennium. The emerging knowledge-based society places universities at the center of the global village, but at the same time developments are necessitating rapid innovative changes to meet the demands made by the international community. Uppsala University is able to change itself quickly when the need arises, which explains how we have survived for well over five hundred years.

What does Uppsala University's cooperation with developing countries look like today? There are of course a large number of activities built on more or less private initiatives. However there are also a number of more official activities, embracing many disciplines, and Uppsala University can thus offer a

cooperation that is truly interdisciplinary. This is an aspect that is becoming increasingly important in today's society.

The oldest activity is the International Science Programme, ISP (formerly called the International Seminars), which started already in 1961. The ISP has the aim to assist in building sustainable research capacity in a number of developing countries in Latin America, Africa and Asia, in the fields of physical and chemical sciences. It also administrates a number of bilateral projects for SAREC, including its support to the College of Science at Asmara University in Eritrea and the assistance in information and communications technology to Makerere University in Uganda. The International Science Programme is very successful, and there have been several external evaluations, all positive. The ISP is mainly financed by Sida/SAREC, which has recently agreed to extend its support also to mathematics as well.

Within the Faculty of Medicine at Uppsala University, the Unit for International Maternal and Child Health and the Unit for Nutrition have well established cooperation with the Third World. The Department of Pharmacognosy, within the Faculty of Pharmacy, also has well developed contacts.

The Faculty of Arts has a special unit for African and Comparative Archaeology, and within the Faculty of Social Sciences the Department of Peace and Conflict Research offers extensive education and documentation about conflicts, solutions of conflicts, ethnicity, and development in the world. The Department of Government has a special Unit of Development Studies.

Another special unit within the university is the Collegium for Development Studies, which serves as a forum for dialogues concerning development and aid issues. The Centre for Environment and Development Studies, CEMUS, is an important student initiative.

Examples of affiliated units outside the University, and with relations to developing countries, include the Dag Hammarskjöld Foundation and the Nordic Africa Institute. Further, the University has close cooperation with the Swedish University of Agricultural Sciences, which is also based in Uppsala.

In all, I feel rather confident when I look at the possibilities of future cooperation between Uppsala University and universities outside Europe and North America. I am convinced that Uppsala University is well prepared for such endeavours, and we definitely have the motivation, provided funds are made available. This last issue is very important, since Swedish universities of today have limited possibilities of initiating any long-term and meaningful cooperation without special financial support. However, I am pleased to see that Sida/SAREC, as one of a few governmental organizations, has realised the importance of capacity building of research in developing countries. This gives hope for the future.

The International Science Programme started on the 1st of September, 1961. This particular book will describe the development of the programme that has taken place during the past forty years, as seen by some of those who have contributed as participants or as staff members.

Aims, Realities and Results – a Historical Review

By Torsten Lindqvist

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Director of the International Seminar in Physics 1960–69, 1979–80
Uppsala University, Sweden

Background

During the 1950s it became more and more obvious that "technical assistance" to developing countries was necessary from all points of view. In those days the term "technical assistance" included support to research and education within universities. All agreed to this but there were many questions about which form of assistance was most efficient. From the financial point of view the question was whether the actions should be bilateral or multilateral. The multilateral assistance, through the UN or UNESCO, was of course more powerful in terms of financial input and also in terms of recognized prestige in the eyes of the developing countries. The drawback was the bureaucracy and delay in multilateral actions. The bilateral assistance, on the other hand, was expected to be less powerful but more quickly received and more personal. When we look back today we notice that the bilateral assistance has been adopted more and more in all industrialized countries.

Another matter under discussion was whether fundamental research or applied research should be supported, a matter still discussed today. Members of the academic community had many arguments in favour of fundamental research, whereas politicians favoured applied research, and that only as a third option after agricultural support (hundreds of tractors to Africa!) and health service. The weight of the arguments from the Swedish academic community, however, convinced the Swedish government that fundamental research was the basis for development in all sectors of the society.

Still, another problem remained. There were two alternatives. Should experts from Sweden go to the developing country and thus be able to teach and train *several* students for the cost of one person but with limited means of demonstrating the infrastructure of research and education? Or should *one* student come to Sweden for a year or so in order to be a member of a functioning research group in a scientific environment? As we shall see later, in the case of the International Seminar/ISP, the second alternative was chosen to begin with, but the first alternative was also applied more and more during the 40 years.

In order to start a project at a Swedish university department with the aim of training colleagues from developing countries it was at that time first necessary to show that there existed

– a documented need for the project,
– enthusiastic people to run the project in Sweden and
– financial support.

All these requirements were fulfilled at the Institute of Physics, Uppsala University, in the late 1950s.

The story starts a little earlier. Kai Siegbahn (Nobel Laurate 1981) became a professor at the Institute of Physics in 1954. He was already then a world famous nuclear physicist and the institute received many inquiries from students and researchers around the world about the possibility of doing research in Uppsala. Those who could finance their stay came. During the period of 1955–1960 there were 54 foreign guest scientists and students from 21 countries staying at the institute for shorter or longer periods. However, very few came from developing countries, as they could not finance their stay and the institute did not have any fellowships to distribute. It was obvious that there was a *need* to start a project with fellowships for students from developing countries.

The presence of the foreign students at the institute during the 1950s created an international atmosphere. The foreign guests were a natural part of the daily life. All postgraduate lectures were given in English. Everyone was *enthusiastic* about having a foreign coworker in their research group.

Finally, an application for *financial support* was well received at this moment in time. As mentioned above, Sweden started to be aware of the importance of contributing to the scientific development of the Third World. Within the long existing Swedish Institute a special section was created, the Central Committee for Swedish Technical Assistance. The purpose of this committee was to be, among other things, a source for fellowships to students who wanted to come to Sweden.

The International Seminar for Research and Education in Physics

Motivated by all the requests for fellowships from students from the Third World, one of the scientists at the Institute of Physics, Tor Ragnar Gerholm, presented a plan for an "international school" in physics, i.e a fellowship programme, to be held yearly at the institute. The plan included a certain number of 10 months fellowships to be distributed by the institute after selection among the applications. After a long discussion, it was decided to name the school "The International Seminar for Research and Education in Physics", a name that later was shortened by deleting "for Research and Education". It also turned out that

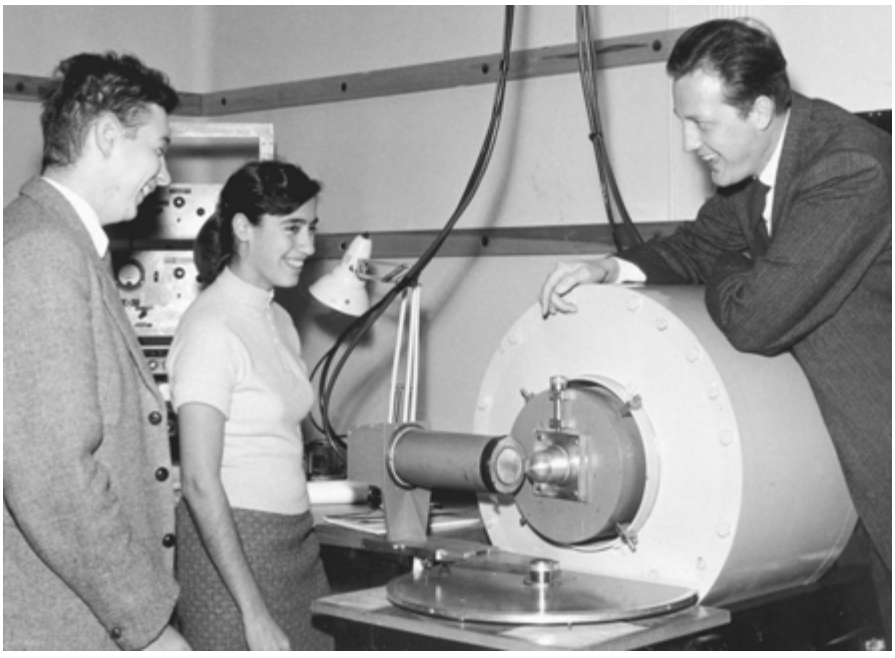


Figure 1. The "inventor" of the International Seminar in Physics, Professor Tor Ragnar Gerholm, demonstrating his beta-gamma coincidence spectrometer to guest scientists from Argentina. (Private photo)

the word "Seminar" created some confusion as to the real character of the project. Later we shall see that the name was changed once more.

The project was strongly supported by the Head of the Physics Department, Professor Kai Siegbahn and also by the Vice Chancellor of the University, Professor Torgny Segerstedt. An application was sent to the Central Committee for Swedish Technical Assistance on the 18th of March, 1959, asking for the necessary funding – about 250 000 SEK – for the first year for 15 fellows. This project was the largest that the Central Committee had considered so far and it took a long time before a decision came. One reason was that the minister in charge of the assistance to developing countries, Mrs. Ulla Lindström, was not convinced of the effect of supporting research in physics in developing countries. A personal lobbying by Segerstedt and Siegbahn cleared the way for the project and in April 1960 it was decided in principle that a Seminar could be funded for a period of five years, after which a new application could be considered.

A Director of the Seminar was appointed from the 1st of September, 1960. His first task was to formulate an announcement and an application form. Another big task was the preparation of the seminar locality (see below). The first Board Meeting was held on the 2nd of December, 1960. At this meeting it was decided which countries should be invited for the first year, set to begin the 1st of September, 1961.

Figure 2. The main room of the Seminar locality in the Institute of Physics, where ISP was located until 1991. (Photo Einar Söderberg)

The Application for the Fellowship Programme

In the application to the Central Committee it was pointed out that the following conditions should be fulfilled:

- A certain number of one year fellowships to be distributed by the Seminar upon application.
- An efficient organization for scientific and social assistance.
- Special localities for staff and fellows within the Institute of Physics.

The funding authority, the above mentioned Central Committee, accepted all details of the application. Thus 15 fellowships were to be announced. Further, a staff of three full-time persons were appointed for the Seminar. The director, an active senior scientist, should organize and conduct the Seminar. An assistant, also an active scientist, should assist in the contact between seminar participants and their respective research groups. Finally, a secretary should help the participants in all social matters. A board headed by the Vice Chancellor of the University was appointed.

The building of the Institute of Physics in Uppsala (built in 1908) had a 200 m^2 large garret space used for storing old instruments. This space was cleared of instruments and designed into a specially made locality for the Seminar by the architect Gösta Wikforss, Uppsala. The locality contained a large room with

the combined function of lecture room, library, study corners and club room. Further there were two offices for the staff and a small kitchen to be used by the participants, e.g. at social evening gatherings. It turned out that this locality became very important for the participants. It functioned perfectly for all the activities it was planned for and also played a role as a second home for the participants. The cost of the rebuilding and furnishing was covered by the University. Due to the reclaiming of the space by the Institute of Physics and to changes in the Seminar programme this locality had to be abandoned in 1991.

Although the Central Committee took the full responsibility for the running costs of the Seminar, it was felt that it would gain recognition by having the organizations IAEA and UNESCO stand behind the project. The project was presented to these two organizations during personal visits in October 1960. There was some confusion as the presentation did not follow the normal diplomatic channels. Fortunately, in both organizations there were key persons who immediately understood the potential of the programme and they promised support at once. In the case of IAEA, four fellowships were put at the disposal of the Seminar. UNESCO covered the cost of a yearly study tour to European laboratories.

Invitation to the first year of the Seminar

During the 1950s there were lots of fellowship schemes for gifted individuals from developing countries. However, those fellowships were known to be associated with a whole series of problems. The training was not always relevant. In some cases, the individuals were trained in e.g. reactor physics or accelerator physics, fields which had not been introduced in developing countries at that time. Therefore, many never returned home from the sophisticated western laboratories, thus causing a severe brain drain from the developing countries. Among those who did return, there was little coherence in research orientation.

The founders of the International Seminar in Physics were fully aware of these problems in formulating the aims of the seminar. In the announcement poster one could read:

> The aim of the International Seminar will be
> 1. To provide possibilities for individual participation in qualified experimental research work in one of various fields of physics (e.g. solid state physics, x-ray physics, nuclear physics, atomic physics etc.) under the guidance of experimental scientists. An introductory course in the operation of and coding for a modern computer, IBM 1620, will be given.
> 2. To inform the participants of various methods of organizing research projects, physical laboratories and teaching of graduate and undergraduate students.
> 3. To demonstrate to the participants how Sweden, and in some cases other European countries, have organized schools, universities, other scientific institutions and industrial laboratories.

In order to get a broad geographical distribution among the participants, it was stated in the announcement that a quota system would be applied, according to which not more than two fellows from the same country could be selected the same year and not more than eight fellows from each continent. This rule made it of course impossible for the selection committee to select the 15 "best applicants in the world" from the applications.

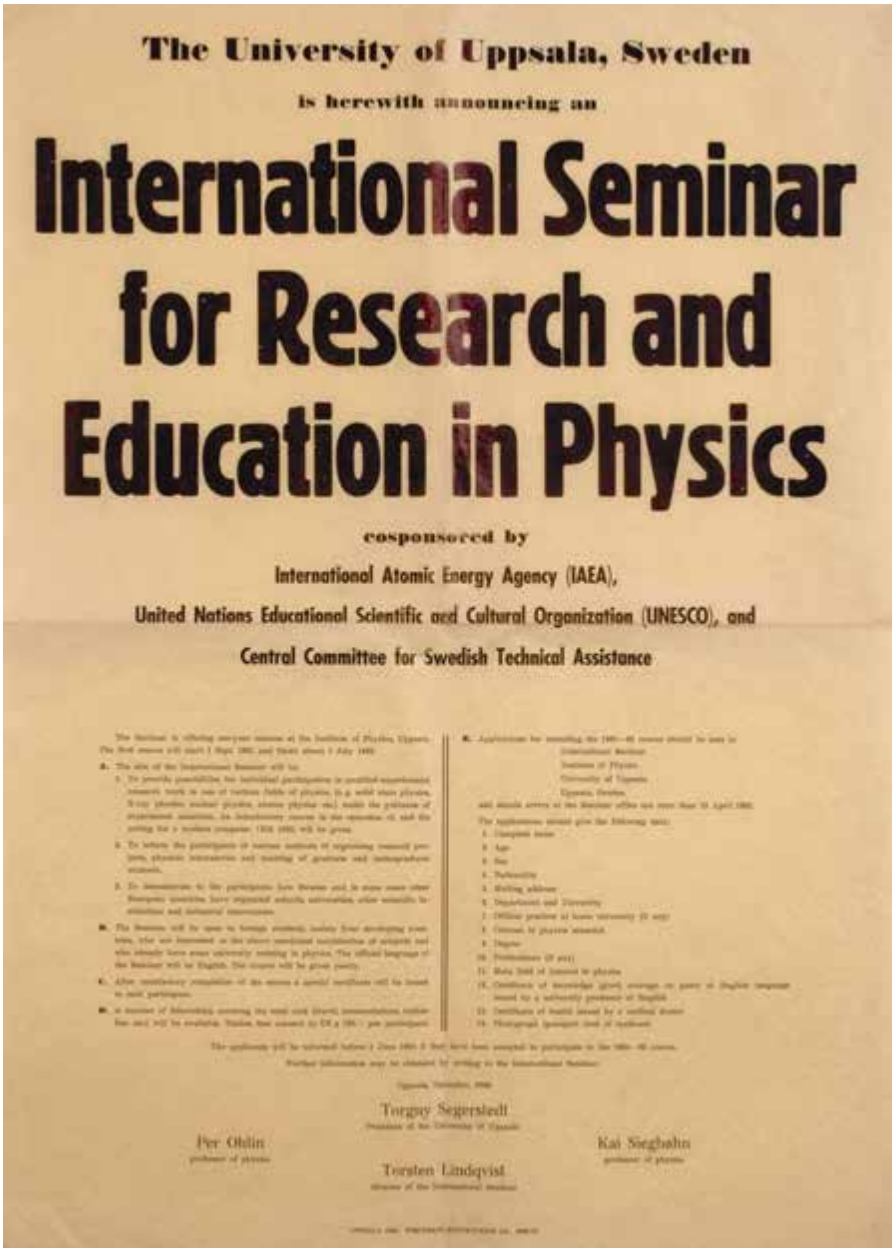
The fields of physics that the Institute of Physics could offer the participants at that time did not require very expensive instruments and were therefore suitable for developing countries. Even if it was not explicitly mentioned in the aims, the founders had in mind the formation of research groups in the developing countries along the same lines as in Uppsala.

The invitation to the first year of the Seminar, in the form of a poster (see fig. 3), went to all countries in Latin America, Africa (except South Africa) and Asia (except China) and were distributed through the Swedish Embassies and through IAEA and UNESCO. This was indeed an ambitious beginning but the procedure could be seen as marketing. A total of 118 applications from 17 countries were received. A special committee with representatives of IAEA, UNESCO, the Central Committee and the Seminar held a selection meeting the 21st of April, 1961. The selection was rather difficult as very little was known at that time about physics in Asia and Africa. Latin America was an exception as two staff members from the Institute of Physics had worked in Argentina as UNESCO experts in nuclear physics and had also visited several countries in Latin America, which had given them a good knowledge of the level of physics as well as of candidates for the Seminar.

In order to demonstrate how the programme developed during its 40 years of existence, a list of the first 15 participants, their home countries and the research groups they chose to work in is given here (f=female, *=IAEA-fellows):

Name	*Country*	*Research field*
H. Ruival	Argentina	Solid State Physics
M. Salomon	Argentina	Nuclear Physics
O. Troncoso	Bolivia	Cosmic Ray Physics
A. Maciel (f)	Brazil	Nuclear Physics
S. Pancholi	India	Nuclear Physics
H. Sahaf *	Iraq	Nuclear Physics
K.S. Han *	Korea	Nuclear Physics
D. Siddique (f)	Pakistan	Nuclear Physics
V. Honma	Peru	Solid State Physics
G. Zita	Philippines	Computing
S. Ogaza *	Poland	Nuclear Physics
P.C. Tsui	Taiwan	Optical Spectroscopy
S. Srirath (f)	Thailand	Nuclear Physics
M. Madakbas	Turkey	Nuclear Detectors
U. Miklavzic *	Yugoslavia	Nuclear Physics

There are some interesting features in this list. Firstly, the dominance of Nuclear Physics as a research field reflects the main interest of the Institute of


The University of Uppsala, Sweden

is herewith announcing an

International Seminar for Research and Education in Physics

cosponsored by

International Atomic Energy Agency (IAEA),

United Nations Educational Scientific and Cultural Organization (UNESCO), and

Central Committee for Swedish Technical Assistance

Torgny Segerstedt

Per Olvin

Kai Siegbahn

Torsten Lindqvist

Figure 3. The poster for the announcement of the first course, 1961–62, which was distributed to developing countries in Asia, Africa and Latin America.

Physics at that time. Secondly, almost all participants had expressed interest in fundamental research and it was possible to meet their requests. All participants had their research groups located in Uppsala, most of them even within the building of the Institute of Physics, i.e. very close to the office of the

Figure 4. The first group of International Seminar participannts (1961–62) during the introduction course. (Photo Einar Söderberg)

Seminar and its staff. (In 1963, for the first time, a fellow was located outside Uppsala. He did his research work at the Physics Department, Stockholm University.) Thirdly, there are no Africans in the group. There were very few applications from African countries and the candidates did not at that time have adequate qualifications for the Seminar programme. In all these respects the programme of today is quite different, as can be seen below.

The lack of candidates from Africa was discussed within the Seminar already during the first year. When the new organization, the Swedish Agency for Technical Assistance (NIB), was launched on the 1st of January, 1962, the Seminar took the chance to inform the new Director General, Dr Arne Björnberg, about the situation and also presented a possible solution to the problem. In a letter, dated the 3rd of January, 1962, the Seminar presented an idea of creating a regional college located in East Africa, "e.g. in Tanganyika". It was proposed in the letter that during two years of studies some 20 good students should attend the college, which would be run by NIB and Swedish teachers. The subjects would be mainly mathematics and physics. After finishing the two years, the best students would be invited to the International Seminar in Uppsala in order to continue towards a BSc. The idea was never realized. Shortly afterwards a new different proposal was presented by professor Kai Siegbahn. After a long period of preparation the new proposal was presented by Uppsala University to NIB. This proposal was realized in 1965, when the Kenya Science Teachers College (KSTC) was inaugurated. KSTC was, however, not intended to be a base for recruitment to the International Seminar in Physics. KSTC is still in operation.

The first African fellow to participate in the Physics Seminar came in 1969/70 – and he came from West Africa.

Experiences from the first year of the Seminar

The International Seminar for Research and Education in Physics was officially inaugurated by the Vice Chancellor, Professor Torgny Segerstedt, on the 1st of September 1961 in the brand new localities designed for the Seminar. Present were all participants, their tutors, several professors from the Faculty of Science and representatives from IAEA, the Swedish Institute, the Student Union and others. Dr Rylov, IAEA, gave a short talk in which he expressed his congratulations to Uppsala University for the undertaking of the Seminar. Finally, the Director of the Seminar reviewed the background of the Seminar after which the University gave a luncheon for the participants, invited guests and staff (see App. 2). This procedure was repeated every 1st of September for about 20 years.

The running of the first year showed that the organization functioned quite well. The constant contact between staff, research group leaders and participants made it possible to check up on the performance of the fellows and to make necessary changes in the working conditions and in the extent of the research work. At the end of the course the participants were asked to fill in a questionnaire in order to find out their opinions of the programme. From the answers it could definitely be stated that the relatively free research studies were preferred to more regular and (then necessarily) less advanced class room teaching. Those who had not worked in a research group earlier, found it extremely important to see the methods "from inside" and to feel the atmosphere in such a group. The "living with the group effect" was obvious – the successes and the failures of the daily work of the group, which actually are evenly distributed in all research work, were openly reflected in the mood of the seminar participants.

To adjust oneself to the new conditions of a foreign laboratory is generally difficult and takes a long time. Compared to what earlier individual guest scientists at the institute had experienced, the adjustment difficulties were overcome much sooner for the seminar participants. The reason for this was certainly the fact that the participants in their daily contact efficiently informed each other about whatever new discovery was made. This "group effect" was extremely important for the progress of the work. This was not only important regarding practical matters but was also important in the scientific sense of information exchange. Instead of being isolated in his/her own field of research, the participants had daily contact with many other fields of physics, which certainly broadened their view of physics.

Even if the stay at the Seminar worked out according to plan, it was soon realized that, when the participant returned to his home department, there were problems. How should he/she make use of the new knowledge obtained in Uppsala? A relevant answer to this important question was the key to success for the whole programme.

It was easy to see that the answer would be to continue to support the fellow

and his home department by means of equipment and visiting experts. Furthermore, other students from the same department should be invited to the seminar the following years. In order to deal with these problems a philosophy was formulated within the Seminar, which can be expressed in three words:

Concentration Continuity Control

i.e. *concentration* on a few universities in a selected group of countries, *continuity* through inviting students from departments of earlier participants and allowing for expert visits to participant's home department for advice, interviews of new candidates and finally, *control*, in the meaning, as is stated later in this article, that it is necessary "to asses the progress [of the projects] continuously. If this did not prove to be satisfactory, measures had to be taken either to find ways to improve the development or to terminate the support to the particular project".

The following four years the announcement was still world-wide. The selection, however, tried to follow the *concentration* and *continuation* principles. As a consequence of the above mentioned principles, the invitation for the 1966/67 course was not distributed world-wide but instead directly to 23 universities/institutes. The number of participants increased that year to 20. The first staff travel – to universities in Asia – was undertaken in 1964. The first Swedish experts who were to support established groups were sent out in 1968.

Another observation made during the first year was that many participants wanted to stay for degree studies. This was, of course, not the intention of the programme at that time. Therefore, a sentence was added to the aims in the 1965 announcement: *The participation does not lead to a degree but the research work carried out will be published in an international scientific journal.* Here one can see an embryo of the sandwich programme later developed. There were, of course, a few exceptions from this in the case of very brilliant students. The first Seminar participants to present a PhD thesis at Uppsala University was Martin Salomon, Argentina, in 1964.

In 1963, detailed plans with lists of equipment, cost estimates and research projects for three research groups, in India, Argentina and Chile, initiated by the Seminar, were worked out and presented to NIB. The following year NIB approved in principle such projects, but they had to be decided separately for each case. The costs of equipment were for the three cases between 30 000 and 50 000 SEK. Such projects later became a very important part of the Seminar activities. The new organization, the Swedish International Development Authority (SIDA), which had replaced NIB on the 1st of July, 1965, continued to accept follow-up projects but it took many years before a budget for such projects was approved. The project idea has over the years developed into a very efficient tool for the adopted activities. The idea of an efficient follow-up model was presented in the form of a cartoon at the closing ceremony of the Physics Seminar in 1967 (fig. 5).

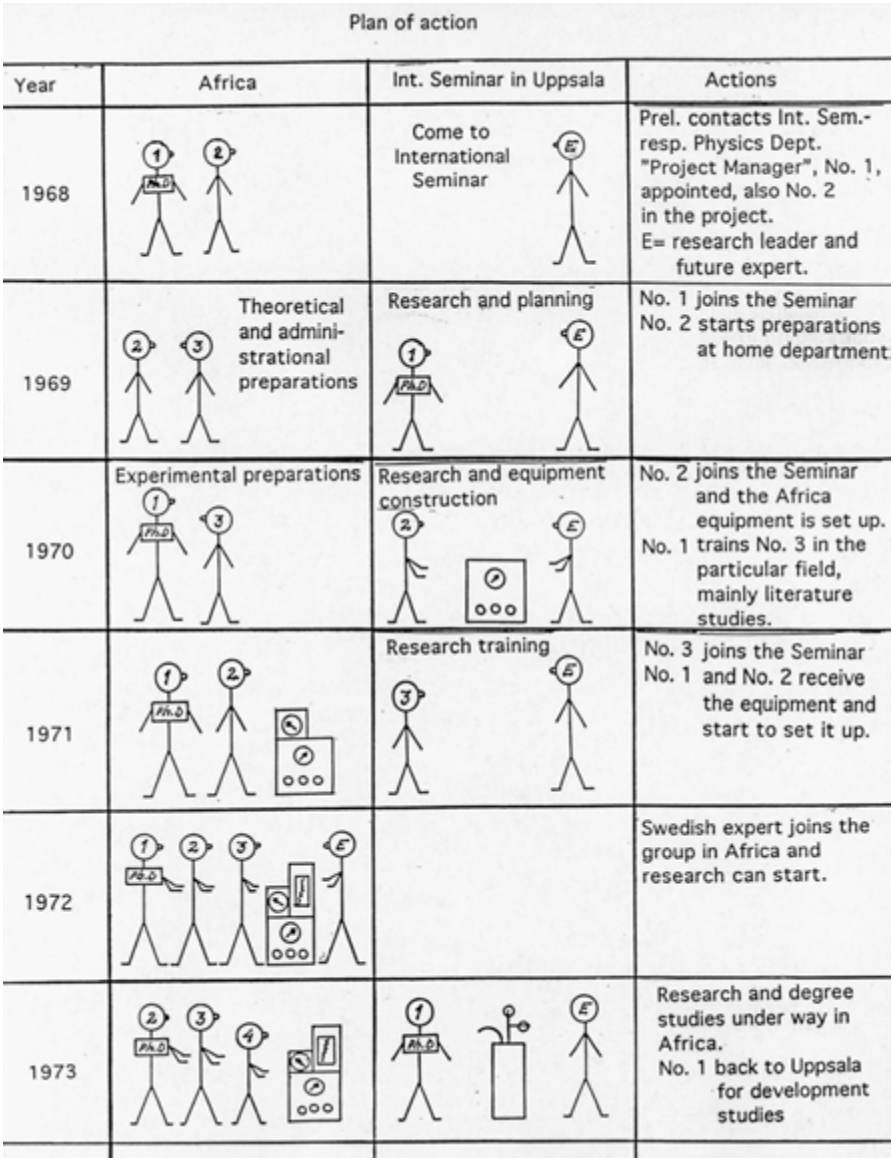


Figure 5. At the closing ceremony of the Physics Seminar on the 28th of June 1967 the Director presented a plan of action for the development of the fellowship programme into a project programme. In many ways the development during the 80s actually followed a similar plan. (The figure is the authentic picture shown in 1967, a time when no computer drawing was available.)

In order to make the choice of research field more efficient, a special list of the available research groups was distributed to the applicants at the end of the 1960s. The applicant could then discuss the matter within his/her department before arriving to the Seminar.

UNESCO found the principles of the programme so important that they recommended other countries to start similar programmes in other fields. What impressed UNESCO particularly was the low brain drain from the activity. The Seminar in Uppsala received during the 1960s many visitors from other countries who wanted to study the organization on the spot. The first country to start such a programme was Hungary, which arranged a Seminar in Mathematics, and several other seminars in other countries were established. UNESCO organized meetings for directors of international seminars. Later a Permanent Conference of Course Directors of Long-Term postgraduate courses in Physics was established. The two Directors of the Seminars took part in these meetings up to the end of the 1980s.

A Chemistry Programme is included in the Seminar

In the Physics Seminar course of 1963/64 one participant wanted to join a research group in x-ray crystallography. This group belonged to the Department of Chemistry but its laboratories were quite close to the Institute of Physics. Furthermore, staff members of Physics and Chemistry departments did know each other quite well and it was therefore easy to arrange for this participant to join the group. The Department of Chemistry had many research groups in several fields, such as inorganic, organic, analytical and physical chemistry and biochemistry. It was therefore natural, considering the success of the Physics Seminar, to start a discussion about a Chemistry Seminar. The first proposal to initiate a programme in chemistry was presented by Uppsala University to SIDA in June 1966. With the experience from the Physics Seminar, it was realized that if the admission requirement was set to MSc level there would be very few candidates from Africa. It was therefore proposed that BSc level with chemistry as the major subject should be sufficient for studies at the Chemistry Seminar in Uppsala. A first draft plan was sent to SIDA in April 1967.

SIDA wanted, however, to further investigate the need for such a programme. SIDA also wanted to give highest priority to ten countries in Africa, and a few countries in Asia and Latin America. Universities in the selected countries were approached through a questionnaire in order to explore the interest in a chemistry programme. Scientists from the Department of Chemistry and from the Physics Seminar were also sent out to a few universities in Africa for investigations. The response to these efforts was positive, and SIDA decided therefore in September 1969 to start a Chemistry Seminar in 1970. It was decided to operate the Seminar for a two-year trial period, and only a limited number of participants would be admitted. Only countries among the programme countries selected by SIDA plus a few countries in East Africa were to be invited. The Chemistry Seminar would be administratively coupled to the Physics Seminar.

A Course Committee was set up within the Chemistry Seminar for counselling of professional matters, and a coordinator was selected to implement its decisions and to handle all regular professional aspects. The programme was in most respects similar to the Physics Seminar although separate arrangements were occasionally made.

The first year of the Chemistry Seminar (1970/71) was announced in the same manner as the Physics Seminar. However, personal letters were also written to 20 university professors with whom previous contacts had been made. The number of fellowships available the first year was six. Out of the 8 applicants, 6 finally received an invitation, one of whom was not able to attend. The distribution of home countries and research fields for the participants in this first year was as follows:

Name	*Country*	*Research field*
D. Ahead	Pakistan	x-ray crystallography
M. Jawed	Pakistan	Analysis of ores and rocks
F. Louder	Tunisia	Organic chemistry
S. Moan	Uganda	Serum protein separation technique
K. Chitumbo	Zambia	Polymers

The first two years of the Chemistry Seminar were successful and the number of fellowships was increased to 15. A side effect of this, however, was the fact that some of the informality was lost when the total number of participants was increased from 20 to 30. Another change in the organization was that the coordinator of the Chemistry Seminar was named Head of the Chemistry Seminar. From now on the two seminars were equal in size and, from 1976 on, also in funding. The co-administration of the seminars, however, continued, although the staff size had to be increased as the amount of office work expanded rapidly.

An agreement between IAEA and UNESCO and Uppsala University was reached regarding the organization of the Chemistry Seminar with the result that from 1973/74, IAEA and UNESCO cooperated with Uppsala University in sponsoring and organizing both seminars.

The International Seminars in Physics and Chemistry

The two seminars were announced together as “The International Seminars in Physics and Chemistry” for 1970/71. The aims announced were then more adequately expressed in accordance with the experience from the first ten years, i.e. the creation of research groups was stressed:

> “The aims of the International Seminars in Physics and Chemistry are to initiate the creation of research groups or to provide assistance to already existing research groups at universities or national laboratories in developing countries. This assistance, which if proven successful may continue through several years, is given in order to improve the conditions and prospects for local research work.”

Figure 6. Ass. Professor Olov Bergman, Director of the Physics Seminar 1969–74, 1978–79 and 1980–82, visiting a former fellow and his family in Pakistan in 1975. (Private photo)

This is the first time that the idea of long-term engagement is mentioned already in the announcement. The Physics Seminar had during the first ten years interacted with some institutions in developing countries over relatively long periods of time through consecutive fellowships and follow-up assistance and thus helped to build up a number of reasonably strong research groups. Some Heads of Departments abroad knew the seminar well and some of them even made long range plans for the use of the seminar resources, mainly its fellowships. The situation at the beginning of the 1970s was thus satisfactory, but there were still some problems.

How sure was it that all applications to the seminars, both Physics and Chemistry, reflected the true priorities at home and that consecutive fellowships to the seminars were properly deployed? How relevant to the home institutions were the research programmes in Sweden? These programmes were actually assigned after the fellows had arrived in Sweden. In some cases it was possible to rely on what was known from earlier visits to the home institutions and on information supplied by the participant, which reduced the risks of misfits. In most cases, however, the application form was the sole source of information. A natural action was therefore to introduce a written research

proposal that was to be discussed between the applicant and the Head of his department before they decided to accept the fellowship. It was, however, soon realized that far greater efforts were called for, and desired, by the Third World scientists.

It became clear that the seminars needed to plan their activities in much closer liaison with the departments abroad. Not only was there a risk that applications were of less priority back home, but it was also noted that some applicant departments had not really gone through the process of selecting research fields in a realistic and qualified manner. In order for the seminars and the associated Swedish scientists to discuss research plans with departments in developing countries and to suggest how to develop or strengthen a particular research group, it was neccesary to be able to guarantee assistance over extensive periods of time. In fact, developing a local research capacity of significance could involve ten years or more, and even a master's degree, which may be a small component thereof, is a matter of 2–3 years. As the budgets were on an annual basis only, the seminars could not promise assistance of relevant duration.

Another problem was apparent after having received objections from developing countries that did not receive assistance. The fundamental idea of the seminars to build up research teams around viable research projects in developing countries implies, as mentioned above, that the seminars would stay in contact with a selected research group for several years. A typical scheme of support included training of scientists, purchase of equipment and spare parts, training of technicians and visits by Swedish scientists (fig 5). This type of long-term support, which seemed so obvious or self-evident to the staff of the seminars and the cooperating scientific groups in Sweden and, in principle, to developing countries, did not, however, seem self-evident to those who did not get support. During the 1970s there was a constant struggle to convince the various Ministries of Education, Vice Chancellors, or even Heads of Departments that the seminars needed to stay in contact with the same department for several years in order to obtain any progress in the department. The objection normally was "it is not fair to support just one group or one department when there are so many groups or departments deserving support". An invitation to a technician for a scholarship to Sweden was very often met by the objection "why should we send a technician when we have a number of PhDs waiting for a possibility to study abroad?" Even UNESCO argued for a more equal distribution of fellowships among countries and departments. The contrast to the declared policy of the seminars to stay in contact with the selected research group over several years was obvious.

The limitations in not being able to promise assistance over relevant periods of time due to the annual budget basis soon became a main concern. In the early 1970s, when the seminars still were under the rule of SIDA, there were only a few occasional undertakings covering more than one year.

A New Donor Agency

In 1975 a new agency, the Swedish Agency for Research Cooperation with Developing Countries (SAREC), was established. It was thus natural that the research oriented Physics and Chemistry Seminars would be funded by SAREC.

The transfer from SIDA to SAREC seemed a very simple operation, of just carrying the files of the seminars from one room in the SIDA office into another room on the same floor where the SAREC office was being established. However, this procedure implied motivating in every detail the features of the programmes of the seminars, including the basic question "Is support to basic sciences at all advisable when there are so many needs to address within the social and medical sciences?" In this process an evaluation of the seminar programmes was an important and welcome ingredient. The evaluation, carried out in 1976/77 (App. 3), included questionnaires to previous fellows and visits to research groups in Sweden and in developing countries. The report concluded by giving a number of recommendations and comments, summarized as follows:

1. Seminars fill a need for many developing countries and should be continued.
2. Seminars should support young scientists in research fields related to the development of participants' home countries.
3. Seminars should support research groups from a limited number of institutes.
4. Priority should be given to candidates with a MSc degree rather than PhDs.
5. More emphasis should be given to follow-up activities and additional funds should be allocated.
6. The number of countries invited should be further restricted. Priority should be given to poor countries with young universities.
7. Seminars should be well organized and of suitable duration.
8. Group study tour to laboratories in other European countries should be reconsidered. Individual study tours should be arranged to European research centres. Group study tours in Sweden should be retained.
9. Planning period should be three years and funds allocated on this basis.

As the result of this evaluation was most positive, it paved the way for a SAREC board meeting on seminar policies and development ideas in November 1978. From then on the need for the seminars to initiate discussions with institutions in developing countries and to sign long-term contracts on research projects without excessive bureaucracy was finally understood by the funding agency.

An Agreement with SAREC

The discussions between SAREC, Uppsala University and the Seminars led to some interesting conclusions. Firstly, the seminars were given the opportunity to enter into long-term agreements in support of cooperation between foreign and Swedish institutions. Such agreements should be based on in-depth discussions between the parties concerned, where problems, development prospects and resource requirements should be identified. The foreign institution would as a consequence be able to make better use of the seminars' resources. The seminars should also find out whether proposed research fields were in line with national priorities and thus direct their resources accordingly. It was anticipated that 1–2 such agreements per year could be signed in the immediate future.

Secondly, the seminars could in exceptional and strongly motivated cases support degree work in Sweden. A condition was that a long-term plan for research development and/or cooperation had been agreed upon with the candidate's home department or that the department was well known to the seminars. As much as possible of the work and responsibility for the degree would rest with the developing country institution.

Thirdly, the seminars could advertise a partially sponsored fellowship, which could be applied to countries with relatively high per capita incomes but with a need for research training or to a small number of supernumerary fellowships. Foreign signatories would pay essentially the incremental costs.

Furthermore, the seminars would investigate possibilities of transferring some activities of their programmes to developing country institutions. It would for instance appear possible to agree with a couple of earlier supported institutions that they should receive some fellows from other countries in order to provide part of the training usually provided by the seminars. This training could subsequently be followed up in Sweden.

With these modifications SAREC agreed to support the seminars from 1978/79 for the following five-year period, allowing the seminars to permit long-term agreements covering up to 15 of the current 30 annual stipends.

