Section 2 Current Developments

Africa

AFRICAN STATES

The Science Education Project in Africa (SEPA) which began life as the African Primary Science Project (APSP) uses common materials from home and surroundings with which to teach. There are some thirty teachers' guides with titles like 'Chicks in the Classroom', 'Common Substances Around the Home' and 'Playground Equipment'. This latter is a delightful example of the use of cheap equipment on a large scale. Bamboo, rope, car tyres and other objects, are used to construct towers, slides, swings, roundabouts, large balances and a giant shadow calendar. As the book says: 'Without too much trouble and very little expense, teachers can make playground equipment which will fascinate and excite their pupils... they will be experiencing with their whole bodies some of the important laws of science'. See photographs 16, 17 and 18.

These materials were developed in the USAID programme by a large number of people in the countries of Ghana, Kenya, Nigeria, Sierra Leone, Tanzania and Uganda, with assistance from the Education Development Centre, Massachusetts (1).

(1) Science Education Project in Africa (SEPA) details of available materials from the Education Development Centre, Newton, Massachusetts, USA.

BOTSWANA, LESOTHO AND SWAZILAND

These three countries are concerned in the experimental teaching of a New Junior Certificate Integrated Science Scheme which has considerably involved in-service teacher training. The Francistown Teachers' Training College, Botswana, is an example of an approach to teacher training whereby the teachers actually construct apparatus themselves. (There is a similar approach in the Nigerian situation.) Most of the developments are based on the University of Botswana, Lesotho and Swaziland, but as yet no concentrated effort in apparatus production exists.

KENYA

The Production Unit of the Kenya Science Teachers' College has designed, and is currently producing, some equipment. This is how it describes itself:

> 'The unit is a non-profit making body run by the Production Board of KSTC. The workshops are equipped with the most modern metal and wood working machinery. It is capable of producing almost any teaching aid required by Kenyan Schools.
>
> 'One of the main projects of the unit is to produce scientific equipment to relieve one of the many problems facing Kenyan schools. A physics kit has been developed and is produced. In the near future chemistry and biology kits will be developed. The annual turnout is expected to be about 1,000 kits. This capacity can be increased if the demand grows.
>
> 'Learning by doing is the motto of the scientists today and the kit gives just that possibility without high costs.
>
> 'The kit also gives an excellent opportunity for the students to train their manipulative skills. Until recently very few students in the country really got an experimental background in science subjects. The kit gives the teacher the opportunity of teaching science experimentally. By spending just a small amount of money the student will be able to perform most of the basic experiments in physics.
>
> 'The kit, although small, can be used as a demonstration kit as well. A manual is supplied with the kit to guarantee a good layout of the experiments.'

There is a pupil's text accompanying this equipment, some of which can be seen in the Curriculum Information Service (Education Information and Research Department) of the British Council, 10 Spring Gardens, London S.W.1.

NIGERIA

Considerable activity in curriculum development is going on in Nigeria, and alongside it is equipment development and improvement.

In 1970, the Federal Ministry of Education with the assistance of UNESCO established a Science Equipment Centre in Lagos. The function of the Centre was to provide facilities and expertise for the design and production of prototypes of school science equipment; the repair and maintenance of existing school science equipment; in-service training courses for primary and secondary school teachers and training courses for laboratory personnel;

and an advisory service in science teaching equipment. The aim was for the Centre to provide a service throughout the Federation, which consists of 12 educationally-autonomous States. To achieve this aim, a network of centres was planned which would be linked by Mobile Repair Units.

Components of the in-service training courses include woodwork, metalwork and glasswork, and participants construct apparatus themselves. It is not intended that teachers should be bulk producers of apparatus, but the activity is designed to boost the practical expertise of the teacher so that he may become more confident in his ability to experiment and more innovative in his science teaching.

Apparatus so far constructed by the Centre has been based on designs from the 'Guidebook to Constructing Inexpensive Science Teaching Equipment', Volumes 1, 2 and 3 (1) - see photograph 41. In addition, apparatus has been constructed for the Nigerian Secondary Science Project pilot schools, and also for the Primary Science Project based in Ahmadu Bello University, Zaria. The Centre workshops have been able to cater for 50-100 pieces of a particular item at one time and development of the workshops currently being undertaken should increase this capacity. The financing of the Centre is by the Federal Ministry of Education with UNDP/UNESCO assistance until 1976.

