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ABSTRACT

This bulletin addresses the topic of out-of-school science education (OSSE) as it is occurring and developing in the countries of the Asia and Pacific region of Unesco. Out-of-school programs/activities are both complementary of and supplementary to science education in the schools, providing activities that the constraints of schooling usually exclude from the curriculum. The first section comprises an introduction to the concept, suggested approaches, and a review of strategies employed by 13 out of the 15 countries represented. The second section consists of individual reports from Australia, Bangladesh, China, Indonesia, Japan, Malaysia, Nepal, New Zealand, Pakistan, Philippines, Republic of Korea, Singapore, Socialist Republic of Vietnam, and Thailand. Areas addressed in these reports include science museums, science clubs, science fairs, and media use (television, radio, printed media). In addition, programs/activities unique to a given country are also discussed. These include the Science Foundation Programme (Philippines), Nature Conservation Association (Republic of Korea), Bangkok Planetarium (Thailand), and others. The final section consists of an annotated bibliography of out-of-school science education activities/programs. (JN)

BULLETIN

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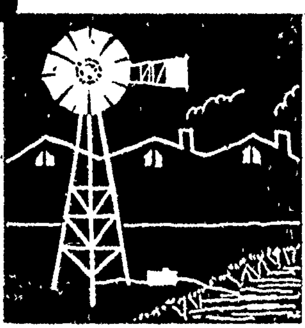
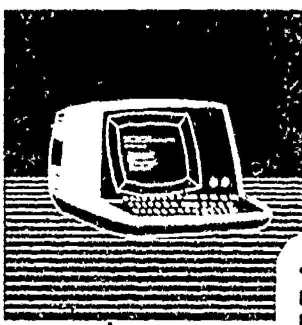
Out-of-School Science Education in Asia and the Pacific





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PREFACE

This special issue of the Bulletin presents reports on out-of-school science and technology education in the countries of the Asia and Pacific region.

The first section of this issue comprises an introduction to the concept, some suggested approaches and a review of the strategies employed by 13 of the 15 countries represented in this Bulletin.

The country articles appear in Section Two.

Australia	:	support structures for out-of-school science and technology education, current practices of science teachers, community participation;
Bangladesh	:	science museum, science clubs, national science week, traditional rural technology;
China	:	organizing out-of-school science, summer science camps, team programmes, problems;
India	:	science museums, science clubs, fairs, the search for talent, media for dissemination;
Indonesia	:	non-formal education, popularizing out-of-school science education, training reporters of science and technology;
Japan	:	science museums, science clubs, television and radio, films and printed media;
Malaysia	:	curricula trends, government agencies, statutory organizations, universities, future trends;
Nepal	:	the Science Club, science fairs, using the mass media, natural history museum, conservation education;
New Zealand	:	field trips, museums, agricultural clubs, conservation organizations, science fairs;
Pakistan	:	museums of science and technology and natural history, using the media;

Philippines	:	the Science Foundation Programme, out-of-school science education laboratory, the role of research;
Republic of Korea	:	science museum system and activities, radio and television, the Nature Conservation Association;
Singapore	:	science clubs and fairs, science kits, science fortnight, the Singapore Science Centre;
Socialist Republic of Viet Nam	:	science and technology requirements, using the media, museums, clubs, exhibitions, technical labour;
Thailand	:	rural technology, population and rural development, Bangkok Planetarium, museums, inland fisheries.

Section Three consists of the Bibliographical Supplement to which more titles contributed by readers would be welcomed by the Unesco library in Bangkok.

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Photographs and drawings reproduced in this issue have been supplied by the individuals and agencies as listed below. The Unesco Regional Office expresses its appreciation to them all. Photos not otherwise credited have been contributed by the authors from various sources.

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Vijay—frontispiece
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SECTION ONE

ASPECTS OF OUT-OF-SCHOOL SCIENCE EDUCATION

FAO photo

Bulletin of the Unesco Regional Office
for Education in Asia and the Pacific
Special issue, December 1982

AN INTRODUCTION TO OUT-OF-SCHOOL SCIENCE EDUCATION IN ASIA AND THE PACIFIC

by Peter J. Fensham

Science is one of the great expressions of humanity. The life-style of every individual on earth is affected to some degree by aspects of this field of human endeavour. Furthermore, its potential to alter life-styles has been increasing at a great rate. Sometimes this potential has been so realized that enormous jumps forward have been possible in the quality of life for some people. These improvements have not all been without cost. We increasingly realize that the applications of scientific knowledge or the introduction of a science-based technology can have very serious negative effects on other individuals and on whole societies.

Because of these all-pervasive influences of science, it is now unthinkable that science should not be part of the totality of fields that education seeks to address. A university system without sections that offer education in science is now unthinkable. Secondary schools in all countries give a high priority and status to science education. Although it is an expensive resource subject area, there is always concern when the teaching of science is threatened by such reasons as lack of staff—a concern that is not so vocally expressed about many other subjects.

Primary education has, since the mid-1960s in many countries, also incorporated science into its range of recognized responsibilities for teaching and learning. Despite this recognition of science by a country's formal education system, the availability of education in science through it is often limited in many respects. It may not be available to all pupils, nor are all potential learners always in school. The school situation encourages certain sorts of science education, ignores other sorts, and only with difficulty can provide many other important experiences that are essential to the learning of or even an appreciation of many scientific skills.

These limitations of school science raise the issue of science education being provided outside the school situation. There are many aspects of individual and social life for which education occurs outside of school.

Aspects of out-of-school science education

The family, the religious institutions, the mass media, advertising, leisure opportunities, the work environment and many other situations and agencies have and do provide education for these aspects of life. Likewise we should expect to find opportunities for science education in the out-of-school scene.

This bulletin is addressed to this topic of out-of-school science education (OSSE), as it is occurring and as it is developing in the countries of the Asia and Pacific region of Unesco. Reports from 13 countries* provide a wide variety of examples of OSSE. In this introduction a framework is set out which aims to provide guidelines and criteria for planning and devising OSSE. The way some of these criteria can be applied will be illustrated by reference to some of the examples from the national reports.

Science—a many splendoured thing

We will begin this development of guidelines by examining science since there are many facets to this great human field.

Science as knowledge and ways of knowing. When we pick-up a science textbook and consider the content of its pages, we find many facts about natural phenomena, natural and synthetic substances, and about events that involve human interaction with the physical world in which we live. In addition to these facts we find many words representing the concepts and theories that scientists have invented and devised to describe and explain all these features of the physical world.

Usually, however, there is not very much in such a textbook about the practical skills that were necessary so that these facts could be determined, nor about the intellectual processes that led to the concepts, and to their interaction with the facts and with each other to provide powerful principles for use in other physical situations. An interesting exercise that readers might like to do is to take a chapter of a school science textbook and list its content in two columns according to whether this was the result of some scientist's experimentation or observation or of his/her intellectual response to such data. Without these tools of science we would not have the facts or powerful principles of science, and it is important to recognize them as quite integral parts of the totality we know as science.