This agreement resulted in an extensive activity of the seminars. The funding from SAREC increased during the 1980s from 3,5 MSEK to 10,8 MSEK. The number of short-term fellows increased. Follow-up funds were allocated, with the largest portion spent on equipment. Staff travel in order to discuss long-term cooperation and to control existing projects increased.

Objectives, Policies and Principles in the 1980s

The announcement of the seminars in the form of posters was terminated with the 1980 poster. Thereafter the aims of the seminars appeared in the annual reports. It was declared that the main objectives of the seminars were to pro-

Figure 7. Ass. Professor Anders Marelius (right), Director of the Physics Seminar 1974–1978, at a fellow evening in the Seminar locality in the mid 1970s. (Private photo)

mote research and higher education in select institutions in developing countries. Seminar assistance was to focus on the development of groups of staff members, each group focusing on a specific project chosen by the institution in the developing country. The programmes thus had a strong element of institution building.

Once a research field or a research group in a developing country institution was identified for seminar support, the seminars would attempt to identify a matching research programme in Sweden, to create the most fruitful exchange or collaboration. Thereafter the seminars would from time to time plan its inputs for the developing country group in consultation with the two institutions concerned. – This was an interesting change compared to the first years in the 1960s. At that time participants had to accept the research fields that were available, mainly at the Institute of Physics or elsewhere in Uppsala. From 1979 and on the seminar staff listened to what the participants wanted and then they found the corresponding host laboratory!

What actually was put into the programme could vary from case to case but

fellowships for research work in Sweden still used a large part of the resources of the seminars. However, the seminars could also provide supplementary equipment or arrange visits by Swedish scientists, support local symposia or courses, etc. In most cases such assistance came after a group member had visited Sweden.

For practical reasons most foreign group members were still invited to Sweden from September 1 each year. An individual programme was arranged for each participant, matching, as far as possible, the needs and the requests of the parent institution. Collective courses and activities, arranged in Uppsala, were of a supplementary nature and averaged less than 15% of the participants' time. In most cases the individual programme consisted of research training for a period of about one academic year. However, substantial variations occurred depending on actual needs. Degree work was not favoured and, when it occurred, attempts were made to transfer as much as possible of the work and/or responsibility to the developing country. The focus on research groups had made it necsseary to limit the announcement to some twenty countries only. Furthermore, applications from groups already supported would receive a preferential treatment.

The physics and chemistry programmes have constantly been developed and improved. A variety of new concepts has been created over the years. The very extensive staff travel to all projects around the world has given invaluable knowledge about the conditions in the various countries and in the region. In some cases this knowledge had not earlier been known to the country and/or region in question and has therefore been of great value to them. The personal contacts with scientists in the developing countries has been equally invaluable.

In the 1980s the concept of "Memorandum of understanding" was introduced. The meaning of this was to serve as a more formal cooperation compared to oral agreements but the written agreement always contained a paragraph allowing the agreement to be terminated if financial support should not be sufficient.

Regional Cooperation and Networks

In 1980 SAREC asked the International Seminars to explore the possibilities of encouraging an exchange of scientists in a region of developing countries. The Physics Seminar had then operated for 20 years and the Chemistry Seminar for 10 years with the result that some departments, institutes and laboratories had achieved a reasonably high scientific level. It was obvious that some laboratories in supported countries were well equipped and had a good research atmosphere. Such laboratories should be able to receive senior and young scientists from less developed countries, to start regional cooperation and to form networks in the region. In this way the Seminars' support could reach many more scientists for only a minor cost increase.

The first project along these lines was started by the Chemistry Seminar. The Chemistry Department of Mahidol University, Thailand, was a suitable host laboratory for research in the natural products field. In connection with a visit to this department it was decided to start a regional cooperation between Mahidol University, Dhaka University (Bangladesh) and the University of Peradeniya (Sri Lanka). The experience of this first small scale project was very positive and this type of activity has continued and developed ever since. The Seminars announced that they were also ready to support and give assistance towards the establishment of regional contacts and to assist with arrangements of regional conferences and workshops.

The main idea of the regional cooperation and networks was to transfer the Seminar/ISP activities to selected laboratories in developing countries. The many regional cooperations and networks over the 20 years represent a variety of structures. The basic activity is of course the exchange of scientists. The cooperation can also be based on the fact that laboratories in a region have complementary equipment for a certain research field. Research training for PhD and MSc students is also a component in a network. In some cases the regional cooperation has a Swedish laboratory as a "senior advisor". In some other cases ISP has made use of more advanced institutes in countries which are no longer supported by ISP but which are located in the region. Examples of such countries are Argentina, Brazil and Mexico in Latin America and China, India and Pakistan in Asia. In the chemistry field the networks are formally established, each with a chairman, secretary and a board.

In connection with the establishment of regional cooperations the host institutes have been given the possibility of operating USD accounts. The number of regional cooperations and networks has been steadily increasing during the 1980s and the 1990s. Regional cooperations and networks as of year 2000 are shown in App. 4–9.

As an example of regional cooperation in the Physics programme the project "Materials for Solar Energy Conversion" in Tanzania will be described more in detail. The project started in 1976 at the Department of Physics, University of Dar es Salaam, Tanzania. The research activities are mainly divided into three main areas, namely selective surfaces, radiative cooling and photovoltaics. The project has received financial support from the University of Dar es Salaam, SAREC, ISP and TWAS. The Solid State Physics Division of the Department of Materials Science, Uppsala University, is the main cooperating partner in Sweden. The group in Dar es Salaam has steadily increased its capacity and since 1989 they have taken on a regional responsibility. Thus they have established long-term cooperation links with other universities in the East African region. More formal cooperation is thus established with University of Zambia, Moi University (Kenya), University of Zimbabwe, Makerere University (Uganda), National University of Science and Technology (Zimbabwe) and University of Nairobi (Kenya). The Department of Physics in Dar es Salaam functions as the regional resource centre in Eastern Africa. With the facil-

ities available at the solar energy laboratory in Dar es Salaam it is possible to perform research studies leading to MSc and PhD degrees in various areas of thin films. ISP is financially supporting some students who conduct sandwich programmes there. Since 1990 the group also arranges "Thin film colleges" every second year. So far six colleges have been arranged.

The chemistry programme is operating several networks, one of which is LANFOOD (Latin American Network for Food Research). The first initiative to this network was taken in connection with a symposium in Quito, Ecuador, in 1993. A group of Latin American scientists, together with cooperating scientists in Sweden and ISP chemists, discussed the outlines for such a network. The objectives of the network and the plans for its creation were presented at a Conference in Caracas, Venezuela, in 1994. The objectives were to promote regional cooperation between research groups working in the field of food science, i.e.

– to exchange information on ongoing research in the field
– to identify research problems of local and regional importance
– to share local and regional resources
– to promote the exchange of scientists and training of students.

At present LANFOOD has 33 members from 13 countries. LANFOOD coordinates training and visits by members to regional laboratories, partly with funds from ISP. The main field of collaboration is related to starches. Dietery fibre is also of interest to the members of the network.

LANFOOD is also visited by scientists from Sweden, Belgium, United Kingdom, Spain, and Scotland. A practical handbook on methods for the characterization of carbohydrates has recently been written in Spanish and published, showing that the cooperation between the network members goes straight down to the laboratory work.

Evaluations in the 1980s

The funding agency of the seminars, SAREC, was itself evaluated in 1985 with respect to all programmes supported. The evaluation report recommended a strategy for support to countries with weak research capacity. The recommendation contained three main ingredients:

1. To contribute in such a way that the universities [in the developing countries] can continue to serve the research development.
2. Contribution to research and education through cooperation directly with universities and research institutes in Sweden.
3. Support to groups within the scientific community to simplify, among other things, the intellectual exchange over national borders.

All these three ingredients had for many years been the main part of the seminar programmes and the report thus supported the activities of the seminars. A positive judgement of the seminars was explicitly expressed in the report.

The following year, in 1986, SAREC initiated a new evaluation of the seminars, which concerned mainly administrative matters. For an outsider the most important proposal was that the name of the seminars should be changed. The word "seminar" had always caused some confusion as to the real character of the activity. A change was proposed already in 1981 but it was then not possible to get consent on the proposed name from all involved. The name was discussed over the years and finally the 1986 evaluation suggested the name "International Science Programme (ISP)". As a matter of fact, the spelling "programs" was first used but was recently changed to "programme".

As divisions within the ISP, the two seminars, physics and chemistry, were named the "International Programme in the Physical Sciences (IPPS)" and the "International Programme in the Chemical Sciences (IPICS)" respectively. The new names were effective from the 1st of July, 1987.

Detailed Policies in the 1990s

In the beginning of the 1990s the ISP described the aims, policies and modes of operation very much in detail. The basic objective of the ISP was (still) to assist in the process of developing active and competent research groups in select countries in Africa, Asia and Latin America. It was also pointed out that this process generally requires long-term engagement.

It was declared necessary to follow the progress of each supported project carefully and to assess the progress continuously. If this did not prove to be satisfactory, measures had to be taken either to find ways to improve development or to terminate support to the particular project. There were no stipulated rules regarding the time limit for support to a certain project. Continued assistance was justified as long as there was a significant component of competence development on the part of the supported research group. When the limited support from the ISP did not result in further development, the support was terminated.

As indicators of positive development in the assessment of the progress, the following factors were mentioned:

- Publications, preferably in international refereed journals, of results produced in the home laboratory;
- Training of post graduate students on the MSc, MPhil, or PhD level; awarding of degrees based on work, some of which is at least partially undertaken in the home laboratory;
- Arrangement of courses and workshops on a national or international level for training of scientists in modern research methodologies;

– Expansion of a project to a multi-disciplinary approach, i.e. chemists, e.g., initiating cooperation with biologists or pharmacologists for studies of biologically active substances;
– Attraction of funds from other agencies than ISP.

The assessment was achieved in cooperation with Swedish scientists involved in the project, as well as scientists from other countries. All projects were regularly evaluated during missions by the staff members and, in the case of physics, by a reference group. Activity reports were requested annually as well as detailed plans on the forthcoming annual period including the actual requests of support from ISP.

The 1993 Evaluation

A new evaluation of the ISP was requested by SAREC in 1993. The evaluating team visited some 40 institutions in Africa, Asia and Latin America and met with several hundred scientists involved in the work of ISP.

In the report the team declared that research in basic sciences, including fundamental research, is an important part of the development in low-income countries. Basic sciences should be supported on three grounds: their contribution to applied sciences, their role in university training and education and their role in technological development. The development of good and inspiring teachers in the sciences and the formation of a new generation of young scientists with a solid scientific training were seen as important results of fundamental research. It was also pointed out that it was important to transfer instrument technology and scientific methodologies between sciences and from fundamental research to development and to production.

Among the observations made by the team, a few details are worth mentioning. It was very positive that the ISP worked on a long-term basis and that it was prepared to make uncomfortable decisions when a project was not progressing satisfactorily. The ISP result had been excellent with a minimum of financial input.

Further, it was noted that the ISP in practice was split up into two separate programmes, IPPS and IPICS, with separate identities under the ISP umbrella. The lack of coordination between the branches had led to a greater spread of the work over countries and universities than was desirable. The benefits of working within a common organizational frame were not fully utilized. The administration services, however, were very good.

The main component of the ISP work, i.e. the south-north links between research groups in developing countries and in Sweden, received a recommendation of continuation. The “sandwich” pattern should be continued, i.e. with support on a project basis to the research groups for equipment, travel, spare parts, additional follow-up, courses etc. The south-south-north pattern, i.e. re-

gional collaboration between two or more research groups in developing countries supported by north-south links looked promising for the future.

The evaluation team recommended the ISP to concentrate on providing support to university institutions. Implicitly it was recommended that special institutes outside the university world should not be supported. In all work the main concern should be to make advances in research projects through postgraduate training and publications.

It was also proposed that new branches, aside from physics and chemistry, should be set up. A new biology branch could include disciplines such as ecology, environmental biology, systematic botany, zoology, limnology, molecular biology and genetics. Chemically oriented aspects of these fields were included earlier in the chemistry programme, which, in case of the existence of a biology branch, could then concentrate more on pure chemistry. A branch for geosciences could include seismology, geology, hydrology, coastal marine research, climatology, atmospheric sciences and solar irradiation energy, many of which have been part of the physics programme.

It was also recommended that the ISP should give increased support to instrument construction, adaptation and development. Training of technicians in instrument repair and handling as well as in workshop techniques should be supported as part of a major project.

As a whole, the evaluation team gave a very positive picture of the ISP, which can be seen in its final recommendation to SAREC to use "the ISP model for the administration of bilateral research support in other subjects areas".

Research fields during four decades

A period of 40 years in science is a long time and naturally the research fields of interest have changed considerably over this period. Furthermore, the conditions for the International Seminars and International Science Programme have also changed. From the beginning, the International Seminar in Physics was more or less an activity that took place at the Institute of Physics. The research fields offered to the participants were therefore those that existed at the institute. The idea of receiving young scientists from developing countries to take an active part in ongoing research activities was new and it was believed that it should involve more giving than taking with respect to scientific experience and results. It was therefore easier to persuade colleagues within the institute to receive a participant than to ask scientists at other institutes. Thus, during the first few years the research fields offered to the participants were mainly low energy nuclear spectroscopy, such as beta- and gamma-spectroscopy, nuclear life time measurements, gamma-gamma and electron-gamma angular correlations, etc. Only very few participants, upon direct request from the participant, were given other research fields. After a few years

Figure 8. The President of Tanzania, Julius Nyerere, discussing with professor Kai Siegbahn (middle) and Dr Torsten Lindqvist, Director of the Seminar, when visiting the International Seminar in 1963. (Photo Einar Söderberg)

it was realized that many participants did in fact contribute to the research activity and it became easier to engage other institutes outside the Institute of Physics. Furthermore, the seminar staff started to have discussions with the home departments of the participants as to which research field was the most relevant for the participant to take part in during the fellowship period. Thus new fields were included in the programme, such as semiconductor physics, solid state physics, computer physics and various fields of geophysics. The participants were, up to 1970, still mainly located in Uppsala. When chemistry was included in the programme, all chemistry departments, including inorganic, organic, analytical, physical chemistry and biochemistry, offered a variety of research fields. From the beginning, the chemistry programme was oriented towards more applied chemistry, although pure chemistry fields were also included.

Around 1980 both physics and chemistry programmes had their widest variety of research fields. The physics programme had 14 different titles, among them Electron Spin Resonance (ESR). Electron Spectroscopy for Chemical Analysis (ESCA), surface physics, lightning research, pulse radiography technique, atmospheric corrosion and high energy physics. The chemistry programme included also many topics, such as chemistry of oils and fat, medical plant chemistry, natural products chemistry, environmental chemistry, biochemistry and molecular biology. At the same time the geographical distribu-

tion of host laboratories became wider. Many laboratories in Uppsala were engaged in the programmes, and other universities and institutes in Sweden also acted as host laboratories.

The project idea became stronger and stronger in the 1980s and towards the end of the 1990s the programmes consisted solely of projects and networks. In order to meet the requests for support from the developing countries on their conditions, host laboratories were also found outside Scandinavia and the new concept of networks included also laboratories in the developing countries as host laboratories. Research fields are always proposed by the developing countries themselves and the fields supported today can be grouped into the following major topics:

Condensed Matter Physics and Materials Science
Biophysics and Radiation Physics
Applied Nuclear Physics
Atmospheric Physics and Geophysics
Biotechnology
Molecular Biology
Ecology / Environmental Chemistry
Chemistry of Natural Resources

Social and other activities

The founders of the International Seminar in Physics were fully aware of the difficulties that students and guest scientists from developing countries could have in adjusting to the Swedish lifestyle. It was therefore strongly pointed out in the application in 1959 that the Seminar must have both personnel and economic support to help the participants of the Seminar in social matters. Fortunately the authorities accepted this request. The construction of the Seminar staff, one director, one assistant and one secretary, made it possible to give adequate help to the 15 participants.

The daily contact between participants and staff made it possible to solve many problems, both personal problems and problems in connection with laboratory work. Experience from times when such social service was not available had shown that such problems can give rise to a situation which quickly becomes out of control – even resulting in the guest scientist returning to his home country earlier than originally planned.

Travel from the the participants' home country to Sweden was organized from the Seminar office, which booked an air ticket from the nearest international airport. Before their arrival in Sweden,the participants were informed about practical matters referring to housing, food and climate. In addition to the fellowship, which was supposed to cover living expenses for one person, a special contribution was included to be used for buying winter clothes. From

the beginning there was no family allowance although occasionally some participants brought the family on their own account. Later on, from 1978/79, SAREC agreed to set up a special fund for family allowances, which, however, could not be used to cover travel costs for the family members.

The seminar staff had noticed that bringing one's family was of very great importance for the participant. It was important from the psychological point of view and gave stability and tranquillity to the working situation. Particularly in connection with sandwich programmes, which became frequent in the 1980s and 1990s, an accompanying family improved the participant's psychological situation.

The housing problem is always present in university towns, and so it was in Uppsala in the 1960s. By agreement with the Uppsala Student Union, the Seminar could have use of a sufficient number of student rooms in competition with thousands of Swedish students. As the number of participants increased in connection with the addition of the chemistry programme and also due to the fact that participants were placed in other university towns, a "room pool" was established in collaboration with other universities. If that proved insufficient it was possible to negotiate with other institutes and temporarily "borrow" rooms. Finally, if necessary, the private market of rooms and flats was used.

During the first 20-year period of the seminar activity all the participants arrived on the 1st of September and most of them left after a 10 months' stay. The year (at that time called the "seminar course") started with an introduction course that met full time the first two weeks and then gradually occupied less and less time in order for the participants to devote themselves to research work. The purpose of the introduction course was mainly to inform the participants about Swedish research and education through lectures, discussions and study visits. The situation of research and education in the respective home country was also presented and discussed. Another topic during this introduction period was the computer course in connection with the top modern IBM1620 computer (see fig 9). In order to give the participants a broad view of Swedish society, many full-day or half-day study visits were organized. Schools, industries, cultural centres, etc. were visited. At the end of the academic year a week-long study and pleasure tour to the north of Sweden was organized. Industries and universities and, last but not least, the midnight sun, were the attractions of this tour. Thanks to a contribution from UNESCO, a study tour to European universities and laboratories was also carried out each year.

It is interesting to note that from the very beginning the Seminar offered a consultation service for starting research projects in the participants' countries according to the following extract from the original course plan in 1961:

> "... . If desired, a detail programme will be worked out through the International Seminar, containing suggestions of the organization of education planning and start of research projects, of experts and scholars, of application for economic aid etc. This consultation activity is supposed to be at the disposal of previous mem-

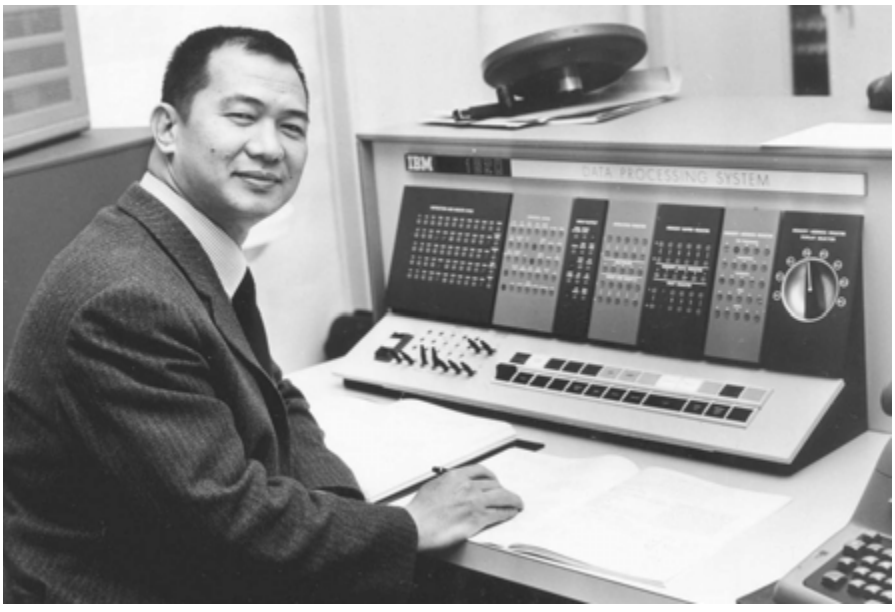


Figure 9. Participant Gregorio Zita (1961–62) working at the computer IBM 1620. This computer was installed at the Institute of Physics in 1960 and was used in the introduction course of the International Seminar in Physics from the very beginning until 1964. It was announced as a ”modern” computer. (Photo Einar Söderberg)

> bers of the seminar and, if possible, also of non-members. The International Seminar is meant to function as a contact organization between physicists from underdeveloped countries and experts from international organizations on one side and Swedish or foreign institutions and authorities on the other side.”

The participants did not register as formal students at the university. However, they entered one of the “nations”, the typical Uppsala student clubs, each nation (in principle at least) gathering students from a particular province in Sweden. Thus the participants would have opportunities to meet Swedish students and to take part in both student life and cultural life. The most important consequence of belonging to a “nation” was, however, the possibility of obtaining an accident insurance as the participants did not have any other insurance. It turned out that over the years a few severe accidents occurred. The insurance took care of the economic if not the personal losses. Later on, when participants stayed at their host institutes for different lengths of time and during different periods of the year, the insurance problem was solved by arranging group insurance.

In spite of the fact that all participants became members of a student “nation”, very few took full advantage of the membership. One reason was that the Seminar had its own club room, called the “Seminar room”, open 24 hours a day, within the Institute of Physics. There the participants could meet, read

international newspapers, prepare their meals and quickly return to the laboratory. The locality functioned as a second home. The weekly "fellow evenings", during which the participants presented their home country's geography, culture, and research and education traditions, took place in the Seminar room, to which many Swedish friends of the participants were invited. In particular there was an organization, Families for International Friendship (FIF), that established connections at these occasions. Many long-lasting contacts between Swedish families and participants were established through FIF. Other activities were social evenings presenting information about Swedish culture.

As the mode of operation of the seminars changed over the years, with participants arriving at any time of the year, staying for a short or a long period and in many cases spending their research period outside Uppsala, it became difficult to carry on group class room teaching. For a period, this part of the programme took the form of short weekend courses in e.g. computer languages and microprocessors. In connection with such weekend meetings a Mid-term conference could be arranged, in which the participants informed the staff and each other about their research work. Nowadays "fellow evenings" in the traditional way do not exist in the programme. However, some kind of social gathering is arranged when it is possible. The transition into irregular fellowship periods also made it impossible to arrange a European tour with the complete group. Instead, the participants were given the possibility of attending international conferences when the topic was relevant to their research work. Nowadays such activities are part of the specific project activity.

The working language within the programme has always been English. This was stated already in the first announcement and it was requested that the applicant show a certificate that he/she had mastered English. In spite of the certificates it turned out in some cases that the knowledge of English was not adequate enough to follow the lectures or the discussions within the research group. In such cases the participant was offered an intensive and concentrated course, which helped to create an acceptable language level.

It was felt that some knowledge of Swedish could be helpful in shopping and other situations. Therefore a 40 hours course in Swedish was given, spread out over the first semester. It was a voluntary course but all participants found it very interesting – and useful. As the seminars developed to give more time to research, and less time for extra courses was available, the interested participants were advised to attend Swedish courses "downtown", i.e. outside the university curriculum. Nowadays it is considered rather useless to take Swedish lessons. However, when requested, individuals can attend Swedish courses.

In order to keep former and present participants, tutors and administrators up to date with what is going on at ISP, a Newsletter was introduced in 1985. The goals included spreading information about the Seminars, including policy and aims, to discuss questions related to the strengthening of research activities in developing countries, to stimulate contacts between individual sci-

entists, and to serve as a forum where short notes can be published on simple solutions to problems of a more general nature. The first Newsletter was published in January 1985 and since then has been published about twice a year. It is distributed to about 700 persons and authorities.

The official annual report of ISP describes in detail the activities from all points of view. In the 1960s it was a rather short and modest report, typed, copied and distributed to a few persons. Over the years the reports have expanded and are nowadays printed books containing more than a hundred pages. Further, a four-page pamphlet with brief information about the ISP has existed since June 1995. This pamphlet has been more or less replaced by a web site (www.isp.uu.se). At irregular intervals other booklets have been published, e.g. project catalogues describing research projects in different regions, international conferences organized by ISP etc. Titles are included in the list of references at the end of this chapter.

The ASMARA Programme

In 1987 the former Italian colony Eritrea became an autonomous region in Ethiopia. However, movements to make Eritrea independent from Ethiopia continued. After a long war with Ethiopia, Eritrea took over a dismantled university in the capital Asmara in 1991. The University of Asmara was the only university in Eritrea and a revitalisation was urgently needed. One of the most immediate problems was, and still is, lack of competent staff members.

The ISP became engaged in the University of Asmara in 1993 by inviting a PhD student in microbiology to spend 5 months in Uppsala. The project was termed an "exploratory project". The following three years new fellows from Asmara went to Uppsala as part of a "staff development" project. During 1996 discussions started between the University of Asmara and Uppsala University. An agreement between the two universities was adopted. The Science College at Asmara and the Faculty of Science and Technology in Uppsala would cooperate in a staff development programme. Sida/SAREC decided to sponsor the cooperation with a two-year grant totalling 20 MSEK. In 1997 the programme was replaced by a larger programme entitled "Strengthening of the College of Science of the University of Asmara" (The Asmara Programme).

The long-term objectives of the programme are to establish a complete College of Science with graduate and postgraduate programmes in Biology, Chemistry, Computer Science, Earth Science, Hydrology and Water Resources, Marine Biology, Mathematics, Physics and Statistics. This will be achieved in terms of various components of the programme. One component, the staff secondment, will be addressed by allowing on average 3 senior faculty members from Uppsala University or other Swedish universities to spend one or more semesters at the University of Asmara. They will contribute to teaching as well as to various research activities.

Another component, staff development, comprises two areas. Firstly, young faculty members at the University of Asmara (average 8 per semester) will complete their graduate education (PhD or MSc) at Swedish universities and, secondly, senior faculty staff members at the University of Asmara (an average of 2 per semester) will pursue research at Swedish universities during certain periods (2–3 months). The strengthening of teaching and research requires good laboratory facilities in terms of equipment and localities. All activities of teaching and research require the services of a good library system. For this, the University Library must be revitalised to meet the increasing demands.

The programme is operated by an Asmara Committee under Uppsala University and a Project Team under the University of Asmara. There is also an Internal Steering Committee directly connected with the Project Team. The Internal Steering Committee is composed of faculty members from the departments of the College and representatives of local institutions with which the College has links. The Project Team is composed of the Dean (the project leader) and the heads of the departments. The Asmara Committee, Uppsala University, is the counterpart to the Project Team and is composed of senior faculty staff members from various disciplines and has an executive secretary attached to the committee.

The Project Team is responsible for the overall management of the project in cooperation with the Asmara Committee. The executive secretary and the Asmara Committee is primarily responsible for the coordination and management of the two core activities of the programme, i.e. Staff Secondment and Staff Development. The Project Team has the prime responsibility of the components on Strengthening of Teaching and Research as well as Strengthening the Library. All activities are undertaken in collaboration with the respective counterpart. The administration of Staff Secondment and Staff Development is executed by ISP and the executive secretary is placed at ISP.

Up to the year 2000 a total of seven Swedish staff secondants have been working at the University of Asmara covering the following disciplines: Biology (3 semesters), Chemistry (3), Computer Science (1), Earth Science (3) Mathematics (2) and Physics (2). A total of 27 PhD/MSc students were trained in Sweden in the year 2000. Three students have successfully completed their PhD training and two their MSc training and all five have returned to Asmara. A total of 5 senior and 30 junior staff members from the University of Asmara have received training in Sweden since the programme started.

ISP of today – a summary

When the International Seminar in Physics started 40 years ago it was a fellowship programme. It could be said that its mode of operation was to train young physicists from developing countries in doing research. The founders of the programme also had a vision that the participants would return to their

home countries and start research projects. The vision was there at that time but not the means and the experience to make the vision come true.

The present aim of the International Science Programme (ISP), as it has been for many years, is to assist Third World countries in strengthening their domestic research capacity. Through an exchange of scientists, by providing postgraduate education, and by funding purchases of equipment, ISP gives long-term project-oriented support for developing active and sustainable research environments in select countries in Africa, Asia and Latin America. Research of strong relevance to the countries of the regions concerned is selected for support and the work is carried out in close cooperation with one or more host laboratories. Uppsala University is the base of operation, but ISP also works together with other universities, institutions and industries in Sweden and other countries in Europe, as well as strong laboratories in the region.

It takes a long time to develop scientific competence and to create sustainable research environments. For this reason, scientific projects selected for support include a long-term commitment, often covering ten or more years. Agreements on cooperation are signed for three year periods and are renewed if the project develops favourably and requires continued support. New projects must be in line with university/institute plans and are launched only after careful evaluation and planning. Individual support outside the framework of a project is not available.

The exchange of scientists and training for young scientists are important components for developing active and stable research environments. Scientists connected to the projects, are invited to come to host laboratories in Sweden, or in other countries, for periods of up to ten months to pursue research, to learn new methods, or to perform measurements that cannot be done in the home country. Host scientists regularly visit participating institutions to teach courses, install equipment, and plan joint work. ISP pays for transportation, board, lodging, and insurance for the participants.

Many researchers taking part in this exchange enrol in educational programmes at the doctoral or master's level, which are offered as an integral part of the total cooperative project. Work in the home laboratory is sandwiched with sejours at the host laboratory. Faculty advisers are appointed at both institutions, but as much of the work as possible is carried out at the home institution. The dissertation is submitted to the home university whenever feasible.

The project grants, allocated after application, may be used not only for the exchange of scientists and training of technicians, but also for purchase of equipment or of chemicals and other material to support the local research environment. About 60% of the project grants go to such activities. Grants may also cover the arrangement of courses or conferences, often involving the participation of scientists from the host laboratories.

An important part of the ISP activities is the regional exchange system, whereby members of research teams from recipient countries visit laboratories in neighbouring countries where complementary research facilities and com-

petence are available. ISP defrays the costs in the same way as for stays in Sweden. Such exchange has in some cases developed further, into the establishment of active regional scientific networks, administrated by the scientists in the region concerned.

The research fields supported today in physics include condensed matter physics, materials science, bio- and radiophysics, applied nuclear physics, atmospheric physics, geophysics and atomic and molecular physics. In the chemistry programme the support is concentrated on biological chemistry, ecology and environmental chemistry, food chemistry and nutrition, chemistry of natural resources and on instrument use and maintenance.

The ISP has recently been granted money from Sida/SAREC to also include mathematics as a programme activity. This new programme will focus on strengthening mathematics in Africa south of the Sahara.

Furthermore, Uppsala University has recently agreed to be engaged in a project focusing on Information and Communication Technology (ICT) at Makerere University in Uganda. One specialist from the virtual IT Faculty will be responsible for the coordination of this project and will be placed at ISP. The total amount of SAREC funding of this project is 10 MSEK per year during the first two years. During this period there will be a focus on the creation of an infrastructure, i.e. a network through fibre optics, nodes and servers etc., by the building up of basic services to be provided, and by the creation of a library service. It should be noted that SAREC is not the only actor. The US Agency for International Development (USAID), the Norwegian Agency for Development Cooperation (NORAD) and the African Development Bank (ADB) are also involved. In addition to giving advice and coordinating SAREC and NORAD activities, there will also be a component where Uganda counterparts will be trained. Expertise from the IT Faculty, the IT support of Uppsala University and the University Library will be involved in the activities. The Faculty of Science and Technology contributes directly to this activity as well as to the initiation of the programme in mathematics.

Through the programmes in chemistry and physics, the ISP also takes part in other SAREC bilateral projects, including support to

- SAREC/NSF Urgent Spare Parts Grant, Sri Lanka
- Molecular Biology, Colombo University, Sri Lanka
- Biochemical Pest Control, Peradeniya University, Sri Lanka
- Programme at Jaffna University, Sri Lanka
- Research Capacity Building, Faculty of Science, University of Dar es Salaam, Tanzania
- MSc Applied Physics Programme and Research, University of Zimbabwe, Zimbabwe
- Rare Earth Materials, Vietnam
- PhD Training Programme, Addis Ababa University, Ethiopia.

Some of these activities stem directly from previous ISP support.

Figure 10. The acting ISP staff in March 2001.
From left, Leif Abrahamsson, Staffan Wiktelius, Linnea Sjöblom, Solveig Lindberg, Åsa Bergengren, Hossein Aminaey, Malin Åkerblom, Mona Thorwaldsdotter, Lennart Hasselgren, Johan Wennerberg. (Photo Teddy Thörnlund)

ISP is governed by a Board consisting of members of Uppsala University, other participating universities in Sweden, the IAEA, the developing countries, and one member nominated by the main sponsor of the programme (App. 10). ISP constitutes a unit of the Faculty of Science and Technology at Uppsala University, with the Vice Chancellor of the University as Chairman of the Board. Under the Board there is an Executive Committee consisting of a chairman with scientific professional competence within one of the programme areas, a scientific member from each of the respective programme areas, the programme directors, an experienced university administrator and the head of administration.

Staff with strong scientific backgrounds are responsible for the scientific aspects of the ISP operations. A joint secretariat, located at Dag Hammarskjölds väg 31 in Uppsala, deals with administrative, practical and social matters (App. 11).

Table 1

	#Male	#Female	% Females
Region			
Africa	241	24	9%
Asia	270	115	34%
Latin America	107	68	39%
Subject			
Physics	370	55	13%
Chemistry	168	152	48%
Total	538	207	28%

Facts, Figures and Funding concerning ISP

In the year 2000 the ISP supported 46 projects and 15 networks in 17 countries (see App. 4–9). The regional distribution of these projects/networks was: Africa 20/9, Asia 14/3 and Latin America 12/3. Totally 340 individual scientists were involved as PhD and MSc students. The total number of fellowship months was 438, out of which 133 months were spent in the specific regions. Host groups for the projects, totalling 95 groups, are found all over the world (App. 12). They are distributed as follows: 50 in Sweden, 11 in the rest of Europe (and USA) and 34 in the developing countries. 22 PhD theses and 71 MSc/MPhil theses were presented during the year. These figures include both sandwich types and non-sandwich types of thesis. In the year 2000 there were 129 PhD students and 211 MSc/MPhil students registered. They produced 115 publications in international journals, 51 in regional/local journals and 25 conference and workshop reports.

The gender distribution among all staff and students engaged in the ISP projects during the year 2000 is shown in detail in the ISP Annual Report 2000. A summary of this gender distribution is shown in Table 1, where the numbers of staff and students are added.

Over the 40 years of its existence the ISP has engaged more than 1200 fellows (App. 13). The majority (582) came from Asian regions followed by African regions (388) and Latin American regions (217). In the early days of the programme a total of 17 Europeans were participating through a special agreement with IAEA. The origin of the participants, country by country, can be seen on the world map in App. 14. The numbers refer to participants who have visited Sweden / Europe for a month or longer. A total of 53 countries have been involved in the ISP activities.

The brain drain of the programme has been very low. In the evaluation report of 1976, covering 263 fellows, only 4% had moved to an industrialized country. In later years, when the programme evolved into giving long-term support to research teams, the brain drain has been even lower.

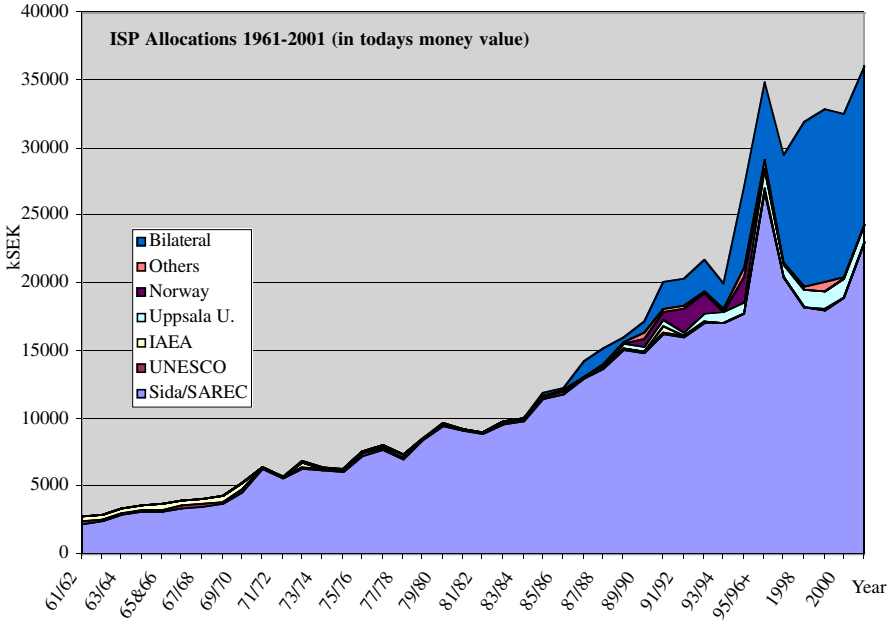


Figure 11. The total funding of Int.Sem./ISP during 1961–2001 in the money value of the year 2001.

Funding for the ISP activities has mainly come from governmental sources. The names and organizatons have changed over the years. It began in 1960 with the Central Committee for Swedish Technical Assistance. Then came NIB (1962), SIDA (1965), SAREC (1975) and from 1993 the funding agency has been termed Sida/SAREC, Division for Thematic Programmes. The funding has increased over the 40 years from the very modest 250 kSEK (1961) to a total allocation for 2001 of about 36 MSEK (see fig. 11).

Over the years also other organizations have contributed. In the beginning UNESCO contributed with grants for a study tour to European laboratories and IAEA payed for four yearly fellowships. Later on both UNESCO and IAEA supported certain projects, which were administrated by ISP. During 1989–96 the Norwegian Agency for Development Cooperation (NORAD) gave support directly to the physics programme of ISP. Among other organizations, that have contributed to the ISP projects, are International Centre for Theoretical Physics (ICTP), International Science Foundation (IFS), and Third World Academy of Sciences (TWAS).

The host groups are contributing in a special manner. The extra cost for having a participant in the group is only symbolically covered by a small bench fee payed to the group.

Furthermore, the Faculty of Science and Technology, Uppsala University, has recently introduced another support to the host groups. For each partici-

pant on a PhD sandwich programme the Faculty pays to the host group half of the sum that is payed for Swedish PhD students.

The main contributors in the year 2001 are Sida/SAREC (23 MSEK), Sida/SAREC for bilateral support (about 12 MSEK) administrated by the ISP, and Uppsala University (1,3 MSEK).

References

International Seminar in Physics, Annual reports 1960/61–1968/69.

International Seminars in Physics and Chemistry, Annual Reports 1969/70–1986/87.

International Science Programme, Annual Reports 1987/88–2000.

ISP Newsletters, 1985 – Jan 2001.

IPPS Project Catalogues, Uppsala University, Sweden. 1978, 1986, 1988, 1994, 1995.