(1) Guidebook to Constructing Inexpensive Science Teaching Equipment
published by the Science Teaching Centre, University of Maryland, College Park, Maryland 20742, USA.

Asia

REGIONAL CENTRE - RECSAM, PENANG

RECSAM is the Regional Centre for Education in Science and Mathematics, in Penang, Malaysia. It is part of the South East Asian Ministries of Education Organization (SEAMEO). It serves Thailand, Malaysia, Philippines, Indonesia, Singapore, Laos, Khmer and South Vietnam. It runs conferences and three-month courses for teachers, introducing them to science and mathematics teaching methods. It receives multi-lateral and bilateral assistance; for example, the German Foundation for International Development (DSE) is probably about to equip a prototype development workshop there, and the British Council has funded some lecturers. Mr Khoo Tiang Lim, the science training officer, has originated a lot of the interesting science apparatus prototypes which are on display, and there is a wide-ranging stock of examples of science and mathematics apparatus from many modern projects. There is a proposal to set up the prototype workshop (with DSE funds) quite soon to design equipment for the SEAMEO countries which, it is hoped, will thus be helped and encouraged by this regional effort to set up their own national centres, or to improve them where they already exist.

Current developments

As in most such centres, the work is seen as involving engineering and educational effort, but without systematic analysis of either the varied classroom situations into which the apparatus must fit or of the administrative and commercial networks upon which its effective use will depend. This important aspect of the design of apparatus production is often neglected. RECSAM, however, does at times hold high-level conferences for administrators and involves administrators in its courses. The extent to which institutes of education in the universities of the region concern themselves with such analysis is uncertain, but no contribution from them seems to have reached any of the conferences on apparatus production.

Clearly there are specific and local examples of such planning with some Ministries of Education and with various projects (such as those of the UN organizations) which have undertaken educational development work involving school apparatus. It would be valuable to collect information on some of these initiatives, with a view to analysing it and making it available to the planners of production units. The Regional Centre for Educational Innovation and Technology (INNOTECH) is, in fact, already undertaking aspects of this at quite a high level in a long-term project. It holds courses for key educators. However, its work seems never to be referred to in the ground planning of actual apparatus production - plans which are rapidly becoming concrete in the region.

PRODUCTION CENTRES IN SOUTH EAST ASIA

THE UNIT IN BURMA

The following account, taken from a UN Newsheet, will help to set the Indian NCERT production unit (see pages 22 - 23) in context and provide an indication of the history and the hopes that people in the region have with regard to such enterprises. It consists of an interview with Soren Hakansson of UNESCO, Bangkok, the originator of and adviser to many of the apparatus production schemes in the region.

> 'This production unit is one of several in Asia which owe their existence to the example of a small industry set up in 1964 at the Rangoon Arts and Science University to make science equipment for education. All Asian nations have expressed a commitment to mass education and many have made remarkable progress towards achieving it. This commitment, coupled with the wish that the pupils should experiment for themselves in their science learning, has brought home to them the need for vast quantities of science teaching equipment. Production in Rangoon began in 1965 and has risen to the point where by 1972 about 200,000 Kyat-worth of such equipment per year was being turned over to the Director of Education. To have imported this would have cost the equivalent of about 460,000 Kyat. A very important point, of course, in all this is the saving of local currency, which in this case is a saving of nearly 100,000 US dollars. (One dollar is worth about 4.8 Kyat at the official exchange rate.) By 1972 the Rangoon workshop had 52 full-time technicians plus up to 100 temporary workers during summer vacations - physics and chemistry students from the University who volunteer their services for no pay. The items currently being produced cover nearly all those needed for high school physics and chemistry: balance, glassware, galvanometers, magnets,

prisms, calorimeters, tuning forks, lenses, hydrometers, etc.

'This project is mentioned in some detail here both because it was the first of its kind in the region and because its success and the consequent spread of the idea is a pointer to the future. It has been given help by the UN through the provision of UNESCO experts in equipment production and building planning and by the contribution of some 290,000 US dollars-worth of assistance by UNICEF. Under the Colombo Plan, Australia has contributed some 40,000 US dollars-worth of machinery and supplies.

'From its Burmese place of origin the idea of local manufacturing of science teaching equipment has spread outward to other countries of the region. Experts from UNESCO and other international organizations, much impressed during visits to the country, have carried the message. The idea has been repeatedly promoted at the regional science-teaching and school science equipment seminars, which UNESCO sponsors.