Science depends on equipment. There will also be few accounts or pictures of the actual apparatus that scientists use in their daily work, either for research or in the applied situations where most scientists in all countries are employed.

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* The reports of China and New Zealand were written subsequent to this introduction.

Science as application of knowledge and skills. Depending on the book we have picked up, there may or may not be any examples of how its scientific knowledge has been applied in industry, commerce and in the daily lives of ordinary citizens. Because it has not been settled or not yet tried, there will almost certainly not be any suggestions about contemporary attempts or future possibilities for application of the knowledge.

Science as answers to questions and problems. Only rarely now (probably less than in the past when some historical aspects were included) is it easy to infer or read what problems or questions led to these facts and concepts. If this is true of science texts, it is even more true of the examinations and tests which have been used in the last decade. This means that even successful learners of the content in science courses are very ignorant of whence and why this content has arisen. For the many other potential learners who need these sorts of information to motivate their learning, its absence means that they will not study science at school.

Science as basis for technology. The content knowledge of the textbook will be the basis of many examples of technology that contribute directly or indirectly to the modern life of all societies. These may be very personal pieces of technology like spectacles, hand tools, household gadgets or transistor radios and television. They may be less overt but are the means whereby clothing, food, shelter and the countless other commodities of living are now provided. Despite numerous calls to include technology in science education at schools by a number of science educators in a number of countries, very little headway has been made and it is unlikely that much serious attention will be given to the science of various technologies in our textbook. Most school science teachers have not had the training or experience likely to enable them to redeem this text deficiency in their teaching.

Science as personal and social attitudes. Finally, unless our textbook is an unusual one at the secondary level there will be very little explicit reference to attitudes like awe of nature, (Newton, Faraday), curiosity (Darwin), perseverance (Curie), flair (Count Rumford, Watson), and creativity (Einstein, Pauling), that are among those that have been claimed for many scientists. Nor will conditions like objectivity, honesty, and availability of data be emphasized as essential for the growth of science. It may not even be evident that science transcends national barriers in ways that many other knowledge fields do not, and that science depends on the co-operation of many people including technicians, assistants, and equipment makers—many of whom have not studied too much formal science at school or beyond.

This brief review of a school science text reveals many aspects of science that are missing. Science teachers can add some of these as can good use of a well-equipped laboratory. However, it is unreasonable to expect science education in school to introduce a number of these aspects of science to school learners. The idea of using the out-of-school situation to extend science education makes many of the aspects just mentioned a possibility at least for some learners.

The dimensions of out-of-school education

The idea or concept of OSSE is an exciting one to consider. It has many dimensions implied in its very words.

First of all it is a form of education and, as we shall see in many of the national reports, it can have educational characteristics that are very difficult if not impossible to include in schooling. In its root meaning, education has a sense of leading out—a widening, an enlarging process which the constraints of large classes, tight syllabuses and teaching oriented to examinations, so often squeezes out of the school scene. As Illich[1] and Freire[2] and others have helped us to see in the penetrating critiques of schooling, education in formal classrooms is more often a process of pouring in to the children's heads from the limited stock of narrowly defined knowledge the teacher has.

The education that is possible through out-of-school locations, persons, and resources can be very different and there are many challenges here still to be taken up.

Second, it is an education in science—as we have seen, an exciting, many faceted subject which, in the school curriculum, is often limited to a few of these facets and is also constrained very commonly by lack of facilities, equipment, suitably trained teachers and timetabling inappropriate to laboratory work. In the out-of-school scene, a number of these limitations drop away. Proper facilities, human expertise, and meaningful time can be provided in a quite staggering number of ways as the national reports indicate. How extensively these are provided will always be a challenging question, but because the out of-school situation is not under the constraint of providing compulsory education for all, it does not have to dilute limited resources to an ineffective level as so often happens in school systems. The science in the out-of school scene can aim for quality resources for its portrayal and its participatory experiences.

Cf 1. Ivan Illich. *Deschooling society*. New York, Harper and Row [1974] xvii, 116 p.

Cf 2. Paulo Freire. *Pedagogy of the oppressed*. Translated [from Portuguese] by Myra Bergman Ramos. [New York] Herder and Herder [c1972] 186 p.

Out-of-school space. 'Out-of-school' conjures up a host of possibilities. It can be looked at in terms of location. In most societies schools are very much places apart, surrounded by a school fence, and inside four walled rooms in which pupils spend many hours sitting at tables or desks writing with pens and pencils and being talked at by an adult person, the teacher. Except in rare instances where schools have caught the potential in John Dewey's[3] suggestion that a school should be a microcosm of the society in which it is placed, schools are very different locations from those that make up the realities of life for the society around them. Out there, factories, shops, homes, streets, highways, forests, streams, ponds, farms, deserts, beaches, sea and many other locations exist, all of which have educational potential; and all, if we are clever enough, are potential laboratories for scientific observation and application.

Out-of-school time. Another way to look at the out-of-school is in a temporal sense. Schooling does have a substantial portion of the children's time—about one third of the waking time, five or six days a week for 80 per cent of the year. Nevertheless, inside the school this time is almost always fragmented into small bits that give rise to limitations about what can be taught and learnt and how this can be done. Exploration and activity in a natural phenomenon or of a scientific instrument or a piece of technology take extended periods of time that are not available in the piecemeal timetables that schools create to meet the competing demands of different subjects and the requirements of the educational system—statutory breaks, compulsory occurrences, shared access to resources and traditional expectations. It may seem a simple thing to arrange a special two hour class, or to hold day excursions for that science experience that will really make the learning of a topic meaningful. Anyone who has worked in a school will know that it is extremely difficult and usually the experience is foregone rather than tackle all those problems. Nor is the school day often elastic. To extend a session to complete an investigation, or to use an out-of-school location or to give more children access to limited equipment raises all sorts of very real problems. Teachers in many countries have other responsibilities on a regular basis outside of their school hours. Some pupils may have to travel home by buses that will not wait for them, or they too have tasks to do for the family or in the society that depends on a definite start and finish to the school day. The out-of-school situation has access to the whole working day and hence to the convenience and particularities of the lives of all sorts of people. It does

3. John Dewey. *The school and society*. Carbondale, Illinois, Southern Illinois University Press, 1980. vii, 115 p.

not require the continuous week after week commitment that schooling has had put upon it and in turn has come to expect in the ordering of its teaching.

Out-of-school 'teaching' potential. Human resources for teaching is another dimension of out-of-school. Outside of school exists most of the scientific and technological expertise in a country. Science teachers in Asian and Pacific countries often do not think of themselves as scientists. Scientists are, in their eyes and hence in the minds of their learners, persons who work in special situations in the society outside the school. Even when a teacher in a school does act as a model of scientific knowledge in practice, his/her confinement within a particular school restricts availability to this model to a very few learners.