IPICS Project Catalogues, Uppsala University, Sweden, 1988, 1992, 1997.

IPPS Supported Research Groups 1997, Uppsala, Sweden.

Liminga, R. 1970–1995 Summing up – looking into the future, IPICS, Uppsala University, 1996.

Niemeyer, H.M., Ed. IPICS 1970–97: Results, lessons learned, and prospects for development of sustainable environments in developing countries, Proceedings of the Meeting held at Termas el Corazón, Chile, 19–23 October, 1997.

Hasselgren, L. and Kivaisi, R., Research activities in Physics and related fields in Eastern and Southern Africa, Updated 1998, Uppsala University, Sweden, 1999.

Garett, Martha J. and Granqvist, Claes G., Ed., Basic Sciences and Development, Rethinking donor policy, Ashgate, UK, 1998.

Kivaisi, R., Nikundiwe, A. and Ulimwengu, J., Proceedings of the Conference on Basic Sciences for Development in Southern Africa, Arusha, Tanzania, March 1–3, 1999.

ISP Application to Sida/SAREC for funding years 2000–2002.

Science at Universidad Nacional de Ingeniería in Peru

By Dr Walter Estrada

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The International Programme in the Physical Sciences (IPPS),Uppsala University, has regularly supported, since 1990, research activities in physics at the Faculty of Science (FS) of the Universidad Nacional de Ingeniería (UNI) in Lima, Peru, within the field of materials science for solar energy applications. However, it should be mentioned that in the frame of an earlier cooperation programme in materials science with UNI, fellowships from IPPS were given to Walter Estrada (1982, 1986 and 1989) and Robinson Vasquez (1980), both of them physics lecturers at FS.

The support from IPPS in the period 1990–2000 was the main resource for research activities at FS, addressed mainly to materials development for different applications, as photovoltaics, electrochromism, gas sensors and hard coatings.

The IPPS-UNI cooperation, from a local viewpoint, had two important goals which are still valid:

– Student graduation (undergraduate and postgraduate levels) with thesis work
– Creation of a stable environment for research activities.

The graduation of students with thesis work is an objective really not accomplished at UNI in all careers (engineering, architecture, economy, sciences). This is one of the serious weaknesses of our university. Many of our undergraduates and most of our postgraduate students (perhaps up to 90%), after having taken courses for 2–5 years, usually go for jobs without any experience of doing a previous scientific or technical work. Consequently, the education of our students is mainly done through courses, complemented at the end by some short training (not longer than three months) in a practical work (at factories, public and private institutions, etc.). This is a general problem of all careers at the university but it is particularly critical for the science students since the Faculty of Science is supposed to be a center for research training. Consequently most of our best students emigrate in order to complete their education, and generally they do not return home. This situation is mainly due to that practically no research activitity has existed at the university. There is no tradition in research activities, particularly in basic sciences, as physics, chemistry and mathematics. Our society does not generally recognize the need

and the importance of doing research. At the end this produces a lack of interest to create instruments to stimulate research activities and therefore the assignment of resources is very limited.

Therefore there is not enough qualified people to direct research programmes and there is almost no funds at all for any research project. The few researchers that exist at the university have very low salaries. The existing limited research activities are carried out by enthusiastic individuals, who usually are financed by international agencies. Consequently extremely few publications at international standards are published.

This is also the case of the Faculty of Science at UNI. There are some research activities based mainly on personal efforts of some university lecturers, and mostly supported by international cooperation.

IPPS support to the Faculty of Science

During the period 1990–2000, IPPS has given seven "south-north" fellowships to members of FS, each for ten to twelve months, to train students from FS in Sweden (one in Finland), within a PhD sandwich programme, ten "south-south" fellowships for short research stays (three to four months) of members of FS at research labs in Brazil, Argentina, Mexico and Chile, five short visits to FS (one to four weeks) from Latin American scientists (Annette Gorenstein from Brazil, Boris Chornik from Chile, Susana Torresi from Brazil, Miguel Blesa and Martha Litter from Argentina), eight visits to FS from European scientists (Claes-Göran Granqvist from Sweden and Vilho Lantto from Finland) and the stay (three to six months) at FS of three students from Sweden for research work. IPPS has also financed members of our group for attending international conferences, almost once a year.

IPPS also provided an important contribution to improve equipment for research activities at FS, with an amount of USD 10 000–20 000 per year. This made it possible to get spectrophotometers (UV and FTR), computers, costly items for Transmission Electron Microscopy (TEM) and Scanning Electron Microscopy (SEM), basic electronic instruments, chemicals, etc., including technical maintenances and services.

The Impact of IPPS support to the Faculty of Science

Our research group on thin films for energy applications has received a continuous support from IPPS since 1990, and from the beginning our aim in the group was to increase the number of undergraduate and postgraduate thesis works, and through this activity to lay the grounds for developing applied and basic research in our faculty.

During the period 1990–2000 the research activity supported by IPPS re-

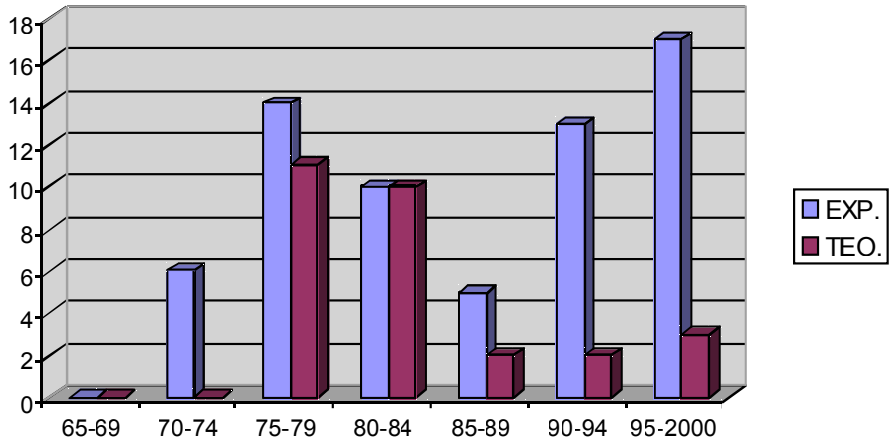

Figure 12. The number of theses in Licentiatura at the Faculty of Science, UNI, from 1965 to 2000.

sulted in 24 theses in the supported thin film group, which was the most active group. The hard coating group (led by Arturo Talledo) and the optic group (led by Anibal Valera) received also support and produced together 8 theses.

The evolution of "licentiatura" theses (theoretical and experimental) in physics at the faculty from 1965 up to 2000 is demonstrated in fig. 12. In the decade 1970–80 there was a continuous increment of theses, mostly of experimental work. After 1980 there was a permanent decreasing in the number of theses in both theoretical and experimental physics, but from l990 (when IPPS support starts) the increment of experimental theses is permanent, recovering the rate attained in the more productive period 1975–79. However, theoretical theses are continuously at low rate. The number of Master theses increased permanently in the period 1990–2000, showing an increment of 100% compared to the period 1980–90.

A particular highlight of the IPPS-UNI cooperation is the creation of a PhD programme in physics. After several earlier trials a PhD sandwich programme in physics was implemented at UNI in 1990, the only doctoral programme in physics in the country and the only doctoral programme (all fields) in our university.. The materialization of this programme was made possible only thanks to the IPPS support. Till now, six persons have got their PhD degrees, all of them within the IPPS programme (five with Prof. Granqvist from Uppsala University, one with Prof. Lantto from Oulu University, Finland). All six are teachers at our faculty and all are active in research.

In 1998 UNI invited an Iberoamerican international commission to evaluate our Physics PhD programme for international accreditation. The conclusion was that our programme has the standards for international accreditation. It has, however, a weakness in the excessive dependency upon international sup-

port and personal local initiatives. This makes the programme vulnerable and in order to get further international accreditation, it needs a more intense local institutional support.

In general, it can be said that the IPPS support to our faculty was essential in order to consolidate research activities in physics at UNI and to implement the physics PhD programme. It should be remarked that the FS of UNI is now known to be one of the main academic institutions for research activities in physics in Peru, and in some way it reflects the development of physics in the country.

Future challenge and conclusions

It is interesting to point out that most of our students who were graduated with theses done in research groups supported by IPPS are currently engaged as lecturers in our university, and some of them are also guiding thesis works. This is an important contribution to improve the Faculty Physics staff in number and quality. This current situation allows us to redefine our aim at forthcoming years. Our priority will be to increase the number of scientific publications at the international standard level.

The number of international publications is still very low compared to the number of local publications, including papers produced by members of our group during their stays at partner research groups in Sweden and Finland. If we consider only locally produced international papers, the rate is one publication per year. Our aim in the coming five years is to increase this to a rate of two international publications per year. This objective is realistic since currently we have in our research group five qualified members with a doctorate level and a minimum of infrastructure to perform research at an international standard level.

Our Faculty of Science has about 40 years of existence, and research activities were mostly supported during all that time by international cooperation. In the 1970s we got a strong support from French cooperation, which basically contributed to train people (in France). We have also received support from the American States Organization (OEA) for local expenses. German cooperations (GTZ and Volkswagen Foundation) have supported solar energy application. In the 1980s international cooperation was very limited, mainly because of the general political situation in Peru and particularly because the increasing terrorism. The effect of this was that the rate of theses decreased dramatically in the 1980s. Without any support, the tendency for the 1990s would have been similar. Therefore, the IPPS contribution to our Faculty of Science has been crucial during this decade. Currently, research activities in physics and materials science at UNI are mostly carried out by teachers who in some way were supported by IPPS. This gives a good perspective for future activities. However, this situation can dramatically change in the future if IPPS support is

Figure 13. The thin film solar cell group at Universidad Nacional de Ingeniería, Lima, Peru. From left, Dr Juán Rodrigues, Dr Walter Estrada (group leader), Dr Monica Gómez, and Dr José Solís. (Photo UNI)

cut down, There is not yet a chance to get a sustainable local support, particularly to run the Physics PhD programme.

To illustrate the IPPS support as one of the most impacting contributions to Peru in the field of physics, based not as much on the amount of money given, but basically on the long duration of the cooperation programme and the kind of support given, let me finish by mentioning the opinion of Dr. Victor Latorre, a well known prominent Professor of Physics in Peru. He stated: "Swedish support was at the beginning one of the less generous international cooperations to UNI. They seemed to request too much results in relation to the limited economical support they actually gave. But with time, they have given the most sustainable and impacting support Peru has got till now for research activities in the field of physics, that is for the development of physics in the country, necessary for the general development of Peru".

40 Years of Altruism

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Having started life 40 years ago at Uppsala University as a Swedish programme with the aim to give support for developing research activities in selected countries in Africa, Asia and Latin America, the International Science Programme (ISP) today is recognised world-wide for its altruism in helping to promote science within the Third World countries. On 40th anniversary, the ISP with its two main programmes, the Physics (IPPS) and the Chemistry (IPICS), deserves to be honoured by its many beneficiaries of these countries and scientists all over the world for its generous dedication to support science in developing countries. The influence and importance of the ISP among other similar organizations in the world are so high that many of them follow its recommendations for action within the framework of research cooperation with the developing countries.

The ISP is strong and efficient in every aspect. Its basic philosophy is well implemented, and the people who guide and manage the two main programmes do everything possible to maintain its financial support and technical assistance to scientists from the developing countries. Of course, this is so because the ISP activities are carefully planned and accompanied by a high spirit of sacrifice and considerable motivation from all the staff concerned.

The strongest part of the ISP organisation is its staff, composed by persons who always are in high spirit and ready to work hard when needed. All its members are well convinced of the importance of science, including physics which represents an important part, in solving many problems of the Third World countries. They believe that science is needed to be supported in developing countries more than ever before if their societies are to draw the greatest possible benefits from modern technology. All of them have been a source of encouragement and help to any visiting scholar from our group who went to Sweden through the IPPS Fellowship Programme. We always experienced an open, welcoming hospitality and felt free to ask them at any time a friendly counsel or a personal assistance.

When we started cooperation with the former International Seminar in Physics in 1984, we saw this event as a possible change of our scientific history up to that time. Our Physics Department was above all a “teaching academic unit”. The infrastructure in the form of equipment and staff members

Figure 14. The IPPS supported research group "Phase Transitions in Ionic Solid" at Universidad del Valle, Cali, Colombia. On the picture, counting from left are the following group members who have been fellows of ISP in Sweden: no 1, Jesus Evelio Diosa, no 5, Esperanza Torijano, no 6, Rubén A. Vargas (group leader), no 7, Ever Ortiz and no 15, Miguel A. Vargas. (Photo Universidad del Valle)

with research experience was practically absent. The research grants in our country were limited. Some research and a MSc programme in Physics were the only activities in the starting phase.

Our cooperation with the ISP started from a research proposal presented by our group to the former International Seminar in Physics in 1984. As a first stage of this programme, I got involved in a research work in ionic systems as a Seminar fellow (1984/85 session) at Chalmers University of Technology (CTH) under the guidance of Professor Arnold Lundén and Dr. Silas Gustavsson. The period that I spent at Chalmers served as an awakening for me and my research group as to the significance of science and technology to our society. This initial step was an essential element to capture the attention of the ISP for helping us in improving our indigenous base for education and research in physics. Our intention at that time was to create a long-term, cohesive research plan in Colombia with the cooperation of the ISP. Back home in 1985, the objectives of our research team were revised, and we started investi-

gating new phenomena that occur in ionic systems, including some of them that are important in fast-ionic conduction for solid electrolytes development. It was obvious to us that some strong action was needed to be taken on convincing our national policymakers to support science in our country. Since then, the steady support over many years that our group has received, initially from the existing International Seminar in Physics and then the IPPS, has been an essential element for the development of our group.

Including the year 2000, the total funding that our group has received from the IPPS amount to about 1.2 MSEK, of which more then 60% has been spent on training programmes. Our group was one of the first groups in Colombia to graduate a PhD student, Jesús Evelio Diosa in 1996. Diosa was a PhD sandwich student with the IPPS. Two other PhD students, Ever Ortiz and Miguel Vargas, also from our group and participating in the same sandwich programme with the IPPS, got their degrees in 1999. Today the group has 5 other students in such programmes and two of them, Fabián Jurado and Esperanza Torrijano, have completed their thesis works that was submitted in partial fulfilment of the requirements for the degree of PhD in Physics in January 2001. The fellowships for the students' work at Swedish laboratories have been partially financed by COLCIENCIAS and partially by the IPPS. This type of cofinancing approach for our cooperation with the IPPS, has been very beneficial to secure a steady expansion of our research activities. Our cooperation partner in Sweden is the Solid State Physics group, CTH, Gothenburg, and after Prof. Arnold Lundén's retirement, we have established a close relationship with Prof. Bengt-Erik Mellander.

Thanks to the successful collaboration between the IPPS and our group, and thanks to additional funding provided by the Colombian government, we have been able to consolidate a research team in our Physics Department. Compared with the rest of physics research groups in the country, we have a relatively well equipped laboratory that presently includes set-ups for performing experiments on thermal analysis (differential scanning and modulated calorimeters), impedance spectroscopy, electrochemistry and sample preparation, which are enhanced by a data analysis computer system. Four faculty members are presently part of our group, as well as 5 PhD and 4 MSc students. Our group is certainly recognised by the national scientific community as a group of excellence by our demonstrated accomplishments in our field of research and our contribution to advancing education programmes in physics at the level of graduate studies. As part of this recognition, several of our members and the group as a whole have been the recipients of national awards in basic sciences.

However, we are facing at the present time a drastic reduction in funding science in our country, due mainly to its present economic crisis. During the last three years, spending on science and technology as a whole has been reduced by about 30% per year, i.e. the total expenditures were reduced from 33.5 million USD in 1996 to 16.7 million USD in 2000. Due to the abundant

problems of all sorts – social, economical, and political – that are plaguing the nation today, the government concentrates its actions on responding to the most urgent national needs or priorities. This situation turns out to be even worse if we take into account that local research funding is solely from the government. As a consequence of the present reduction on funding science and technology in our country, there has been a negative impact on the research activities that are conducted mainly at national universities (Bogota, Cali, Medellin and Bucaramanga). In fact, the fellowships for doctorate students have practically been cancelled since 1997: from almost 150 fellowships in 1997 there was not anyone granted in the last two years.

It is apparent today that the nation's dreams of a consolidation of a scientific base will not come true in the years to come. Fortunately, the leaders of our country, specially the scientific community, seem to agree on the importance of science and technology for the nation's progress. We hope that due to our political action and by building up a wider public opinion the present gloomy picture in science and research will certainly change in the future. Eduardo Posada, President of the Colombian Association for the Advancement of Science (ACAC), argues that "although the collapse of the Colombian economy deeply affected the development of all the economical sectors, the one related to science and technology must always be a priority for a country that wants to increase its ability to compete on a global level". Posada claims that the problem of establishing priorities for funding is a political decision of the Colombian government. He refers to the state of Sao Paulo in Brazil, where 2% of its total budget is allocated to promoting natural sciences. In Colombia, "the total budget of COLCIENCIAS for the year 2000 is equivalent to the cost of a helicopter Black Hawk", said Posada. During the last three years, Colombia has spent about 0.2% of its GDP in R&D.

I have emphasised the point that the support we have received from the ISP for almost 16 years have been concentrated to give us complementary assistance to that we attract from local sources. Under this scheme of cooperation we have been able to develop scientific competence and to build-up sustainable research infrastructure. We are contributing to the building of a functioning university with teaching and research relevant to the further goals of a sustainable progress of our society. However, our country is still far behind of having enough manpower: the number of people with a PhD degree in Colombia is estimated at about 4000 with a total population of 40 millions inhabitants, that is 0.01%. There are at present 36 PhD programmes in which are enrolled 296 students. The distribution of these programmes are as follows: 21 in basic sciences including biomedicine, 4 in engineering, 2 in education and 7 in humanities. A total of 441 staff members (holding PhD degree) are in charge of these programmes.

On this special occasion, when all the ISP family distributed over the whole world, is celebrating its 40 years of existence, I have tried in this article to present my testimony of the success of its altruistic mission of given support

and assistance to Third World countries for building their research capacity. In particular, the success of the various schemes of support that are implemented by the ISP have been well demonstrated in our case. However, I also called the attention that we still need to be linked to the ISP for more years under the same scheme of cooperation as in previous periods.

Do We Need Long-Term Support?

By Dr Federico Dajas

Head, Neurochemistry Department
Instituto de Investigaciones Biológicas Clemente Estable
Montevideo, Uruguay.

The International Science Programme (ISP) is celebrating its 40 years of existence. The group of the Neurochemistry Department of the Clemente Estable Institute (IIBCE) in Montevideo, received continuous ISP (IPICS, more precisely) support from 1984 to 1998 – almost half of this time! This is absolutely unique among agencies providing support to research in non-industrialised countries. Beyond the expression of deep gratitude – in the name of neurochemists in Latin America and on behalf of fellow countrymen scientists – it seemed important to contribute with some reflections on ISP policies and their effects, possibly the best way to celebrate such a long and prolific life of an international agency.

Nobody questions today that knowledge is a very important component of economical development. Nevertheless, political leaderships in our non-industrialised societies systematically fail to give priority to creation of knowledge and to critical and independent thinking in development. In this way, they provide the background for our question: why provide long-term support in such political scenarios?

Support to research is a particular case of support to development, in this case helping people to reach the highest capacity they have: the ability for critical and independent thinking, the ability to do science. Science grows when it is linked with the general economical activity in every country or region. In non-industrialised societies, economical forces show a lack of interest for science and technology; the history of science already shows the important part that researchers have had in showing, explaining and linking innovation with economy. Development of science in poor countries need scientific leadership: very good scientists, recognised as such by their societies and actively promoting research, giving the political struggle for a role of innovation in the academy and the economy.

For these reasons, strong basic research together with the establishment of links with industry are key strategic aspects of scientific development in low-income countries. Besides, present science is multidisciplinary and great breakthroughs are only possible through cooperative, multidisciplinary activities.

It can be understood that with the tasks required to develop independent science, *it takes time.* Science has to be produced *locally* to start having posi-

Figure 15. The Director of the International Programme in the Chemical Sciences 1970–1997, professor Rune Liminga (right), discussing with Dr Federico Dajas, IPICS project leader, Instituto de Investigaciones Biológicas Clemente Estables, Montevideo, Uruguay. (Photo International Seminar)

tive repercussions. Long-term support is the practical answer and the ISP (IPICS in our case) way of functioning has been an adaptation to the unique mission it has: promote research to a level of independence.

It is interesting to see how the neurochemistry group has changed over the 20 years from 1979 to 1999. The original ISP support to one group has resulted 20 years later in 3 groups at the Institute, 2 groups in the country and 1 group in the region. Together the 6 groups have produced more than 12 papers per year. The number of people involved has increased from 1 scientist and 2 students to 11 scientists and 9 students. Before the ISP support the Institute did not have any international contacts whereas today 2 regional networks (LANBIO, SARBIO) exist and an annual international course is held with more than 150 students and 50 professors. Support is coming in not only from ISP but also from National and University Research Councils, from international agencies (IFS, EC, SAREC) and from national and international industries.

Obviously, the ISP support to one group has qualitatively changed the situation in science in the Institute, the country and the region. The level of independent research has been reached and multiplied, and positive regional influence is already operating in the form of scientific cooperation, networks and courses. We believe that these figures show that a mission is accomplished and that the policies applied are justified.

Historical development of the project

The first contact between the Neurochemistry Division and IPICS (then International Seminar in Chemistry) occurred in 1979 when a fellowship was awarded to F. Dajas for a stay in Sweden. Research training programmes were not available in Uruguay at that time. The fellowship was successfully ended but the political situation in Uruguay (a military dictatorship was running the country) precluded the starting of any follow-up programme at that moment. It is difficult to imagine less favourable conditions for doing creative research. The fact that the Neurochemistry Group introduced the first High Performance Liquid Chromatograph (HPLC) in the country (1979) can give an idea of the prevailing conditions at the time. During the first three years after the initial fellowship, contacts were kept only with Swedish scientists that generously provided initial raw material, spare parts, drugs, etc. An Agreement of Cooperation, including the following main aspects on the basis of a Research Proposal, was signed in 1984:

– training of Neurochemistry staff in Sweden
– support for the organisation of international meetings
– funds for minor equipment and partial support to local staff.

These three aspects of the Agreement were critical for the maturation of the Neurochemistry group as an independent research group with international recognition. The outcome of the agreement was as follows:

– Young scientists were trained in Sweden and other European countries, increasing significantly the quality of the research and complementing it with the equipment and technical facilities that could be found in Sweden.
– The Symposia Series "Neurotoxins in Neurobiology", becoming a recognised event in the field, opened the doors of international contacts for the Neurochemistry Group and were the basis for the collaborative links established with many research groups in Europe and Sweden. They were also the basis for establishing the regional contacts that led to the foundation of LANBIO (Latin American Network for Research on Bioactive Natural Compounds) some years later.
– Project Funds were instrumental for keeping young people linked to the research activities and allowed research developments through the purchasing of new minor equipment.

Achievements of the project

The research of the Neurochemistry Group aims at isolating and characterising new natural compounds active in the central nervous system and to develop diagnostic analytical approaches to human neurological diseases. The unsur-

passed richness of nature can provide a great variety of entirely new compounds to be tested as remedies in neurological pathologies. The South American continent contains the largest area of tropical vegetation in the world comprising a diversity of plant and animals species. The exploration of these natural resources can provide original tools for neuroscience research and potential compounds for the development of novel therapeutics.

The discovery and characterisation of Fasciculin, a very potent natural inhibitor of the enzyme acetylcholinesterase (AChE) has been the main scientific achievement of the Neurochemistry Division, followed by the description of the anxiolytic properties of a family of flavones in the extracts of local plants utilised as sedatives.

The development of original methodologies for the assessment of monoamines in blood and urine in human patients, a practical approach for diagnosing subtypes of hypertension, has been another important contribution with social consequences since the methods are in daily use for clinical diagnosis in the country and internationally.

The neuropharmacology programme of LANBIO

IPICS supported research groups in South America have been the basis for support to regional activities through networks like LANBIO. This situation offers the opportunity to utilise these resources for further training in science of less developed groups in less fortunate countries (e.g.: Paraguay, Bolivia, Peru). The first objective of LANBIO is to contribute to the building of research capacities in these countries. Co-ordinated, multicentre, multinational research activities in natural products can get meaningful results in reasonable periods of time and train people in the scientific use of regional resources of local and general strategic importance.

The Natural Products Research Unit in Montevideo

The Clemente Estable Institute in Montevideo is a research centre of excellence in biological sciences (neuroscience, genetics, molecular biology, etc.). The Neurochemistry Division of the Institute is a leading group in neuropharmacology of natural products and in basic research in neuroscience. The Department of Pharmacognosy of the Faculty of Chemistry of the Republic University in Montevideo has a long tradition of natural product analysis. Together with the Dept. of Pharmacy and the Neurochemistry Division of the IIBCE they constitute a multicenter Unit where every aspect of natural product research activities, from analysis to bioassays, can be undertaken.

Present strategy offers stays at the Unit in Montevideo, Uruguay, as part of local training activities. Another important aspect is the participation of re-

searchers from Uruguay, Argentina and Brazil in local courses. During the next two years, the Unit in Montevideo will offer short and medium stays (3, 6, or 10 months) to PhD students in training, as part of a local degree programme in Natural Products Chemistry with the university in Asunción, Paraguay or with Universidad de San Andrés, La Paz, Bolivia. A similar arrangement exists in Biology with Universidad Mayor de San Marcos, Lima, Peru.

Food Research within LANFOOD and in Ecuador

By Dr Jenny Ruales

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Quito, Ecuador

The Latin American Network for Food Research (LANFOOD) was created in 1995 with the support of Professor Rune Liminga, former director of the International Programme in the Chemical Sciences (IPICS), Uppsala University, who extended generous financial assistance, and of Professor Baboo M. Nair, Department of Applied Nutrition, Lund University, who was behind the idea of having such a network in Latin America for promoting regional and international cooperation. In the beginning the members were mainly recruited from those Latin American scientists who have had some connection with Sweden. After 5 years of the creation, scientists from thirteen countries including Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Ecuador, Mexico, Uruguay, Venezuela, Sweden and Denmark are members of LANFOOD. Effort in establishing regional cooperation leading to collaborative work is being sponsored by IPICS. We have succeeded in sharing local and regional resources, through exchange of scientists and postgraduate students among the research groups of Latin America. It is important to mention that common postgraduate programmes in Food Science have also become a reality.

The aim of LANFOOD is to promote regional collaboration between research groups working in the field of food science and biotechnology. The expression "effective research through cooperation" was the main motivation for our activities.

The main objectives of the network were to increase the cooperation between regional and international research groups and to improve the sharing of research facilities among the members. It was also important to identify problems and formulate projects of local importance as well as to develop a policy and a mode of operation for supporting regional cooperation. Exchange of scientists and postgraduate students in the network needed to be strengthened and also the sharing of information on food analysis and on nutritional composition data. It was natural to create a database of resources available for research among the members.

Since 1995 several workshops, conferences and symposia have been held in the region. Proceedings from these meetings have been produced, which have added to the scientific communication within the network. A practical Handbook on methods for the characterization of carbohydrates has been published

recently showing that the cooperation between the network members goes straight down to the laboratory work.

Exchange of staff and students between the different institute members will continue to be supported by LANFOOD. Scientific regional events have been organized in several Latin American countries, giving to the scientists of the region the opportunity to share the experience and knowledge with others working in the same field of work. LANFOOD has also coordinated some training in Ecuador, Venezuela, Argentina, Chile, Mexico and Spain and visits of its members to regional laboratories, with funds mainly from IPICS, but also from IFS, CYTED (Iberoamerican Technical Cooperation for the Development of Science and Technology), Spain, national ONCYT (Organisacion Nacional de Ciencias y Technologia) and French Technical Cooperation. LANFOOD has been the seed to promote collaboration with research centres mainly from Spain, France and Belgium, and also with other countries from outside of the region. Research projects sponsored by the European Union and through bilateral cooperation have involved scientists from LANFOOD.

The main field of collaboration at present is related to characterisation of starches from non-traditional regional materials like roots, tubers and tropical beans, and to their utilisation according to their intrinsic characteristics. Physico-chemical, functional, rheological and nutritional characteristics are being evaluated in starches. Dietary fibre is also of interest of the members of the network, as are studies of micronutrients, like lipo- and hydro-solubles vitamins and minerals as Fe, Zn and Ca. The effect of processing on the quantity and bioavailability of pro-vitamin A is also studied.

Minerals, the content and their availability by using *in-vitro* and *in-vivo* methods, are matters of research. Different processes are being applied for improving the stability, nutritional properties and organoleptic characteristics of the final products based on cassava, rice, tropical beans, etc. Research activities on cassava, quinoa, lupine, tropical beans, roots, tubers and non-traditional fruits, are oriented to adding value to local materials by using their bioactive compounds, or maybe enzymes with special characteristics.

Training programmes of students and exchange of scientists have been carried out in collaboration with CYTED. Through joint efforts between LANFOOD and CYTED a large number of exchanges programmes have been performed. Through the European Union postgraduate programmes in Latin America in Food Science and Technology are being under discussion for their validation.

During this time a familylike relation has been established among the members of the LANFOOD network. As Executive President of LANFOOD, I would like to thank all the members for having confidence in the aims of the network and for using this system as a complement to their own research activities. IPICS, represented by Professor Rune Liminga in the beginning and now by Professor Malin Åkerblom, is the main source of technical and financial support and of inspiration for continued cooperation among the food scientists of Latin American countries.

Figure 16. Members of the food research group of the Department of Food and Biotechnology in Quito, Ecuador. From left Cecilia Carpio, PhD student, Priscila Santacruz, MSc student, Francisco Salgado, student, Valeria Díaz, PhD student, Juan Bravo, research assistant, Mayra Paredes, research assistant, Jenny Ruales, project leader, Fernanda Reyes, student, and Christina Arteaga, student. (Photo Quito)

Food Research in Ecuador

The leading group in LANFOOD is the IPICS supported group at the Department of Food and Biotechnology in Quito. This group has been supported since 1984. The main goal of this research group is to add value and to improve the uses of local raw materials. The studies are focused on the chemical and nutritional evaluation of the non-traditional products in order to contribute to the improvement of the nutritional status of the Ecuadorian population. In this way, soybeans, lupine and quinoa have been the matter of the research work.

Quinoa (Chenopodium quinoa, Wild)

This project was carried out in collaboration with the Department of Food Chemistry and Applied Nutrition at Lund University (Prof Baboo Nair). A PhD project and a MSc sandwich project were products of this project.

Adding value to local roots and tubers

The results of these studies have been published in thesis works. Scientific papers are being prepared. It is important to mention that this project is sponsored also with funds from the International Bank for Development and the

National Ecuadorian Foundation for Science and Technology. Five honours and now three Master students are involved in this project and it is performed in collaboration with CIRAD-France (Dr Christian Mestres) and Department of Food Technology at Lund University (Dr Ann-Charlotte Eliasson).

Cassava and Production of glucose, maltose and fructose syrups from cassava starch using immobilised amylolytic enzymes

The results have been presented in the regional annual meeting held in Cancun, Mexico. Some papers have been written with the data from this first part of the research. This project is part of a PhD thesis and it is carried out in collaboration with Department of Biochemistry of the Universidad de la República del Uruguay (Prof Francisco Batista).

Carotenoids: total amount and availability, antioxidant activity

The research now is focused on a social and productivity work. We have taken contact with Gatazo-Zambrano Community, Chimborazo Province, which is one of the major carrots producers. This work will deal with postharvest studies of carrots keeping organoleptical and nutritional quality. The development of a carrot juice after lactic acid fermentation, stable at room temperature with relatively high vitamin A availability is being studied.

The study of the availability of carotenes was subject of one honour student thesis work and one MSc thesis. The project is performed in collaboration with Department of Food Science at Technical University of Chalmers (Dr Ulf Svanberg).

Clarified juice from non-traditional fruits

Cross-flow microfiltration is being applied to produce clarified juices with good organoleptic characteristics. The novel technology has been applied in passion fruit. This project has been performed in collaboration with CIRAD-FLOHR, France (Dr Fabrice Vaillant) with the financial support from the French Technical Cooperation, IFS and IPICS.

Other activities

Under the IPICS support 1 PhD and 4 MSc projects were completed. This year 2 PhD and 2 MSc projects started. The MSc projects were implemented as sandwich projects at Escuela Politécnica Nacional under the technical support of Swedish universities. The PhD studies will be carried out as sandwich projects also. Foreign students, as Minor Field Study (MFS) students, are joining our sandwich postgraduate projects in Food Science.

Our research group is recognised for the quality of its research activities. Our department is considered as a department of reference in the region and is ready to assist other research groups upon request. The members of LANFOOD are being invited to take part in scientific events and also to give scientific comments to the different aspects in which we are involved.

Our scientific work was recognised by the Iberoamerican Scientific community by nominating Dr Jenny Ruales as coordinator of the Food Science project in the Iberoamerican region under the CYTED programmes. Twenty-one countries are members of CYTED, 19 from Latin America plus Spain and Portugal.

Thirty Years of Sustainable Research Cooperation

By Professor Isaac B. Osazuwa
Department of Physics Ahmadu Bello University
Zaria, Nigeria

The Department of Physics of Ahmadu Bello University (ABU), Zaria, Nigeria, came into existence with the establishment of the University in 1962. At its inception the Department inherited what used to be the Physics Department of the defunct Nigerian College of Arts, Science and Technology, Zaria. Thus, the Department was saved the initial problems which are peculiar to academic departments in a new university. Further expansion of existing facilities was undertaken gradually as the need arose.

Research activities commenced in the Department as early as 1964 in the areas of ionospheric physics and geomagnetism when an ionospheric sounder, on loan from the Radio Research Station in Slough, U. K., was installed. In the same year the Department received a grant of 6 250 US dollars from the United States National Science Foundation for the purchase of an induction magnetometer. Research activities in the Department then was based purely on individual academic interest. Thus the research activities could not be said to be coordinated. Attention was focussed on the area of applied geophysics when in 1966 Deborah Enilo Ajakaiye completed the gravity survey of a granite outcrop in central Nigeria. The scope of geophysics research was widened to cover the Younger Granite Province of the Jos Plateau area also in central Nigeria. This initial impetus on the part of the Department to have a well coordinated research programme was hampered by the Nigerian political crisis which began in 1966 and culminated in a civil war that ended in January, 1970. The state of the Department after the war, as far as research was concerned, could be likened to that of a patient who is learning to walk after suffering from a stroke. This was the situation in which the ISP met the Department when the research cooperation began in 1971.

Contributions of the ISP

The beginning of research cooperation between ISP and ABU in 1971 was marked by a fellowship award to Elias E. Myada. The one-year fellowship was utilised at the Institute of Geophysics of Uppsala University, Sweden. Thereafter there was a passive phase which lasted for ten years. The cooperation was

reactivated in 1982 when Jacob Adetunji (now Professor at the University of Sheffield, U.K.) was awarded a one-year fellowship to undergo training on Mössbauer Spectrometry at the Institute of Physics, Uppsala University. In order to maintain continuity, Isaac B. Osazuwa (now professor of geophysics and Head of the Department from 1997 to 2001) was awarded a ten-month fellowship in 1983 which was utilised at the Institute of Geophysics, Uppsala University. Ever since then a number of group members have been awarded fellowships to the ISP programme.

Initially, three programmes, *viz* geophysics, Mössbauer spectroscopy and neutron physics, were supported by ISP at ABU, but this number was reduced to only geophysics in 1991. This turn of event enabled the ISP to focus attention on the strengthening of geophysical research at ABU while focussing attention on other areas of physics in other institutions.

During the period of cooperation, three major research groups evolved. These are the geophysics, nuclear physics and radiation biophysics groups. While the geophysics research group is sustained by ISP, the other two groups are funded from grants provided through Centre for Energy Research and Training (CERT) with active collaboration of International Atomic Energy Agency (IAEA) and Deutscher Akademischer AustauschDienst (DAAD). The activities of each group is designed to promote interdisciplinary research. The contributions made by the ISP towards the development of the Department can be assessed in terms of capacity building and the provision of ancillary facilities for the advancement of research.

Capacity building

The ultimate objective of establishing a university particularly in a third world country is to provide a strong base for training high level manpower needed to enhance the scientific and technological growth of the nation, which in themselves are precursors to the political and socio-economic development of the nation. The ISP has contributed immensely towards the realization of this objective. Eight personnel have so far benefited from the ISP linkages with universities in Sweden. Five out of the eight obtained their PhD degree through the programme and, at one time or the other, they participate in the training of others to obtain their PhD degree from this same Department. It thus becomes obvious that at this time of economic depression in Nigeria, which has more or less paralysed the staff development scheme of the various universities in the country, ISP has remained a fountain of hope for the survival of staff development in the Department.

Ancillary Support

Recognizing the importance of ancillary facilities to the full realization of staff development, the ISP provided some back-up facilities which are expensive and difficult to obtain locally, the most recent one being the donation of the magnetic susceptibility system (costing about 40 000 US dollars) to the group

in August, 2000. Scientific journals have been provided for the Department, in some cases annual dues for individual membership of professional societies/ associations outside Nigeria have been paid by ISP, repairs have been carried out on major research and teaching equipment such as magnetometer, spectrometer, susceptibility meter and seismic equipment. In other cases, spare parts such as batteries and cables for LaCoste and Romberg gravimeter have been provided. Some personal computers and a terrameter have been donations to the geophysics group by ISP. Electronics tools and instruments worth thousands of US dollars were also supplied by the middle of 1991, specifically to equip the microprocessor workshop in the Department. The workshop now serves as a strong technical back-up for the geophysics programmes for the repair of its equipment and computers.

Research activities

During the period spanning from 1972 to 1991, several socio-political and economic changes took place in Nigeria among which were: the recovery from the civil war with its attendant reconciliation and reconstruction; the military *cum* civilian politics and its amphibious transitions; the economic depression. The euphoria that ushered in the end of the civil war brought in its trail a dramatic, but remarkable development in the general academic structure of Nigerian universities. This continued until the early 1980's when things began to fall apart. The economic depression in Nigeria at the period under consideration posed a great threat to the university system in Nigeria, especially when universities have been proliferated in the country.

Research activities within the group span a wide spectrum of geophysics, involving the application of electrical/electromagnetic, gravity, magnetic, radiometric and seismic methods. Following the establishment of a primary gravity network for Nigeria in 1985, the group has embarked on a detailed and systematic gravity mapping of Nigeria in collaboration with the Federal Surveys of Nigeria, and the Nigerian Geological Survey Department. The group, working in conjunction with geophysicists from other universities in Nigeria, was commissioned in 1988 by the National Technical Committee on Earthquake Phenomena (NTCEP) to prepare a gravity map of the Nigerian continental margin and also to set up a microgravity network in a section of Southwestern Nigeria where earth tremor was reported to have occurred in August 1984. A more intensive geophysical investigation of the northern Nigerian Basement Complex was embarked upon in the 1996/97 session and this culminated in a three-year research grant support from 1999 to 2001 by ISP. During this three-year period, there was tremendous improvement in the provision of research facilities for the geophysics research group which in turn hastened the pace of research among the group members. Among such research facilities are:

– The training by ISP of additional technical staff in microprocessing technique for the group;
– The setting up of the microprocessor/electronics workshop where repairs and maintenance are carried out on our equipments and computers;
– Procurement of additional research equipment (the Bartington Magnetic Susceptibility System) and computers with peripherals by ISP;
– Expansion of the intake into our postgraduate programme.