'The success of the project has overcome some of the doubts of surrounding countries as to whether they could find the trained personnel, the machinery and the facilities. The doubt, of course, remains as to whether such an enterprise could be instituted and continue as an ordinary commercial, self-financing (if not profit-making) enterprise. This seems very unlikely over an initial period of ten years. The financial input to the Rangoon workshop has been of the order of half-a-million US dollars while the apparatus produced has been of value about one quarter of a million US dollars. The funding agencies would have been able to provide twice as much equipment to the schools over this period if they had merely imported the items. This, of course, is invalid as adverse criticism on several counts.

'It is a primary task of international agencies to help countries to help themselves even though long periods elapse before countries can support the work themselves. It would, of course, seem natural that the shorter this period is the better, provided that the burden that the country thereby imposes on itself is acceptable. Further, aid of the type considered here is fully intended as a free initial provision, not part of a profit and loss transaction. Of great importance too is the model it provides for subsequent developments in other areas - and in this the Burmese project has been particularly fertile.

'Today one form or another of a school science equipment facility exists or is about to be established in Bangladesh, India, Indonesia, the Republic of Korea, Nepal, Pakistan, the Philippines, and Sri Lanka. In some, the Burmese pattern prevails, with the manufacturing of the school science equipment done at the facility itself. In other countries, with an established tradition of small-scale manufacturing - for example Bangladesh, India and Pakistan - the facility merely does the design work, producing pilot models suited to the needs of both student and serial production, with actual production being carried out by private industry.

'In Burma, the Science Workshop Superintendent U Chit Khiang says: "We expect to see annual production volume, as well as the number of employees, multiply by 4 or 5 times over the next four years. Right now we're producing science kits for high schools. But we intend soon to produce science kits for use in primary and middle schools. We're already testing the pilot kits."

'The ultimate aim is to manufacture all the science teaching equipment needed at primary level (for use by teachers) as well as all that required at middle and high school levels. The anticipated expansion includes broadened production facilities. To their present machinery for metal-working and glass-working the Workshop directorate expects to add machinery for plastics working - injection moulding, blow moulding and vacuum forming.

'Dr Maung Maung Kha, Rector of the Rangoon Arts and Science University says,: "The advantages of setting up our own plant for producing school science equipment go beyond just a saving of foreign exchange. We have provided new jobs. We now have trained technicians, we have acquired technical know-how. Moreover, the school science kits we produce are better suited to the needs of our own science courses, that we have ourselves developed, than foreign-produced kits."

'The chemistry kit built at the Workshop, which was designed by a professor at the Rangoon Arts and Science University, demonstrates the point. A semi-micro kit, it not only consumes one-tenth the quantity of chemicals required by normal-scale lab kits, but makes ingenious use of discarded materials - empty penicillin bottles, for example, serve perfectly as semi-micro reagent bottles.

'The Burmese project has also introduced another change into the region. Many of the countries of Asia have had no small precision industry at all. They do not have the technicians such industry needs. Good craftsmen they have, men who can turn out one beautifully-made item of a kind; but precision technicians, who can turn out 500 units exactly the same, exactly meeting blueprint specifications, and completely interchangeable - these have not been available.'

Soren Hakansson, the UNESCO consultant principally associated with the workshop in Rangoon said recently: 'I look ahead ten or twenty years. I see the Asian science teaching equipment industry largely taking care of the needs of the countries here; but I see more. Because a large part of the total cost of school science equipment is skilled labour, and labour is much cheaper here than it is in the developed countries, it is quite possible that in the future Asia will become an exporter of school science equipment to the West. Instead of just saving foreign exchange the industry will be earning it.'

INDIA

The National Council for Educational Research and Training (NCERT), New Delhi, India, is undertaking a very large scheme of curriculum reform, textbook production and apparatus manufacture.

Some of the apparatus has been designed by UNESCO experts. It takes the form of kits for primary and secondary level. The primary science kit is for an integrated study, though most of the materials are for physics. The secondary kits are at a series of levels in physics, mathematics, chemistry and biology. The NCERT workshops produced the early prototypes and Soren Hakansson of UNESCO drew the blueprints. UNICEF is supporting early stages of the production of primary kits, some 20,000 of which have been produced by local industry. (This is, of course, only a small proportion of the need: there are 500,000 primary schools in India.) In fact, it is rare for UNICEF to purchase locally - usually it is cheaper to purchase in Europe to an easily checked good quality. In this case, they must feel that, provided the schools use the apparatus effectively, the project will prove worthwhile. At present, UNICEF is responsible for seeking out manufacturers of the items, quality controlling them and getting them assembled into the kits. Photographs 19-25 show examples from the primary science kit, mostly prototypes. The quality is now higher though quality control is still a serious problem.