Although out-of-school science may only be able to have limited access to the array of scientific and technical expertise in a society, that access can often then be made available to very large numbers of persons because of time flexibility. Combination of this with the media techniques we will now discuss enables a short time contribution from a scientist to become education on many occasions for quite enormous numbers of people.

Out-of-school modes of communication. Schooling in any country develops its own dominant style of communication. Some variation of speaking, listening, responding and recording takes up most of the time in class, and classroom behaviour—teacher and 20 or 30 or 40 or more children—makes up most of each day. Sometimes audio-visual methods of communication are used but compared with the out-of-school scene these take a very much second place to the oral and literal modes. The oral mode also has its own special school character in which there is only rarely a sustained conversation between individuals—teacher and a pupil. The communication is often at an abstract level since the 'thing, object, event or phenomenon', is not present in the classroom; 'it' is out there, and out there are persons with direct experience of 'it'. Experience of the 'thing or object' is rarely part of school communication processes and even when teachers work hard at a simulation or model of these realities, there are major difficulties. Out-of-school situations can much more easily provide this experiential feature as part of the learning sequence. The mass media, television, radio, newspapers, posters and slogans, are much more major modes of communication outside school and they are accepted, perceived and received in a more effective way there than when they are used as supplementary modes in school.

Out-of-school learners. The learner potential of the out-of-school also provides an amazing contrast to the in-school situation. Although some countries have high percentages of the population in the school ages, for all countries in the region the great majority of the population are not in school nor will most of them ever be again. In some countries of the Asia and Pacific region there are also significant numbers of school-age children who have no contact or only a very limited contact with formal schooling. There is also the irony that, despite the high status and the recognized importance of science education, large numbers of children in school are not studying science. This arises from the demands that higher education puts upon the school system to select and prepare pupils for further studies in science. Although these further studies will only involve a tiny minority of the total school population, in almost every country one finds these needs being given priority (sometimes exclusively) over the other groups and the other needs that science education in schooling could serve. Furthermore, these same constraints of selection and preparation affect the small minority who are successful in school science education. Their interest and achievement is constantly confined in school to a tightly prescribed list of items of science knowledge and practical experiences. The out-of-school scene has not only the non-school population as its potential learners, but also the school population who in these different ways are limited with respect to science education in school.

In summary of this amazingly rich concept then, we can say that OSSE should be both complementary of and supplementary to science education in school. It should take hold of all those opportunities for science education that are not open to schooling and it should add for those who are part of the school population, types of science education that the constraints of schooling usually exclude from the curriculum.

A framework of possibilities for OSSE

The aspects of 'science' and the dimensions of 'out-of-school' can be put together to form the matrix that follows. The matrix, as drawn, has 25 cells and each of these represents a challenge for OSSE. Many of these cells are in fact sub-dividable as the sub-categories on the left-hand side indicate. The dimensions of out-of-school across the top have also been sub-divided in the description of them earlier. The opportunities for OSSE to complement and supplement school science education are thus very considerable indeed, since as will be indicated, there are already examples from the 13 national reports that fall into many of these cells.

This matrix is derived primarily from consideration of the concepts of 'science' and 'out-of-school'. The concept 'education' as mentioned earlier is also one that can be thought about but it will for our purposes be enough to simply regard it in two ways—active and passive learning. Both have their place but each contributes very differently to the learning experience. The learner passively watching via a television demonstration by a scientist is in a different learning experience from the learners who are carrying out the experiment for themselves at a science camp or in a participatory science centre. As you use each box of the matrix as a frame of possibility for OSSE, the active and passive learning modes can be considered.

An opportunity matrix for out-of-school science education (OSSE)

	Aspects of science	Out-of-school dimensions: Location	Time	Human resources	Modes of communication	Potential learners
Knowledge	Facts Concepts Theories					
Skills	Practical Intellectual processes Equipment					
Applications (Industrial, Social, Personal, Commercial)	Existing Possible Technology					
Answers to	Questions Problems					
Attitudes	Personal Social					

Learner needs for OSSE

As we saw earlier, science itself is a human phenomenon in which there are a variety of aspects which could be included in education. Many of these distinctive aspects were listed above and it may now be helpful to give an example of the priorities among them for one of the large learner groups our discussion of the out-of-school concept identified.

An International Workshop on Science Education and the World of Work was held in March 1982 in Cyprus. This meeting of curriculum experts in science education faced the question, 'What broad topics in the field of science education include learning that should be essential for everybody but particularly for that great majority of pupils who will not go on to further formal studies in science? ' As an answer to this question, 11 topics were identified and justified in the following list. The question this workshop asked was about a population in school but it is a population that also becomes in due course the great bulk of the persons in a society. So, if these answers have validity for this group they are also important areas for the science learning of that great mass of humanity who have either 'failed' at science in school or whom the school system failed by not including or by not offering these aspects of science to them.

This list of basic (essential for healthy and positive living) science topics again can be used as a checklist when the content of out-of-school science is being determined or evaluated. Readers again may like to do this when they read the lists of topics covered by the many programmes described in the country reports.

Another school population identified above who are sold short on science in school are those with the interest and cognitive preparedness (from home or school) to push more deeply into their school science topics or to grapple intellectually with the many topics, ideas and phenomena that are not mentioned in school science.

Topic area	Justification
1. Senses and measurements	– Human beings explore the world around them through their senses. The use of these senses and technology related to them enables man to make a record of the world around him. – Measurement is a way in which human beings compare and communicate about objects, phenomena, space and time. There are many measuring instruments in existence that form part of our civilization. – Measurement both extends our senses and overcomes limitations of them.
2. The universe	– Children have a natural curiosity about, and interest in 'their surroundings' around them, above them and below them. This can stimulate an interest in scientific exploration which goes beyond the confines of the classroom and which will help to promote a lifelong interest in science and technology.

Topic area	Justification
3. The human body	– For children's own personal development they should have a basic understanding of how their bodies work. Furthermore, they have a natural interest in their bodies and are curious about its structure and functioning. A knowledge of the basic physiology and anatomy of the human body is basic to an understanding of caring for it and keeping it healthy.
4a. Health, nutrition and sanitation	– One of the fundamental aims of science education is to improve the quality of life both for the individual and at the national level. Health is an essential factor contributing to the quality of life and is considered as a valuable possession of man. Nutrition is an important factor necessary for the building up and preservation of good health. Some science concepts are needed for basic understanding of the link between health and nutrition.
4b. Food	– Food is the basis of life.
5. Ecology	– This interactive concept forms the base for all aspects of environmental education. In some ways, it is also the base for the quality of life, and for the impact of technology on life in the past, present and future.
6. Resources	– Resource development is an important component of national economic life. Resources are known to be finite and their conservation by personal and social action needs to be encouraged.
7. Population	– Human reproduction has basic biological aspects that are part of the life of all families. All countries are faced with achieving a balance between population growth, and the availability of food and other resources. This balance is essential to their desired quality of life.
8. Pollution	– Pollution of the earth, air and water is now a recognized feature of all communities and societies. How individuals and groups and industries contribute to this is an essential step in reducing its effects. In this way the prospects for improved quality of life will be improved.
9. Energy use	– Efficient use of energy resources, is a pressing personal and social need everywhere. All countries need to lower their dependence on imported energy resources. Understanding of efficiency in energy use can lead to an enhancement of quality of life.