Also at an advanced stage of completion is the environmental impact study of Kaduna metropolis using electrical resistivity, very low frequency electromagnetic and seismic methods. In addition, the group has diversified its research into groundwater exploration, mineral prospecting and environmental studies. The improved research climate within the group has resulted in the large turnout of postgraduate degree recipients.

Research outputs

Academic activities within the Department are streamlined so as to make research results relevant to the needs of the greater Nigerian society. The Geophysics group, which is the oldest of the three groups, has made tremendous impact not only in Nigeria, but also among the third world countries since ABU entered into research cooperation with ISP. Some of the research works completed by the group with the support of ISP are: the establishment of a primary gravity network for Nigeria; gravity and magnetic investigation of the Sokoto basin; regional geoelectric study of Zaria area; and the interpretation of the magnetic anomalies of the Mamfe basin. Gravity survey of Kaduna and Katsina States was completed in 1996. The trends of gravity anomalies in the region has opened up a systematic geophysical study of the area. Our recently concluded research work in the Nupe Basin has shed light into the structural evolution of this inland basin and its associated mineral potentials. Consultancy services have been rendered by the group. These include seismic investigation at Ajaokuta Steel Company river port, and the interpretation of the gravity data of the Gongola basin for Shell Petroleum Company. The achievements of the Geophysics research group can also be measured by the number of publications which are turned out annually in both local and international journals as well as conference presentations, and the annual output of postgraduate degree holders. All these advances are made possible through the support of ISP. The group has developed its activities beyond routine research and presently offers postgraduate courses in applied geophysics on regular basis. Besides the over seventy MSc (Applied Geophysics) degrees that has been awarded in the department, twelve PhD degrees have also been awarded in Applied Geophysics. Out of this twelve, three are still in the services of ABU as lecturers in the Department, while the rest, but one, are practising geophysicists in other Nigerian and foreign universities.

Limitations

Our major pitfall is our inability to fully achieve our objectives due to inadequacy of facilities. For a geophysicist to give a good account of himself, he needs functional, reliable and up-to-date equipment. Geophysical research is field-oriented, therefore it is capital-intensive. Lack of funds has seriously undermined our field activities. In spite of our reputation, we are not yet able to stretch our activities far enough to reach more countries so as to adequately cater for their geophysical research needs. Every year we receive numerous applications from foreign candidates for postgraduate admission. In majority of the cases the applications are turned down because of limited facilities. The paucity of modern communication facilities (for example Internet connectivity) is rendering the group scientifically impotent.

Projections

During the period 1972 to 2001 the Department made great impact on the society at large through the activities of its research groups, particularly the geophysics group. In order to further enhance the position of the Department as a leading geophysical research outfit in Nigeria so as to be able to provide a virile postgraduate training programme for the sub-region, the geophysics group has proposed the following plans for future development.

- Expansion of the postgraduate degree programme so as to cater for candidates from the West African sub-region.
- Introduction of exchange programme with other universities in the sub-region.
- Setting up a permanent site, with adequate facilities, for the geophysical field school.
- Industrial attachment of the postgraduate students to reputable institutions.
- Setting up a data processing and small printing unit to enhance rapid production of conference materials.
- Promotion of conference attendance both locally and internationally among members of the group.
- Organizing conferences, symposia and workshops which will enable geophysicists in the sub-region to come together and exchange scientific ideas.
- Provision of Internet connectivity and e-mail services.
- Replacement of all obsolete and non-serviceable equipment.
- Subscription in many geophysics journals.

Executing the plans set out above is, by no means, an easy task as it would involve a lot of capital outlay. We will therefore need the benevolence of external agencies like ISP in order to fully attain our goals.

Figure 17. The Advanced Geophysical Research Laboratories, Department of Physics, Ahmadu Bello University, Zaria, Nigeria. (Photo ABU)

Conclusion

The period from 1971 to 2001 when ISP became involved in the research activities at Ahmadu Bello University, Zaria, Nigeria, witnessed a marked improvement in the capacity building and research capability in the department of Physics of ABU. In particular, the geophysics research group has become recognised as a leading geophysical outfit in the country, having produced over seventy MSc and twelve PhD degree holders since inception in 1974. Beside its achievement in the area of postgraduate training, the group has made remarkable impact in the scientific development of Nigeria and the world at large through its research break throughs in geophysics. Some of the group's work include basinal and basement complex studies, establishment of gravity networks and many others. Recently the group has embarked on environmental impact studies and ground water prospecting in the arid zone of Nigeria using advanced geophysical methods. All these achievements were made possible with the cooperation and involvement of ISP in the research activities and manpower development of Ahmadu Bello University.

The activities of the group has extended to other tertiary and research institutions in Nigeria, with whom it has established research cooperation. The research facilities have improved appreciably through the benevolence of ISP. Only recently the ISP donated a Magnetic Susceptibility System to the group. We are again looking forward to receiving a seismograph and a terrameter

from the ISP. The group is now fully established at a building complex provided by ABU which now houses the group's Advanced Geophysical Research Laboratories. Such laboratories include a Microprocessor Laboratory manned by a competent technician trained in Norway under the auspices of ISP, a laboratory for each of the following research areas: gravity, magnetic seismic, geoelectric/electromagnetic; and of course the computer laboratory. Given all these facilities and the high calibre manpower available, the group can attract postgraduate candidates from the West African sub-region and the entire third world. To sustain this set research objectives, the continued support of ISP and other international donor agencies will be highly desirable.

Biotechnology in Cameroon

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The first contacts with the International Programme in the Chemical Sciences (IPICS) were established as a result of the interactions the author of this article had with Uppsala University. During the period 1973–1978 I studied for a PhD degree, successfully completed at the Department of Medical and Physiological Chemistry, Uppsala University. Before returning to Cameroon I took up a research position with a WHO/UNDP/World Bank Project on human Onchocerciasis. The project, as it was conceived at that time, was oriented towards clinical studies with biochemical and molecular biologic aspects not adequately emphasized. I decided then to explore these aspects in view of my previous training in biochemistry at Uppsala University.

In 1987 a cooperation agreement was signed between University of Yaounde and Uppsala University with the understanding that IPICS would fund the continuation of the work on onchocerciasis. The Vice Chancellor of Uppsala University, Professor Martin H:son Holmdahl, gave a strong support for this link. As the ISP approaches its 40th anniversary, it is befitting to cast a retrospective look at its contributions in the development of sustainable scientific environments in the developing world.

IPICS support came to our group at a time when the implantation of Biotechnology was at its initial stages, and has since been a vital catalyst in the promotion and sustainance of this discipline in Cameroon. Before 1988, when the first IPICS grant was awarded to our group, we already had financial support from the International Foundation for Science (IFS), the World Health Organisation (WHO), the Swedish Institute and most especially Uppsala University. Twelve years later IPICS support has continued to give vital impetus to our group. The aims of the present article are to cast a retrospective look at the development of health biotechnology in Cameroon and to describe the contributions of ISP/IPICS in this process.

Figure 18. A workshop in Molecular Biology at University of Buea, Cameroon, in 1997. From left, Dr Ames Sakwe, Professor Vincent Titanji (group leader), Dr Ndip and Mr Boyd. (Photo University of Buea)

Development of Biochemistry and Biotechnology in Cameroon

The teaching and practice of Biochemistry in Cameroon is associated with the foundation in 1966 of the Medical School at the University of Yaounde. Subsequently a Biochemistry Department was organized at the Faculty of Science of the same University with the active participation of the leader of an IPICS project. The Foundation of the Biotechnology Center at the University of Yaounde and the Biotechnology Unit at the University of Buea benefitted directly from IPICS support. Currently there are 4 Biochemistry/Molecular Biology degree programmes in four state universities of Cameroon, that award Honours, Masters and doctorate degrees in Biochemistry. ISP/IPICS alumni are among the prominent academic staff members at two of these departments.

The Role of ISP / IPICS

The ISP/IPICS philosophy of long-term support to deserving research groups has been instrumental, through the multiplier effect of recipient groups, to affect profoundly the development of appropriate technology in countries where it operated. This has been the case in Cameroon where a new generation of biotechnologists and chemists have drawn their inspiration from ISP/IPICS

sponsored projects. The first ISP/IPICS project in Cameroon was established in 1988 and accommodated both organic chemists and biochemists. By 1991 it was evident that the first funds could not fully satisfy the needs of the organic chemists and therefore a new project was created to cater specifically for the development of phytochemistry. Though both projects maintained collegial links, each developed in its own direction. The basic principles that guided the development and impact of the first project during this period included a coherent staff development policy, networking, material and financial support, flexibility and sustainability.

Coherent Research and Staff Development Policy

We realized early in the process that advanced technology transfer could only win the support of national and international donors if it addressed problems of relevance to national development objectives of Cameroon. Hence we chose to employ the study of the debilitating and blinding disease, onchocercias, as a vehicle for biotechnology acquisition. Narrowly defined, biotechnology involves the use of Recombinant DNA Techniques and Hybridoma Technology as research tools to generate health care products as diagnostic reagents, vaccines and drugs. With time the research emphasis of our group has expanded to include malaria and tuberculosis, two infectious diseases that are resurfacing with devastating consequences with the context of the global HIV/AIDS pandemic.

Apart from the selection of a relevant research theme, capability building was recognized by our group as an important factor for sustainable technology transfer. Thus we developed and implemented with the assistance of IPICS a staff training programme resulting in the award of more than 30 MSc and 10 doctoral degrees to our trainees. A post doctoral training programme allowed for the conversion of PhD level biologists into biotechnologists, which was necessary for building up to the critical mass of researchers needed for this field.

Networking

The methods of networking employed included formal MSc/PhD sandwich courses in which our trainees, with ISP/IPICS support, did part of their research training in collaborating laboratories in Sweden, Britain and Germany. The formal training courses were supplemented by Annual Biotechnology Workshops, which were organized for the benefit of Cameroonian and other African Trainees. Between 1988 and 1992 vigorous weekly seminar series were organized at the Biotechnology Center, Yaounde, which served as a meeting point for bioscientists from all over the country. These series have now

ended. However, the project scientists have continued to be major contributors to the Proceedings of the Cameroon Biosciences Society and the Cameroon Biochemical Society which meet annually with a cumulative membership of nearly 300 life scientists.

Logistical Support

In contrast to other donor organizations which are satisfied to end their support with the provision of grants for one to three years, the ISP/IPICS has an efficient follow-up mechanism. This in my opinion singles it out among donor organizations. Technology acquisition like any other human endeavour needs time to mature. It cannot be completed within the usual 1–3 years duration of international research grants. Even when the grants are substantial, assistance in the acquisition of research goods is crucial for the success of the programmes. In the case of biotechnology, the purchase and supply by ISP/IPICS of enzymes and other labile fine chemicals were critical for the setting up and exploitation of gene cloning techniques in our laboratories in Cameroon. Given the fact that private sector suppliers of molecular biology reagents are few in our region, ISP/IPICS role in supplying equipment spare parts and these reagents have been paramount in our work.

Flexibility and Sustainability

ISP/IPICS policy gives the research team considerable freedom in deciding on their orientation and use of funds. This creates ample opportunities for adaptation as the project evolves. Thus, although our group was mainly concerned with the molecular biology of Onchocerca volvulus, we were able to work on a number of other parasitic infections prevalent in our region such as malaria, loaisis and schistosomiasis. The study of medicinal plants and tuberculosis also found place in our programme. More recently we have begun to make overtures to structural biology and bioinformatics – themes that are bound to dominate biological research in the post-genomic area. All of these adaptations have been possible within the framework of the first project that was devised more than a decade ago.

Constraints and Prospects

Perhaps, the single most important constraint of the ISP/IPICS programme has been the limited financial resources available to support the research groups. Although support for fellowships, reagents and spare parts has been adequate, there has usually been no funds for the purchase of heavy equipment. Drawing upon its considerable strength as a successful and well managed donor pro-

gramme, ISP/IPICS should try to influence other richer foundations to set up a heavy equipment acquisition programme for groups in developing countries.

The field of biotechnology and its applications will witness a revolutionary build-up of new applications spear-headed by high-through-put post genome technologies. It will be important that research groups in developing countries develop the necessary capacity to participate in this exciting process. As such the development of indigenous capability in the emerging field of structural biology molecular genomics and drug discovery represents one area in which ISP/IPICS can continue its praise-worthy support of scientific environments in developing countries. The Cameroon projects intend to remain partners in developing these new trends.

Major Achievements of the First Project in Cameroon

- We have successfully transferred and established cutting-edge molecular biology techniques in Cameroon. This was achieved by setting up and directing the Biotechnology Center in Yaounde, and subsequently expanding to a new laboratory at the University of Buea. Such laboratories did not exist in Cameroon or in the sub-region when the project started in 1986/87.
- We have now trained at the two laboratories more than 100 postgraduates,10 of these received their doctorates from the first project whilst 30 students earned MSc or equivalent qualifications from the same project.
- We have developed techniques for the isolation and in vitro maintenance of the developmental stages of Onchocerca volvulus including the main stages that occur in humans. This has opened the way for in-depth studies of the parasite.
- We have identified and characterized some dominant onchocercal antigens, leading to the development of specific diagnostic methods based on antibody and antigen detection.
- Our group has identified cloned, sequenced and mass-expressed four new onchocercal antigens termed OV42, 0V47, OV62 and OVL3.C1 which are currently being evaluated along with other recombinant antigens as candidate vaccines. OV47 has emerged as a promising marker of immune protection.
- We pioneered research on protein phosphorylation in O. volvulus and identified stage specific phosphoproteins of the developmental stages of the parasite.
- Recently we described a sensitive PCR method for the diagnosis of M. tuberculosis.
- In recognition of our achievements three academic prizes of excellence have been awarded to members of our group by: (a) The International Society of Infectious Diseases, New York (to VPK Titanji in 1992); (b) The Uppsala Medical Society (to JP Muluh, VPK Titanji & Zetterqvist in 1995) and (c) The International Foundation for Science/DANIDA (to VPK Titanji in 1998).

The African Laboratory for Natural Products

By Dr Ermias Dagne

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The African Laboratory for Natural Products (ALNAP) is an offshoot of the Natural Products Chemistry Project based in the Chemistry Department of Addis Ababa University (AAU). It developed as a result of activities which, over the years, was supported by the AAU, the Ethiopian Science and Technology Commission (ESTC), Sida/SAREC, the International Foundation for Science (IFS) and the International Programme in the Chemical Sciences (IPICS). The basic aim of ALNAP is to contribute to the development of the science of natural products in Africa. ALNAP's main programmes are:

- Conducting phytochemical research on African plant species of interest to medicine, agriculture and industry
- Organizing short courses and workshops
- Implementing exchange of researchers scheme
- Providing analytical services
- Compiling and disseminating phytochemical information on African plants.

Regional activities

ALNAP is one of the active centers in the region where intensive work is undertaken in the study of the chemistry of African plants. Although much emphasis is given to the search of bioactive compounds from plants, equally significant is the attempt to generate scientific data to validate the use of medicinal plants in traditional medicine. Considerable work has been undertaken on essential oil bearing plants originating from different parts of Africa. Using gas chromatography in combination with mass spectrometry (GC-MS) valuable information on numerous plants has been generated, which has now been compiled in the form of a monograph entitled: "Gas Chromatographic Profile of Essential Oils from the African Flora", which is also available on CD ROM. Other noteworthy contributions of ALNAP include the work on chemistry of Aloes of Africa and on gums and resins.

Organizing short courses and workshops is one of ALNAP's means of contributing towards the enhancement of research capabilities of African scien-

Figure 19. Professor Ermias Dagne (left) and some of his assistants at the Natural Products Chemistry Laboratory, Addis Ababa University, Ethiopia. (Photo NPCL)

tists. Since its establishment in 1996 ALNAP has successfully organized a number of such activities including the following short courses:

– Super critical fluid extraction and gas chromatographic techniques
– Focus on High Performance Liquid Chromatography (HPLC) methods
– High field NMR theory and techniques.

These short courses are targeted to participants from the Eastern African Region.

An important component of ALNAP's activities is implementing an exchange of researchers scheme. In this programme researchers from the region, are hosted for a period of one to two months.

Lack of trained support staff is a problem faced by research laboratories in the region. In this respect the IPICS supported Home-based Training Scheme allows the project to engage on full time basis young research assistants. While the assistants render invaluable service, they also at the same time gain considerable experience in conducting research. Under this Scheme two research assistants were employed since 1997.

Using a variety of research instruments under its disposal, ALNAP has the capability to provide analytical services to researchers from local and regional institutions. The recent acquisition of a 400 MHz NMR spectrometer will bolster this capacity.

Dissemination of information

A large body of information has accumulated over the years on the chemistry and biological activities of plants and their products. Articles on African plants appearing in journals, proceedings, dissertations, monographs etc are regularly entered in the ALNAP Database, which has now over 10 000 entries. The database is an important source of information on the chemistry, ethno-botany and ethno-pharmacology of African plants. Using the database, information service has been given to several requesting scientists from the region and elsewhere.

The Project Leader has taken part in a number of scientific meetings such as: The NAPRECA International Symposia; Conferences on Natural Products Research held in a number of countries in Europe, Latin America, China and South Africa.

Unique aspect of IPICS support to ALNAP

Donors usually give funds to get projects started, in many cases however, they fail to nurture projects and help them overcome set backs and hurdles they face. In the case of IPICS, its modest but long-term support is geared towards making projects stand on their feet and help them walk through a sustained follow-up and guidance programme. An IPICS grant also enables projects to put equipment and other materials obtained through other grants into effective and optimal use.

In the case of ALNAP, without the IPICS grant, which provided us with some essential equipment, supplies, critical accessories, spare parts, literature and software, a number of major analytical equipment in our possession would have been idle and non-operational. Thus the GC-mass spectrometer and the NMR spectrometer that we purchased using generous support of Sida/SAREC are put to good use because we were able to purchase high grade helium gas for the GC-mass spectrometer and liquid helium for the NMR spectrometer. A hydrogen generator that we purchased using IPICS grant enables us to use effectively a gas chromatograph that was purchased through Sida/SAREC grant. Another unique aspect of IPICS is the expert back-up support we enjoy from its staff in Uppsala. The Director and her assistant are literally on their toes answering queries, getting the right item from the right supplier, settling bills and from time to time coming to visit us to get first hand knowledge of what is going on. All these are gratefully acknowledged.

Regional Cooperation in East Africa

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The department of physics, University of Dar es Salaam, was established in 1965. This is one of six departments in the Faculty of Science. The department was initially established to provide mainly secondary school physics teachers but later on it is become inevitable to take up an additional responsibility to provide other professional oriented courses like electronics, applied physics, etc. The best students have always been absorbed by the department who later took up teaching positions within the department. At present, there are 14 local staff members all with PhD qualifications. It is with this critical mass of physics staff that the department decided in 1977 to establish distinct research groups. These were the solar energy group, the agricultural physics group, the nuclear physics group, and the geophysics group. The last group later changed its name to seismology as the major part of its activities are more related to seismology than pure geophysics. Almost all physics members of staff fit in one of these groups.

As noted earlier when the department started, there were no local staff members and that meant that serious recruitment began in the early seventies. This was not an easy task because all the training had to be done abroad, mainly in the UK. One would wonder why UK only. The reason for that was simple; the British government provided financial support through the British council. In some cases, however, commonwealth fellowships were also offered to some young staff members.

The relationship between the Physics Department, University of Dar es Salaam, and the International Programme in the Physical Sciences, Uppsala University, Sweden goes back to 1968 when the then Director of the International Seminar, Professor T. Lindqvist, visited the department of Physics. Ever since, many academic staff members of the department of Physics have gone to Uppsala on a 10-month fellowship, or have been sponsored by the seminar to visit or pursue research studies in some leading research centers in Sweden or Norway. Some of them have used the fellowships to do research leading to an MSc degree at the University of Dar es Salaam, while others were able to use the financial assistance from IPPS to pursue their doctoral studies.

By 1985 a good of number of academic members of staff visited Sweden

under this programme. At this point the programme took a new direction towards supporting its former Seminar participants. More attention was paid to a follow-up programme upon the return of staff members to Tanzania.

Research Agenda and Its Justification

There are many reasons why countries need their own research capability. The primacy of research is based on the realization that effective teaching at university level must be fed by the research outputs of the teaching staff. Apart from the important role of research in the teaching process, it is generally acknowledged that research, in the widest sense, is the basis of development of any society. Research is a source of new knowledge that drives innovation. In addition to playing an important role in advancing and refining knowledge, research provides solutions to problems facing society not only in the local but also within the wider international context. In this aspect, research complements teaching in feeding the other. Furthermore, since the creation of scientific knowledge involves collaborative work among scientists, nations are best synthesized and benefit more when both parties have a new information to offer. In this regard countries wishing to take advantage of information exchange, must also be involved in knowledge production.

Science and Technology do indeed need investment for their appropriate and effective application and utilisation. First and foremost, they need well-trained scientists and technologists who are competent and can cope with the fast technological changes in the world. It is a pity that there is scant movement to build up the relevant training in a country like Tanzania. The need for science and technology transfer is not properly understood or appreciated. It is imperative to involve communities of scientists who can execute science and technology transfer more effectively. Thus such communities need building up of a critical size in their human resources and infrastructure.

Tanzania is at present going through an economic structural adjustment programme, which envisages the changing the economy from its present high-regulated state to one where market forces play a dominant role. Although one of the effects of such a programme will be to reduce the number of employees (through redundancies) in the public sector, it is anticipated that highly trained and skilled personnel in the right discipline will be needed in the private sector. This group of people will no doubt be more dynamic and have better understanding of the day to day operations of an enterprise. Furthermore, they will be able to make feasible proposals that will ensure smooth implementation of a project. Foreign and local investors are expected to draw most of their work force from this group.

The traditional teaching of science and research in physics in many African countries has mostly been done in way that there was little or no link at all with industries. Thus the gap between what is taught or researched and production

sector remained to be large. However, in order to bridge between production capacity and technology one needs to set a dynamic and rigorous industrial development process. Thus, problem of production capacity will be invented; innovated, fabricated, developed, and sustained through application of applied science in such a way that going back to applied science solves the problem of technology. Through this process, one realises that applied science is a direct result of research in basic sciences through which we probe knowledge to discover new knowledge to build science teaching for sustainable development.

Thus in order to enhance production capacity we need to build a body of scientific knowledge which can apply to create new technologies which results in industrial development in a positive way and hence contribute to production process thereby enhancing sustainable development where human beings are the centres of development.

Research, together with Teaching and Public Service, constitute one of the three principal objects in the mission of universities throughout the world. Research in this context is defined as the relentless but systematic quest that seeks to expand the frontiers of knowledge in the society. It is indeed a truism that a society lacking an indigenous capacity for research becomes totally dependent on the outside world. It is for this reason that any country must have at least one researching university that is also capable of reproducing itself through teaching at both undergraduate and postgraduate levels.

Faculty of Science at the University of Dar es Salaam

Now let us turn to a case study pertaining to research development at the Faculty of Science at the University of Dar es Salaam. Although research has been conducted in the Faculty of Science right from the time of its inception in 1965, most work was uncoordinated and fragmented as a result of which there was little cumulative growth of knowledge. Apart from the lack of a well-articulated Research Agenda, this state of affairs can also be attributed to the lack of sustainable research funding from local sources. In the absence of such funding research has mostly been haphazard and driven by the agendas of the various external donor agencies. The harsh economic environment pertaining in the country and the poor remuneration of academic staff also contributed to alluring most researchers to devote most of their effort to the more lucrative arena of routine consulting rather than research per se. As a result of this unfavourable environment, the available human, financial and infrastructure resources have not been optimally harnessed to create quality research outputs in the form of new knowledge that can be translated into effective teaching and public service.

It is against this background that the Faculty of Science has proposed a Research Agenda. The Agenda is a blueprint which aims at optimising the

research outputs of the Faculty through the efficient utilisation of the available human, financial and infrastructure capacity in the light of the University's Core Mission of Teaching, Research and Public Service. The Agenda also provides a mechanism for prioritising and coordinating research at the departmental and faculty levels to ensure that research addresses the national development objectives. In order to ensure long-term supportable research funds as well as research facilities, the agenda also provides a number of strategies in the implementation of the research agenda. In order to augment the number of active researchers and ensure continuity in the national research effort, the Faculty envisages postgraduate students as playing a key role in the implementation of the Research Agenda. In this regard, postgraduate students are expected to shoulder an increasing proportion of the actual research activity under the strict guidance of academic staff members.

South-South and Regional Cooperation

When discussing about South-South cooperation, it is of vital importance to identify first research institutions (mostly universities and research councils) within a country or sub-region that are engaged in similar kind of work. In this way one has a basic knowledge of the different research activities in the region, and an inventory of scientific equipment, periodicals, research and technical manpower available. The purpose of this task is to look for effective possible ways of sharing different research loads based on the available resources, which could help to partially fill the gaps of individual national research capacity. In this way duplication of research work in the same region could be avoided.

At the national or institutional level, the most important component in the research building capacity is the critical mass of the researchers and technicians. There should be a minimum number (to be determined by the nature of the research project) of researchers who have the relevant training in their disciplines, and they must be in a position to apply their skills and research findings to solve immediate and long-term problems, have ways and means of solving them, and be able to write up the results in a language that can be understood by both scientists and the general public.

In establishing institutional regional cooperation, there should be a room for the developing countries to cooperate with appropriate counterparts in the donor countries. Care should be exercised to avoid a situation of one-sided interests in the advanced countries being imposed on the poor nations of the south. Both partners should carefully discuss the process of setting priority in research in advance, so that there is a mutual benefit. South-South institutional links have also the advantage of working in similar environment, and furthermore the running cost of a research project is probably lower.

The object of networking with advanced countries is to help train scientists

to work together and accords well with the modern tendency of research to become more multidisciplinary. Such training should always be accompanied with a strengthening of research capacity in the recipient country. One good example is in the form of PhD sandwich programmes. In such arrangements, some work can be done at the recipient institution. This kind of programme will not only help building the research capacity but also strengthen departmental teaching staff at national universities. Sandwich programmes will probably reduce tensions and frustrations often encountered by scientists upon returning to their own institutions and probably avoid brain drain mainly to the developed countries.

A follow-up programme can also be worked out between the host institution in the north and recipient scientists in the south. This can be in the form of technical training or material support, such as spare parts, periodicals, and minor equipment or second hand equipment. In general there is much second hand equipment lying idle in western laboratories which can be very useful in the developing countries. Examples include coating systems and spectrophotometers but the problem with second hand equipment is to get spare parts when they break down. Again care should be exercised in this respect.

Research Priority Areas

The choice of priority and relevant research areas depends on many factors. The majority of the developing countries are economically poor and for that reason not every type of research can be done in every country. The limited research resources in terms of manpower., equipment, and financial means often force these nations to set up their own research priorities. In view of this, it is clear that if a nation is to develop research capability, there should be in the first instance "a national strategy for science and technology development". It is only at this level one can define objectively the national research goals and hence set up priority research areas, which should be developed in two steps: (1) short term problem solving research (food productions and storage, health and environment) and (2) long-term coordinated research where long-term implication factor such as energy issues, communication, peace and security have to be taken into account. There are of course a number of disadvantages in defining priority areas. Sometimes scientists are deprived of their intellectual independence, since priority implies that some other research areas are forgotten. There is also the danger that the priority may meet the wishes of a small group of society, such as academics or politicians or the business community, and if priorities are wrongly chosen the nation can be paralysed.

Funding

The limited access to human resources and the scanty grants available are some of the restrictions that dictate on what type of research can be done. Within these limitations one ought to look for research activities that can be performed locally, which have economic impact to the communities. This would necessitate institutions establish their own research agenda that will guide them to focus on the priorities set by the countries. However, contacts with research teams within or outside nations/region are important for complementary work. As mentioned earlier, funding of research projects is very difficult in most developing nations. Most of the funding mainly goes to pay salaries (often very low) to personnel working at the institutes. Very little or no money at all is budgeted for equipment, spare parts, and periodicals and not to mention a possibility for a scientist to participate in an international conference. It is estimated that less than 0.3% of the GNP goes to research and development in developing countries. Furthermore only a small fraction goes to basic sciences. Developing countries have been urged to increase their basic research budget, but as mentioned earlier, these nations cannot afford beyond the present level of less than 0.3% of the GNP. In some cases however up to about 40–50% of their annual national budgets consist of foreign aid or loans from world financial institutions. Donor agencies and Western laboratories have always been asked to be more sympathetic to the science research situation in the less developed nations. Through financial and material assistance, it is possible to bridge the gaps that exist in research infrastructure by providing the necessary research resources and essential services that are not available in individual countries. Meanwhile, the developing countries should take a lead for the long-term sustainable research for their own development.

IPPS Involvement in Eastern and Southern African Universities

A relationship between some universities in eastern and southern Africa and the International Programme in the Physical Sciences (IPPS), Uppsala University, has existed for almost three decades. During this period, many academic members of staff have gone to Sweden on a 10-month fellowship, or have been sponsored by IPPS to visit or pursue research studies in some leading research centres in Nordic countries. As for a follow-up programme, IPPS has always set aside a grant to assist with the purchase of minor equipment or spare parts at their home institutions. IPPS has also helped to initiate cooperation between Swedish teams and active research groups in the region or between active groups within the region. Thus later sections will discuss the present research activities and the organisation of a regional cooperation in some universities in eastern and southern African countries. IPPS is at present involved in four major fields of research (and respective subfields) in the region:

Condensed Matter Physics.	Polymer Science	(Ethiopia)
	Dye Sensitized Solar Cells	(Kenya)
	Photovoltaics	(Kenya)
	Thin films	(Tanzania, Uganda, Zambia)
Applied Nuclear Physics:	X-ray fluorescence	(Kenya, Tanzania)
	Mössbauer spectroscopy	(Tanzania)
Geophysics	Seismology	(Tanzania, Uganda, Zimbabwe)
Applied Atomic Physics	Laser physics	(Kenya)

In the case of geophysics IPPS is also giving assistance to the network ESARSWG and in case of applied atomic physics IPPS is assisting a network in laser physics.

In the following sections we will discuss case studies of the establishment of research groups in some countries of Eastern and Southern Africa, their research activities and their association with IPPS.

Solar Energy Group

At this point let us say something about the establishment Solar Energy Group, Physics Department, University of Dar es Salaam. The solar energy group was formed with two of its former IPPS participants. One of them used the IPPS fellowship (1975/76) to pursue sandwich studies leading to MSc degree while the other used the IPPS financial support (1982–86) to pursue a sandwich PhD programme. Both degrees were, however, awarded at the University of Dar es Salaam. Presently IPPS has also supported a third member of the group who finished his PhD sandwich programme with the Department of Materials Science, Uppsala University, in 1995. The IPPS has also assisted the group to train several technicians in specialised courses.

By 1984, the cooperation between IPPS and the Physics Department, University of Dar es Salaam, became more intense. Since then the group in Dar es Salaam has also received direct support from SAREC through a joint grant application with the then Materials Science Group at the Chalmers University of Technology, Sweden. This grant was administered by IPPS. The direct SAREC financial support which started 1986/87 together with IPPS assistance, implied that apart from continued support with fellowships more expensive equipment were procured. Such equipment include, a coating unit, UV/VIS/NIR and IR spectrophotometers, talystep (thickness measuring equipment), computers, optical set-up for ellipsometric studies and a sputtering unit. With the equipment support the group has been able to supervise students leading to MSc degree. This systematic and gradual support from IPPS and SAREC has promoted this group to serve as a centre for the whole region within its field of specialisation. This has already shown a positive impact on physics in the region. We have for example assisted in training MSc students from neighbouring countries and there is great interest by students from Zimbabwe and Kenya for a PhD sandwich programme with the group in Dar es Salaam.

Since the last ten years the solar energy group in Dar es Salaam with the assistance of IPPS has opened room for regional cooperation with other universities in the region. These include the Physics departments at Makerere (Uganda), Moi, Kenyatta, Nairobi (Kenya) Universities and the Universities of Zambia and Addis Ababa (Ethiopia). During the period 1989–99, the group has received over 70 senior and junior research scientists from different universities in the region. The main aim of some of the visits was to discuss the possibilities of sending their students to carry out research with the group. The idea here is to establish a regional centre where the department can offer a MSc programme in solar energy and materials science.

The motivation to establish a regional cooperation in the field of materials science and solar energy in the sub-region was prompted by an earlier preliminary survey made by the group that showed that some of the physics departments were planning to start or engage in some research mainly in the utilisation of solar energy. It was observed that most departments lacked equipment as well as trained manpower (both academic and technical staff). This problem was also raised during a workshop for planning of network projects in materials science and solar energy, which was organized by the Department of Physics, University of Dar es Salaam, in collaboration with the Interdivisional Group on Physics for Development (IGPD) of the European Physical Society (EPS) and took place in Nairobi, Kenya, in November 1988. The meeting, which was attended by about 50 scientists from 18 African countries, was financed by a number of organisations including IPPS and SAREC. The direct commitment by both SAREC and IPPS in assisting to set up network projects for the South-South and North-South cooperation in materials science and solar energy was acknowledged and recognised as good and promising examples of meaningful activities. It was therefore felt that there was a need to strengthen the already existing group in Dar es Salaam where its experience and good research facilities can be utilised by scientists in the region.

Apart from research, it is worth mentioning another activity that is run by the group in Dar es Salaam. The group conducts a course on "thin film technology" which runs once every two years. This course is mostly intended for young scientists or postgraduate students who are planning to start a project in solar energy and materials science. Participants are mostly drawn from the eastern and southern African countries. The first course took place in July 1990 and such courses have been running to date. Over 100 young scientists have participated in these types of courses and this has influenced their later research direction of the home institutions. The course contents vary slightly each year but broadly cover the following areas; thin film technology and characterisation, photovoltaic, and solar energy coatings. Instructors for this course are often invited prominent scientists from Europe and other local faculty members. At present, this activity is wholly financed by IPPS.

Figure 20. A Thin Film College organized and conducted in 1996 by the ISP supported Solar Energy Group at the University of Dar es Salaam. In the front row, 4th from right, is Professor Rogath Kivaisi, group leader. Second row, 1st from right, is Professor Björn Karlsson, visiting Swedish expert. (Photo University of Dar es Salaam)

Research Activities

There are a number of areas in physics that can be used for research training at the University of Dar es Salaam. One most useful area of research includes the non-conventional energy and environment. This is a general theme of research endeavor that can be pursued in the department of physics. An area that has not received significant attention is research in development and utilization of solar cells. The department of physics has already initiated preliminary activities in photovoltaic and materials science. This is an area where the department can make an impact, not only in Tanzania but also in the sub-region as whole. This effort is truly relevant in such sun-rich countries for the improvement and development of new technologies. Innovative uses of solar radiation and development of special materials with unique properties in terms of their interaction with sunlight offer imaginative and exciting research areas for training of students at postgraduate level.

There are solar energy research activities in almost every country in the region, but mainly at the utilisation level. In this section I will confine myself to selective surfaces and photovoltaic. The five universities, Makerere, Zambia, Moi, Nairobi and Dar es Salaam are engaged in a cooperation programme financed by IPPS which includes MSc and PhD sandwich programmes. The current research programmes include:

Selective surfaces

The advances in coating technology has led to the production of advanced surfaces for energy absorption or energy efficient coatings, namely: transparent heat mirrors, solar selective surfaces, smart windows, antireflection coatings, spectral splitting and cold mirror films.

The solar energy group at the Department of Physics, University of Dar es Salaam, has a long experience in research in these areas of solar energy materials. Cooperation has been developed mainly with the departments of physics at Makerere University and University of Zambia, where similar and complimentary activities have started.

The University of Zambia and Makerere University are also supported by IPPS but have fewer facilities than the Dar es Salaam group. Both have access to evaporation units and equipment for ellipsometric measurements. The Department of Physics at the University of Zambia has recently installed a UV Visible spectrophotometer and an integrating sphere for optical characterisation, anodization and spray pyrolysis for thin film preparations. At the moment there are two members in the department working on selective surfaces. Both are IPPS former participants.

In Uganda, there were two active scientists working on selective surfaces of whom one of them had a MSc sandwich programme with the group in Dar es Salaam. The senior researcher is finalising his PhD work this year. The group has recently acquired equipment for electrical and magnetic characterisation.

Photovoltaics

It is true that the present day technology for developing solar cells is less competitive from an economical point of view. This is a field where more research and development is required. It is also quite clear that countries having the ambition to make use of photovoltaic should have some domestic activity in order to keep up the knowledge with respect to the technology and also to be able to follow what is happening elsewhere.

There is no institution in the region, which is researching in this area except a small activity at the University of Dar es Salaam and Nairobi University. Research has started on amorphous silicon solar cells but their efficiencies are rather low. The work on MIS solar cells was earlier conducted in cooperation with the physics department at University of Addis Ababa and at Nairobi University. One of the difficulties in making efficient cells is the lack of appropriate equipment and clean rooms. The current study involves fabrication of ITO/Si interface devices.

Moi University has embarked on a research on photovoltaic. The investment for equipment and laboratories was through a loan from the World Bank. One difficulty in implementing this type of programme is the lack of experienced staff members. To reduce this problem, a cooperation has been initiated with the University of Dar es Salaam to train some of their staff on a number of essential experimental techniques. (See also the article by Mwamburi.)

Photovoltaics for local communities

For developing countries that do not produce oil, the problem of energy supply continues to be a key factor towards their development. The problem was first experienced in 1973, with the steep increase in oil prices. The impact of higher oil prices was particularly felt by developing countries (including Tanzania) as the cost of the energy imports constitutes a much higher proportion of export earning. In rural areas, decentralized energy is needed e.g., for water pumping, irrigation, cooking, lighting and to run small scale industries.

The rural population of Tanzania relies heavily on firewood and charcoal for both heating and cooking while liquid fuel is used for lighting purposes. The problem of cutting trees for firewood and charcoal poses a great threat of deforestation if not controlled while alternative options are sorted out. Although there is a high shortage of firewood in many parts of Tanzania, the country is blessed with sunshine, through out the year. Tanzania lies within a geographical zone that receives between 4,5 and 6 peak sun hours per day. What is required is a technology to tap the energy and put it to service to man.

The motivation behind this project is the general concern on the performance of photovoltaic system by the local community and dealers who are supplying photovoltaic equipment to the rural areas. The Solar Energy Group has provided expert guidance in this area and where possible has been involved directly in the installation and commissioning of rural PV systems. The move to use other forms of energy, particularly the renewable energies, is in line with the consensus reached at the World Solar Summit held in Harare, Zimbabwe, in September 1996.