CEDO (now British Council) did a feasibility study in 1970/71 for UNICEF and reassured them about the project into which they are putting some millions of dollars for at least the pilot phase. The CEDO recommendations included the following points:

> The NCERT should not be left high and dry for funds with a partially complete project - there is a moral obligation upon the Indian Government and UNICEF to help see it through.
>
> The planned staffing and physical facilities of key institutions should be strictly enforced before apparatus is supplied.
>
> The supply of modern syllabuses and instructional materials in training colleges is an urgent necessity.
>
> The kits must go to all colleges which train elementary and middle school teachers.
>
> The project must be widely and realistically spread within the States of India in a properly phased manner and the release of kits and materials must be dependent on the maintenance of a good standard of training.
>
> Teacher re-training courses should be six weeks or at the worst, four. It is no use aiming to train only one teacher per school.
>
> The project should be tried in careful steps for three years before general implementation is considered.
>
> The States should be responsible for their own curriculum and should be prepared to vary the written materials as they translate them.
>
> There must be a proper repair service for the school kits.
>
> Supervisors have a very important role in getting the materials used.
>
> The ministry must have an officer concerned exclusively with the project.
>
> There should be improved communications between States, between the Ministry and States, and between NCERT and UNICEF and the States.

Current developments

The NCERT has itself written a great deal about all aspects of this project, from simple explanatory books to detailed reports. There are, of course, school texts, apparatus lists, teacher's guides, many of these in several versions and various State languages. Although it does not concern this present review booklet, the NCERT is working in all the school subjects and similar materials for these subjects are being created.

Some States in India have their own science development projects with apparatus and written materials. That of Bombay is perhaps the most developed of these.

COMMERCIAL INDIAN MANUFACTURE

A certain amount of school science apparatus is made commercially in India. There are small industries for this in Bombay; there is the Dynam Company in Bangalore, and over one hundred factories (some very small) in Ambala, between Delhi and Chardigarh. Some of these are highly-sophisticated, producing, for example, some good microscope series. Ambala produces much industrial scientific equipment. It has a consortium or chamber of manufacturers and a government standards certification establishment. The school science apparatus produced is the standard, sturdy, old-fashioned stuff.

These Indian commercial manufacturers might possibly benefit greatly from some good advice on how to suit their production to the new educational needs of their country, the region, and the rest of the world. They have adequate potential, the needs exist, and the government could encourage export in material ways - such as tax rebates on materials purchased abroad and subsequently exported as manufactured goods. In many cases the government will provide loans to industry. A parallel could be drawn here with Pakistan, which manufactures and exports to Europe surgical operating equipment to a high standard. The factory at Sialkot was, apparently, set up with German assistance, and the equipment bought by UNICEF. UNICEF and other international agencies would consider the purchase of science teaching apparatus from India if they could be assured of a commercially satisfactory supply. Naturally there are many economic factors, such as currency availability, to be considered in such export hopes. As yet, Indian production is still in a seller's market within the country and is hardly export-conscious.

Information on Indian manufacture exists in various trade directories produced in the country. Organizations such as the National Small Industries Corporation can provide surveys of potential manufacturers, production capacity, quality standards, prices inspection and distribution. Many countries have similar potential for obtaining such necessary information. India has some 30,000 large industries and 9.8 million smaller ones, excluding those concerned principally with agriculture, so the need for making explanatory surveys before embarking on a commercial or quasi-commercial venture is obvious. In most countries it is equally wise if not so obvious.

INDONESIA

Indonesia has some 14 million primary school pupils. The schools rarely have more than a blackboard, some chalk and a few textbooks. The teachers, if they do any science at all, teach it by rote, knowing little of the subject or of the new approaches to teaching. There is almost no science apparatus in the schools. There are other formidable problems. Indonesia's population of some 116 million is spread over three thousand islands, and probably some 30 million children have never attended school.

Now that events connected with the rise in oil prices have made Indonesia richer, it proposes to spend some millions of US dollars on school science equipment. This is already going ahead at the secondary level although there are at present few schools and teachers satisfactorily prepared for using the equipment. The teacher problem is much worse in the primary schools. Over the years Indonesia has received quite a lot of apparatus from international aid schemes, though educationists there have reported that much of it is unused by teachers because they lack the necessary preparation to handle sophisticated equipment. This sort of waste has been perpetrated in many countries and will occur again unless designers look realistically at the whole system of countries into which apparatus is to be introduced.