Topic area	Justification
10. Technology	– Technology, both locally developed and imported, is increasingly effecting the lives of people. Yet education has not kept pace with this development and people's knowledge of how even personal technological devices work, and their implication for their lives are often rudimentary. At the wider levels of social and industrial life, there is a sense of personal inadequacy and alienation in the face of technology.
11. Quality of life	– To help in creating healthy attitudes to individuals, to the community, to the world of work and to the environment in which people live and play.

Even the most recently revised school chemistry and physics courses will have little in them that has not been known for 30 years. Much of their content, with perhaps new forms of presentation has been quite stable knowledge in these disciplines for nearly 100 years. It is a sad commentary on the constraints higher education places on the schooling of these subjects that their successful students can have been at school for 12 years and still not met in chemistry more than a handful of the fascinating chemicals of our own bodily processes. Polymerised molecules and the inorganic world of ceramics will be almost closed books and the highly developed field of organo-metallic chemicals has never been opened at school. The same is true of most applied chemistry; and physics is no better. The solid state physics that underpins the world of music and television—so dear to adolescents in all countries—is, at best, an optional topic in many physics courses. The optics of the laser, holography and of fibre optics has not yet been translated into school physics courses and even the physics of modern time-measuring or of age-dating do not seem to be shared with these successful teenagers.

The designers of school biological science courses seem to have been much more successful at sharing the contemporary knowledge and interests of their subjects with the school population, but there is still lots of scope for further study of the other fascinating bits of the many biological and health sciences.

Out-of-school science is well suited by its lack of constraining syllabi and examinations to provide these bright school pupils with the challenge and intellectual stretching that can come from involvement in these sorts of studies.

Present state of OSSE and future challenges

This introduction does not provide a summary or catalogue of what is presented in detail in the reports that follow. It would have been possible to do that for each type of OSSE activity that is presented. For example, Australia, India, Japan and Singapore are all countries where deliberate efforts are made to seek out and encourage talented students at school; science clubs are important and growing sources of OSSE in most but not all of the countries; science fairs are a stimulus to the scientifically orientated at school, and through them investigative skills are developed which lead to products which attract large crowds to their displays at the various levels of judging.

And so it could have gone on, but this type of summary loses detail and adds nothing that is not already better reported in the national chapters. Furthermore, gaps in OSSE are not likely to be revealed by this process unless specifically referred to—as happens in a few of the country reports.

It is hoped that the following matrix, and more importantly the discussion of its various elements, will provide readers with a real basis for checking what has been achieved in OSSE at this stage and what other possibilities are as yet unexplored in the various countries. The entries, restricted in the matrix to two or three per country, lead to the report now presented.

A number of the entries could have been multilisted since an out-of-school location also often exploited out-of-school time. Quite a number of these entries were in the passive mode of education but not all, and some excellent examples of active learning by groups from the school population were reported by many countries. There is a lot to be done in increasing the active mode for the out-of-school populations of adults or less scientifically oriented pupils although some clubs seem to achieve mixed membership.

There were few reports in which the specialized equipment of science being in some senses 'shared' with the wider population could be detected. Since this equipment is a very important aspect of the mystified view people often hold about science, its 'debunking' by explanation or observed operation may go a long way towards removing a barrier between ordinary people and science. Most of the other gaps in this matrix arise from the limitations of using only a couple of examples per country. On the other hand, if the matrix is placed on any single national report, there are numerous gaps in the opportunities it represents.

The location of some national programmes of OSSE in the opportunity matrix

Aspects of science		Out-of-School Dimensions: Location	Time	Human resources	Modes of communication	Potential learners
Knowledge	Facts	Singapore		Indonesia	Japan	Nepal
	Concepts			Singapore	India	
	Theories				Australia	Philippines
Skills	Practical	Indonesia India	Australia			Nepal Pakistan
	Intellectual processes	India	Rep. of Korea	Bangladesh	Japan	Republic of Korea
	Equipment					
Applications (Industrial, Social, Personal, Commercial)	Existing				Thailand	Socialist Rep. of Viet Nam
	Possible	India Thailand	Malaysia		Nepal	
	Technology	Socialist Rep. of Viet Nam		Nepal	Bangladesh Indonesia	Pakistan
Answers to	Questions		Malaysia			
	Problems	Bangladesh				
Attitudes	Personal	Philippines	India			
	Social				Malaysia	Republic of Korea

Accordingly, although the reports indicate considerable progress in OSSE since 1960, there is enormous scope to continue this type of education. Several national reports like India, the Philippines and the Republic of Korea, specifically refer to an environmental emphasis in some of their OSSE, and this may be a good focus for the next phase of development of OSSE.

In the years since the 1972 United Nations Conference on the Human Environment in Stockholm there has been a growing understanding of how education might contribute to the solution of existing environmental problems and to the establishment of behaviour patterns which will contribute to a sustainable society. Almost all environmental issues have a scientific or technological aspect so science education is a very essential component of environmental education.

Unlike much other education, education for the environment is rooted in real situations. Furthermore some of the most successful programmes have involved a much more intimate interplay of action and knowledge than is customary in formal education. It is by involving persons in action relating to some environmental problem that they become willing to learn the knowledge and skills that will improve their actions.

A tree planting programme in a denuded area is an excellent example. In many places it has been possible to get many members of the public or a school community involved in planting trees. This simple but communal act then motivates them to learn the rudiments of soil chemistry and physics and horticulture, which will help to ensure their trees live. Similarly waste reclamation schemes, river and stream clearance projects, noise abatement, traffic and accident control and many other issues have led to excellent community learning including aspects of the related science.

In this way a more active learning dimension may be added to the OSSE for the non-school learner populations. Most national reports of their OSSE opportunities for these persons seem to be based on passive modes like watching television, observing exhibits at science fairs or models at science museums. The latter two are great experiences for the school pupils who actively create the exhibits and for the model makers, but for the observers, they often remain things 'out there' with little point or relevance.

Science clubs appear to be an important means of OSSE in most of the countries of the region. It was interesting to note that in all the reports except the Socialist Republic of Viet Nam, these clubs are specialist ones for science that would require an interest in or a commitment to this field before people joined the club. In the Socialist Republic of Viet

Nam, the clubs are more general in character, people belong to them for many reasons. Science and technology education has been inserted as a component into their programmes. This may be an interesting approach which would have application elsewhere and thus OSSE can be brought to much wider audiences by being offered through a range of existing community organizations and societies.