Nuclear Physics Applications

This field is one of the strongest research fields in the region, which strongly reflects the interests of the donor agency. The International Atomic Energy Agency, IAEA, in Vienna, which has provided most of the equipment and some training of scientists and technicians, supports all the projects in this field. IPPS is also engaged in some activities in the region. The research activities in this field include Mössbauer spectroscopy, X-ray fluorescence, X-ray Diffraction, atomic absorption, low level counting, neutron generator based research and electron spin resonance (ESR). In this section, I will discuss only two important research areas where IPPS is coordinating in the region: Mössbauer spectroscopy and X-ray Fluorescence.

Mössbauer spectroscopy

Mössbauer set-ups are available in Sudan at the University of Khartoum, at the laboratories of the Sudan Atomic Energy Commission (SAEC), in Tanzania, at the University of Dar es Salaam, and in Zambia with the laboratories belonging to the National Council for Scientific Research (NCSR). These are conventional set-ups, using 57Co sources and studying the recoil free absorption of

gamma rays. Some work using conversion electron Mössbauer set-up has been performed in Dar es Salaam in order to study corrosion.

Mössbauer spectroscopy is quite generally applied to studies of magnetic materials, soils and geological samples. In the study of alloys for example, it is rather difficult to prepare interesting samples, which often call for a need to use other research laboratory experiences in the region. Another complication could be the analysis of soil or geological sample spectra, which may require high capacity computers.

Mössbauer spectroscopy is a field where regional cooperation can make use of complementary experiences and the experimental set-ups to strengthen research activities in the region.

X-ray Fluorescence (XRF)

X-ray fluorescence, is an elemental analysis tool with many applications. In western countries this tool is available as a standard method for elemental analysis, in industries and laboratories where such analysis is needed. It has many applications within chemistry, biology, geology, medicine and environment.

This technique is available at quite many places. The Department of physics, University of Khartoum has set-ups using both source and x-ray generators as excitation facilities. This is also the case at Nairobi University, at the University of Dar es Salaam and at the laboratories of the National Council for Scientific Research in Zambia. The Department of Geology, University of Zambia has source excitation facilities.

The research activities are sometimes conducted in cooperation with other departments and faculties. One such example is the study of malnutrition in children conducted as a cooperation project between the Department of Physics, University of Dar es Salaam, and the University Hospital in Dar es Salaam. Another example is the activities in Nairobi, which are very strong and imply cooperation with scientists from medicine, biology and geology as well as making services to other institutions in Kenya. This group is also prepared to assist in training scientists and technicians not only in the region but also for the whole Africa. A cooperation has been initiated with Ahmadu Bello University, Zaria, Nigeria.

In the field of XRF there is a number of research activities especially within medicine and environment where cooperation with other laboratories working on similar studies in the region could be of interest.

Seismology

Seismology is an example of a field where regional cooperation is inevitable. Seismic activities have no borderlines and exchange of data is important for the scientific and technological aspects. The equipment for registering seismic activities are quite expensive, implying the need to make use of the existing stations in the neighbouring countries. The need for planning and coordina-

tion between different countries in the region and to set at least one centre is vital.

The East African Rift Valley runs all the way down from Eritrea in the north, through Uganda and Tanzania to Zimbabwe and Mozambique in the south. This is a very seismic active part of the world. Unfortunately, seismology is weakly developed in this area. The reason for this is probably that there have not been heavy casualties in connection with seismic eruptions. However, we can see today that there is an increased number of big constructions like dams, industrial and tall commercial buildings. Thus it is expected that the number of casualties in future earthquakes will increase.

The number of earthquakes in the region is numerous. In Tanzania alone, it is estimated that the number of earthquakes with magnitudes 3–4 is around 2000 per year, with bodywave magnitudes 4–5 about 200 and more than 25 with magnitudes 5–6. Those with magnitudes larger than 6 may occur at a rate of about 1 in every 10th year.

There is a small seismic network in every country in this region, but there are few seismologists to analyse the seismographs. This applies also to technicians to run the networks. In Ethiopia, for example, the seismic set-up was done through the assistance of SAREC while some of the training of technicians was provided by IPPS. In Uganda a seismic network has been set up by support from the IPPS. The training of the personnel in Uganda is also provided by IPPS through MSc and PhD sandwich programmes with the University of Bergen, Norway. The training and equipment for the network in Tanzania were provided through the assistance of IPPS. In 1992 a local network of five digital seismic stations was established in Mbeya Region, southwest in Tanzania, through the funds from the Royal Observatory of Belgium (ROB) and IPPS. The Geology department, University of Nairobi, has operated the WWSSN station since 1963. But there has been nobody to analyse the seismographs. However, from 1980, IPPS has provided training for both scientists and technicians.

The network in Zambia is run by the Geological survey department and the set-up was made through the Finnish assistance. The network in Zimbabwe is presently being updated through assistance from the IPPS. There are plans to train local staff through the IPPS fellowships. The network in Mozambique is operating with great difficulties and it is doubtful if the other old stations can be put into operation.

Concluding Remarks

This article gives a brief description of some of the research activities going on in the region. We noted for example, that the heavy investments in equipment and experienced manpower available in Dar es Salaam in the field of solar energy and materials science can serve as regional centre for this activity for

the whole region. Makerere, Zambia, Nairobi and Moi Universities have already started a joint project where similar but non-overlapping work is conducted together.

XRF activities are conducted at various institutes in the region. Most of these laboratories are at different stages of development with regards to both manpower and instrumentation. The group in Nairobi for example has some long experience and is prepared to assist in training of scientists and technicians from the region. With regard to Mössbauer work, there are only four setups in the region. As mentioned earlier, analysis of some Mössbauer spectra can be difficult and complicated, and this implies that cooperation with other laboratories in the region could be attractive.

However, finally one can conclude that the region has developed in research capacity and many physics departments in Southern and Eastern Africa have reached the critical mass for further development.

Building Research Capacity in the Addis Ababa University

By Dr Bantikasegn Workalemahu

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One fine weekend in 1987, the Chairman of the Department of Physics was in his office when his colleague and friend (Solomon) knocked at his door. The Chairman was reading an article from Europhysics News, which Solomon borrowed when he left the office. Three days later, Solomon came back with the bulletin and pointed at a small column in one of the pages of the Europhysics News that briefly described the activities of the then "International Seminar in Physics" whose director was Dr L. Hasselgren. Out of his strong desire to pursue his studies further, Solomon asked the Chairman's advice on what the Seminar's response could be if he applies for fellowship. They both agreed to give it a try.

About four weeks later, they received a letter in response to Solomon's request. However the Seminar added that it does not deal with individuals, but rather with institutions. The moment was disappointing to Solomon (now Associate Professor of Physics at North Carolina State University). It was the beginning of the department's relation with the Seminar, now called the International Programme in the Physical Sciences (IPPS). The Chairman wrote to Hasselgren about his interest to initiate discussions as to how IPPS could support the department. Hasselgren responded promptly, suggesting that he would pay a short visit to the department on his way to Dar es Salaam, Tanzania. When he visited our department, he posed several questions about the staff profile, the status of teaching and research laboratories, the problem related to "brain drain", and so on, taking notes at the same time. He left Addis Ababa without committing himself to any of our requests. During the discussion, it was pointed out that the department has placed an order to purchase equipment for research and teaching with a UNDP grant.

About a year later, Hasselgren visited the department and saw that the equipment ordered with the UNDP grant had arrived, was installed and in a working condition. This time we were in serious business as Hasselgren was willing to provide support in the field of experimental physics by arranging training and also purchasing equipment. To this end a memorandum of understanding was signed, following which two different visits were arranged for the then chairman of the department. One of the visits was to the Department of Physics, University of Dar Es Salaam to see how the project supported by IPPS was organized and what the physicists were doing. The visit was inform-

ative as to how much can be achieved with the IPPS support. The second was to Sweden to select a particular field that suited the interest of the department. After visiting departments of physics of the Universities of Uppsala, Stockholm, Gothenburg and Linköping, it was agreed that people should get initial training in the field of organic semiconductors at Linköping University under the supervision of Docent Olle Inganäs.

Training

The training started with one fellow who joined Linköping University in September 1990. The second fellow joined the Indian Institute of Sciences (IISc), Bangalore, in 1992. The third was admitted to Linköping University in 1994. He was unfortunately unable to continue his training beyond one year.

During the training, two visible opportunities were offered to the trainees. The first was to support the accompanying family with regards to finance and insurance. The second was the encouragement by IPPS to frequently visit the home department during summer vacations. Such visits had a multitude of impacts in that the trainee (a) would have uninterrupted contact with relatives and friends, and (b) could keep the relation with the home department. At times the trainee was encouraged to stay 6 to 12 months in the home department. During this period, some equipment was purchased so that the trainee could do some research work while at home in addition to his/her usual teaching work. An important consequence of such a scheme was that detachment from home institution was minimized and the trainee could see by himself/herself that upon the completion of studies, he/she has a laboratory or some facility to work with back at home. Moreover, IPPS also supported short-term training of two technicians, one in Sweden and the other in Norway.

While the training was in progress, the need for a qualified chemist who could synthesize organic polymers to supply the material became obvious. To this effect, an organic chemist from Addis Ababa University was sent to Chalmers University for 12 months, where he successfully synthesized several thiophene based conjugated polymers. In the mean time, another electrochemist was being trained under Inganäs in the field of all-solid state photo-electrochemical energy conversion using polymers. However, he was supported by a Sida/SAREC scheme. This was assumed to add strength to the group to be working on organic semiconductors later on.

Equipment

Procurement of equipment was being effected when the training of the above mentioned fellows came to an end in 1997. In the mean time research equipment were purchased and installed. The most important pieces of equipment were:

– Edwards Auto 306 Vacuum Evaporator
– Perkin Elmer I19 UV/Vis/NIR Spectrophotometer
– HP LF Impedance Analyzer
– Keithley Digital Multimeter
– Wave Generator
– Ultra-Spark 5 Workstation

IPPS, in its programme to assist projects until they build a critical mass and standard research capacity, adopted a three-year project scheme. The first period started in January 1998. The major share from this grant was meant for establishing and running the synthesis laboratory.

Impact of the IPPS support

When the Department of Physics launched a MSc programme in 1982, almost all academic staff involved in teaching graduate courses were expatriates. As a result the research conducted was not in a particular area that could develop into a full fledged and sustainable stream, but rather randomized and dictated by the availability of these expatriate teachers who stayed only for a temporary period. Thus, publication of research results in international journals was limited to about seven per year.

At present there are nine academic staff members with PhD degree, of whom two are expatriates. Of the seven Ethiopians, five are involved in teaching postgraduate courses. The department has now set defined streams to be followed. These include Quantum Optics and Laser Spectroscopy, Organic Semiconductors, Photovoltaics, Statistical Physics, and Nuclear Physics. It was the acquisition of equipment and a continuous assistance from IPPS which served as a research trend setter. As a result several publications have appeared in journals of international repute.

One IPPS project encompasses both the Organic Semiconductor and the Statistical Physics research streams. Under the former, six young students have completed their studies out of whom three are now staff members of the department. Out of the latter ones, two have finished their MSc studies and both have now joined the staff of our department. This is indicative of the impact of IPPS support in initiating and building research capacity at our Department of Physics. Several members have also participated in regional and international conferences sponsored by IPPS. The following are some examples: International Conference on Synthetic Metals (ICSM92), E-MRS95, 7th International Conference on Magnetic Fluids, 20th International Conference on Statistical Physics, 5th International Conference on Diffusion in Materials, 6th College on Thin Film Technology, South African Institute of Physics (SAIP96). Graduate students in the field of Statistical Physics and Organic Semiconductors have benefitted directly from the IPPS support in that they

used all the facilities as well as consumables made available through the project. Other graduate students have also used the facilities in one way or another. For instance, there is only one connection to the internet which serves the entire department as well as the graduate students, the cost of which is covered by IPPS grant.

Future plan

As mentioned above, IPPS has invested a substantial amount of money both for training and equipment, the effect of which is being realized in human resource development and building research capacity in a period of a decade. It has also served as a trend setter in selecting and planning research areas in the department. Through participation in conferences, workshops and colleges in the region (Eastern and Southern Africa) it was possible to introduce the physics of organic semiconductors, and as a result many people are now aware of these relatively new and emerging materials or devices.

Although the synthesis laboratory has not been put in place yet, we strongly believe that the conjugated polymers should be supplied locally by the Chemistry Department of AAU. A continuous supply of the polymers presupposes a continuous supply of chemicals, glassware, and some equipment. It is obvious that electrochemistry and other chemical properties of these newly synthesized polymers must be studied. This is an area where the IPPS input is also expected to play an important role.

The device characterization has been limited to electrical properties in nature, always looking into the current-voltage, capacitance-voltage, impedance and photo-voltaic properties. Additional input as well as enriching the existing equipment is necessary to diversify both optical and electrical measurements, which will be effected during the second cycle of the project. In the mean time, the department plans to work out a sandwich PhD programme and get it approved by the Addis Ababa University. This will further enhance the training of our staff. In the course of consolidating and upgrading the existing activities, providing the opportunity of training students from the region will be effected. Moreover, periodic conference will also be hosted and the possibility of establishing networking will be explored.

In summary, the impact of IPPS support has played a significant role in initiating and building research capacity at the department of physics of Addis Ababa University. The staff is approaching an optimum number and members of the research group aspire for a quality product in the near future by increasing the scope and depth of work programmes. It is also hoped that the department will be able to serve as a center for training students from the region.

Tanzania Food and Nutrition Centre

By Dr Nicholas Mlingi
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The ISP support to Tanzania Food and Nutrition Centre (TFNC) through the International Seminar in Chemistry dates back to 1980/81. The TFNC was introduced to the International Programme in the Chemical Sciences (IPICS) by two Swedish experts working at TFNC, Drs Urban Johnsson and Björn Ljungquist. The first support was extended to Dr Alex Mosha in 1981/82 to undertake studies on the use of germinated cereal flours (popularly known as "power flour") as a means of solving the dietary bulk problems of starch based gruels prepared at household level for weaning children. Today the "power flour" concept is one of the internationally recognised technologies as a low cost means of solving dietary bulk at household level. Dr Mosha's studies led to obtaining a PhD from the Sokoine University of Agriculture (SUA), Morogoro, Tanzania, in 1984.

Expansion of the IPICS support

IPICS established contacts with Tanzania right from the beginning of the programme in 1970. Several institutions have been involved, but the long-term support has been concentrated to TFNC. The IPICS enabled TFNC to acquire various up-to-date laboratory equipment and facilities such as HPLC, computers, freeze drier, incubators, chemicals and reagents, etc. This support increased concurrently the analytical capacity at the TFNC laboratory enabling it to establish methods for iron analysis of availability in cereals and cyanogens in cassava, for thiocyanate determination in serum and urine, and for retinol and carotenoids determination by HPLC methods. The support was also extended for acquiring spare parts unavailable in the country.

The IPICS support to staff training has given the result that MSc degrees have been awarded to six staff members, of which three have continued to PhD. So far three staff members have obtained PhD degrees and three are close to finish. The support has also given the staff members the possibility to attend conferences/symposia/workshops regionally and internationally. This gave our staff the opportunity to prepare and present reports at scientific meetings and to publish 24 papers in international journals since 1995.

Development of the scientific project

After some years of IPICS support on two separate studies, namely *Weaning food development* and *Cassava processing in Tanzania with special reference to cyanide exposure*, it was resolved that the studies be carried out under one project since they were all under the field of nutrition. Hence, the project title *Nutritional Biochemistry and Biotechnology* was started January 1997. In addition to working with link institutions in Sweden, project staff have established collaborations with other researchers in Tanzania, United Kingdom and USA. These collaborations will be useful in expanding the scope of the project and enriching the experience of individual scientists.

Three members of the project are currently undergoing doctoral studies on sandwich basis with Chalmers University of Technology in Sweden. Beyond the project, discussions with colleagues in the region have led to the establishment of an IPICS supported network, which will provide a wider forum for scientists in the area of food science and nutrition to work together. The first conference of this Food Science Network for Africa (FOSNA) will be held in Dar es Salaam in February 2002.

Scientific achievements

Apart from attaining academic excellence, individuals who have received fellowship through IPICS have collaborated with scientists from Sweden and other parts of the world to make notable progress in their areas of research. Attention is drawn to the following three illustrative examples:

- The beneficial effect of the amylase enzyme activity in germinated cereal flours was demonstrated. This was an extension of studies on amylase enzyme activity which were undertaken extensively in India as a means of reducing the dietary bulk problem in starch based foods and increasing energy density in cereal gruels for feeding children. This technology is now extensively used in many developing countries especially in processing weaning flour blends. In Tanzania, the product so produced is called “power flour”.
- The second contribution is from studies on cassava fermentation and exposure to cyanide through consumption of insufficiently processed cassava. The cassava fermentation studies revealed that air or dry fermentation of cassava as practised at village level in Tanzania results in a three fold increase of protein content of the roots. The cyanide exposure studies revealed and supported the notion that there was an association of cyanide exposure from consumption of insuffenciently processed cassava and the paralytic disease konzo and acute intoxications reported in two areas in Tanzania.

– The third contribution was through studies on lactic acid fermented cereal gruels and their effect/influence on enteropathogenic faecal flora and diarrhoea in children. These studies revealed that regular consumption of lactic acid fermented gruel called *togwa* could protect young children from being exposed to potential diarrhoea causing bacteria.

The ongoing studies being supported by IPICS are well related and targeted to the problems TFNC is addressing. These studies will contribute to the solutions of alleviating iron deficiency anaemia, vitamin A deficiency and nutrient bio-availability in cereal and leguminous foods used for child feeding in Tanzania.

Biotechnology in Zimbabwe

By Dr Julia Hasler

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In early 1986 Professor Rune Liminga visited the Department of Biochemistry, University of Zimbabwe, (Chairman at that time, Dr Julia Hasler), to investigate opportunities for research cooperation and funding between the International Seminar in Chemistry and the University of Zimbabwe. As a result of that visit, three fellowships between 1986–1989 were awarded to staff from our department to do research in the area of biotechnology in Sweden and two Swedish scientists from Lund University visited Zimbabwe. By 1989/90 and with the support of the International Programme in the Chemical Sciences (IPICS) funds, the link between the Biotechnology Group (comprising by now three academic staff members) and Lund University had developed to the extent that major SAREC funding was awarded for the Biotechnology link between these two universities. This group has expanded and continues to flourish today with continued funding from Sida/SAREC. The IPICS funding to this group ended, therefore, after the major SAREC grant was awarded.

In 1989 it was suggested by Professor Liminga that the small research group headed by Dr Julia Hasler should apply for IPICS funding. The first application for funds was submitted for the 1990/91 budget year. With funds from 1989/90 Dr Hasler visited Sweden in June 1990 in order to develop links with Swedish scientists. As a result of that visit, a link with Professor Bengt Mannervik, Biochemistry Department, BMC, Uppsala University, was started. Since then, other valuable research collaborations have been conducted with Professor Magnus Ingelman-Sundberg, Dr Lars Gustafsson, and Professor Leif Bertilsson of Karolinska Institute, and Professor Joe de Pierre of Stockholm University.

An essential component of the relationship between IPICS and the Zimbabwe group is the one that has evolved with time and experience and for which no one event could be cited. From the point of view of the project leader, the evolving relationship with IPICS/ISP has been characterised by a growing trust and confidence, manifested by the increased funding over the years from IPICS and by encouragement and moral support from the present and past Directors to our research group. This aspect of the relationship has been very important for success in the development of the research group and is in stark contrast to the bureaucratic and impersonal relationship usual with large funding agencies.

Development of the scientific project

The research group was established in 1981/82 to study aspects of metabolism of drugs and other xenobiotics that were peculiar to Zimbabwe and other subtropical developing countries. With local funding entirely, a project investigating the effects of schistosomiasis on drug metabolising enzymes in rodent models was commenced. In addition, another project on the effects of an antischistosomal drug on drug metabolising enzymes was started. Research goals within these projects were very modest and techniques used were old classical enzyme assays. Current new methodologies and the explosion of molecular biology techniques in research was an entirely theoretical issue for the group. Publication of work tended to be at local research meetings and the rate of output of papers in international journals was very slow. The major item of equipment in the group was a spectrophotometer and the availability of funds for consumables was low. During the 1980s, stringent foreign currency control also inhibited development of research. Attendance at international conferences was infrequent and the scientific isolation resulting had deleterious effects on confidence as a scientist, and on the ability to direct good current research projects.

As the relationship with IPICS developed and research infrastructure and capacity were built up, however, the group was able to consider seriously embarking on answering questions about drug metabolism that were of current interest not only to Zimbabwe but internationally. The emphasis has shifted to studies in humans with the rodent model serving in feasibility studies and methodologies using molecular biology tools have been introduced. This would have been extremely difficult and perhaps unthinkable without the support given by IPICS.

Research capacity building

The contribution made by IPICS has been invaluable in many areas all of which have lead to a strengthening of the research capability of the group.

Equipment and consumables

In 1990/91, Dr Hasler sought funds for an HPLC from a number of agencies. IPICS was able to provide the funds for this major item of equipment, which has become an invaluable asset for research in the group. Other major items of equipment supplied have been a fluorescence detector for the HPLC, column chromatography and electrophoresis systems, a high speed rotor for centrifugation, a bench microcentrifuge, a water purification system, a spectrophotometer to replace the obsolete one, obtained in 1981, an analytical weighing balance, a spectrofluorimeter, a -80^{0}C deep-freeze, a biosafety hood, several computers, printers, and a scanner. Many smaller items of equipment have also

been provided, such as automatic pipettes and a pH-meter. A most important component of IPICS support has been the contribution to costs of consumables including specialised biochemicals and plasticware. By having a well-equipped and supplied laboratory, more current research projects can be conducted and research students are more readily attracted to the group.

Establishment of links with research groups in Sweden and elsewhere

Another very valuable aspect of the interaction with ISP is the opportunity afforded to group members to spend time working on their research projects in a laboratory in Sweden supported by IPICS fellowships. These research visits have, without exception, been critical in the development of these fellows as independent scientists with a broader view of science and the world. Having links with research groups in Sweden has made the possiblity of establishing other links much easier because of the valuable contacts in international science and also because of increased confidence of the Zimbabwean scientists. A number of links have arisen indirectly because of IPICS support to the group.

Participation in international meetings

The IPICS has sponsored directly the participation in many international meetings. In addition, the active support of IPICS in terms of equipment and consumables has allowed for greater research output and for members of the group to seek funding successfully from other sources for international meetings. The attendance at good international meetings has been critical for ongoing research and an essential component in research capacity building. Besides the valuable contacts with other scientists that are made, the value of meetings in terms of intellectual stimulation is high. The negative effects of scientific isolation within ones field can only be overcome by attendance at international meetings.

Impact on postgraduate programmes and institutional development

The postgraduate programme that has benefitted from IPICS support is the MPhil and DPhil (PhD) degree programme (degree by research dissertation). Research for these degrees is supervised by academic staff in areas of interest to the staff member. Having postgraduate students as part of a group allows for more active research while at the same time involving training of manpower. It is very difficult to offer good postgraduate research projects when consumables and equipment are limited or when academic staff are out of touch with developments in their field. IPICS support has greatly assisted in overcoming these problems. A critical component of IPICS support is that the group can pay student stipends locally. There is little to no support locally for this component of postgraduate education. A few Teaching Assistantships are available but these are not adequate to fund all those wishing to do postgraduate programmes. Three members have been trained within the group and have been awarded University of Zimbabwe degrees.

A number of other students have benefitted from the infrastructure and from the funding of this project in order to graduate at Masters level. In addition, more than 25 students have carried out undergraduate research projects for the BSc Honours in Biochemistry in the group supervised by Drs Hasler, Naik, Mukanganyama and Magwere. Although these are only undergraduate projects, the BSc Honours programme is a feeder programme for postgraduate studies.

The project leader, Julia Hasler, has benefitted enormously from IPICS support as exemplified by her own career development and promotion from Senior Lecturer to Associate Professor and then full Professor during the period of IPICS support.

The SARBIO Project

By 1996 the Zimbabwe project had developed its infrastructure and expertise to the point that regional interactions could be considered and nurtured. One of the considerable disadvantages facing development of science in Africa is that, for the most part, scientists work in relative isolation in a number of different countries with few opportunities to interact. With the positive development of democratisation in South Africa, the Southern African subcontinent was poised to start reaping the benefits from the existence of a critical mass of scientists in the region. The SARBIO Project (Southern African Regional Cooperation in Biochemistry, Molecular biology and Biotechnology) was started with IPICS support in 1996 and with Julia Hasler as project coordinator. The objective of SARBIO is to strengthen regional research capacity by promoting links between scientists in Biochemistry, Molecular Biology and Biotechnology in the Southern African subcontinent. This objective is achieved by activities that include the exchange of ideas and expertise, sharing of equipment, and collaborative studies. This regional cooperation project is developing well with scientists participating from Zambia, Kenya, Tanzania, Malawi, Botswana, Zimbabwe and South Africa. One successful activity is an annual Biochemistry Research Day for the University of the North, South Africa and University of Zimbabwe. Postgraduate students arrange the two day event in consultation with staff and this is held alternately in Harare and in Pietersburg, South Africa. The event gives students and young staff members the opportunity to present research work orally, and experience at organizing and financial accounting such an event.

The development of this regional project illustrates well a natural and desired evolution in an IPICS sponsored project from local to regional level.

Conclusion

The commitment to and interest in our research group shown by IPICS has been an important component in our own commitment to build up a competent research group with long-term goals. Our research group has been able to respond very positively to the practical, flexible and efficient way in which support is rendered. Long-term, multifaceted and flexible support together with a close interest of the staff of IPICS in progress of research is a very effective approach to research support and will be crucial for our ongoing success in research and training.

Photovoltaic Research at Moi University in Kenya

By Dr Mghendi M. Mwamburi
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Physics in Africa is something we rarely hear of but it exists and is growing. Though tormented by the many years of chaos and neglect, reality is slowly creeping in to the minds of our planners. Kenya has been no exception in this regard, where we have seen declining and resignation trends in basic sciences, especially in research. Moi University in Kenya, based in a rural setting, has had interest in solar energy and in particular photovoltaic technology (PV). Photovoltaic technology, like many other renewable sources, has not received the acceptance it deserves in most of the developing world for various reasons. In principle, the long term usage of PV is both cheap and reliable, but in reality the high initial cost and storage problem have been major drawbacks. This is because the cost of fabrication and manufacture of solar cells and reliable storage devices is still relatively high. But we cannot ignore the uniqueness that PV has to offer, especially for remote applications.

History

The PV group at Moi University (MU) was constituted in 1991. The motivation behind the formation of this group was the interest of some members of the Physics department in solar energy. Another contributing factor was that there was a development grant available to the department for the purchase of scientific equipment and the training of personnel. This group was amorphous and ideas on a research proposal came streaming from different directions as the constituents of the group all had very different educational backgrounds and skills. But one common idea that was floated on several occasions was that of making solar cells. This was purely motivated by the need for an alternative source of energy, for most of our rural areas. In this state, the problem was then "What type of solar cell shall we make?" Prof. Laszlo Szolgyemy headed both the PV group and the Physics department, and it had about six members. After several meetings and discussions, we managed to formulate a future plan by first making a very ambitious order list of equipment that we needed to be able to make amorphous silicon solar cell. I say "ambitious", because none of us had ever made solar cells let alone have the experience and resources to do it,

but everything seemed very possible and easy. But we soon noted that, what we also needed was a scientific collaborator/sponsor and somehow the International Programme in the Physical Sciences (IPPS) was there. In my opinion this was the single most important step that we made.

First encounter with ISP

It was in 1992 that we first met the director of IPPS, Lennart Hasselgren, in a brief meeting in Nairobi. The main topic of discussion during this meeting was our future plan. There were five people in attendance from Moi University, namely Prof. Peter Tole, Prof. Laszlo Solzgyemy, Mr Charles Matiasi, Mr George Amulele and myself. Coincidently, there was one other person present from the University of Dar es Salaam whom we had previuosly met, together with Matiasi, at a Physics Subject Meeting held in Arusha, Tanzania in 1991. This happened to be Prof. Rogath Kivaisi, the group leader of the Solar Energy group from the University of Dar es Salaam and apparently most of their activities were ISP sponsored. In digression, at the Arusha meeting I was presenting a paper on a theoretical survey of high temperature superconductors which drew some attention from Kivaisi as the current issue then was thin film high T_c superconductors, so we had a short and very general discussion on thin films.

It was very encouraging to see that we received very keen interest from both Lennart and Rogath and some important resolutions were made. One was that we needed to visit and see some regional scientific facilities, specifically those at the Kivaisi's department in Dar es Salaam, and another was that we should write a detailed research proposal for collaboration with IPPS. In the meantime we could also be introduced to some international links, such as the International Centre for Theoretical Physics (ICTP) in Trieste, Italy, a Prof. Ivan Chambouleyron of the University of Campinas, Brazil, and also to attend some conferences. In essence this was really much more than we had hoped to achieve.

Experience with ISP and Dar es Salaam

Since the first meeting in Dar es Salaam, we spent many days at Moi writing a research proposal that we finally submitted to ISP. This proposal was exciting but still too ambitious as it was not easy to care for details then. This was a mistake that we repeated on several occasions and we slowly learnt that "Impression is nothing and detail is everything". All the same we still received support from ISP for our endeavours.

A few weeks later Laszlo and Matiasi visited the solar energy group in Dar es Salaam for a week – all catered for by ISP and hosted by Kivaisi. This was the beginning of a chain of events thereafter. Another member of our group,

Mr Cosmas Ronno, attended a solar energy conference in Toulouse, France – again through ISP – which was really an eye-opener for him and gave many new contacts abroad. Later on he also went for a few weeks to ICTP, Trieste. Ivan was also able to travel to MU from Brazil for an evaluative and advisory visit through Lennart's initiative. During his one week stay at Moi he got a feeling of what was achievable at Moi and stressed on some details of the problems involved in the making of solar cells. Basically, solar cell research is not an isolated affair but more so the result of integrated industry.

Meanwhile, Kivaisi was organizing the "2nd College in Thin Film Technology" in Dar es Salaam, August 1992 – again mainly sponsored by ISP. The two weeks of this college that Amulele, Matiasi and I attended among other participants from Zambia, Zimbabwe, Malawi, Uganda, Ethiopia and Tanzania, dwelt mainly basics of thin film processes and solar energy. This was a platform where mainly young scientists from the region grouped up to learn about thin film technology per se and share with others their research experience, sometimes at a more personal level. It was then arranged that I should stay in Dar es Salaam a week more after the college to work and discuss with Kivaisi on my MPhil research proposal. This work would be centered around solar cells and a one-year fellowship would be available from ISP to carry out the work on a sandwich scheme with MU. The feasibility of working on an amorphous silicon solar cell in Dar es Salaam was shattered by the very informative and authoritative lectures of Prof. B.O. Seraphin, from the Optical Science Centre of the University of Arizona, Tucson, USA. Seraphin was a guest lecturer at the college, his lectures were wide ranging but covered to a large extent thin film devices for solar energy utilization. I now had 12 months to make an Indium tin oxide/silicon solar cell as part of my research work leading to a masters degree at Moi University. A simple choice it was at first sight, but the end result was a 1% efficiency Indium tin oxide (ITO)/Si solar cell. This was because of a lot of things I had overlooked, and this boiled down to detail again. To make this type of a cell there were basic prerequisites. That is to have a clean room facility, an optimized ITO deposition and characterization process, best choice and cleaning of silicon wafers and an optimized front and back contact metallization process, all of which were fully fledged projects in their own right. But from an academic point of view there was a lot to be learnt and I must say that experience is the best teacher. Compromises had to be made, almost always trading off between time and investment.

To systematically prepare and characterize ITO films on glass for instance, requires a lot of time in manhours and investment in equipment. This was one of the problems I had, ITO is both transparent and conducting so it was not a problem to perform the basic optical measurements in Dar es Salaam. We had to device a way to measure its electronic transport properties like resistivity, charge carrier concentration and carrier mobility. Equipment was readily available in the market but too expensive to buy. So we fabricated our own four-point probe and a Hall effect apparatus. This was a brilliant solution but

one thing was missing, to conduct the Hall effect measurements we needed silver paste. ISP once more came to our rescue and our measurements went on very well. It was during my stay in Dar es Salaam that I had the opportunity to work with an accomplished regional scientist, Mr Teddy Chibuye. His programming skill in FORTRAN were meticulous. Teddy and I both worked under the supervision of Kivaisi. One thing that I learnt from Kivaisi is that he was always there and a professor in every sense, so problem solving was frequent and thorough. This was unlike the common joke in Africa, where supervisers are known as just being partners in the bureaucracy.

At the same time a new development was taking shape at MU. The prolonged purchase and delivery of our equipment, coupled by the uncertainty of what and when will come from the World Bank grant, was a big blow to the PV-group as this worked on the patience of many group members. Progress was steady but too slow, while many of the members were young and eager to go for further studies. Some found other alternatives within the group while others left peacefully. Laszlo had now initiated an application based approach to our PV research activities and this was to develop PV-peripherials and to characterize solar panels. This was very successful, as it resulted in the development of a commercial product, the solar charge controller, by a new member of the group, a Mr Joel Tonui. He was also working on this "solar cell controller" for his Masters degree research under the supervision of Laszlo.

It was now August of 1996, time for the "Fourth college in Thin Film Technology" to be held in Dar es Salaam again. I had the unique opportunity to have attended the 3rd college in 1994 and I was going to attend this one too, this time as an instructor for the sputtering sessions and also to present a paper. So there was progress from my part per se. All this time we still maintained close contact with Lennart at ISP and Kivaisi in Dar. We had not received our equipment yet but something kept us going, and this college proved to be another turning point in our effort. Many members of our group had now visited Dar es Salaam and were familiar with its group members and activities. During this college I happened to be working on a PhD proposal and I had a discussion with one of the guest lecturers from Sweden, Prof. Björn Karlsson, on an optical problem. But this discussion led to the idea that, it would be of interest to me if I visited Sweden to see and learn about some aspects of research in solar energy in Sweden. As judicious as he was, I remember him say "You have to rethink your stance about making solar cells, even in Sweden we still find it difficult to do it". This was not new to us, but it simply cemented the fact that we needed to be more detailed and look for certain aspects of photovoltaics that can be studied as a starting point. Now things were moving fast. Proposals kept coming and fellowships too, scattering the group members to some universities abroad and some registered locally at MU. In fact, we see that Dar es Salaam has been a springboard or – in physical terms – it acted like an interstitial state in a wide energy gap, so that researchers did not have to make quantum leaps to get accustomed to some highly advanced laboratories.

The situation and people at present

In November 1999, the PV group project was finally granted support by IPPS. Our research activities are now centered around three main areas of interest specifically, PV peripherals, PV materials and solar radiation. This has resulted in a number of scientific publications in international journals, in local journals, in conferences, MSc theses and internal reports. Solar radiation and performance monitoring of PV modules under concentrated solar radiation are carried out. The solar efficiency of photovoltaic cells generally increases with illumination intensity thus allowing the use of concentrator systems. The economic viability of concentrator photovoltaic systems strongly depends on maintaining a high cell and optical efficiency. Hence the need for solar cells that operate efficiently under concentrated sunlight and cheap, highly efficient concentrators that do not have stringent maintenance requirements. Eldoret, Kenya, which lies in the equatorial region, makes an important case study. Here several problems need to be addressed, particularly the optimization of acceptance and tilt angles by performing long-term studies on the compound parabolic (CPC)/PV systems, performance of PV accessories and the annual solar irradiance distribution. Research in this area is being done at both MPhil and DPhil levels. The design of a truncated 2D CPC with an acceptance angle of 15º for photovoltaic applications at equatorial latitudes has been undertaken. The Eldoret region is at a latitude of 00º34' N. It is also a high altitude area (2134 meters above sea level), and as such, receives relatively high solar irradiance in the range of 900–1200 W/m^2 on clear-sky days. Four to six hours of solar concentration are expected between the solstices. Presently aluminum is used as the reflector material because it is relatively cheap and exhibits good optical properties.

We have made proposals as concerns photovoltaic materials, two main areas that have been identified for investigation and research are currently being done at the department through cooperation with Uppsala University (UU) and the University of Dar es Salaam at DPhil level. That is the development of solar selective reflectors and studies on porous silicon. Our task is to optically analyze the solar selective properties of thin transparent conducting films on aluminum and the photoluminescence of porous silicon layers and to perform material characterization through cooperation with other labs with an objective to finally develop novel materials and thin film structures for photovoltaic applications. The concept of applying spectrally selective reflectors (SSR) for lighting and concentrator arrays for solar cells is not new, but their application has normally been hindered by either the cost of production or stability problems in operation.

Despite many problems, we are now striving to build new scientific contacts and cooperation, acquire new equipment and skills, improve the laboratory working space and optimize the output of the currently available stall and equipment.

What you have read is a true testimony on behalf of the PV research group at MU by the author. The article is merely meant to motivate many upcoming scientists from the region and highlight some of the difficulties faced. We would like to acknowledge the fact that we have received invaluable support from many individuals and institutions both locally and abroad, some of whose names do not appear in this article.

We wish to take this opportunity to thank all those who have contributed to the continued success and growth of our research activities. Special thanks goes to Moi University, the International Science Programme and the Solar Energy group of the University of Dar es Salaam.

Some ISP Programmes in South-East Asia

By Professor Krishna B. Garg
Department of Physics, University of Rajasthan
Jaipur, India

One of the very strong points of the ISP programme is that they have always emphasised the need for first building up a minimum platform in Basic Sciences and stuck to this idea from the very inception. The ISP cooperates only with those countries whose main emphasis is still focussed on building up a platform to promote scientific research. It has also done well to clarify the meaning of the terms Basic and Fundamental Sciences which are frequently erroneously used to mean the same thing. Another important point to take note of in the ISP programme is that it concentrates on helping research in experimental physics for the obvious reason that any technology development has to come from experimental work. This is, however, not to undermine the importance of theory but a question of choosing priority in a way that would be more functional to the group/country being assisted. What is more, before choosing a particular group or place to help, it has tried to evaluate what level and kind of research support would be in keeping with the resources and needs of the country concerned. This is a very important factor to be taken into account and has proved to be a very functional approach. For instance, if a country is rich in rare-earth magnetic materials, would it be better to support work on magnetism or high energy or particle physics? Of course, one may justifiably argue that where is the harm if one does theoretical particle physics in that country as he has no access to accelerators. Really nobody can say anything against this, but the question is, if this work may be beneficial to him and the field of particle physics or can it at any time be of help in making good use of the abundant natural resources, the magnetic materials, in that country! Nobody can tell him not to do what he likes best or what he is best at but one can certainly make a choice which work to support if the funds are not unlimited. And this is what the ISP, barring a few exceptions, has been precisely doing, i.e. it has been investing in fields and research groups that it finds may have the potential to grow in the direction their countries need. The ISP also exercises great care in choosing the host group in Sweden, in some cases outside Sweden too, for a particular group chosen from the south for this North-South cooperation.