The curriculum in science is aligned with environmental needs between grades 4 and 6 (72 per cent of the working population are in agriculture), but the teaching has been very rigid. New curricula in mathematics and science are now in existence and about 60 million textbooks have been published to date, with aid from UNICEF and the Canadian government.

Some prototypes of apparatus and kits are designed at the Science Teaching Centre in Bandung. There is one small manufacturer of school apparatus in Indonesia and some expensive foreign apparatus is available.

KHMER

In the Khmer Republic, the Division of Pedagogic Services attempts the supply of apparatus on a small scale. Some courses in simple apparatus construction are available for teachers. There are no teachers' centres but UNICEF has equipped workshops with hand tools and they make some use of these. With the intention of making some apparatus locally, they have imported some prototypes (from Western catalogues). There have been meetings concerned with modifying and simplifying these prototypes but no one there is expert in the matter.

Khmer has sent a lot of trainees to RECSAM over the years. Some prototypes, based on RECSAM and UNESCO designs, have been designed by the Primary Inspectorate for schools in Phnom Penh. These prototypes are to be tried out in selected classes and, if they are satisfactory, pupils' books and teachers' guides will be prepared to guide their use.

Photograph 26 shows examples of papier mache bas-relief models and lino-cut printing blocks made in Khmer. This is about the limit of what is made at present. Priority of interest is in the use of local material, and during 1973 some thirty teachers had a six-month training course in its construction. The thirteen small workshops, set up originally by UNICEF for developing skills of primary school children, are currently being used to produce teaching items. The raw material used is what the children can bring in, plus that bought with what funds the Educational Development Committee can provide. The hope is that eventually all the primary schools of Phnom Penh can be supplied. In-service training of district supervisors and principals will be organized in order to pass on the new ideas. Then the principals will train their staff. This training concentration on key personnel is insisted upon. (See also the section on Vietnam.)

In the long term, Khmer realizes something much bigger is needed. There are some general plans, and some help from RECSAM and INNOTECH and other international and regional agencies is hoped for in developing them. There is a strong realization that their educational system is irrelevant to the needs of the country and that training methods are outmoded. Any improvements have happened only in Phnom Penh but they feel that improvement in rural schools is becoming a priority. The war has, of course, prevented this.

KOREA

There is a small amount of science teaching apparatus manufactured in the Republic of Korea by commercial firms. In addition, the Kyongpook Student Science Centre, Taegu, and Hoeingsung Teaching Materials Warehouse, Kangwon-do, produce small quantities. Some small-scale industry which once produced science teaching apparatus has now turned over to other products - but the capability to produce it must still exist. There is commercial production of scientific equipment - such as ovens, thermometers, balances - not specifically intended for schools but usable by them.

Mr Hakansson, who prepared a report on design and production of school science equipment in Korea (UNESCO Regional Office for Education in Asia, Bangkok, August 1972), states that although there was a fair amount of apparatus in schools and colleges, much of it was traditional and not designed for the present curriculum and student use. The equipment in most of the colleges was supplied through UNICEF assistance.

There is a proposal to set up a School Science Equipment Centre to design for mass production, and this may well by now have made some progress. Details of this proposal are fully set out in Mr Hakansson's report.

LAOS

Laos trains its teachers, to some extent, to make science apparatus with local materials, and an in-service training course on this, run by Dr Ponniah of RECSAM, took place in July 1973. The Laotian schools have few materials - particularly at primary level - and, of course, the country is terribly war-wracked. Most innovation is introduced through inspectoral visits to schools. The inspectors demand much initiative from the teachers, particularly in such matters as using local material, and assert that teachers can and will make things for themselves.

The Directorate of Materials and Educational Productions produces some very simple materials. The Ministry of Education has created the National Pedagogic Centre, within which the Department of Pedagogic Materials will produce materials for primary schools throughout the country.

They express the need for some short-term consultants in the development of science teaching material. They also wish to duplicate in large quantities some suitable materials developed by RECSAM. Thus here, as in most countries of the area, there is a need for help to set up a national science/mathematics workshop and get advisers to train counterparts. As with many other countries in a like situation in the area, their need would attract funds if an adviser would help them prepare and submit a project proposal.