Almost none of the reports refer to serious evaluation of the effectiveness of the OSSE programmes. It is not enough in the long run to establish programmes and to extend them. Their quality must always be checked to see if effective and useful learning is occurring. If not, the nature of the programmes will need to be revised accordingly.

Extending the matrix of OSSE and increasing the active character of its learning are the two big challenges for OSSE. This Bulletin sets out what has been achieved so far in some of the countries of the Asia and Pacific region and the base from which such challenging tasks must be tackled. □

SECTION TWO

OUT-OF-SCHOOL SCIENCE EDUCATION IN COUNTRIES OF THE REGION

Bulletin of the Unesco Regional Office for Education in Asia and the Pacific
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AUSTRALIA

by Peter J. Fensham and Richard F. Gunstone

Introduction

Schooling in Australia, takes place within eight very autonomous (and largely non-interacting), separate education systems in the six states and two territories that make up this geographically very large nation of 14 million people. Over the last two decades there has been a tremendous expansion of the school age population (through birth, immigration and greater retention) and the resources for education in terms of schools, equipment and teachers have often lagged behind this expansion and its particular needs.

As the 1970s draws to a close, a more stable situation is developing which may even see a decline of the pressure of numbers on the systems as a whole during the 1980s. Although in most states the minimum school leaving age is still only 15, the numbers of students staying on beyond this age now far exceeds those who leave at that point or at the end of that year of their studies. More than 60 per cent of 16 year olds—the original intakes of more than a decade ago—are still at school now and almost 40 per cent of those intakes are appearing in grade XII, the final year of the formal education programme. Compared with about 8 per cent in the early 1960s, today more than 20 per cent of each age cohort are now finding their way into tertiary education programmes at universities or colleges.

Science and technology education were ambivalent features of the past 20 years. They were acknowledged as important targets for improvement and expansion in the educational task as a whole. They were, however, because of their requirements of special facilities—laboratories and equipment—and of highly trained staff whose skills are also usable in other societal employment, fields of education that suffered during the great period of expansion just mentioned.

The national government in the mid 1960s recognized the burdens these special demands were imposing on the states and introduced a special programme to build and equip science laboratories in all the secondary schools of the country. This was followed by several national curriculum projects for science and some massive programmes to train science teachers. Gradually these resources have been developed and by the present time it can be said that most schools have better resources and opportunities for science education than have ever existed on such a general scale.

The developments just described have, however, tended to lead to a view of schooling that has excluded technology. This has occurred for a complex variety of causes that it would be inappropriate to discuss in this article. Technical education was, until 20 years ago, a viable alternative at the secondary level to the academic education of the elite minority who then aspired towards the professions and a university education. As secondary education became a general phenomenon it was the academic orientation that expanded and technical education moved to a new sector of middle level colleges that were beyond normal schooling, leaving only a residue of 'craft' education in the schools. Science education, previously very much part of the highly sequential and elite academic stream, was modified and adapted to be suitable for the much wider abilities and interests now in secondary schools. These adaptations did not however go in the technological direction so that, while science is now officially part of the education of all secondary students and even (though much less so in practice) of all primary students, technology education within formal schooling is very weak.

This paper concentrates on science and technology education in Australia outside the formal curriculum of learning that takes place within the classrooms and laboratories of schools. With such a highly developed system of schooling it seems inevitable that most of it (perhaps even an increasing amount) does take place within the walls of the buildings established for it. There are, however, many examples and even some new recent initiatives that indicate that the scope in Australia for science and technology education out-of-school is substantial. Perhaps even gathering this information together in this way may contribute to the rich potential being more widely used.

The first part of the paper is concerned with the support structures that exist both within and without the formal systems of education for out-of-school science and technology education. Part two reports in some detail the range of examples of this type of education that have occurred in recent years. Finally, in part three, there is a briefer account of some of the opportunities for out-of-school science and technology education that exist for the community at large in Australia; particularly those that are aimed at the non-school population.

Support structures for out-of-school science and technology education

Within the formal systems of education. There have been a number of developments in each of the education systems that acknowledge the importance of out-of-school contexts for science and technology learning. As has been indicated, the science part of this educational pair tends to have been stressed, but once the out-of-school is accepted, this stress can more easily be changed since the science in these real contexts is often essentially technological if the users wish to see it in that way. Among these developments are: (a) educational field officers; (b) field study centres; (c) camping; (d) curriculum materials for out-of-school science; (e) in-service education of teachers; (f) work experience; and (g) school and community.

a) *Educational field officers*

Each state system now has a number of science teachers who are appointed as education field officers at (or to facilitate the use of) community resources or activities other than schools or teacher centres. These locations vary from state to state but museums of science and technology, zoos, state and national parks, forestry centres, and the Gould League (originally a bird lovers' body that now has wide environmental interests) are common examples. These field officers develop educational programmes at these locations or are associated with these interests that can then be used by a teacher with his class. Often these officers become the teacher or key resource person during these half-day, day or longer visits away from the children's normal classroom. The education officers usually encourage the school science teachers to co-operate in planning the educational experience by preparing the children in class before the visit and following it up afterwards back in the classroom. Many worksheets have been prepared for use at these field locations that take into account the level of the children and appropriate learning objectives.

b) *Field study centres*

The last five years has seen the active encouragement by the school systems of special field study centres. Queensland used a major innovations grant from the national Schools Commission to pioneer the establishment of several field study centres in that state. To a lesser extent this initiative from within formal education to establish an educational location that is not a school has also occurred in most of the seven other systems.

The system as a whole and particular schools in the local area then set out to develop these areas as educational contexts. Nature trails are established, experiments in wilderness regeneration are undertaken, facilities for the mapping and identification of flora and fauna are provided and more ecological forms of study and analysis are also being developed. Some of the centres are in urban regions and in these cases the science education takes on quite different foci such as the properties and use of materials, the generation, distribution and consumption of energy and other resources and the pollution of noise, atmosphere and water.

c) *Camping*

In the last five years camping has become a common and regular feature of the life of many secondary and senior primary classes in Australia. This takes the children and their teachers out of school to, usually, a rural or seaside site for often a week of the school year. An educational and social programme is planned by the teachers (sometimes with local community co-operation) and this will usually involve biological and earth science studies and less often but increasingly physical science and technological aspects. The state education departments have assisted and encouraged this development by providing sites (former small schools in country areas where educational consolidation no longer requires their use) and by outlining regulations and procedures that enable schools to include these camps in their programmes with confidence and with the expertise of others' experiences.