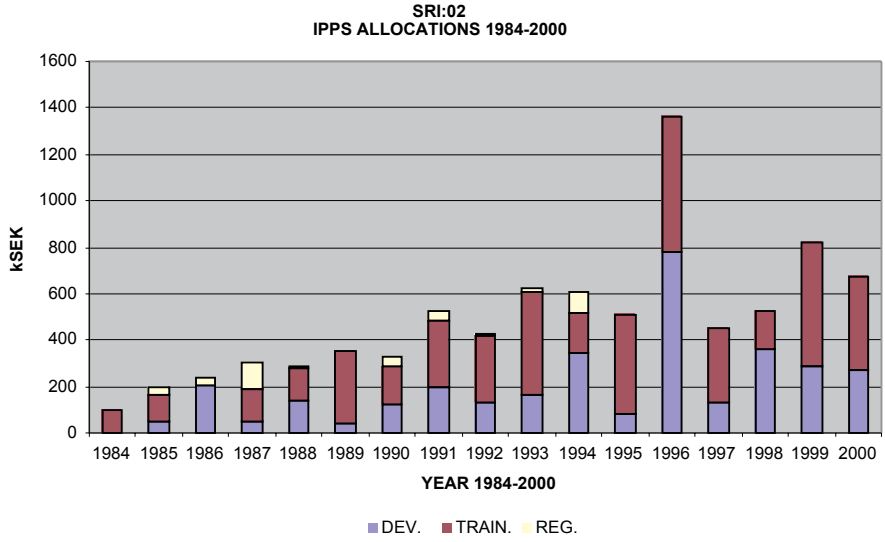

Figure 21. An example of the allocation development for a long-term project. The example shows the IPPS supported project "Semiconductors and Thin Film Solar Cells" in Sri Lanka..

The Choice of Fields and Groups to Support

Since the ISP has had only limited funds at its disposal it was incumbent upon it to use them very discreetly and to show caution in order to achieve positive results. In the beginning one can find some cases wherein scientists from advanced institutes may have been supported, e.g. from Tata Institute of Fundamental Research or from University of Madras in India, but later on it has been consistently following the policy of making a discreet choice. In addition to considering what field may be more appropriate for scientists to work in a particular country or region the ISP has also first tried to ascertain if the research group or department or institute has the potentiality to develop and become self supporting after a specific period. The ISP could not afford to have permanently dependent groups on its hands. As they say the proof of the pudding lies in eating so it may be relevant here to cite examples of India, Pakistan and Thailand in this regard. After a little wavering in the initial period the ISP had finally opted to support three research fields at the Department of Physics, University of Rajasthan, Jaipur and one at the Department of Physics, Punjab University, Chandigarh. Qualitatively similar are the cases of Pakistan and Thailand. India and Pakistan have been fully phased out of the ISP support and similarly one of the four groups from Thailand has been phased out.

A pertinent question to raise here is if the above decision has been vindicated or not. And the answer is in the positive. The Condensed Matter Physics groups that was supported at Jaipur are all doing very well, both physicswise

as well as in obtaining local funding for their work. That is also the case of the High Energy Physics group which although has become trifurcated but each of those sub-groups is doing well. Perhaps the only exception has been the Plasma Physics group which after doing so well simply collapsed when its leader retired. But then, the ISP cannot be held responsible for that for it helped to train a number of people in that field to a level that every one of them is capable of working on his own but decided not to. As far as the groups in Pakistan and Thailand are concerned to the best of my knowledge they also make success stories. Phasing out of groups/countries is a very important and daring decision for if done prematurely it can mean dissipation of resources but fortunately that has not been the case here. It is also important in cases wherein one senses that the assisted group has failed to make any progress. India is the worst example for this. The government initiates a programme and if it fails to achieve the desired result, it launches another programme in its place but without closing down the failed programme resulting into obvious waste of resources and unproductive duplication. Moreover, in general, the phasing out has been done groupwise or centrewise rather than countrywise at one go which ensures that the process of phasing out turns is not akin to axing.

The ISP support to groups in Bangladesh, Sri Lanka and the three groups in Thailand is still continuing. The ISP supported research groups have been doing very well in these countries also, some very well and some less so but have the potentiality to come up. This is perhaps also because of the scant research funds available in case of Bangladesh and war-torn Sri Lanka. Another pertinent question to raise here is why only these countries have been chosen for support in Asia, why not Nepal or Burma or Indonesia or Philippines etc. and how long support to a group/country should last!! The answer is that it is always very hard to make choices but if one has only limited funds one can either fritter them away by distributing them amongst all without anyone really making any long-term gain from such support or choose a few of them at a time based on one's judgement. As far as length of time for which support should last there can be no uniform yardstick for that. One can only say until such time such that the supported group is able to stand on its own legs. For example, the optimum support period in case of countries in Africa is bound to be much longer than in Asia or Latin America.

Networking, South-South Cooperation and Resource Centres

A very important aspect of the ISP programme has come in the form of encouraging regional cooperation between ISP-ISP as well as ISP-Non-ISP groups in a region. For this it designated some of the phased out groups, as the Condensed Matter Physics Lab and the Magnetism and Mössbauer Laboratory at Jaipur, India, as Resource Groups and the Department of Physics, Quaid I

Azam University, Islamabad in Pakistan, as a potential Resource Group. This has been quite useful. For example, scientists from Vietnam, sponsored by the ISP, have visited and worked in our Condensed Matter Physics Laboratory for one to three months to perform photoemission measurements on their high T_c superconducting samples and also learnt to analyse these data. They have published this work and one of them has even incorporated it in his thesis for getting a degree from the ITIMS, Hanoi. Similarly, scientists from Bangladesh have benefitted from association with the Magnetism and Mössbauer Laboratory. Another example in Bangladesh itself where the ISP has assiduously and very successfully promoted interaction and joint research amongst various groups based at the Atomic Energy Commission, the Dhaka University and the Bangladesh University of Science and Technology (BUET) resulting into a spirit of cooperation amongst them and a better product, both in quality and quantity. It has also made good use of cooperation with non-ISP advanced centres like the Indian Institute of Physics, Bangalore, where it has sponsored ISP fellows from other countries to go and work. Other such examples are Beijing, Guangzou and Shanghai universities/institutions in China which act as host groups for scientists from ISP assisted groups. The Asian Network of Research on Antidiabetic Plants, Network of Instrument Technical personnel and User scientists of Bangladesh (NITUB), and the Regional cooperation in Asia are other such examples of South-South cooperation in Asia. Another example is that for strengthening research activities in semiconductors physics in Sri Lanka and Thailand the ISP promotes use of complimentary facilities at Peradeniya and Bangkok as also the more advanced facilities at the Shanghai group. For materials for solar conversion ISP promotes cooperation among Rajshahi and Hanoi for magnetic and high T_c materials between Jaipur, Dhaka and Hanoi.

Some Achievements

Again, it is difficult to mention achievements of every group but it may still be worthwhile to mention a few:

The Peradeniya group in Sri Lanka through its vigorous efforts and active participation in the Asian Solid State Ionics Society (ASSIS) successfully organized the Fifth Asian Conference on Solid State Ionics at Kandy in 1996 in which scientists from not only Asia but also from Europe and U.S.A. had participated and its proceedings were published by the World Scientific Publishing Co., Singapore. This speaks volumes for the tremendous strides made by the group and its level of confidence. (See also the article by Dissanayake.)

Similarly, the High T_c Superconductivity group of Jaipur has to-date organized three international symposia, seminar and conference on high T_c superconductivity (in 1988, 1989 and 1996; two international workshops on the XANES & EXAFS techniques (in 1990 and 1992); the annual National D.A.E

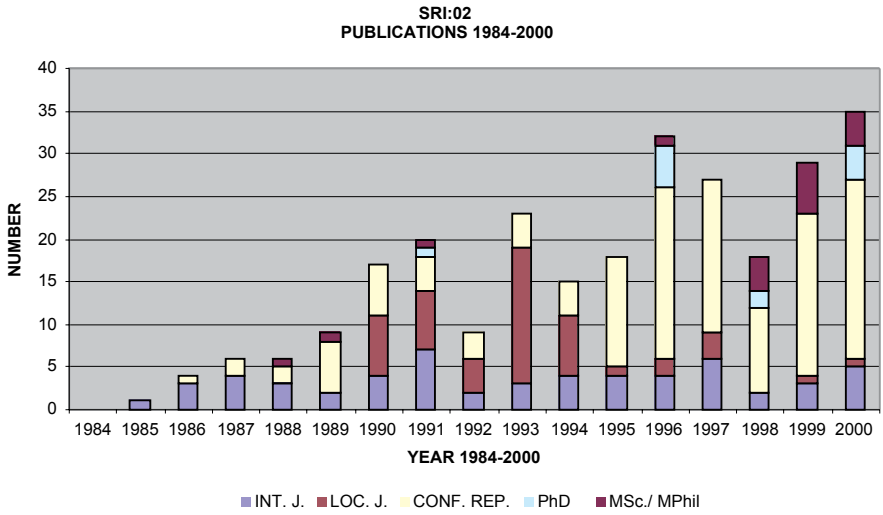

Figure 22. An example of the development in number of publications and degrees from the start of the project. The example shows the IPPS supported project "Semiconductors and Thin Film Solar Cells" in Sri Lanka.

Symposium on solid state physics in 1995. Of course, the proceedings of all of these were also published.

Several individuals, who went through the ISP path, have earned a name for themselves and their groups, are now members of important national and international bodies and have been able to get substantial funds for furthering their research programmes from within their countries as well as from international funding agencies.

The sandwich PhD programme run by the ISP has also been of great value particularly in respect of the countries like Thailand and Sri Lanka, wherein the universities were not having any PhD and sometimes not even post-graduate programmes in basic sciences.

Future outlook

The future of the ISP and those being assisted by it cannot be anything but promising. This statement is based on the fact that ISP has constantly supplied and will certainly also in the future supply the laboratories in the assisted groups with equipment at optimum performance level. In addition to this ISP has sent expert engineers/technicians to the assisted groups. Another succesful type of support that hopefully will continue is the support for making specific measurements in another laboratory involving only a short distance travel and a short stay.

In order to further strengthen the programme and enhance the quality and quantity of its outcome it may be useful to consider the following suggestion:

– Even in this age of IT progressing by leaps and bounds acute shortage of relevant scientific literature is a big impediment to work. One wonders if it is possible for the ISP to subscribe to some important chemistry and solid state physics journals for electronic access akin to the ICTP so that one can log into the ISP account and download the necessary papers. Side by side it can ascribe responsibility of downloading and mailing the papers to a group in every region and mail the same to any group in that region making such a request to it. The ISP may be able to think of an alternative solution to this problem but the problem does merit its attention.

Developing Research From Scratch – the Peradeniya Example

By Professor M.A.K. Lakshman Dissanayake
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Up to 1961, Sri Lanka, had only one Faculty of Science, attached to the University of Ceylon, situated in the capital Colombo. In 1961, a second Faculty of Science was established at Peradeniya, situated in the mountains in the middle of Sri Lanka. This new faculty was to accommodate the increased number of students qualified for higher education in Science. As in Colombo, the second Faculty also consisted of five Departments, namely Botany, Chemistry, Mathematics, Physics and Zoology, and the students were admitted into two streams – Biological Sciences and Physical Sciences. By the 1980's there were about 75–100 students every year, offering Physics as one of the 3 subjects for a 3 year BSc General Degree Programme and about 10 students per year selected to follow a 4 year Physics Special (Major) Programme. The number of permanent academic staff of the Physics Department holding PhD degrees did not exceed 10 during the 1970's and 1980's, although the approved cadre was 20. They were assisted by temporary Assistant Lecturers (graduates) and temporary Demonstrators in carrying out the academic programmes. Largely due to the heavy academic work load, the research activity in the Department up to early 1980's was almost nil. Senior Faculty members had obtained their PhDs from UK or USA. Most of the young lecturers who were sent abroad for their doctoral studies did not return aggravating the shortage of senior lecturers even further. Even the few members who wanted to initiate some research activity in Physics had to face many obstacles due to heavy teaching loads, lack of guidance (as there were no senior teachers active in research), lack of equipment, research grants and other facilities. The staff situation started to improve somewhat during the early 1980's making it possible to introduce some short term (3 months) research projects for the final year Physics major students. However, up to mid 1980's no meaningful research activity was in sight due to the factors mentioned above.

The turning point

The situation with regard to research activities in the department started to change when contact was established with the International Seminar in Phys-

ics, Uppsala University. Information on this programme was available to university researchers in Sri Lanka even during the 1970's, through their information brochures. The Department of Physics at University of Colombo already had started their research programme on Atmospheric Electricity during this period. However, young lecturers at the Department of Physics at University of Peradeniya, who returned to Sri Lanka after getting their PhDs from UK and USA, were not aware of the possibility of spending short term periods, 1–3 months, in Sweden and to initiate a collaborative research project under the Uppsala programme. They were able to get long-term sabbatical leave (one year) only after serving for 7 years although it was possible to get short-term leave of up to 3 months at any time. The information available to us was only through the brochures issued by The International Science Programme (ISP), which was the new name of the Uppsala programme.

Only when one of our colleagues, M.A. Careem, was due to go on sabbatical leave in 1983, he inquired from ISP and made an application for a fellowship to carry out research on solid electrolytes at Chalmers University of Technology (CTH), Gothenburg, Sweden. While he was working at CTH the author, M.A.K.L. Dissanayake, was due for his sabbatical leave in 1984 and made an application to ISP, but the area of interest was photovoltaic semiconductors. The ISP, however, suggested that if the area of research interest can be changed to solid electrolytes, they will consider granting a second fellowship and also long-term support to the Peradeniya group. This was followed by a visit by Lennart Hasselgren to Peradeniya on a fact finding mission. He was impressed with a pool of about 6 young PhDs, who have specialised in solid state physics or related fields, a good pool of undergraduate students, a machine shop, a library and good teaching laboratories. Subsequent to this only the ISP decided to grant long-term research support to the Solid State Physics group at Peradeniya.

The Solid State Physics research group at Peradeniya was chosen by the ISP as a suitable group to initiate a collaborative research programme with Prof. Arnold Lundén's group at Chalmers University and to grant long-term research support aimed at building an indigenous research capacity at Peradeniya. In 1986, Peradeniya had two well trained senior Physicists and basic equipment donated by ISP necessary to initiate a research project on " Sulphate based Solid Electrolytes" in collaboration with the Chalmers group. Dr Bengt-Erik Mellander, a coworker of Lundén, visited Peradenya in early 1986 to assist the group to initiate the experimental work.

The first research paper, based on measurements carried out entirely at Peradeniya was presented at the Asian Workshop on Materials for Solid State Batteries, held in June 1986 at the National University of Singapore. This was a turning point in research activities of the Peradeniya group! At this workshop the Asian Society for Solid State Ionics (ASSIS) was founded and two senior members from the Peradeniya group became founder members of this society. Since its inception, this society has been very active in promoting

solid state ionics research in the Asian region covering India, China, Malaysia, Japan, Singapore, South Korea and Sri Lanka. Starting from 1988 the society has been organizing a series of biennial conferences under the title "Asian Conference on Solid State Ionics (ACSSIS)" in different countries in the region.

Sandwich postgraduate programmes

An important part of the research collaboration in Solid State Ionics initiated in 1986 between Peradeniya University and Chalmers University was the training of a PhD student, P.W.S.K. Bandaranayake, on a sandwich basis where a part of the research work was to be carried out at Peradeniya and a part at Chalmers University. After successfully completing five years of research work, Bandaranayake obtained his PhD in Solid State Physics from the University of Peradeniya in 1991. This was the first ever PhD in Physics offered by a Sri Lankan University! He is now a Senior Lecturer in Physics at Peradeniya and an active young researcher of the group.

The Solid State Physics research group at Peradeniya has expanded considerably during the past 14 years. The group has now expanded to include three more research areas, Conducting Polymers in collaboration with Prof. Steen Skaarup's group at Denmark Technical University, Lyngby, Denmark, Semiconductors in collaboration with Prof. Thorwald Anderson's group at Chalmers University and Ceramics in collaboration with Prof. Bill Bergman's group at the Royal Institute of Technology at Stockholm. The group at present has several active researchers including five senior members, four postdoctoral staff (temporary) members and six postgraduate students registered for MPhil and PhD degrees. Up to now the group has published more than 130 research papers out of which about 60 are in internationally refereed journals. Under the sandwich postgraduate training programme, the group has up to now awarded 11 PhD and 2 MPhil. In addition the group has also awarded several MSc by research as well as by research combined with course work. All these postgraduates are currently employed in universities, research institutions and industries in Sri Lanka and other countries. Four PhD and one MPhil are in the permanent academic staff at universities, one PhD is a member of a research team at a leading research institute, one PhD is a quality control manager of an international manufacturing company located in Sri Lanka, one PhD is the Director of an International Studies Centre in Colombo, and one MPhil is a senior staff officer at the Central Bank of Sri Lanka. All these positions are permanent. One more PhD is a post-doctoral researcher at a university in USA. Three newly awarded PhD are still working at Peradeniya university as Temporary Lecturers until they find a suitable permanent employment. The ISP continues to support our research activities by way of providing student fellowships, equipment, spares and consumables, exchange visits and assisting

Figure 23. Research students Ms Kumudu Perera and Mr Roshan Bokalawala carrying out impedance measurements on polymer electrolyte samples at the IPPS supported Solid State Research group at the University of Peradeniya, Sri Lanka.
(Photo University of Peradeniya)

towards participation at international scientific conferences and organization of national research conferences. The total ISP support received so far amounts to well over US$ 1 million.

National and international recognition

Due to the recognition received from the international scientific community, the group has been successful in receiving a major research grant from the European Community during 1992–1995 to develop novel solid ionic materials with potential applications in solid state batteries. The group has managed to convince the University and the National Science Foundation about the possibility of training postgraduate students locally through research collaboration with developed countries and as a result received and continues to receive several government research grants to offer Research Assistantships to students and to meet the local expenses of research projects. Through its active participation in the Asian Solid State Ionics Society (ASSIS), the group also successfully organized the Fifth Asian Conference on Solid State Ionics in Kandy in 1996 where a large number of active researchers from Asia, Europe

and America participated. The proceedings of this conference has been published by World Scientific Publishing Co. Ltd., Singapore with Prof. M.A. Careem , Prof. M.A.K.L. Dissanayake and Prof. B.V.R. Chowdari as editors.

All the above achievements during a relatively short time, starting from scratch in 1986, has been possible due to several important factors: the closely followed up and generous support given by the ISP, Sweden, the proper research guidance and support offered by the host scientists in Sweden, Denmark and other developed countries and the dedication, careful planning and good team work by the senior members with mutual understanding.

Over the years, the group has also managed to establish important international scientific collaboration with several leading research groups active in solid state ionics and other research areas. Among them are the groups led by Prof. A.R. West (UK), Prof. J.L. Souquet (France), Prof. Roger Frech (USA), Prof. Roger Linford (UK), Prof. M.H. Lewis (UK), Prof. Paul Smith (Switzerland) and Dr Dharmadasa (UK). Informal scientific contacts have been established with several leading scientists in Europe, USA, Japan and India.

In addition to sustaining a postgraduate level research programme in technologically important new materials, we have also catalyzed the research activities in other universities and research institutes in the country. This has been achieved through national seminars, conferences, and by publishing joint research papers. We have also been successful in 1994 in re-starting the Ceylon Journal of Science (Physical Sciences), which is published by the University of Peradeniya with Prof. M.A.K.L. Dissanayake as the Editor-in-Chief. This journal is devoted to research papers in Physics, Mathematics, Chemistry and related disciplines. This journal, which was originally started in 1948, did not continue after the first few issues. Now it has become a popular journal among young researchers in Sri Lanka. The journal has published papers also from scientists in India, China and Bangladesh. Currently the journal is published once a year. Our group's contributions to research activities of the Faculty of Science has played a key role in the establishment of the Postgraduate Institute of Science (PGIS), a national institute for developing postgraduate level scientific research and training. It is affiliated to the University of Peradeniya and situated in the Faculty of Science premises. As Chairmen of Boards of Study, and as Coordinators of MSc programmes, senior members of our group play a vital role in the activities of the PGIS.

Future Plans

In the near future we would like to become a regional centre for training researchers in solid state ionics and other fields. Already there is some interest shown by researchers and students from neighbouring countries in the region. We have most of the major equipment, several senior scientists with proven experience in training young researchers, publishing research papers and or-

ganizing research conferences. We have the administrative set up of the PGIS for easier handling of administrative formalities of postgraduate students. This type of regional training activity could be initiated if the ISP and other donor agencies are prepared to provide the necessary financial assistance to purchase a few more pieces of essential equipment and to cover the cost of consumables, international travel and local accommodation of foreign students by way of providing them with studentships.

In the case of Sri Lankan students, it should be possible for us to train MSc and MPhil students entirely locally with presently available facilities. However, in the case of PhD students we would like to send them to Sweden, Denmark or to another country for one year in order to expose them to facilities in advanced laboratories and to give them some advanced training. We strongly feel that, even though our group is now somewhat independent scientifically, we still need the assistance of the ISP or another donor agency because economically the government funding is not adequate to sustain the activities of the group.

Geophysics in Thailand

By Dr Warawutti Lohawijarn
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The Prince of Songkla University (PSU), named after and dedicated to His Majesty the King's illustrious father, was founded in 1967. It is the first university established in the Southern Thailand in order to upgrade the regional education and consequently yield economic and social development in the Southern Thailand.

The Department of Physics was established in 1968. Since 1975 the department offers BSc programmes in physics and in 1991 it started the MSc programme. The research interests of the staff are geophysics, biophysics, plasma physics, material physics, electronics, underground water resources and environmental studies.

The geophysics group employs means of physics to study the earth structurally and simply considers rocks as media of different physical properties. Results from the geophysics research are potentially applicable to local and regional development in the form of mineral deposits, underground water resources and environmental study. The ultimate goal of the project is to form a national regional center of geophysical research and education.

IPPS support

The contact with IPPS started in 1985 when our geophysics group submitted a proposal to IPPS. The response from IPPS was that the proposal was “too ambitious”. However, IPPS asked Prof. D.S. Parasnis, a well known geophysicist of Luleå University of Technology, to visit PSU to discuss the plans of the department and assist in the preparation of a new proposal. This proposal was much more realistic and was accepted by IPPS. Academic and technical assistance from IPPS to the geophysics group was started in 1987.

The project comprised mainly (1) fellowships for geophysics training and graduate studies at Swedish universities, (2) research equipment, (3) geophysical textbooks and (4) travelling costs for Swedish professors to supervise ongoing research work in Thailand. In addition, Prince of Songkla University was requested by IPPS to put contributions in the geophysics project, i.e. local costs for visiting professors and field work, a suitable transportation vehicle

Figure 24. Undergraduate Physics students on their geophysics field work, electrical resistivity measurement, at the IPPS supported Geophysics Project, Prince of Songkla University, HatYai, Thailand. (Photo Prince of Songkla University)

for field work and research equipment. This kind of assistance project, or sandwich project named and initiated by IPPS, has been gradually proved to be the best kind of academic and technical assistance project in geophysics to south universities. The project will certainly ensure long lasting research activities, such as geophysics research activities at Prince of Songkla University. In addition to the geophysics staff, enrolled students will certainly gain experience and take part in research activities much more than in the past.

It is not too exaggerated to state that the IPPS assistance has caused dramatic improvements in research capability of the geophysics group at PSU. This is because before the assistance, the group was a small one of 3 academic staff members and 1 technician. The main responsibility of the group was to arrange basic geophysics courses for undergraduate physics students. The research activity was mainly senior project of final year physics students and was concentrated only on geo-electrical technique. With assistance from IPPS, together with Luleå University of Technology and Uppsala University, the group has expanded its research capability to a wide range of geophysical techniques.

Present situation

The group now comprises 5 academic staff members and 1 technician and is involved in teaching courses and supervising thesis work in MSc programmes in Physics and Geophysics of the Physics department, PSU, since 1992 and 1999 respectively. At present, the geophysics group becomes more and more active in research activities. The assistance has resulted in a number of qualified staff members and the installation of modern research equipment. Through this assistance a necessary potential core for research has been formed for the future.

The geophysics group can now draw a number of research grants from university, government budget, funding agencies, such as the Thai Toray Science Foundation, and the industrial sector. The research activity of the group has expanded to cover both global geophysics and applied geophysics. In global geophysics, seismology, rock magnetism and palaeomagnetism are being addressed. In applied geophysics, the following research fields have been taken up: rock magnetism in environmental problems; induced earthquake studies; subsurface geological structure determination; ground water, coal and mineral prospecting and geophysics in environmental, engineering and archeological problems.

Publications of the geophysics group, at present, comprises local journals, local reports, MSc theses, national and international conference proceedings. The geophysics group is ambitiously aiming for publication in international journals by next 2 years.

It could be observed that the research activity of the geophysics group at Prince of Songkla University, has been steadily increased since 1987 thanks to the assistance from IPPS. It causes development in research activity that is related to local problem. It aims at a university laboratory, which results in benefits for the students and creates sustainable research activities. The IPPS support brings in contribution from local university to ensure the recognition and continuing support by the university. Ultimately, it develops research behavior and research mind in the university staff and students of developing countries, which is proved to be necessary for the development of the society in the future.

Therefore, the 40 years of IPPS activity is a great contribution to the development of science in developing countries. The magnificent contribution of IPPS will certainly create new innovation and peaceful living environment in the world. The IPPS should therefore continue its mission and enjoy its invaluable success.

Natural Products Research in Bangladesh

By Professor Mohammed Mosihuzzaman
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I consider myself privileged to write about my rewarding experience with ISP over the last 23 years. In fact whatever I have achieved in my scientific career has been made possible through my association with ISP. Development of a good research laboratory in a country like Bangladesh, establishing a research group and involving the group in national and international cooperation were big challenges. I could overcome the difficulties by the constant support of ISP and through it by the Swedish scientists involved in collaborative research activities. The initial success could draw significant local support from the University of Dhaka (DU) in building up the scientific capability of the research group and attracted good students to it. The results are manifested in the award of 60 MSc, 4 MPhil and 9 PhD, publication of 65 scientific papers and 58 conference reports, expansion of the first ISP supported research group into the creation of a new group, establishment of the national Network of Instrument Technical personnel and User scientists of Bangladesh (NITUB) and a regional network, Asian Network of Research on Antidiabetic Plants (ANRAP). My appointment as the Chairman of the Bangladesh Council of Scientific and Industrial Research (BCSIR) in 1997, holding of the international conference ASOMPS X in November 2000 in Dhaka and my uncontested election to the position of President of the Bangladesh Chemical Society for the years 2001 and 2002 are also indirect recognition of my achievements earned through the continued ISP support. After my appointment as the Chairman of BCSIR my able student, colleague and research coworker Prof. Nilufar Nahar is very successfully leading the group. In the meantime, Prof. Rune Liminga, Director of IPICS, who was the architect of the long-term support to research groups and regional cooperation, retired in 1997. Fortunately, the new Director, Prof. Malin Åkerblom has not only continued the support to successful research groups but has brought newer ideas and dynamism to the IPICS programme. I am confident that IPICS will continue to have a tremendous impact in developing research capabilities in the third world countries with its open-minded attitude and with grants which are absolutely string-free.

The beginning

I first met Prof Rune Liminga, the Ex-director of IPICS, at Dhaka in 1973 and came to know about the International Seminar Fellowship programme. Later, I was awarded a 10 month Fellowship during 1977–78 to work with Prof Olof Theander and Dr Olle Larm at the Department of Chemistry, Swedish University of Agricultural Sciences (SLU), Uppsala. My stay in Sweden was scientifically stimulating and I applied for Follow-up support from IPICS and a grant from IFS. Fortunately, I got grants from both the sources and began to build up my laboratory at Dhaka with a gas chromatograph (GC) and other smaller equipment. In the next few years a freeze-dryer, and complete gel-filtration system were bought from IPICS and IFS grants whereas DU provided a capillary GC, a second freeze-dryer and a 60 MHz NMR spectrometer. At this stage much of the basic chemical work could be done at Dhaka. The high resolution NMR and Mass spectroscopic work were done almost routinely at SLU. Later these facilities are also obtained from Mahidol University, HEJ Research Institute in Karachi and National Cancer Institute (NCI), USA.

First PhD students

While my research laboratory was being organized at Dhaka, M Nizamuddin, an employee of BCSIR, registered in 1982 as a Sandwich PhD student with Dr Olle Larm from SLU as the Swedish supervisor. The PhD programme on jute and other plant materials brought SLU and DU closer and real collaboration took off. While Nizamuddin was progressing with PhD work and the DU laboratory was improving, a young staff member of DU, Mrs Nilufar Nahar, registered for her PhD in 1983. By her excellent performance Nahar earned a special registration at SLU and received her PhD from SLU in 1987. Nizamuddin received his PhD from DU in 1989. The coworkers at SLU got deeply interested in the utilization of fast-growing jute and other similar plants for producing pulp and other cellulose derivatives. Conversion of non-cellulosic polymeric carbohydrates into useful products was also of interest. Nizamuddin and Nahar got their PhD by working on cellulosic and non-cellulosic carbohydrates of jute, *Cajanas cajan,* and other plant carbohydrates.

SAREC support

As the IPICS follow-up money was generally small I discussed with Liminga and Larm about the possibilities of getting funds from sources other than IPICS to develop the DU lab acceptable to international standard. Accordingly I made an application to SAREC and met the SAREC authorities along with Liminga and Larm. SAREC could not grant money directly to me as there was

no agreement between the Government of Bangladesh and SAREC but fund was allocated to Prof Olof Theander and Larm for the collaborative project on jute and other plant materials. The SAREC money tremendously helped in building up research facilities at Dhaka.

Collaboration with ICDDR,B and Stockholm University

Within five years of IPICS support the DU lab became capable of handling most of the basic work in the carbohydrate field and at this stage collaboration with the International Centre for Diarrheal Diseases Research, Bangladesh (ICDDR,B) and the Department of Chemistry, Arrhenius Laboratory, Stockholm University (SU) developed with IPICS playing a catalytic role. The collaborative work involved structural elucidation of polysaccharides isolated from new diarrhea causing bacterial strains isolated at the ICDDR,B. The collaborative work led to the structure elucidation of more than 10 new polysaccharide materials and produced two PhD and several MSc. During this time another postgraduate student got his PhD working on rice straw and its rumen digestibility in collaboration with the Department of Animal Feed Science at SLU.

Natural Product Chemistry

In the early eighties, when jute was the main focus of work, the DU group had to start handling secondary metabolites in the extractives of unretted jute and other plants, which led to get the group involved in Natural Products Chemistry. Through the introduction by IPICS, I visited Prof. Vichai Reutrakul's lab at Mahidol University, Bangkok, Thailand, in 1983. Regional collaboration on natural products started by training of post-graduate students at Mahidol since 1985 and it is still going on. Collaboration with the HEJ Research Institute of Chemistry, Karachi, Pakistan has, in the last few years, enhanced the scope of utilizing spectroscopic facilities and training of PhD students.

Antidiabetic Plants: Collaboration with BIRDEM and Uppsala University

During 1987 Nahar and I met Dr Liaquat Ali, a researcher from Bangladesh Institute of Research and Rehabilitation in Diabetes Endocrine and Metabolic Disorders (BIRDEM), who was working under Prof. Bo Hellman at the Department of Medical Cell Biology, Uppsala University (UU) with WHO fel-

lowship. This was a turning point in the historical development of my research group. We discussed and agreed to work on plant materials reputed to have antidiabetic activity in the traditional medical practice. IPICS assured support. Hellman, who already had interest and experience in experimenting with some plant extracts from Sri Lanka through another IPICS fellow, appreciated the idea and agreed to support the programme on antidiabetic plants. At the other end, Prof A K Azad Khan, Director of the Research Division at BIRDEM, came up with an all-out support from the BIRDEM side. Consequently, a Memorandum of Understanding was signed for collaboration between BIRDEM, DU and UU. While BIRDEM and DU were undertaking the groundwork for the new programme, Hellman and Liminga came to Dhaka in January 1989 when the research programme on antidiabetic plant materials actually took off. During the next few years this programme developed to be the main research area of our group comprising BIRDEM and DU. With the expanding area of work, the group was divided to create a new IPICS supported group, headed by Liaquat Ali in 1995. However the two groups are working in full cooperation since then.

Research on antidiabetic plant research called for setting up a proper rat house at BIRDEM, developing diabetic rat models and standardizing experimental techniques for studying hypoglycemic effects of plant extracts on rat models by feeding tests. On the DU side the first job was selection of plant materials in consultation with the BIRDEM scientists, identification and collection of the plant samples and development of a standard reproducible extraction procedure for the preparation of test samples. The two laboratories developed in unison for screening of plant extracts primarily collected from local sources. Soon contacts were established with scientists in India and Nepal, especially through the workshop in 1992 and a number of plant materials and extracts were received from Calcutta, Darjeeling and Nepal. These collaborations have already shown great promise and a few very interesting plant materials have been selected for further studies involving fractionations and isolation of bioactive compounds.

On the biology side, *in vitro* studies with plant extracts on isolated rat islets were made possible by direct technology transfer from UU through Liaquat. Hypoglycemic bioassay by feeding tests on rats and insulin measurement by using ELISA technique were standardized. A very special IPICS grant enabled the group to buy a fluorescent microscope for measuring cytoplasmic free calcium in single B-cells by the Fura-2 method. BIRDEM supplemented the large investment by IPICS through procuring the CO2 incubator system for cell culture.

On the chemistry side, the methodologies for plant selection, plant collection, test sample preparation, extraction, and fractionation of active extracts have been standardized. Prof Salar Khan, a consultant botanist from the Dhaka University and the Bangladesh National Herbarium (BNH), and Prof Vichai Reutrakul from Mahidol University have rendered valuable services in these

respects. With their help most of the available literature information on antidiabetic plant materials have been collected. These are presently being compiled as an inventory by ANRAP.

Expertise in the fractionation and isolation of pure compounds has been greatly enhanced through IPICS supported training of Nahar at SLU and at Mahidol and several post-graduate students at Mahidol and at the HEJ Research Institute of Chemistry, Karachi, Pakistan. The training included extensive work on HPLC, MPLC, chromatotron, flash chromatography and other conventional separation techniques. With grants from IPICS the HPLC facilities both at BIRDEM and DU have been brought to full use especially through the visit of Prof. Prapin Wilairat from Mahidol. Procurement of the Peter Bäckström's medium pressure liquid chromatographic system and a chromatotron tremendously improved the separation facilities at DU.

Anti-cancer and anti-HIV plants: Collaboration with NCI

With the development of facilities at our laboratory for working on antidiabetic plant materials the possibility of working on other medicinal plants became a reality. During the collection of antidiabetic plants folkloric information about other diseases were also gathered. Incidentally, at this stage Nahar and I came in contact with Dr Gordon Cragg of the National Cancer Institute (NCI), USA. Discussions with Dr Cragg led to several visits of Nahar and myself to USA during 1995–2000 and a strong cooperation has developed in our work on anticancer and anti-HIV plant materials. Brine shrimp lethality bioassay has been established at Dhaka for preliminary screening of plant extracts and fractions thereof. Anticancer activity tests using human tumor cell lines of extracts, fractions thereof and pure compounds are now routinely being done at NCI. One candidate has obtained his PhD last month and three others are working on anticancer plants. Cooperation with Mahidol university and SLU has also been extended to include work on anticancer plant materials. Recently some very promising plants have been identified and a few isolated compounds have shown good prospect of development into therapeutic agents against cancer.

Pesticide Residue Analysis

With the improvement of research facilities at our laboratory an important national problem of pesticide residue analysis and its incorporation into cereal crops, fruits and vegetables has been taken up for in depth research. Malin Åkerblom, the present Director of IPICS, has personal expertise in this field and we are getting encouragement and guidance in this new area of expansion

Figure 25. Professor Nilufar Nahar (left) of the IPICS supported Natural Products research group in Dhaka, Bangladesh, explaining to postgraduate students how a gas chromatograph works. (Photo Dhaka)

of our research directly from her. Dr Iqbal Rouf Mamun, one of our students and now a staff member and a post graduate student have started to work on pesticide analysis. GC-MS and high resolution NMR facilities at BCSIR will be utilized for this work under a new collaboration.

Instrument maintenance and formation of NITUB

When various equipment received from IFS, IPICS and SAREC grants started working in our laboratory we realized our deficiencies in technical know-how. Understanding our difficulties, the co-workers at SLU kindly dispatched their Instrument Engineer, Mr. Rolf Andersson to Dhaka several times for helping students and technicians at Dhaka in proper use, maintenance and repair of different kinds of instruments and IPICS financed his visits. A laboratory technician under the project was also trained at the International Centre for Advanced Technology (ICAT), Luton, UK.

From the experience gathered from handling different instruments and tackling the problems of maintenance and repair, I coordinated and organized a workshop on instrument maintenance and repair in November 1991. Fellows of IPICS and IFS Grantees in Bangladesh took part. The workshop, first of its kind in Bangladesh and financed by IPICS and IFS, generated great enthusi-

asm among the scientists of various disciplines and a follow-up workshop on a bigger national scale was organized with Prof. M Shamsul Huq, Chairman, Bangladesh University Grants Commission (UGC) as the Chairman of the Organizing Committee, myself as the Coordinator, Prof Altaf Hossain (IPICS Fellow) as General Secretary and Nilufar Nahar as Joint Secretary. Besides IPICS, IFS came in a big way to finance the workshop which included sponsoring of six resource persons from ICAT. The workshop was organized at DU with practical sessions at Chittagong (BCSIR Laboratories), Dhaka and Mymensing (Agricultural University). A major outcome of the national workshop was the formation of the Network of Instrument Technical personnel and User scientists of Bangladesh (NITUB). NITUB obtained official recognition and initial funds from IPICS, IFS and UNESCO and started functioning from July 1994. In the last six years NITUB has made tremendous contribution in the proper use and maintenance of scientific instruments in Bangladesh. NITUB has so far organized 12 training programmes on various instrument groups and since 1996 it has repaired hundreds of equipment in various Universities and research organizations. NITUB may be considered as a model in the developing world in its scope of service.

ANRAP

With the development of research on antidiabetic plants programme the Dhaka Group (BIRDEM & DU) organized a Regional Workshop at Dhaka in January 1992. The successful Workshop was followed by a wider First International Seminar on 'Plant Materials as Source of Antidiabetic Agents' organized by the Dhaka Group in January 1994. Both the Workshop and the Seminar was primarily sponsored by IPICS and IFS. During and immediately after the Seminar, discussions among the scientists from various countries and the sponsors led to the formation of the Asian Network of Research on Antidiabetic Plants (ANRAP). IPICS, IFS and UNESCO supported the Network and the ACGC meeting in Melaka, Malaysia in June 1994 also approved it. ANRAP was launched in January 1995 by adopting its constitution at a meeting of the Ad hoc Committee which included representatives from IPICS, IFS and UNESCO and scientists from the Asian region. The first ANRAP Board was elected according to the newly adopted constitution with myself as its Chairman, Prof A K Azad Khan as the General Secretary and, Prof Avijit Banerji (India) and Prof Eric H Karunanayake (Sri Lanka) as members. Formation of ANRAP added a new dimension in regional cooperation. IPICS is continuously supporting ANRAP since its inception.