MALAYSIA

Malaysia already manufactures more than half its secondary school needs for science teaching apparatus. It has recently instituted new curricula at this level. The Curriculum Development Centre in Kuala Lumpur is re-designing equipment for the teaching of integrated science in the classroom (as opposed to apparatus which needs to be used in laboratory rooms). Presumably it is hoped this will then be produced by local manufacturers, since there will be a large market.

Primary curricula remain as they were. Apparatus is being developed at the Centre to suit these curricula - apparatus prototypes for local component manufacture. These components will be assembled in schools.

A few items in course of development at the Curriculum Centre are shown in photograph 27. The full work on apparatus development will begin in 1975 when a permanent building is put up. This will:

Develop prototype equipment of physics, chemistry, biology and social science, for pre-school, primary and lower secondary level, for pupil use and teacher demonstration.

Investigate the use of local materials.

Give technical know-how to local manufacturers (in die and mould-making, for instance) and educational/curriculum advice.

Lend its machine facilities to other Ministry of Education departments - ETV, for example.

Effect quality control on manufacturers, vet samples and advise on the suitability of tenders.

On rare occasions, actually manufacture.

Exhibit.

Malaysia does not expect its teachers to improvise the necessary apparatus for teaching; there are too many difficulties. In any case, school science equipment manufacture is now a fast-developing local industry. Plenty of commercial production facilities exist, much of it in small workshop/cottage industry form, given to a single type of product - such as thermo-plastic articles. These are often in the nature of family affairs, often with rather crude machinery and ill-paid workers, but well suited to science apparatus manufacture. There is also a rapidly-expanding sophisticated industry: this can be seen in the industrial estate beside Penang airport.

Malaysia would provide a very informative case-study for anyone wanting to examine how school science apparatus production is being successfully pursued. The Ministry of Education is obviously both keen and effective in getting the process going. RECSAM has provided advice and training, and the materials are available in the country. CEDO (British Council) has provided consultants for the new curricula and textbooks.

NEPAL

A Science Equipment Centre has been established in Kathmandu. It was initially set up as a distribution centre for imported school science equipment. Plans are now in hand for the Centre to be used to develop and produce equipment locally, alongside the development of curricula being carried out by the Curriculum Development Centre.

PAKISTAN

There has been for some time an Educational Equipment Centre in Lahore. This Centre has been attempting to construct apparatus suitable to local needs: generally such items have been copies of traditional apparatus. Plans exist to improve the facilities and activities of this Centre.

PAPUA NEW GUINEA

An example of an 'integrated science' primary school course which uses a mixture of standard and local resource material is the Papua New Guinea Primary Science project (1). It is an easy one for other projects to study because its 200 or so work-cards - produced in three handbooks for teachers - each carry a photograph of the materials being used. An example is shown in photograph 30.

UNICEF originally supplied the standard apparatus, consisting of sixteen types of item for the pupils to use and about two dozen types of item with which the teacher can demonstrate. The Education Department supplied some sixteen types of common or domestic item, available locally. Each kit caters for forty pupils and is housed in a lockable cabinet with pull-out trays. In addition, children collect and bring in materials from home and their surroundings. Thus there are similarities with the African Primary Science Programme but the PNG project has a more defined set of experiments and uses some school science apparatus of a standard type.

(1) Papua New Guinea Primary Science
published by the Jacaranda Press, Elizabeth Street,
Brisbane, Australia.

THE PHILIPPINES

The Philippines school system is very active in curriculum development. In addition to the work of the Department of Education and Culture, the University of the Philippines, through its Science Education Centre, has produced curriculum guides, teachers' guides and pupils' texts, some still in a pilot stage and some in commercial publication.

There are private and public schools. Despite efforts by the Department and foreign and UN agencies, the problem of supplying science materials to the 38,000 primary and intermediate schools is almost insurmountable. Standard items of equipment are available locally (imported) at very high prices which means that only the richer schools can acquire them. Most other apparatus is of a home-made sort purchased out of petty cash or the teacher's own pocket. There are courses on the use of inexpensive apparatus or kits provided by international agencies. Teachers organize workshop courses based on the construction of UNESCO Source Book items. Some private technical schools make a small amount of apparatus but this cannot be widely spread and is little known about. One or two equipment firms have opened up in the last few years and some importers have begun manufacture to new curriculum specifications but the output is small at present.