d) *Curriculum materials for science out-of-school*

The Australian Science Education Project (ASEP), the Academy of Science's Web of Life (biology) and Environmental Science (Curriculum Development Centre) are three national curriculum development projects which have provided specific materials that involve science learning outside the school. A number of other recent materials also encourage this type of science learning either on excursions to appropriate sites (the seashore, local ponds and lakes, gorges or cuttings), or by simulating the conditions of more distant environmental conditions (like a desert or rain forest ecology) in carefully tended sections of the school grounds.

e) *In-service education of teachers*

Since 1973 the Schools Commission, established by the Labour government at that time, has provided substantial national funds to the state systems of education for much more systematic in-service education of teachers. Science education has had its share of these funds and many short courses have been organized in all states, a significant proportion of which have been concerned with out-of-school science education. Examples include weekend courses to equip teachers with generalized skills for geological and seashore excursions and with more specialized skills such as mineral identification and scuba diving. So far, much less attention has been given to the major lack most teachers have concerning technology. Some of these in-service funds have been used for courses which have been associated with the scientific professions or research institutions like the Institution of Physics and Chemistry and the Commonwealth Scientific and Industrial Research Organization (CSIRO). 'Electronics', 'Foods' and 'Solar energy' are recent topics for this more technological in-service development of teachers which could lead to continued contact with these out-of-school sources of science education. Another project involved teachers with 'discovering' examples of 'mathematics in action' in factories, shops, homes, dental surgeries and hospitals and developing teaching and learning packages so that their students can also learn these concepts and applications in the world of their everyday lives.

f) *Work experience*

After some experimentation by some schools with brief periods of work experience for their students during their school year, Victoria and several other states enacted formal legislation that facilitates and protects employers and schools in this enterprise. Many schools now have highly developed programmes which enable all of their students at the grade IX or X level to have 5-12 days per year of this work experience. It is clear that a number of these opportunities are being provided by industries, universities and research establishments that are engaged in scientific and technological activities. There is obviously a real potential for the work experience in science type situations to be seen as an educational experience by both the students and their teachers.

g) *School and community*

Another recent development that has been formally fostered is the sharing of resources between schools and their local community. In most cases this has amounted to little more than community groups using school facilities when the school does not require them. However, in some cases the flow is the other way. A small number of schools have been developed during the 1970s without traditionally separate school buildings. They rent halls or churches that are free during the week and do as much of their curriculum as they can in existing community facilities like the library, local council workshops, local parks, gardens and reserves and local industries. More generally the schools that have looked outward to enlarge their resources by using the local community have been able to include much more applied science or technology in their students' programmes.

Outside the formal system of education. There has been for a number of years a network of support from outside the schools and school systems for science and technology education. Happily it is possible to report that this is also growing.

A number of companies (e.g. the oil and paper industries) have produced educational films that present science and technology in action. The CSIRO has also prepared films on various of the many research programmes of national interest. The Australian Broadcasting Commission also prepares educational programmes aimed at the schools, for both television and radio, that include their share of science topics.

Most university science faculties have some regular liaison with schools. This often takes the form of a series of lectures (usually with excellent demonstrations) for senior science students in secondary schools. Sometimes the lectures aim to make students aware of the frontiers of science and at other times they are pitched much more at the level of school science topics. More recently the science departments in universities and colleges have offered their resources to teachers with small groups of students so that instrumental analysis and the use of other complex equipment can be added to the projects some science teachers are encouraging their students to undertake. The most famous example of a university providing out-of-school science education is the now long established Summer School arranged by Professor Harry Messel and the late Professor Stuart Butler at the Physics Department of Sydney University. Senior science students in schools all over the country compete for places at the week-long feast of science. They are joined by students from Britain, Japan and the United States of America and a team of leading scientists from all over the world lecture and interact with them at the Summer School.

The Australian and New Zealand Association for the Advancement of Science (ANZAAS) also provides excellent opportunities for school science teachers and their students to move outside the schools and learn about all sorts of aspects of science. Associated with each annual conference is a student ANZAAS which is attended by 500 or more students from the host state's schools. Each year ANZAAS also is involved in making recent science films more readily available to schools.

The Academy of Science has provided a similar opportunity for school teachers to participate in their annual conference that each year has a major scientific field of interest as its theme.

A number of government departments at both state and national level regularly make available to schools, journals and other reports that describe scientific and technological developments with which these bodies are concerned. Prominent among these are the Department of

Agriculture, Fisheries and Wildlife, Department of the Environment and CSIRO. These materials are not specifically aimed at school age students but many schools and teachers regularly avail themselves of these easily read accounts of Australian science and technology. CSIRO is an interesting example of a government body which carries out a great deal of research into all sorts of aspects of Australian primary and secondary industry. It has over the past few years done much more to publicize its activities amongst teachers and now provides a copy of *Scifile*—a resource booklet for teachers containing about a dozen short research reports—to each member of the Science Teachers Association, three times a year. Many industries provide informational material about their science and technology to school teachers and their students who often tap these resources for school projects, many of which are done as homework.

More occasional examples are the kits about uranium mining that were prepared for schools by the Mining Industries Council and the Australian Conservation Foundation/Friends of the Earth/Movement Against Uranium Mining—opposing proponents on this vital national and international issue. It was science teachers and students who used these out-of-school source materials.

One interesting individually inspired support has been a series of very high quality booklets on *Weather, Paper, Energy* and *Mining and the environment*—specifically written and designed for schools and published by J. and D. Burrows with financial support from a number of Australian industries. Class sets of these have been made available free of charge to science teachers throughout the country.

Teacher initiated support structures. The primary support structure that depends on teacher initiative and participation is the Australian Science Teachers Association and its eight constituent associations in the states and territories. These associations have now been in existence for many years and have naturally known periods when the activities have waxed and waned. However, in general, they provide considerable support for teachers through state and national journals of high quality, professional meetings, annual conferences, and liaison with sources of science and scientists outside the school system. Scientists of all sorts regularly contribute through these channels and the applied or technological emphasis has been increasing. A recent volume of one of these journals contained instructions from a CSIRO scientist on the construction of an anechoic chamber, a notice of a display of home and small business computers, an article on Technology and Australian Society (computerization, energy production and environmental protection), a suggestion that membership of the Institute of Physics is worthwhile for teachers and an announcement of the venues for its annual Youth Lecture and *son et lumière*,* and four short extracts of science news and developments from the new scientist.

More recently an Environmental Teachers Association has been formed in some states. These, by the nature of their interests, set out to provide support and ideas for the many science teachers among the membership to involve their students with the scientific and other aspects of the out-of-school environments of Australian society.

There are also increasing examples of teachers seeking and gaining support from Australian industrial companies. Some individual teachers have no doubt always done this and so assisted their students to see and learn science outside the school. However, these examples have not been readily available to less confident or enterprising teachers. Excellent co-operation is now emerging that has led to curriculum materials in the form of case studies of Australian technology and to some well planned excursion programmes that will enable many teachers to have access to these out-of-school situations.