During the last five years ANRAP has organized the 2nd (1997) and 3rd (2000) International Seminar on 'Plant Materials as a Source of Antidiabtic Agents', conducted two workshops in Karachi and Dhaka, given ANRAP Fellowship to about a dozen young scientists, supported exchange visits of senior

scientists and held regular Board meetings every year. On 17 Nov 2000 ANRAP had its 3rd General Assembly where a new Board with myself as Chairman, Prof A K Azad Khan (Bangladesh) as General Secretary, Prof Biswajit Mukherjee (India) and Prof M Iqbal Choudhury (Pakistan) as members, has been elected. ANRAP has started cooperating with other Natural Products Networks in Africa & South America to establish a Coordinating Group between the three continents.

ASOMPS X

The Asian Symposium on Medicinal Plants, Spices and Other Natural Products is held almost every three years in different Asian Countries. Nahar and I have been attending them since the Sixth meeting in Bandung, Indonesia in 1989 and came into close contact with many reputed scientists from all over the world. This, ultimately resulted in selecting Bangladesh as the host of ASOMPS X in 2000. Myself as Chairman and Nilufar as Secretary of the National Organizing Committee, we have very successfully conducted ASOMPS X in Dhaka on 18–23 Nov 2000. About 450 scientists of whom about 200 came from 43 different countries outside Bangladesh took part in ASOMPS X. This Symposium is a direct result of IPICS support to Dhaka group over the years and is a recognition by the scientists and science managers worldwide.

Post-graduate studies

Close relationship with IPICS has tremendously developed the scientific research capability at Dhaka both by transfer of knowledge and infrastructure development. Equally important, if not more, development has taken place in the creation of an atmosphere of research at Dhaka where higher studies by research was hardly present. The culture of science and research has been rooted first at DU and recently at BIRDEM. Earlier, one or two MPhil or PhD were being produced at DU where the candidates were either a senior member of staff of DU or other research organization who could not manage to go abroad for higher degree. Induction of fresh graduates for higher study and research leading to PhD was practically non-existent.

The development of research culture leading to higher degree started with the enrolment of Nizamuddin for PhD quickly followed by that of Nilufar and Shajhahan. They were followed by Tofail, all of them being staff members but relatively junior. Introduction of fresh graduates receiving there MSc from DU started with Mizan followed by Mahbub, Mamun and Rabin, whose successful completion of PhD by course work and research, comparable to international standard, established a tradition at DU for going for higher studies at home

right after graduation. IPICS has directly supported all the candidates mentioned by giving them fellowship at home and abroad and creating facilities at the home laboratory. Following the tradition, fresh graduates are registering for higher degrees regularly and presently there are eight candidates at different stages of their MPhil and PhD work. This positive trend has spread to other fields in the chemistry department and also to other departments in the University of Dhaka and beyond.

During the last few years similar development of research atmosphere has been generated at BIRDEM through the IPICS support. Earlier, physician postgraduate researchers would get their MPhil, MD or Diploma in Diabetes, Endocrinology and Metabolism (DEM) by course work and working on a chosen clinical subject. The influence of scientists working in the IPICS projects and the culture of deeper scientific research created at BIRDEM Research Division have attracted fresh regular postgraduate workers not only from BIRDEM and BSMMU (Bangabandhu Sheikh Mujib Medical University) with medical background but also from DU and other universities with science (Chemistry, Biochemistry, Pharmacy etc.) background involving collaborative work.

The Department of Chemistry, University of Dhaka has been benefitted tremendously having a number of modern and sophisticated equipment, valuable glassware and huge amounts of organic solvents by direct contribution of IPICS. A full-fledged research laboratory of the Organic Branch of the Department attracts brilliant students every year to work in the MSc programme. As the Group has strong regional and international collaboration fresh and young scientists are being interested and enrolled for MPhil and PhD programme almost every year.

The Tutors' Opinions – Inquiry Results

By Torsten Lindqvist

In the early 1960s the International Seminar contact with a university in a developing country began with a young scientist visiting a host laboratory in Uppsala or elsewhere in Sweden during one academic year for research experience. This first contact could in some cases, but not all, be the beginning of a long-term cooperation between the host laboratory and the home institute of the visiting scientist. Today the ISP is actively stimulating the building up of viable research teams in developing countries and members of these teams are invited to partake of research periods in Swedish host laboratories. In both cases personalities from different cultures meet each other, and work together both in the country of the host laboratory and in the actual developing country. This cooperation has certainly had an impact on the host laboratories and upon their personnel. The outcome of the cooperation will of course depend on many factors, not least on personal relations. The ISP is constantly monitoring the progress of its projects in order, among other things, to level out to some extent the differences mentioned.

Hundreds of tutors from research cooperating groups have been engaged in the ISP activities during its 40 years of existence. Their experiences are naturally of utmost importance to the ISP but they have never been investigated in a systematic way. Therefore a group of tutors were approached recently with a number of questions in order to find out what impact the ISP activities have had on themselves and on their research groups. The tutors were also asked to briefly describe to what extent a personal contact with the group in the developing country was kept. Advantages and disadvantages of being an ISP tutor is of course an indication of the impact that the activity has had. Suggestions as to improvements may also be of interest to investigate.

A form with 7 questions was distributed to a group of tutors from both the physics and the chemistry programme. Answers came back from about 50 tutors. They represent the experiences of more than 300 participants.

Below are the questions, along with a summary of the responses:

Q 1. For how long after the participant's return to his/her home institute did you stay in contact with him/her?

The answers revealed that the majority of tutors stayed in contact with the participants continuously after the return to the home country. That means that

in some cases contact has lasted more than 30 years. The sandwich model of degree studies has of course made it natural to stay in contact for many years. During the last 20 years the tutors have been given the possibility of visiting the participants in their home institutes, which certainly has increased the length of contact time.

Q 2. Did you at any time visit the home institute of the participant? If so, for how long time?

Only six of the tutors had not visited the home institute of the participant. The majority had made several visits of one or two weeks' length. Quite a few tutors stayed for 1–3 months.

Q 3. What has been the advantage (if any) of having an ISP participant in your research group?

These answers are quite interesting and reveal to some extent the tutor's attitude towards the ISP activity. The majority look upon the presence of a participant from the third world as a possibility of contributing to the development of the participant's home institute/country, which is considered an advantage. There are, however, quite a few tutors who look upon the fellow as another assistant, which increases the working capacity of the laboratory. All tutors acknowledged certain advantages in having a participant in the research group.

A variety of "advantages" was given. A common opinion was that the cultural exchange was of great value to the whole research group. As a result, the group members started to be aware of the conditions under which most humans live. The feeling of helping a developing country was also considered as an advantage. The fact that the young visiting scientist contributes to the research work in the host laboratory was pointed out. This has nothing to do with "exploiting" the participants. The more useful a participant is the more he can learn during the relatively short visit.

Q 4. What has been the disadvantage (if any) of being an ISP tutor?

The majority did not see any real disadvantages whatsoever. Some did see minor disadvantages, mainly the fact that it takes more time to instruct a Seminar participant compared to a regular Swedish student. However, most tutors found the extra time they spent on participants "rewarding". The participants' ambition and eagerness to learn were also acknowledged by most tutors. Naturally there are cases when the personal relation between tutor and participant has not worked but that is indeed the exception.

Q 5. How would you, with your experience as an ISP tutor, describe the ISP activities to a colleague who is not familiar with ISP?

This question was put forward in order to find out what tutors in general found most important out of the ISP activities. The answers to this question are very congruent in their meaning but they differ in word choice. It was pointed out

Figure 26. Two cultures meet. (Photo International Seminar)

that the most important aspect of the ISP activity was that the support was directed to research groups and not primarily to individuals, as it is in many other fellowship programmes. ISP acts like a "lubricant" between foreign institutes and Swedish units.

Q 6. Do you have any suggestions as to changing the ISP activities?

Again the answers are quite congruent, i.e. no changes are needed. On the contrary, most answers contain an appraisal of the ISP activity. Some answers include, however, possible improvements and changes of priority. Naturally many tutors would like to get more money for follow-up support. Two tutors stressed the need for a stronger recognition of the ISP activities within the Swedish universities. In one case it was pointed out that the sandwich model for PhD work naturally takes longer time than the stipulated 5 years. Another tutor was criticized by a faculty dean for having only two registered graduate students, which was considered to be too low of research activity.What was not noted was that the tutor also had four ISP graduate students. Generally it was suggested that the universities should show a higher degree of commitment (a contract with the university) so that the ISP activities became part of the regular activities of the university.

The success of the ISP has of course inspired several tutors to suggest that

this type of programme should be extended to other major fields in science, e.g. mathematics and biology. It is interesting to note that this suggestion will be implemented in the near future as Sida/SAREC has decided to start a mathematics programme in Africa south of the Sahara.

Q 7. Any other comment?

For the most part, no comments were given.

SUMMARY

The general impression from all responses is that the ISP activity changed the atmosphere in all laboratories that are engaged in the projects. It is not only scientists that are engaged in the contact with the visitors from the developing countries but also technical and administrative personnel of the host laboratory. That means that knowledge of foreign cultures is spread into many Swedish homes, which is another positive result of the ISP activity. Many social contacts outside the specific scientific contacts have been created over the 40 years.

Those scientists and technicians that travel to developing countries are of course not only giving but also taking back experiences of e.g. how problems are solved in other countries, an experience that in many cases can be applied in Sweden. The international atmosphere that has developed in the engaged laboratories thanks to the ISP activities is of great value to the Swedish scientists and universities.

Today and Tomorrow

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What is the situation for science in the countries and regions where we are operating? Is there a need for an ISP in the future? Unfortunately, the answer to the second question is still a yes. During the last 40 years, there have undoubtedly been many positive changes for science in developing countries, but in terms of the less developed countries that we focus on, the need for support from the outside is still very high. As an example, one can examine the situation for physics in Eastern and Southern Africa. Moving from Sudan down to Swaziland, Lesotho, Namibia and Angola but not including South Africa (16 countries and about 244 million people), there are less than 80 research teams doing research related to physics and there is not more than 1 PhD per 2 million people engaged in such research. The situation is about the same for university faculty of science based research in the other basic sciences, i.e. biology, chemistry and mathematics. The local investment is less than 0.1% of the GNP in general. We must, however, remember that even if these countries invest as much as 1% of their GNP in science, the actual amount of money will be so small that outside support will continue to be vital. The situation for science is thus very critical and most countries are in a capacity building phase. However, even in these difficult circumstances, we clearly see the formation of very good research teams taking on regional responsibilities and thus slowly decreasing dependence on the industrialized countries in the north. This is most rewarding.

The situation is somewhat different regarding Asia and Latin America. Here we find many more countries with a rather well developed base while at the same time there are others where science is very weak. Let us recall that the first PhD in physics from a university in Peru got his degree through a sandwich programme with us in 1990. Since then, five more have graduated. All of them have received their degrees from Univ. Nac. de Ingeniería (UNI) in Lima, which is still the only university in Peru with a PhD programme in physics. In Ecuador, the first PhD degree in physics was given by Escuela Politécnica Nacional in 1999, with the second degree occurring in 2001, also through sandwich programmes with us. Economic recession has also hurt science in some countries very hard.

Science in Asia is in many cases in a very interesting development phase,

with comparatively heavy investments in some countries. Others are still in a capacity building phase, such as for example Sri Lanka, where research in physics started almost from scratch in the beginning of the 1980s through the assistance from the ISP at University of Colombo and University of Peradeniya. The first PhD received his degree in 1991 from University of Peradeniya followed by the second, who got his degree from University of Colombo in 1992. Since then 17 more PhDs have graduated, 11 from University of Peradeniya and 6 from University of Colombo. In comparison to Africa, we see more local investments in Latin America and in Asia, which means that it is easier for us to phase out projects once the groups have reached a certain standard.

The Need for Support

Thus, the need for outside support of science is still very high. This support could and should be given in many different ways. There is a need for different opportunities to apply for and to get research grants, and we encourage the groups to ask for support from elsewhere. In recent years, block grants given to universities have become one option. Sida/SAREC supports a number of universities in that way. The administration of these grants should, to the extent it is possible, be handled by the universities themselves, but a Swedish coordinator is also needed, and in some cases we are involved in the administration of such grants. This is a development that most probably will increase in importance and which to some extent can be compared to the "faculty supported" research at Swedish universities. We are definitely interested in taking part in such activities. Other examples of support in the natural sciences are grants, mainly in the life sciences, given to young scientists by the International Foundation for Science (IFS), the activities in Trieste, Italy, by the Abdus Salam Centre for Theoretical Physics (ICTP) and Third World Academy of Sciences (TWAS) and the support given by the International Atomic Energy Agency (IAEA) in research fields related to nuclear sciences (in a very broad sense). However, the support to the basic sciences as a whole has been rather small. In fact it has been mainly the Nordic countries who have shown some interest, with SAREC as the main donor. The support from the Italian Government to the Trieste activities is also worth noting. In Eastern and Southern Africa, out of 64 cases of support given to physics research, we contribute in about 40% of the cases, SAREC directly in about 16% and ICTP and IAEA in about 8% respectively.

The present ISP programme – Something to build on

Possible future developments of the ISP are of course dependent on past and present activities. Therefore we want to give a short summary of experiences

which have been gained from the 40 years of existence. We believe that this could be of general interest and maybe form the basis of continued development and improvement of our programme.

Why a university organization?

The ISP is a special unit within the Faculty of Science and Technology at Uppsala University. To us it is natural that a university engages itself in this type of activity and in the introduction, the Vice Chancellor of Uppsala University has already discussed this to some extent. There are many universities engaged in cooperation with developing countries in different ways, but in terms of support to "Basic Sciences", we do not know of any similar organization. One reason could be that universities have difficulties in finding funding agencies to support this type of activity. To us there are obvious advantages in having a university organization directly engaged in and administrating the support to the strengthening of science in developing countries.

Capacity building

One strong argument is the fact that we are mainly engaged in capacity building, which automatically implies cooperation with universities. To be a part of a university and of the scientific community as such will facilitate such cooperation and imply very direct communication on common grounds. This will also imply partnership, since partnership has always been a natural ingredient in university cooperation once such cooperation has been established.

Respond to incoming requests

In the initial phase, we play an important role as an initiator of cooperation responding to the requests forwarded from the developing countries and identifying the most suitable cooperation partners. We should remember that cooperation between Swedish research teams and research teams in developing countries may be natural within fields like natural products chemistry and tropical medicine but not as natural within physics and parts of chemistry.

Long-term cooperation – linking

Another important role is to be a steady link sustaining the long-term cooperation. That is a must. An active support system spanning many years, not only focusing on training, but on building up a local infrastructure for science, can hardly be handled by individual research teams in an efficient way. This is moreover so since it is more and more obvious that support based on the demands from developing countries themselves should involve not only one cooperation partner but several, while at the same time maintaining cohesion.

Good background information

It is essential to have as good of background information as possible about the situation of science in the respective countries and the regions. We pay a lot of

attention to acquiring such information, and together with the other ingredients listed above, this implies a good platform for meaningful cooperation in strengthening the infrastructure for science in developing countries. We are thus one member of the dialogue needed in order to build up research cooperation and which is a must for a long-term programme to function. We not only administrate, we participate. This is a good starting point for future developments.

The ISP programme

Long-term support – strengthening of local infrastructure

We focus on the building up of viable research teams through long-term support and "tailor-made" assistance to strengthen the local environment with equipment, consumables, spares, training, etc. Training in itself is important but not enough. The research fields should be chosen by the countries themselves and they must be in line with university/institutional plans. The support is thus not individually oriented. However, the identification of key people around whom it is possible to build a sustainable research activity is very important and one of the key elements in the programme.

Low brain drain

Over the years more than 1,200 people have been trained within our programmes. The brain drain is very small. In the first evaluation of the ISP (then the International Seminar in Physics and Chemistry) the brain drain was estimated at less than 4%. The figure is about the same today, mainly due to two reasons: as short fellowship periods as possible and a focus on the strengthening of the local infrastructure. People must have something to return to and from the beginning they should be aware of why they participate in the programme. This makes them motivated.

Most suitable cooperation partners – regional resource groups – networks

The programme is dependent on finding suitable cooperation partners. In order to function in the way outlined above, such partners must also be found outside what Uppsala University can offer. To have that possibility is very important in order to meet the requests from the developing countries on their conditions. Further, training should be provided not only to scientists and MSc and PhD students, but also to technicians. We are thus making use of research facilities not only in Sweden as such but also in other European countries as well as in the regions. Cooperation partners should be chosen according to what is most suitable with respect to what the supported group wants to achieve.

The regional part has steadily grown in importance and is a very efficient way of strengthening science with a definite ownership in the countries themselves. Stronger groups in the regions function as resource groups and if successful, an ISP supported group can also develop into what we call a regional resource group taking regional responsibilities regarding MSc and PhD pro-

grammes. Support is also given to networks where an ISP group serves as the node for the cooperation. This aims at making efficient use of complementary equipment and knowledge.

Sandwich MSc and PhD programmes

It is very difficult to quantify the success of support towards the building up of science. In capacity building it is not the immediate research results that are most important, but the creation of a scientific culture and the building up of a scientific community that can serve the surrounding society where they live. One example of this is the assistance to create viable MSc and PhD programmes, which is automatically built into the project support. Students on such programmes with us do their work on a sandwich basis with the degree given by the home university if possible. As much as possible of the research work should be made in the home laboratory. During the last five years, 1996–2000, a total of 125 PhD theses and 354 MSc theses have been produced within the ISP supported projects. Another measure of quality of research, but of course with limitations, is the possibility of publishing in internationally refereed journals. It can be noticed, that during the same five year period, 1996–2000, the approximately 45 supported groups had 75 to 117 publications per year in such journals.

Weak environments

Some people still claim that there are parts of the world where it is rather meaningless to support science. We do not agree with such statements. On the contrary, our activities have shown that it is possible to build up good science in very weak environments. We do not believe in a scenario where the only science produced is in industrialized countries and that developing countries should be left to make use of data banks, maybe at a considerable cost. The science may be limited in size but it must be there.

Ownership

The question of ownership has been in focus for at least the last few years. A starting point for our programme has always been the situation in the respective countries. Projects should be designed as much as possible according to how the cooperation partners envision them. Ownership should be in the developing countries themselves. This means by necessity that we must be flexible in our operations. Further, there must be the aim to transfer as much as possible of the responsibilities to the developing countries. One such activity involves the regional cooperation in the form of networks and the building up of resource groups. Most such activities are already entirely administrated locally.

Internet

Internet implies access to scientific information in the form of literature and scientific data bases. It also implies access to more detailed information about

individual research teams as possible cooperation partners. To provide databases with such information is extremely important. Internet will thus introduce many changes in the way we operate, but it will never replace the need for direct personal contacts and interactions.

We also hope that through the introduction of the Internet the possibilities of local purchases of equipment and consumables will be increased. However, many such matters are still handled by us. This is due to other constraints like the unwillingness by foreign companies to deal with, for example, small quantities of chemicals or in providing even quotations on equipment. Another reason could be inflation, which quickly "eats up the money" if dollar accounts are impossible to handle. Over the time, however, our role in procurement should be more and more as a "sounding board".

An expansion of the ISP programme

We strongly believe in the role of education in development processes. Higher education can in this respect not be neglected and every country should have a certain base for science. In countries where such a base is missing, capacity building must be focused upon. The strengthening of the basic sciences – biology, chemistry, mathematics and physics – is thus very important. Without a certain base to stand on it is hardly possible to attempt to develop applied sciences of more direct importance. We do not underestimate the importance of interdisciplinary research, but as stated by the Swedish research council "Forskningsrådsnämnden", FRN, a few years back: "there is no strong interdisciplinary research without strong disciplines".

The following four points further underline these views.

- It is a fact that, even if results of research from an individual country only constitute a minor part of the total amount of outcome in the world, academic research activity is of vital importance for carrying out education at an acceptable level. This is obvious with respect to MSc and PhD programmes, but is equally important regarding undergraduate education and degree projects at that level.
- Research activity is needed to gain admission and access to research being pursued outside the country in question.
- Only a small part of the research carried out today is of any direct relevance to developing countries. This circumstance can be changed only by the developing countries themselves, by proposing, setting up, participating in and as much as possible performing such research. Without recognized and competent domestic scientists, this is not possible. This in turn requires a certain level of domestic educational potential.
- The possibility of using available results of scientific research or technological developmental work presupposes people exist with the knowledge to

exploit this information. Transfer of knowledge and technology from abroad is not possible without people to locate, understand, select and judge the information and to transfer this information into practical use.

Application to SAREC on an expanded programme

Along these lines, the Vice Chancellor of Uppsala University, in an application to Sida/SAREC of 8 April 1999, requested funds for the period of 2000–2002 that should make it possible to operate an expanded programme (described and motivated in detail in the application). The application requested expanding the activities to also include biology, geosciences and mathematics as individual programmes, headed by specialists in the respective fields as well as strengthening the ongoing programmes in chemistry and physics. This would make it possible to cover all four basic sciences – biology, chemistry, mathematics and physics – as well as the geosciences, which is normally one field within a Faculty of Science. The arguments for the new programmes were based on the fact that, according to our view, there is also a great need to strengthen *university based research* in biology, the geosciences and mathematics. Before Sida/SAREC could decide future support, an assessment of the application was required. The assessment was carried out by Prof. David Wield, Center for Technology Strategy, The Open University, Milton Keynes, UK, and was delivered in September 2000.

In general, the assessment was positive to our proposals. It ended with five key recommendations:

- To continue and slowly expand the present programme in physics and chemistry, including areas which interface with biology and the geosciences, but not to begin separate programmes in biology and the geosciences.
- To begin planning for a programme in mathematics.
- To include stronger stakeholder ownership, particularly of developing country universities in Africa.
- To respond to the gradual strengthening of African universities by decentralisation and building capacity to enable decentralisation.
- To create stronger formal decision-making relations with developing country universities and scientists by adding to the board, and setting up north-south proposal evaluation and monitoring panels.

At the SAREC Research Committee meeting on 14 December 2000, a decision was taken, awarding the ISP 23 MSEK for 2001 and 23,5 MSEK for 2002. In an appendix to the contract for 2001 and 2002, SAREC includes the following:

– The programme in mathematics should begin by arranging a workshop somewhere in Africa south of the Sahara. Programme funding for 2002 will be agreed upon after a detailed presentation of activities and achieved results for 2001.
– SAREC does not want to see the present activities expanded to include the fields of biology and the geosciences. Instead, SAREC wants the programme to focus more on pure chemistry and physics.
– The ownership of the projects should be strengthened further by having senior scientists from developing countries more involved in the planning and evaluation of projects.
– ISP should discuss its role and future strategy in relation to the "great variety of programmes and activities related to research and education for developing countries in Sweden as well as outside".

The immediate future

Application assessment

The assessment recommended a slow expansion of the present activities in physics and chemistry to include more biology and geosciences. In our view this is not a good solution. Nor did SAREC support this particular recommendation. One of the key elements in our programme is the fact that the directors have a background in their respective fields, and according to our view, this should not be changed. Therefore, it is important that the new programme in mathematics is handled by a mathematician and that possible new programmes in biology and the geosciences are handled by a biologist and a geoscientist, respectively.

Thus, the mathematics programme begins by arranging a workshop for mathematics in "Africa south of the Sahara". This workshop will aim at presenting the present status of mathematics in that region, but above all will give guidelines on how mathematics should be supported in the most efficient way. This is a useful approach, since mathematics is quite different from experimental fields like physics and chemistry. It is also one way of avoiding an accusation of being "donor driven". The interest from the mathematics community in the region is very high and more than 50 institutions from 30 countries have responded to our preliminary approach. The workshop is not organized by us alone, but in cooperation with already existing networks and other main activities for mathematics in Africa, as well as ICTP and TWAS in Trieste, Italy. The workshop is planned to take part in Tanzania in the end of November 2001. About 25 participants from other African countries are expected to participate. The activities are expected to start in 2002.

In order to have more representatives from developing countries be involved in decision-making, we will start by appointing one senior chemist and one senior physicist from each of the regions of Africa, Asia and Latin America as

members of the reference groups. They will travel together with the directors at least once a year to evaluate activities. They will also participate in the evaluation of applications on support and be available to the board for advice on ISP strategies etc. We have chosen this way to begin, because it implies direct involvement in our activities.

We will not receive any funding from Sida/SAREC for biology and the geosciences in the immediate future. The evaluation admits that we have a strong case, and we still believe in the need for intensified support of university-based research in biology and the geosciences. This support is a must if the universities are to produce the local scientists needed to design and conduct the applied research of more immediate importance to developing countries. We further believe that if such a possibility was to be given to us, it would be easier, with time, to participate in the building up of strong interdisciplinary research. Our structure is well suited to such experimental fields and the possibility would be a complement to the present university support from Sida/SAREC. Therefore, we will look for other funding possibilities, especially in the case of biology.

Participation in the SAREC based bilateral support

As pointed out above, the ISP is a unit within the Faculty of Science and Technology. There is an interest from the university that cooperation with developing countries within science and technology, officially agreed upon by the university, should be handled by us. The main advantages of such an arrangement are our available knowledge of the situation within science in developing countries, the broad network of contacts and the synergy effects in general. An example of such involvement is the participation in bilateral projects supported by SAREC. Support to the building up of the College of Science at Asmara University, Eritrea, is directed by a "shadow faculty" at Uppsala University, with the coordinator placed at the ISP. The recently initiated cooperation to build up Information and Communicaton Technology (ICT) at Makerere University, Uganda, is also handled in a similar way. Other examples include the bilateral projects handled by the programmes in physics and chemistry respectively. We have a definite interest in continuing to be involved in such activities. However, the involvement should imply participation, not only administration.

Projects financed outside SAREC support

Our aim is to concentrate the Sida/SAREC grants on supporting science in low-income countries. Projects in other countries will thus have to be financed in other ways. Thailand belongs to the latter category. For quite a few years, training of PhD students from Chulalongkorn University has been financed by grants from the Thai government. Recently, the Department of Physics, Chiang Mai University, also in Thailand, received governmental funds to strengthen the PhD programmes at the department. We are coordinating these

activities in Sweden. Another example of activities financed by developing countries themselves is the support from the Colombian research council, COLCIENCIAS, towards the covering of costs for fellowships in Sweden. We believe that such cooperation will increase in the future.

Further ahead

As indicated earlier, there are very few organizations supporting "Basic Sciences". We have been and should continue to be engaged in working towards changing this. During the last few years, there seems to be a slow change in attitude and at least the matter has been put on the agenda.

Millennium Science Initiative, MSI

One initiative, where we have taken part in the discussions, is the "Millennium Science Initiative (MSI)" supported by the "Science Institutes Group (SIG)" and the World Bank. According to the programme, the "MSI seeks to create and nurture world-class science and scientific talent through the identification, support and linkage of individual scientists, groups of scientists, and institutes. Primary goals of the MSI are to foster innovative research and applications of specific value to the host country or region, to prepare future generations of scientists and engineers, and to develop linkages with educational and research institutions, the private sector, and the world scientific community". The idea is that MSI will provide scientific guidance, while funding will largely be provided by World Bank soft loans. (SIG consists of "Institute of Pure and Applied Mathematics (IMPA)", Rio de Janeiro, Brazil, "Jawaharlal Nehru Centre for Advanced Scientific Research", Bangalore, India, Korea Institute for Advanced Study (KIAS), Seoul, Korea and The Institute for Advanced Study (IAS), Princeton, New Jersey, USA.)

So far projects have been initiated in Chile and Mexico and there have been several meetings related to Africa south of the Sahara. We have been actively involved in these discussions. Provided initiatives and ownership is given to the regional scientists and provided the support is centered on already existing activities, the initiative may have an impact.

European Community, EU

We also feel that the European Community, the EU, is giving too little attention to the role of "Basic Sciences" in the development. Therefore, Uppsala University, through the Vice Chancellor, has approached the EU to address these issues. The ISP was given as an example on how cooperations could be designed but of course emphasising that any new initiative must be designed according to the optimum manner of collaboration dependent on participating countries, regions and, of course, field of support. The approach is thus not a request for funding of the ISP but an attempt to initiate a debate concerning

these issues, hopefully including additional support from other European universities and research organizations.

ICTP, IFS, ISP and TWAS

The ICTP, IFS, ISP and TWAS already cooperate and try to make as efficient use as possible of the complementary programmes and activities. This will definitely continue and be further strengthened.

Another initiative to be undertaken by ICTP, IFS, ISP and TWAS is a joint approach to the donor community. The idea is to point out the need for support of the "Basic Sciences" in developing countries. Our methods are very complementary and it is our hope that some of the large donor organizations will show renewed interest in supporting our activities. In the past, the ISP has been supported by the Norwegian government, but unfortunately this support ended in connection with the last reorganization of the Norwegian aid programme. Despite a positive attitude from the Danish government we have not managed to attract any financial support from Denmark. The only possibility of Danish support is through direct applications from respective projects to DANIDA. Thus, without more support from SAREC, the only alternative for increased funding for ISP seems to be private foundations and a joint approach through the four organizations above is another option.

The four organizations, mentioned above, can also cooperate on other general and important issues regarding the strengthening of science in developing countries. We suggest support and stimulation in order to

– popularize science
– strengthen regional cooperation and planning for science
– strengthen maintenance of equipment
– improve on curricula
– strengthen the exchange between academic activities and society.

A strategic plan

A plan for the coming five years period is presently under preparation and will be discussed by the board in the near future. We believe we have a good platform to stand on, from which further developments can be achieved. We will of course make use of past and present cooperation partners in the developing countries, as well as "host groups" both in the north and in the respective regions, in order to obtain further input into such a plan.

The input from institutions and scientists in developing countries will be of a special value. It is their views on, for example, the role of the ISP, which will guide our future activities and our ways of working. We have also to address issues like whether or not we should continue to focus on basic sciences, and whether or not continue to work toward new programmes in biology and the

geosciences. A further improvement of the transfer of ownership towards developing countries is another important issue, as well as the issue of which countries and how many of them to concentrate on. How we should operate in countries where SAREC funding can not be justified, but where there is a Swedish interest for cooperation, and where the ISP fits well as an organization, is another matter for discussion, as well as the everlasting problem of funding.

The International Science Programme will also be needed in the future. This unfortunate state of affairs ensues from the currently increasing, not decreasing, difference in scientific output between developed and developing countries. Science is a very important component in a developmental process, but unfortunately many developing countries do not have the possibility of fully making use of this force. Furthermore, a number of growing problems will undoubtedly require science for their alleviation or solution. These problems include overpopulation in mega-cities, global environmental problems, global warming, an uneven availability of many natural resources including water, as well as health issues and epidemics connected with increasing temperatures and population concentration patterns. This list can be extended to a distressing length. Energy resources have always been critical in the Third World. Here, new energy technologies may offer some relief. Positive changes may also be facilitated by affordable information and communication technology.

Only joint efforts – embracing industrialised and developing countries alike – can make the manifold problems and challenges ahead of us less daunting and ensure that human beings can lead their lives with dignity. Every country must contribute. Science is an essential instrument for mobilizing the necessary human resources. The International Science Programme strives to accomplish this now – and is ready to continue to do so for years to come.

Appendices

1. Acronyms
2. Guests at the inauguration ceremony 1961
3. Evaluations at various periods of the programme
4. IPPS projects, networks and south-south cooperation in Africa year 2000
5. IPPS projects, networks and south-south cooperation in Asia year 2000
6. IPPS projects, networks and south-south cooperation in Latin America year 2000
7. IPICS projects, networks and south-south cooperation in Africa year 2000
8. IPICS projects and networks in Asia year 2000
9. IPICS projects and networks in Latin America year 2000
10. Board members 1960–2001
11. Staff members 1960–2001
12. ISP host/resource groups year 2000
13. Number of participants 1961–2001
14. Geographical distribution of participants

Explanations to the appendices 4–9 and 12–14

On the maps (App. 4–9) countries engaged in *regional or south-south cooperations* are connected with coloured lines according to the colour code to the left on each map. Countries engaged in *networks* are marked with a letter according to the explanation also to the left on each map. *Projects* are listed on each map with the administrative code for the project, the supported university and the research field of the project. A line points to the geographical position of the university in question.

The bars on the world map (App. 12) indicate the numbers of host/resource groups at various cities in the world. The numbers are also listed under the map.

App. 13 is a table showing the number of participants 1961–2001 from each country, separated in physics and chemistry. The world map in App. 14 is a summary of App. 13 giving the total number of participants from each country.

Acronyms

ALNAP	African Laboratory for Natural Products
ANRAP	Asian Network of Research on Antidiabetic Plants
ASOMPS	Asian Symposium on Medicinal Plants, Spices and other Natural Products
ASSIS	Asian Society for Solid State Ionics
BCSIR	Bangladesh Council of Scientific and Industrial Research
BIRDEM	Bangladesh Institute for Research and Rehabilitation on Diabetes, Endocrine, and Metabolic Disorders
BUET	Bangladesh University of Engineering and Technology
COLCIENCIAS	Instituto Colombiano Para el Desarollo de la Ciencia y la Tecnología
CTH	Chalmers University of Technology
CYTED	Iberoamerican Technical Cooperation for the Development of Science and Technology
EC	European Community
FIF	Families for International Friendship
FOSNA	Food Science Network for Africa
GC	Gas Chromatography
HEJ	Husein Ebrahim Jamal (Research Institute of Chemistry, Karachi)
HPLC	High Performance Liquid Chromatography
IAEA	International Atomic Energy Agency
ICT	Information and communication technology
ICTP	International Centre for Theoretical Physics
IFS	International Foundation for Science
IPICS	International Programme in the Chemical Sciences
IPPS	International Programme in the Physical Sciences
ISP	International Science Programme
IT	Information Technology
KI	Karolinska Institutet
KTH	Royal Institute of Technology
LAM	African Laser, Atomic, Molecular and Optical Sciences Network
LANBIO	Latin American Network for Research in Bioactive Natural Compounds
LANFOOD	Latin American Network for Food Research
MOLCAS	The Cassava Molecular Diversity Network
NABSA	Network for Analytical and Bioassay Services in Africa
NAPRECA	Natural Products Research Network for Eastern and Central Africa

NITUB	Network of Instrument Technical Personnel and User Scientists of Bangladesh
NORAD	Norwegian Agency for Development Cooperation
R&D	Research and Development
SARBIO	Southern African Regional Cooperation in Biochemistry, Molecular Biology and Biotechnology
SAREC	Department for Research Cooperation
SEM	Scanning Electron Microscopy
SIDA	Swedish Internatonal Development Authority
Sida	Swedish International Development Cooperation Agency
SLU	Swedish University of Agricultural Sciences
TEM	Transmission Electron Microscopy
TFNC	Tanzania Food and Nutrition Center
TWAS	Third World Academy of Sciences
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UU	Uppsala University
WHO	World Health Organization
WMO	World Meterological Organisation
XRF	X-ray fluorescence

Guests at the inauguration ceremony of the International Seminar for Research and Education in Physics 1 September 1961

Beckman, Olof	Professor of Solid State Physics
Beite, Ann-Marie	Fil.Mag., Teacher of the Swedish Course
Bengtsson, Arthur	Engineer, Uppsala University
Bergvall, Pär	University lecturer of Physics
Björling, Carl Olof	
Claesson, Stig	Professor of Physical Chemistry
Danielsson, Folke	Engineer, Wikforss Architect Co.
Fredga, Arne	Professor of Organic Chemistry
Gerholm, Tor Ragnar	Ass. Professor of Physics
Håstad, Disa	Student Union of Uppsala
Leijonhufvud, Inger	
Lindqvist, Torsten	Ass. Professor of Physics, Director of the Seminar
Nordling, Carl	Professor of Atomic Physics
Rylov, Arkadij	Deputy Director General, IAEA, Wien
Schönmeyer, Carl	Swedish Institute
Segerstedt, Torgny	Professor, Vice Chancellor of Uppsala University
Siegbahn, Kai	Professor, Head of Physics Department
Siegbahn, Manne	Professor, Nobel Laureate in Physics
Tallroth, Tore	Managing Director of the Swedish Institute
Tiselius, Arne	Professor, Nobel Laureate in Chemistry
Tove, Per-Arne	Professor of Electronics
Wallin, Nils Olov	Manager of Lundeqvistska Book Store
Wikforss, Gösta	Architect
Åberg, Eric	Construction Manager

and the 15 fellows of the Seminar.

Evaluations of International Seminars / International Science Programme

1976/77
Committee appointed by SAREC:
Dr Göran Leide, School of Education, Malmö (secretary)
Dr Olle Edqvist, SAREC
Dr Ingvar Carlén, SIDA

The committee gave a report to SIDA in March 1977. The report is published by SIDA under the title "The International Seminars in Physics and Chemistry, Uppsala, Sweden 1961–1976. An evaluation report"

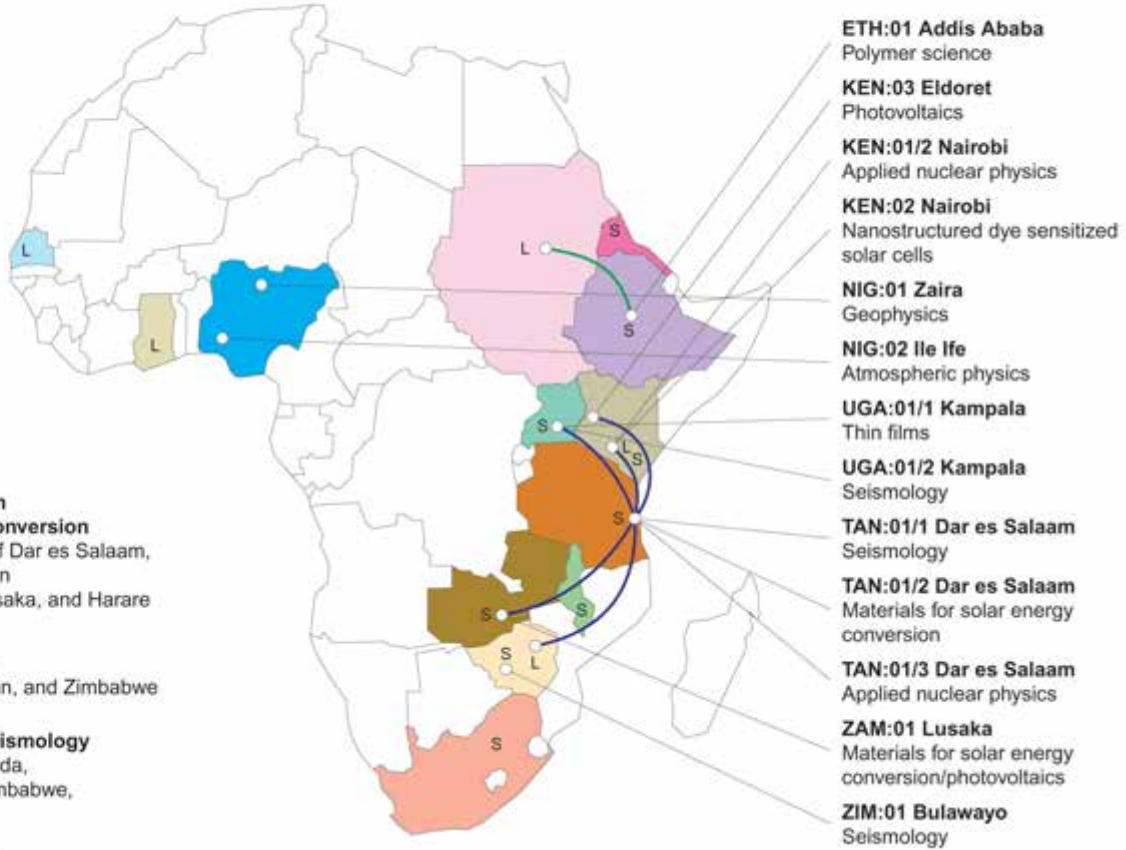
1985/86
SAREC initiated an evaluation of the Seminars 1985/86, which was carried out by Dr Lars Yngve Nilsson, Head, Development Cooperation Unit, Royal Institute of Technology, Stockholm. The final report was presented in August 1986.