UNESCO has done a study of science equipment in Philippine schools with a view to getting a pilot production unit in operation. Essentially, this unit would make prototypes and pursue their manufacture far enough to demonstrate to local industry the viability, costing, and technical processes involved; and, hopefully, convince local industry to undertake manufacture.

The UNESCO report itself is 'UNESCO-UNDP Feasibility Study on the Production of School Science Equipment in the Philippines' by Crunden, Hakansson and Crellin. (Manila, July 1972. Published, internal document, at Bangkok by UNESCO. BK/72/D291-200.) This very thorough study brings out many of the problems and possibilities faced by a school science apparatus production unit.

SINGAPORE

Singapore schools are relatively rich and there are few major problems in getting apparatus into the schools. The curricula are changing, however, so new apparatus has to be obtained. At present apparatus is bought locally from firms which either manufacture or import the items. Quasi-governmental industrial agencies have helped in the design and production of science apparatus for sale to schools.

SRI LANKA

Sri Lanka has a production unit at Pattalagedera, Veyangoda, set up and equipped with help from UNESCO and UNICEF. Unlike most production units, there is a proposal to mass-produce there. (Most other units are prototype makers; or they make small batches; or they set out to demonstrate possibilities and costings to encourage local industry to undertake production.) To this end, it is getting mass-production machines such as turret lathes, a foundry, and a glass-blowing unit. Mr Hakansson visited the unit in early 1974; there is a report (internal document with restricted circulation, UNESCO, Bangkok 1974, BKS/74/D/219-25). CEDO (now British Council) was earlier involved in this unit and has documentation on various aspects.

THAILAND

In Thailand, elementary schools desperately lack teachers capable of teaching any science. There is a general teacher shortage and many teachers have to do a second job in the evening to earn a living wage. Textbooks are, on the whole, unsatisfactory; some are very poor. Most elementary schools in Thailand are totally devoid of any sort of teaching material for science, or indeed other subjects.

A number of Elementary Science Supervisors have prepared some teachers' manuals, supplementary books, experiment books, and lists of apparatus, to help develop science education. Some of the supervisors have been to RECSAM for courses over the last three years, and since their return have been writing work-sheets in conjunction with a Ford Foundation research project. One supervisor has designed a sample science kit - photograph 29 - with the hope of getting it replicated and distributed to elementary schools. However, its cost is around 65 US dollars, and it therefore reflects rather badly on the realism of this and other supervisors' projects.

The Department of General Education run short courses for supervisors on modernizing elementary education which include apparatus use and improvization. UNICEF has started planning an elementary science centre in Phyathai School, Bangkok (a library, laboratory and workshop) to be equipped with apparatus, audio-visual aids and workshop tools.

In a very well-endowed programme for the improvement of secondary science teaching, the Institute for the Promotion of Teaching Science and Technology (a Thai government and UNDP project) in Bangkok designs and makes prototype and small-scale production runs of apparatus for its newly-designed curricula. Examples are shown in photographs 28 and 31. It expects to work on primary level equipment later. It has a fine display of this equipment - for mathematics, chemistry, physics and biology - in its huge new building behind the UNESCO office. The British Council Curriculum Information Service (Education Information and Research Department, 10 Spring Gardens, London S.W.1.) has a few of the materials and also some of the books of specifications and photographs of the IPTST apparatus.

Prior to the full IPTST programme, Keith Warren and Lars Rudstrom (UNESCO) designed some apparatus at Bangkok, largely for the training of technicians (see photograph 32). One of those technicians remains with the IPTST; the other two, attracted by wealthier employment, have left. This is a frequent problem: nationals in many countries may be paid only at national civil service rates if in a government project. The result is that once they are trained they realize they have a high market value and leave for industry.

The UNESCO Pilot Project for Chemistry Teaching in Asia 1964-1970, took place in Bangkok. It was a high-level chemistry project using high-level techniques and was mostly in English. A bland evaluation was prepared in January 1972 by UNESCO, Paris (SC/WS/505). In contrast, the IPTST has looked for locally-available chemicals and materials and has to some extent aligned its syllabus on these.

VIETNAM

The Republic of Vietnam has no spare space in its classrooms so there is little chance of science materials being used for years to come - at primary level, at least. Teachers use some flash-cards and wall-charts, locally produced by silk-screen printing, but with sixty or seventy pupils per class - and sometimes three such classes in one room - there is no other possibility in the public schools. Private schools have around 100 pupils per class.