A rather unusual but vigorous example of out-of-school science is the INSPECT movement. This was initiated by teachers but operates as a co-operative venture between teachers and students from a number of schools. It has a strong environmental concern and seeks to involve its members in out-of-school investigations of real situations during their leisure hours. Participation in one of its projects has usually proved to be an exciting and stimulating learning experience.

Some examples of out-of-school science and technology utilized by Australian science teachers

In general, the following descriptions and discussion of some relevant current practices of Australian science teachers are just that—no implications about 'popularity' or 'frequency of use' are intended for any practices unless these are specifically stated. Many of the examples described below have been taken from responses received, from science teachers in all eight Australian states and territories, to a survey conducted by the authors.

Many of the activities currently undertaken by Australian teachers in this area need to be seen in the context of the widespread curriculum changes of the 60s and 70s. In particular, the dramatically increased curriculum autonomy which schools now possess in itself encourages greater

* The use of recorded sound and light, held at night, to present a narrative about an important building.

use by teachers of out-of-school resources, through their design of courses which attempt to take account of the particular features and interests specific to that school.

Two decades ago, when much more control over courses was exerted from outside the school, out-of-school activities in science and technology did exist. A majority of teachers when instructing in areas such as nature study (in primary school) or astronomy and agriculture (in secondary school) utilized obvious out-of-school observational and experimental work. Other out-of-school activities then used included half or one day field trip type excursions (geological or botanical) and visits to industrial plants. Both the later examples were almost exclusively confined to the last two years of secondary schooling. In today's Australian schools teaching strategies which utilize some form of out-of-school science or technology are much more common and much more diverse. Increased school-based curriculum autonomy has fostered this growth which is apparent both in topics not previously included in school science and in alternative approaches to topics remaining from the science courses in existence 20 years ago.

Within that very broad curriculum context, secondary and primary school examples of currently used out-of-school science/technology resources are discussed below.

Secondary school examples

The field trip type of excursion referred to above is still often used by secondary teachers. The existence of the support systems as described above in the first section of this paper has changed the pattern of many such excursions, with the staff provided by the support systems being commonly involved in the teaching undertaken during the excursion. As already suggested, in such circumstances it is usual for the support system staff to discuss the specific requirements of the excursion with the science teacher prior to the excursion so that the experience undertaken by the students is co-ordinated with the in-school science being studied. The more common venues for such excursions are national parks, zoos, museums, planetariums. It is clear that many excursions to national parks in which the normal classroom teacher does all the excursion teaching and organizing are also conducted.

An alternative approach to providing the classroom teacher with expert assistance for the excursion has been used at some field study centres and at least one planetarium. This involves the 'teaching of the teacher' by the out-of-school staff prior to the excursion so that the classroom teacher, with his/her newly acquired skills, conducts the excursion himself/herself. The benefits of this approach are seen to be the integrating in one person of the specialized knowledge relevant to the excursion site with the specialist knowledge about the individual students in the group and the particular topic being studied. The major disadvantage is that the in-service training being provided to the teacher is usually on the very inefficient basis of one-to-one teaching.

Industrial excursions are still used by teachers. In these cases a form of support staff usually exists although such staff are invariably members of the public relations department of the industrial concern being visited rather than teachers provided for the task by the education system. The only exceptions to this are found in government-run industrial undertakings.

The particular forms of industry chosen by teachers for excursion visits have changed somewhat over the last 20 years. At that earlier time the bulk of these type of excursions were undertaken by senior secondary school (grades XI and XII) chemistry classes who visited industrial chemical plants for the purposes of learning about manufacturing processes, or senior physics classes who visited electrical power generating plants. Today these types of excursions are still undertaken, but not as frequently (and a small number of teachers have used the industrial processes of chocolate and/or ice cream manufacture rather than production of sulphuric acid for reasons of student motivation). The focus of industrial visits now is much more towards environmental issues—visiting industry to learn about environmental controls, visiting recycling centres. This change in focus has also meant that junior secondary (grades VII or VIII to X) are more frequently involved in industrial excursions than was previously the case.

Tertiary institutions (universities, institutions of technology, colleges of advanced education) have become much more open to visits in recent years. Virtually all of these have annual open days, which are designed for the general public rather than school students. Of more relevance in the context of excursion visits designed to contribute to the school science curriculum is the willingness of many tertiary institutions to act as hosts to excursions. The purpose of such excursions is usually to visit research laboratories and consequently these visits are very largely confined to senior school students. In some states, where the curriculum in grades XI and XII enables or even encourages it, some teachers have been able to organize small groups or even individual students to spend a small part of each school week with one tertiary staff member on a long-term basis in order that the secondary students can undertake a research project. This obviously allows the school students access to both expertise and equipment which the school system could never hope to provide.

Other forms of excursion venues currently being used by secondary science teachers include geological sites of all descriptions, sites containing ecosystems of interest, mines, farms with provision for educational visits (these include both government-run and privately-owned), hospitals and pathology laboratories, animal and plant breeding locations, theatres (for the purposes of studying the lighting used as well as more tangentially relevant issues such as physiology of the ballet) and field and marine study centres.

Field study centres (FSCs) are recent developments in this country as in most others. FSCs in Australia are generally undertaking two tasks within the education system. They are involved with both serving the needs of schools for relevant excursion sites (and are used in this way for field trips of longer than one day as well as shorter visits), and serving the needs of teachers for in-service training in relevant areas (again through both single day and residential courses). Obviously FSCs have great relevance to the study of ecological issues in particular and environmental issues in general. It is the growth in interest in environment education which has been the strongest factor in their development.

FSCs have become quite widely used as field trip venues by science teachers in those states with a network of established FSCs. Their environmental focus seems to be utilized with all levels of secondary school whilst the biological/ecological focus is used more with senior secondary students than with junior secondary students.

Marine study centres are less common and even more recent than FSCs. They are serving similar functions to FSCs but obviously, in a marine environment.

An educational activity in Australian schools with many similarities to FSCs, which has grown dramatically in the last decade, is the school camp, which was discussed in the first section of the paper. Typically these camps involved a group of students from one grade level for a period of a week (some are shorter, some longer). The huge majority of school camps are located outside urban areas. The purposes of school camps are very diverse, and may in a few cases have no overt connection to science/technology *per se*. However, teachers at many school camps make use of the presence of their students in a particular environment to teach about that environment. Many schools with their own permanent camp location have structured such experience into the total science programme provided by the school.

As well as teachers and students moving out of school to study science in the above ways, both teachers and students bring out-of-school resources into the school science room. Almost certainly this happens more commonly via television than any other mode. The Australian Broadcasting Commission (ABC) produces programmes specifically for educational use in a wide variety of subjects (including the sciences) and at all grade levels. However, since the recent availability of video-tape recorders in many schools, programmes produced for general entertainment which have science content are becoming more widely used in science classrooms than the programmes made specifically for educational use. Certainly students bring many ideas, concepts and opinions into their science classes as a result of viewing these entertainment programmes. It is of course trite but important to state that television in general has dramatically widened the range of science related experiences students can have, even if these are rather passive and second-hand. These issues are taken further in a later section of this report.