1992/93
Committee appointed by SAREC:
Dr Olle Edqvist, SAREC (coordinator)
Dr Berhanu Abegaz, Department of Chemistry, Addis Ababa University, Ethiopia
Dr Barry Noller, Department of Mines & Energy, Darwin, Australia
Prof Lee Singh. School of Science, Nanyang Technological University, Singapore

The report is published by SAREC under the title "The International Science Programs of Uppsala University. Evaluation Report. Olle Edqvist, Berhanu Abegaz, Lee Singh, Barry Noller. Stockholm, 1993-02-28"

IPPS projects, networks and south-south co-operation in Africa

year 2000



Regional co-operation on polymer science
Addis Ababa, Karthoum

South-south co-operation on materials for solar energy conversion
Resource Center: University of Dar es Salaam, co-operation with universities in Nairobi, Eldoret, Kampala, Lusaka, and Harare

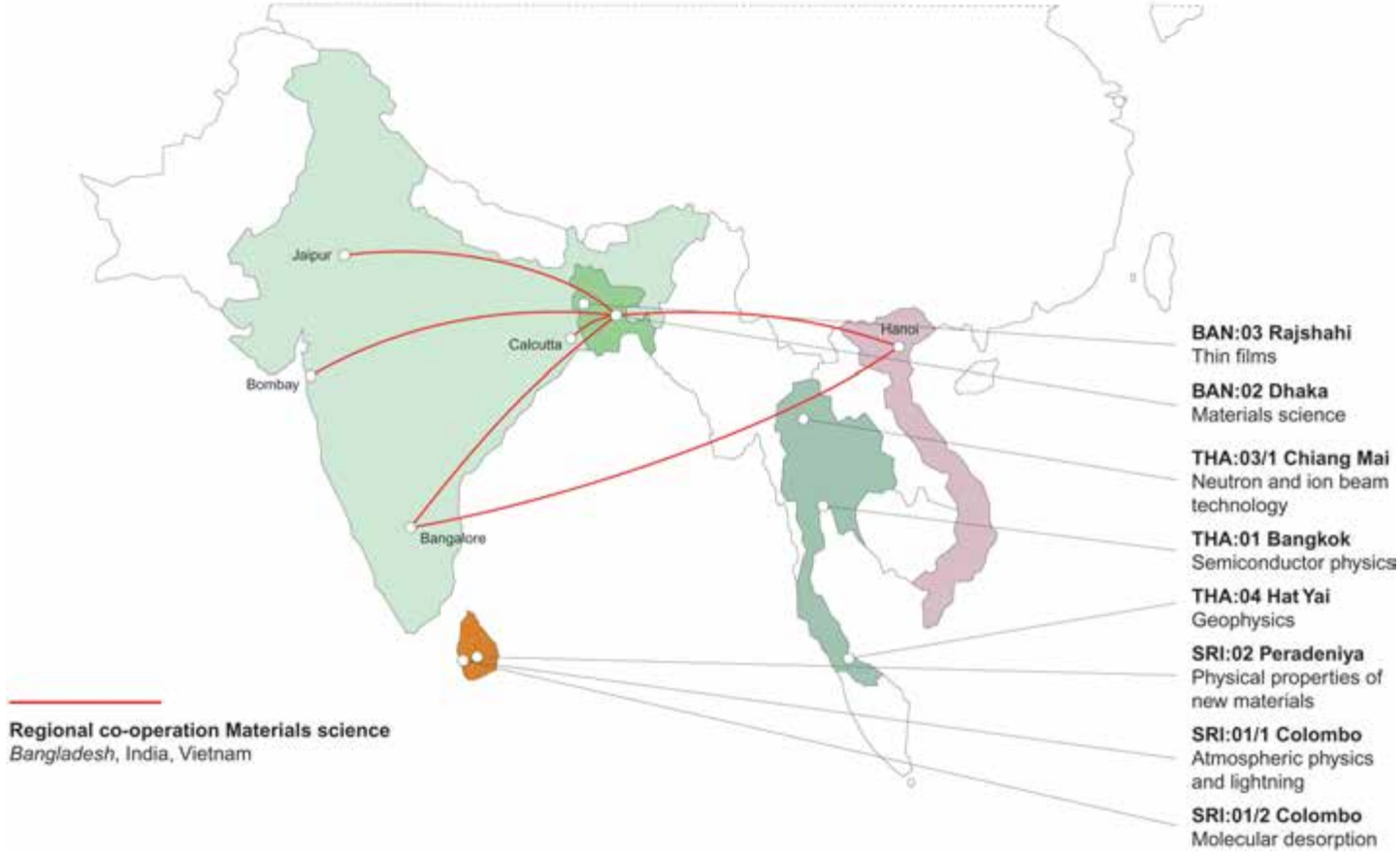
L Network on laser physics
Senegal, Ghana, Kenya, Sudan, and Zimbabwe

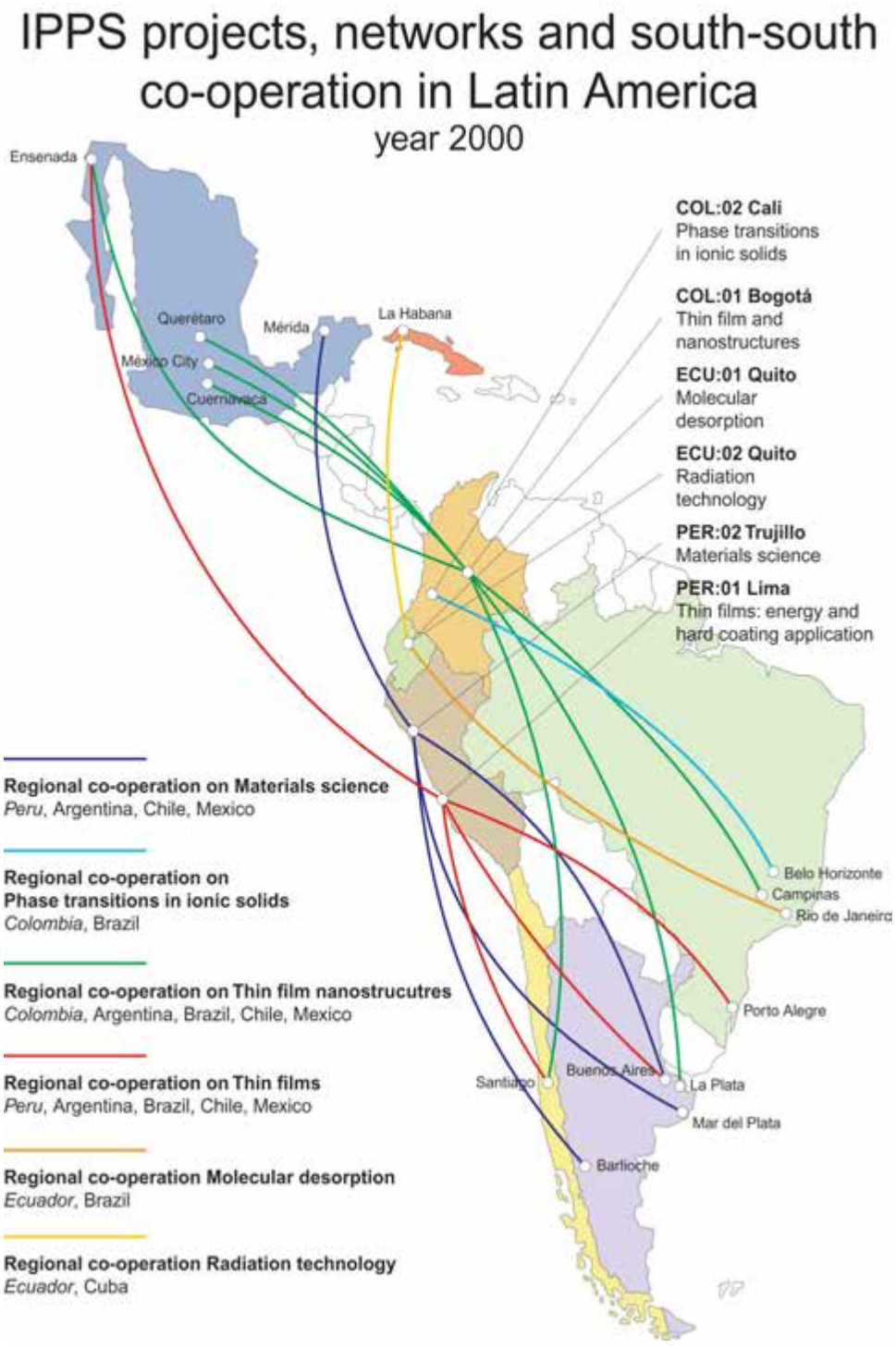
S ESARSWG Network on seismology
Eritrea, Ethiopia, Kenya, Uganda, Tanzania, Malawi, Zambia, Zimbabwe, and South Africa

International Science Programme
www.isp.uu.se

IPPS projects, networks and south-south co-operation in Asia

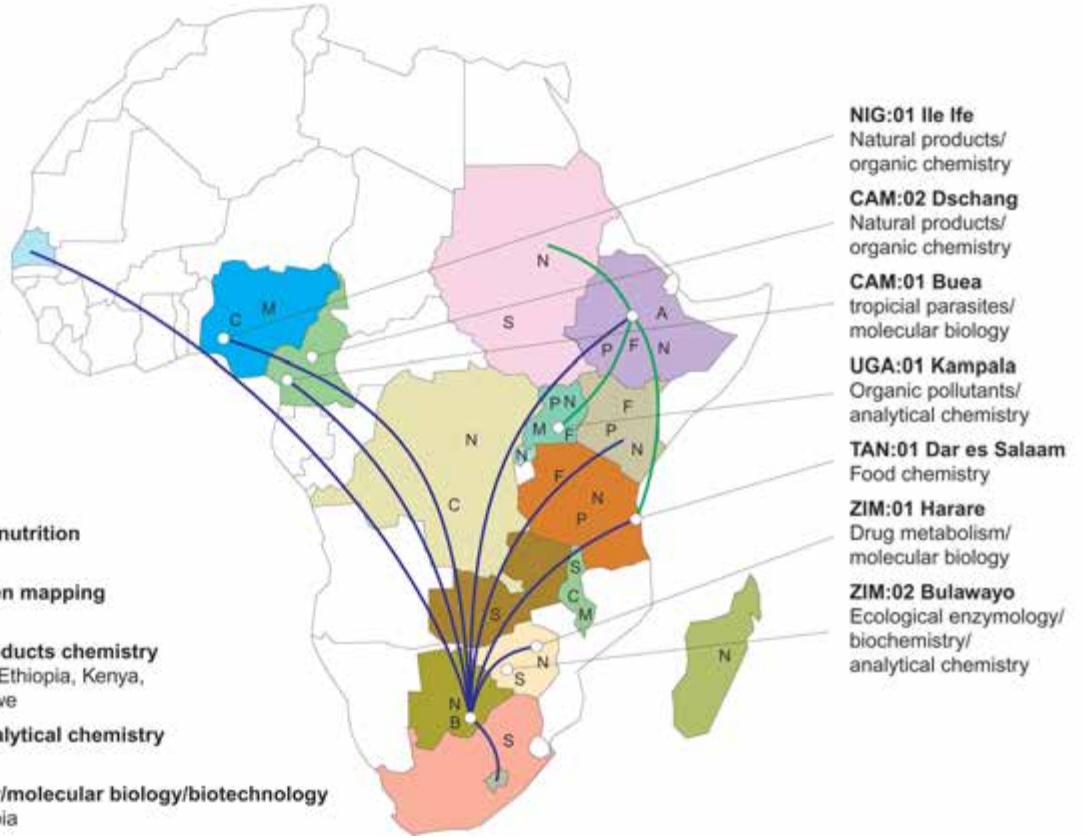
year 2000




IPPS projects, networks and south-south co-operation in Latin America
year 2000
Ensenada
Querétaro
Mérida
La Habana
México City
Cuernavaca
COL:02 Cali
Phase transitions in ionic solids
COL:01 Bogotá
Thin film and nanostructures
ECU:01 Quito
Molecular desorption
ECU:02 Quito
Radiation technology
PER:02 Trujillo
Materials science
PER:01 Lima
Thin films: energy and hard coating application
Regional co-operation on Materials science
Peru, Argentina, Chile, Mexico
Regional co-operation on Phase transitions in ionic solids
Colombia, Brazil
Regional co-operation on Thin film nanostrucutres
Colombia, Argentina, Brazil, Chile, Mexico
Regional co-operation on Thin films
Peru, Argentina, Brazil, Chile, Mexico
Regional co-operation Molecular desorption
Ecuador, Brazil
Regional co-operation Radiation technology
Ecuador, Cuba
Belo Horizonte
Campinas
Rio de Janeiro
Porto Alegre
Santiago
Buenos Aires
La Plata
Mar del Plata
Barlioche

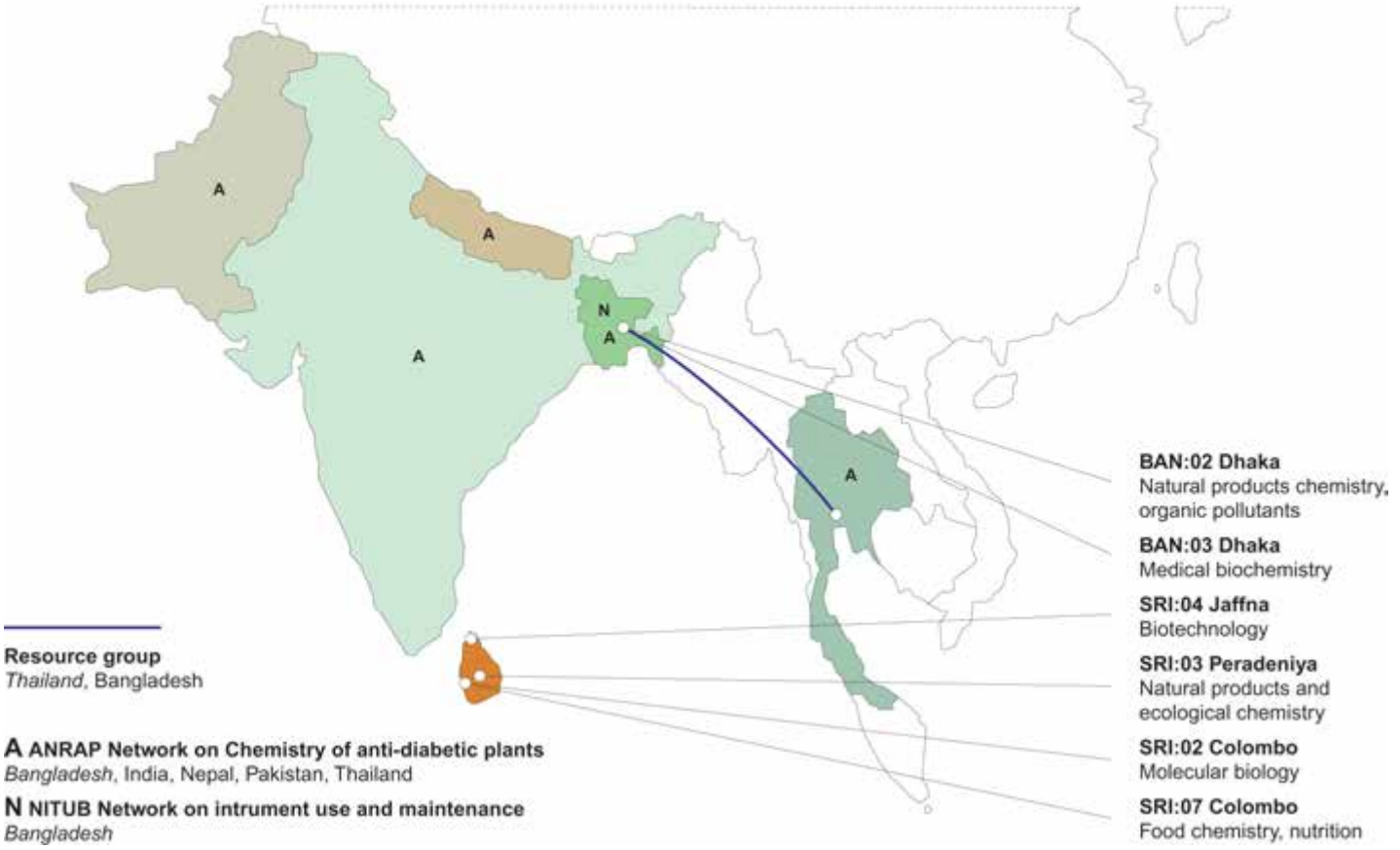
IPICS projects, networks and south-south co-operation in Africa

year 2000



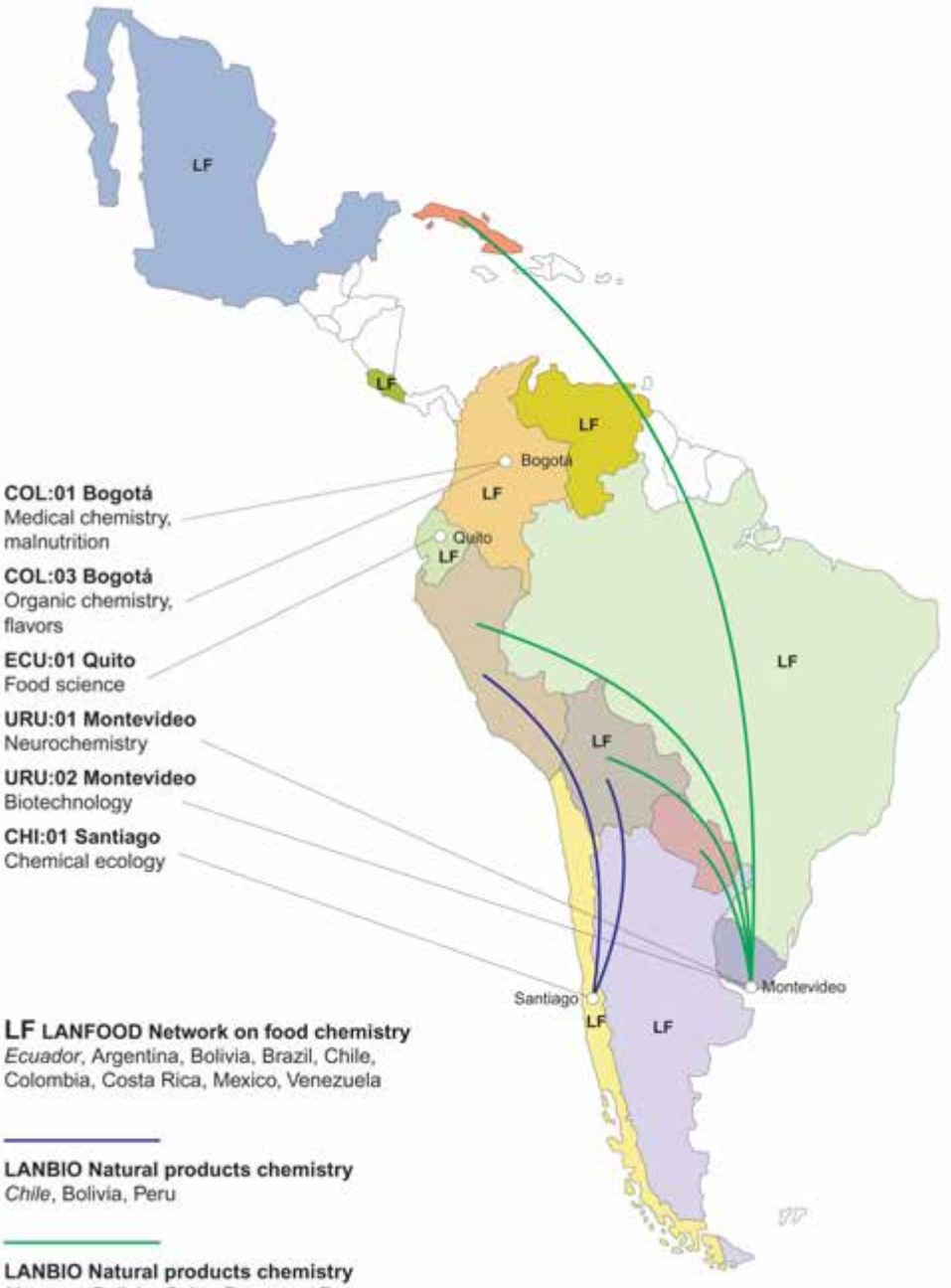
IPICS projects and networks in Asia

year 2000



IPICS projects and networks in Latin America

year 2000



Board Members

Chairman

1960–77	Torgny Segerstedt
1978–88	Martin H:son Holmdahl
1988–97	Stig Strömholm
1997–	Bo Sundqvist

Representing IAEA

1960–62	Arkadij N. Rylov
1963–64	G. Konstantinov
1965–66	Forest J. Remick
1967–68	Sidney Gaardner
1969–70	Rollin G. Taecker
1971–72	C.J. Roberts
1973–86	S.B. Hammond
1987–91	M.F. L'Annunziata
1992	Mohammad Ridwan
1993–97	Paul M.C. Baretto
1998–	H.S. Cherif

Representing UNESCO

1960	H. Roderick
1960–61	G. Hambreus
1961–62	Albert V. Baez
1963–67	Thérèse Grivet
1968–71	V. Parail
1972–87	A. Forti
1988–91	John V. Kingston
1992–93	V. Zharov

Representing Swedish Donors

1960–61	T. Tallroth, Swedish Institute
1960–61	S. Heppling, Central Committee for Technical Assistance
1962	A. Björnberg, NIB
1963–64	P.E. Rönnquist, NIB
1965	P. Lindeberg, SIDA
1966	B. Berggren, SIDA
1967–73	S. Ringensson, SIDA
1974	I. Karlén, SIDA
1975–76	G. Rosengardt, SIDA
1977	B. Östberg, SIDA
1978–84	O. Edqvist, SAREC
1985–87	L. Prage, SAREC

1988–91 M.R. Bhagavan, SAREC
1992 R. Carlman, SAREC
1993–98 L. Wohlgemuth, SAREC
1999– Afzal Sher, SAREC

Representing scientists of Uppsala University

1960–83 Kai Siegbahn
1960–71 Per Ohlin
1960–63 Tor Ragnar Gerholm
1972–98 Ivar Olovsson
1984–91 Kurt Johansson
1992 Sven Kullander
1992– Claes-Göran Granqvist
1995– Kurt Nordström
1998–2000 Lars Rask
2000– Jan-Otto Carlsson

Representing scientists of other universities

1988–91 Jan Nilsson
1988– Torbjörn Norin
1993–98 Lena Torell
1998– Maj Hanson

Representing the University Administration

1970–82 Gunnar Wijkman
1983–98 Johnny Andersson
1998– Ulla Myhrman

Representing Swedish Industry

1961–63 Halvard Liander, ASEA

Representing the developing countries

1994–97 Hermann M. Niemeyer, Chile
1998– Mohamed H.A. Hassan, TWAC

Representing the Student Union

1961 Terry Carlbom
1962 Bengt-Erik Rydén
1963 Sven Linder
2001– Ulrika Skarp

Working Group / Executive Committee (Only Chairman)

1989–95 Johnny Andersson
1995– Kurt Nordström

Staff Members

International Seminar in Physics / International Programme in the Physical Sciences

Director / acting director

1960–69	Torsten Lindqvist
1969–74	Olov Bergman
1974–78	Anders Marelius
1978–79	Olov Bergman
1979–80	Torsten Lindqvist
1980–82	Olov Bergman
1982–	Lennart Hasselgren

Assistant / Ass. director

1961–65	Lennart Boström
1965–67	Anders Marelius
1967–69	Kurt Spåhr
1969–71	Lars Hoel
1971–73	Anders Johansson
1973–75	Wolfgang Dietrich
1975–79	Lennart Hasselgren
1979–80	Reinhard Jadrny
1980–81	Lennart Hasselgren
1981–82	Lennart Hasselgren/Lars Nordborg
1982–84	Lars Nordborg
1984–86	Lars Nordborg/Arne Roos
1986–91	Lars Nordborg
1991–94	Garreth Bray
1994–95	Garreth Bray/Anders Hallén
1995–96	Anders Hallén/Jan Isidorsson
1996–99	Jan Isidorsson
1999–00	Jan Isidorsson/ Staffan Andersson
2001–	Johan Wennerberg

Secretary / Head of administration

1961–67	Karin Abrahamsson-Westman
1967–68	Margareta Sieverth
1968–	Åsa Bergengren

Secretaries / Adm. assistants

1971–	Mona Pettersson-Thorwaldsdotter
1976–81	Catharina Åsbjörk

1987– Pravina Gajjar
1997– Solveig Lindberg
1998– Hossein Aminaey

International Seminar in Chemistry / International Programme in the Chemical Sciences

Director / acting director

1970–71 Rune Liminga
1971–72 Rune Liminga/Åke Kvick
1972–75 Rune Liminga
1975–77 Rune Liminga/Kersti Hermansson
1977–78 Rune Liminga/Åke Kvick
1978–79 Rune Liminga/Kersti Hermansson
1979–83 Rune Liminga
1983–84 Rune Liminga/Kersti Hermansson
1984–97 Rune Liminga
1997– Malin Åkerblom

Assistant / Ass. director

1978–81 Anders Hårsta
1981–83 Markku Karppinen
1983–84 Markku Karppinen/Jan Strömbom
1984–87 Jan Strömbom
1987–88 Thomas Palo
1988–92 Ros-Mari Bålöw
1994– Linnea Sjöblom

Mathematics Programme

Coordinator

2001– Leif Abrahamsson

Asmara Committee

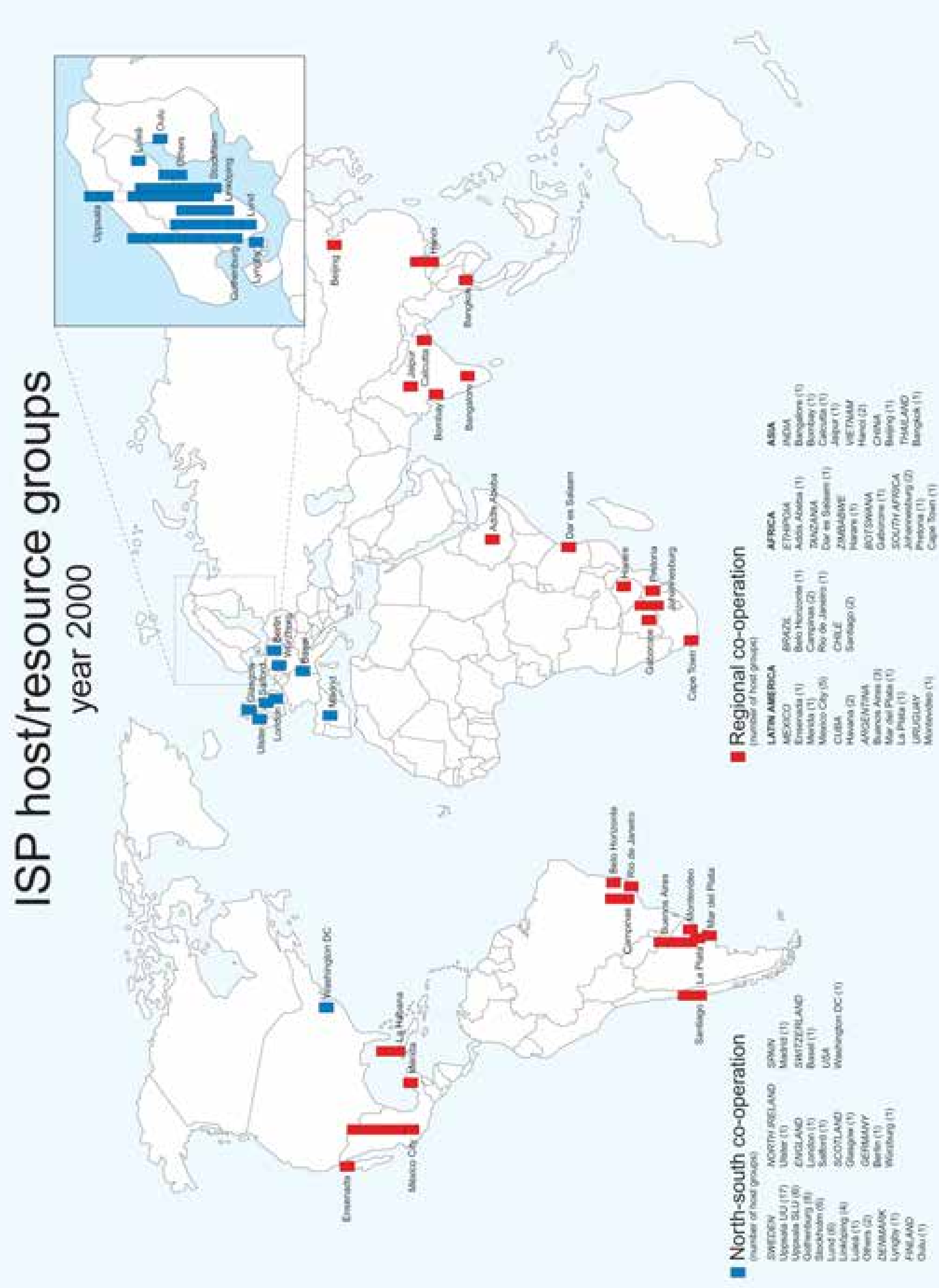
Executive secretary

1997– Staffan Wiktelius

Information and Communication Technology (ICT)

Project coordinator

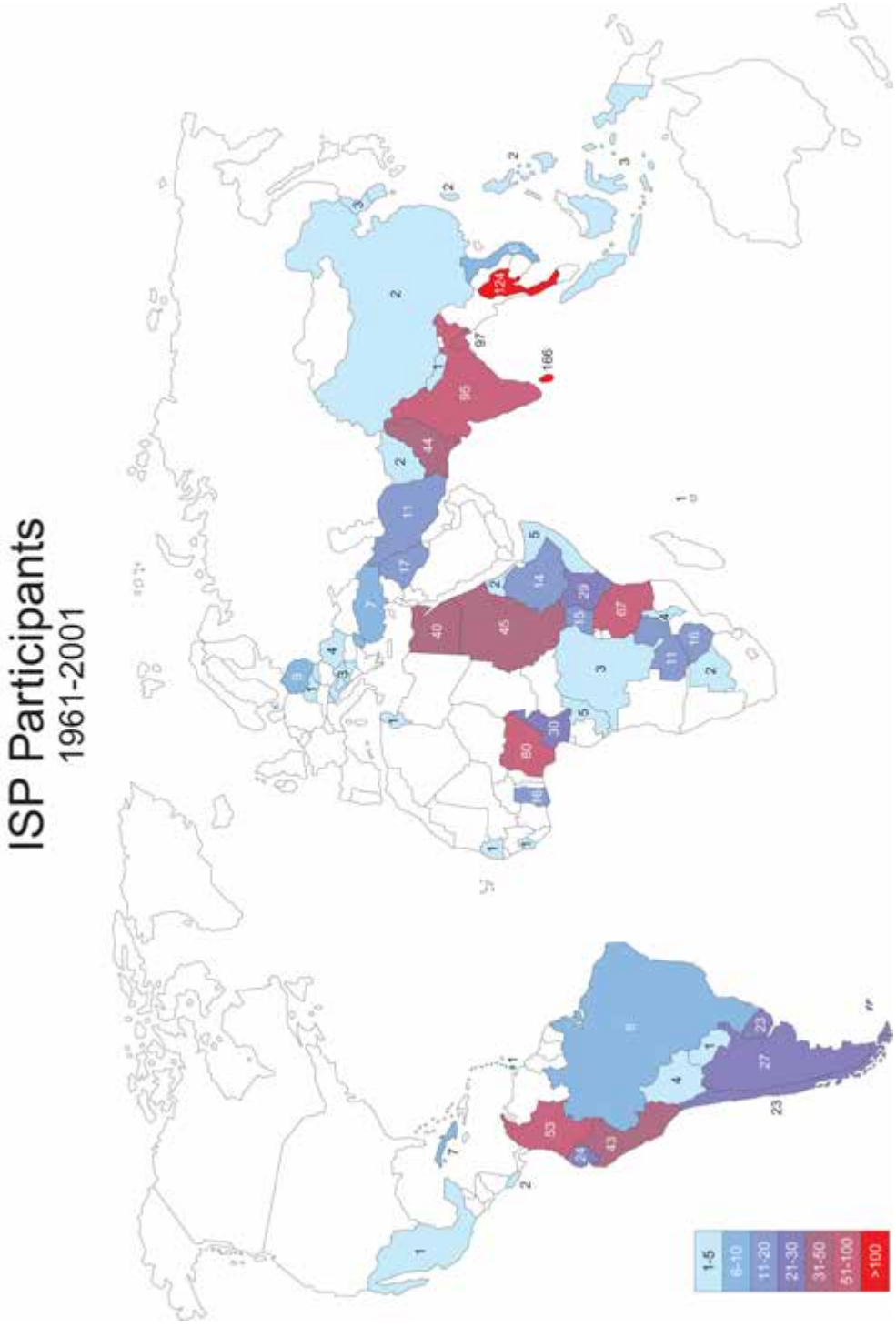
2001– Richard Wait


ISP host/resource groups
year 2000
Uppsala
Luleå
Oulu
Others
Stockholm
Gothenburg
Linköping
Lyngby
Lund
Ulster
Glasgow
Salford
London
Berlin
Würzburg
Basel
Madrid
Washington DC
Ensenada
Mexico City
Merida
La Habana
Belo Horizonte
Campinas
Rio de Janeiro
Buenos Aires
Montevideo
Santiago
La Plata
Mar del Plata
Addis Abeba
Dar es Salaam
Harare
Gaborone
Pretoria
Johannesburg
Cape Town
Beijing
Jaipur
Calcutta
Bombay
Bangalore
Hanoi
Bangkok
North-south co-operation
(number of host groups)
SWEDEN
Uppsala UU (17)
Uppsala SLU (6)
Gothenburg (8)
Stockholm (6)
Lund (6)
Linköping (4)
Luleå (1)
Others (2)
DENMARK
Lyngby (1)
FINLAND
Oulu (1)
NORTH IRELAND
Ulster (1)
ENGLAND
London (1)
Salford (1)
SCOTLAND
Glasgow (1)
GERMANY
Berlin (1)
Würzburg (1)
SPAIN
Madrid (1)
SWITZERLAND
Basel (1)
USA
Washington DC (1)
Regional co-operation
(number of host groups)
LATIN AMERICA
MEXICO
Ensenada (1)
Merida (1)
Mexico City (5)
CUBA
Havana (2)
ARGENTINA
Buenos Aires (3)
Mar del Plata (1)
La Plata (1)
URUGUAY
Montevideo (1)
BRAZIL
Belo Horizonte (1)
Campinas (2)
Rio de Janeiro (1)
CHILE
Santiago (2)
AFRICA
ETHIPOIA
Addis Abeba (1)
TANZANIA
Dar es Salaam (1)
ZIMBABWE
Harare (1)
BOTSWANA
Gaborone (1)
SOUTH AFRICA
Johannesburg (2)
Pretoria (1)
Cape Town (1)
ASIA
INDIA
Bangalore (1)
Bombay (1)
Calcutta (1)
Jaipur (1)
VIETNAM
Hanoi (2)
CHINA
Beijing (1)
THAILAND
Bangkok (1)

Number of participants 1961–2001

	Physics	Chem-istry	Total
AFRICA			
Botswana	0	2	2
Cameroon	1	29	30
Congo	0	5	5
Egypt	36	4	40
Eritrea	0	2	2
Ethiopia	13	1	14
Ghana	11	5	16
Kenya	20	9	29
Malawi	0	4	4
Mauritius	0	1	1
Nigeria	45	35	80
Senegal	1	0	1
S. Leone	1	0	1
Somalia	0	5	5
Sudan	26	19	45
Tanzania	35	32	67
Tunisia	0	1	1
Uganda	14	1	15
Zaire	0	3	3
Zambia	10	1	11
Zimbabwe	4	12	16
Sum AFRICA:	**217**	**171**	**388**
ASIA			
Afghanist.	1	1	2
Bangladesh	43	54	97
China	1	1	2
India	92	3	95
Indonesia	2	1	3
Iran	10	1	11
Iraq	6	11	17
Korea	3	0	3
Nepal	1	0	1
Pakistan	23	21	44
Philippin.	2	0	2
Sri Lanka	78	88	166
Taiwan	2	0	2
Thailand	87	37	124
Turkey	7	0	7
Vietnam	6	0	6
Sum ASIA:	**364**	**218**	**582**

	Physics	Chem-istry	Total
LATIN AMERICA			
Argentina	26	1	27
Bolivia	4	0	4
Brazil	7	1	8
Chile	12	11	23
Colombia	25	28	53
Costa Rica	2	0	2
Cuba	6	1	7
Ecuador	10	14	24
Mexico	1	0	1
Paraguay	1	0	1
Peru	40	3	43
Trinidad	1	0	1
Uruguay	0	23	23
Sum LATIN AMERICA:	**135**	**82**	**217**
EUROPE			
Czechoslov.	1	0	1
Poland	9	0	9
Romania	4	0	4
Yugoslavia	3	0	3
Sum EUROPE	**17**	**0**	**17**
Sum WORLD	**733**	**471**	**1204**


ISP Participants
1961-2001
1-5
6-10
11-20
21-30
31-50
51-100
>100