In a recent conference, the Vietnamese delegate officially reported his country's difficulties in terms such as 'How can we get an overhead projector easily?' 'How can we buy a video recorder without tax?' Meanwhile, the morning's newspaper (which the conference delegates had just read) carried pathetic pictures of children taking home-made desks along to sit on the beach near Quang Tri. Formal reports at international conferences often do not show the truth, and this in no way helps donors to hit the right level of international aid. The USAID programme has supplied Vietnam with one hundred movie projectors: the Overseas Technical Agency of Japan has given projectors and video-tape recorders to set up an audio-visual centre. Yet, in most Vietnamese schools there is no electricity; only a few of the largest schools have a laboratory; and there are no repair facilities except in the central workshop in Saigon (Ho Chi Minh City).

There are divisional, provincial and regional centres through which apparatus innovation could be introduced - at present these are largely supervisory. In a conference in Penang in 1973, an officer remarked that in ex-French colonies no teacher would dare to introduce new ideas that were not first suggested by the inspectorate. This is therefore an organizational matter. Its positive side was also asserted; if an inspector passes on some new ideas and says that he will later check and see whether they have been implemented, they will be taken up. The officer asserted that RECSAM should 'go and thump the table and get this done'.

Latin America

BRAZIL

The UNESCO Pilot Project on the Teaching of Physics operated in Sao Paulo, Brazil from 1963-1964 at the Instituto Brasiliero de Educacao, Ciencia e Cultura (IBECC). It was conceived as being for the whole of Latin

America (as was the Chemistry Project in Bangkok for Asia, and the Biology Project for Africa).

The project limited itself to the topic of Light. The team was made up of three UNESCO experts, three consultants, and twenty-six teachers from universities and pedagogical institutes in eight Latin American countries. They developed, and physically made, 200 lots of eight kits. One of these is shown diagramatically in photograph 33. These experimental kits were accompanied by 50 hours of student instruction in mimeographed programmed-learning texts in Spanish and Portuguese. The team also produced twelve short silent (single-concept) 8mm. films, and prepared a 30 minute sound film and eight television programmes. This tour de force took only one year.

The materials are still available (commercially, it is thought) and are probably now at least partly translated into English. Further details can be had from Dr Nahum Joel (who was assistant director of the project), UNESCO, Paris. The project is also described in a UNESCO booklet (reference SC/WS/160).

The FUNBEC kits, which have already been mentioned on pages 5 - 6 and which will be mentioned again on pages 43 and 44, are also of importance in Brazilian and Latin American context.

COSTA RICA

Apparatus for local construction has been designed in Costa Rica by the Programa Conjunto Gobierno-UNESCO-UNICEF, under the Ministry of Public Education, San Jose. Detailed drawings have been produced and some prototypes made, using wood, tinplate and metal strip. A few of these items are shown in photograph 36. Blueprints are shown in photographs 34 and 35. It was hoped that local workshops would be able to undertake the production but there was some doubt about the commercial viability of the enterprise, but this information is only up to 1972. At that stage, they were considering using instead the low-cost Japanese mini-science plastic kits.

Other Countries

ISRAEL

The Curriculum Centre of the Ministry of Education and Culture in Jerusalem, Israel, has created a non-vocational curriculum for a modern approach to agriculture and rural science. They have produced apparatus kits, books, work-sheets, blueprints for 'land laboratories' and so on. There is a general description of the project in a Ministry publication in English: 'Let's Grow Plants' (Ministry of Education and Culture, Jerusalem, 1971).

In Israel, a commercial firm, Or and Kol (1), produces science teaching apparatus of a simple, modern kind - some of which may be to Soren Hakansson's designs. It is mainly applicable to secondary level and most of it is for physics. Some samples are shown in photographs 37 and 38. The firm, which is half government owned, planned the apparatus partly under the sponsorship of UNESCO. The simplicity of form (and presumably the consequent relatively lower cost) of many of the items is a pleasing contrast with much of the commercial apparatus available elsewhere.

(1) Or and Kol, Israeli Corporation for Educational Materials Limited, 40 Eben Gvirel Street, Tel-Aviv, Israel.

TURKEY

The Ministry of Technical Education established, some eighteen years ago, a Trade School to construct apparatus and equipment for the school system. This 'Trade School' employs some 1,400 people, and produces approximately 80% of the country's educational equipment needs.

Approximately five years ago an Audio-Visual Aids Unit was separately established to meet the educational requirements in this field.