Apart from the use of television programmes not specifically intended for the education system, secondary teachers are bringing a wide range of out-of-school resources into their science classes. These include other branches of the media; newspapers provide a continuing source of topical science issues; many magazines contain science and pseudo-science articles; and radio (particularly the ABC) produces science programmes. A number of metropolitan daily newspapers carry a comic strip 'Frontiers of Science' which depicts topics from science research. Numbers of teachers use these in class lessons. Examples of these resources are giver later in this report.

Many of the organizations (listed above as venues used for excursions) also provide literature which some teachers use in their formal teaching at school. In addition to those publications mentioned on pages 21 and 22 a set of comic strip type cards produced by CSIRO and depicting their research are used by some teachers. These cards, entitled 'Researcher', have been published by some newspapers and are currently being distributed by the Science Teachers Association of the Australian Capital Territory. Professional associations (e.g. astronomical societies) and activist groups (e.g. Movement Against Uranium Mining) also produce printed material. Many of the above organizations provide speakers who are invited to speak to science classes at some schools and some (e.g. Royal Australian Chemical Institute) run organized lecture programmes for senior secondary students.

Specifically, science magazines and journals are also used. Amongst these are *Scientific American* and *New scientist* (in senior forms) and *Science world* and *Ranger Rick's nature magazine* (in junior forms). Most are overseas publications, with *Scientific Australian* being one of the exceptions. This Australian journal is relatively young and apparently not yet widely known. Quite extensive 16mm film libraries exist in each state and science teachers frequently borrow from these. Many industrial organizations (both government and private enterprise) and consulates also have relevant films available for loan. Films from these sources are widely used by science teachers.

The curriculum autonomy referred to above has resulted in the inclusion of many topics in current junior secondary science courses which have much relevance to out-of-school science. The following are a small number of such topics currently included in some science courses: house insulation, motor cars and motor mechanics, the science of cooling, bleaches and detergents, nuclear energy, solar energy, photography, bikes and boomerangs, model rockets; swimming pool chemistry, repairing household appliances. Examples of equipment constructed by students in such courses which can be used outside school include radios and tape recorders, solar water stills, plastic greenhouses, soap and cosmetics. In some cases, the making of working science models has become a specific unit in the science course.

One activity which encompasses aspects of many of the things already described is the Science Talent Quest or Science Talent Search. This involves the development by a student or group of students of some form of research project which is judged and awarded a prize deemed appropriate. Although the competitive nature of the Science Talent Search has caused some teachers to consider it not suitable for their students, the activities involve large numbers of students and result in some quite remarkable work. The organization is generally state-wide although sometimes conducted in intra-state regions, or even within and by a single school in a few cases. Financial support from industry is common, thus providing useful links between industry and science teaching. Some Science Talent Searches have broadened their approach in recent years to include sections for essays, posters, simulation games and models.

Both the breadth and depth of the projects undertaken by students for Science Talent Searches is shown by the following very brief list of examples from recent years:

a) 'Lunar photography'—the report included not only lunar photographs of good quality, but also a substantial discussion of the physics and technical problems involved (done by a senior secondary student);

b) 'A study of slaters'—a study of both the functional and behavioural characteristics of the common woodlouse (*oniscuss asselus*) (two senior secondary students);

c) 'Locomotive bias in white mice'—determination of the existence or otherwise of such bias and description and results of an experimental attempt to influence any detected bias by thought alone (one junior secondary student);

d) 'Science concepts in animation'—creation of three short animated films, each dealing with science topics (one senior secondary student);

e) 'Solar energy research: parabolic reflector'—the making of a parabolic reflector and the use of the reflector in a number of experiments (four intermediate secondary students); and

f) 'Shoelaces'—an experimental investigation to determine which type of shoelace is 'best' (one intermediate student).

Most of the Science Talent Search activities run in Australia are organized by the appropriate state science teachers association, whose support is directly responsible for their popularity and success.

Displays consisting of many of these entries to the Science Talent Search are organized and visited by both the general public and excursion groups of school students. At such displays, the secondary student(s) responsible for each project are with their project display to discuss with and answer questions from visitors. Research scientists are frequently amongst the visitors and, as a result, a number of secondary students have been invited to spend time in tertiary institutions working further in the area of their project.

Primary school examples

Despite many attempts to foster the growth of science in the curriculum of primary schools, there is generally much less science of any sort taught in the primary schools than in the secondary schools. Consequently, a concise (if a little simplistic) statement about out-of-school science in primary schools would be, 'similar to the above patterns for secondary schools, but much less of it.'

Despite this relatively minor place of science in the curriculum of many primary schools, some particular activities of those listed above for secondary schools are also quite common in primary schools. In particular, excursions of all sorts are widely used and many of these include nature study/environmental issues. Probably the most common difference in the primary school excursion, as compared to the secondary school excursion, is that the primary school is more likely to see its excursions in the context of a whole school curriculum than in the context of a single subject. Consequently, a primary school excursion is less likely to be exclusively science based but frequently includes science as well as other topics. Venues for excursions which include science issues at this level are largely ecological/natural environment, but sites such as museums are also sometimes used. Other out-of-school resources used at this level include television (both directly and, in some schools, via video recording), radio, project work (which may utilize literature from out-of-school sources) and the materials of the Gould League.

One resource more commonly used in primary schools than in secondary schools is the expertise of parents of the students at the school. This use of parents in teaching roles sometimes extends to parents conducting electives or clubs, usually for one teaching session per week. In this context, some primary schools have had parents running science programmes which the parents rather than the school have structured.

Community out-of-school science and technology education

The major emphasis of this paper has been out-of-school science education for the school age population. However, it would be remiss of us not to mention some of the sources that do exist in Australia for science and technology education outside the formal structures of school and tertiary education. These are aimed at the Australian community more generally, but of course students at school, their teachers, as well as parents and other citizens are free to use them with equal access (in almost all cases).

The sources to be discussed are under five headings: (i) Newspaper; (ii) Libraries; (iii) Television and radio; (iv) Community education; and (v) Participatory science groups.

Before considering these five groups of sources, it is important to briefly describe another type of influence on both school students and the general public which is best termed 'pseudo-science.'

Many teachers recognize that the science ideas and perceptions which are brought into science classes by their students are of real significance in influencing the science learning of the students. The general community sources listed above are important in influencing these ideas and perceptions brought to the classroom, as are the student's peers and his/her family (one teacher described this to us as the effect of 'family folk-myths' on the science learning of his students). All of the details given below of the five listed community sources have some influence in this way whether or not the teacher recognizes it.

Talking with school students makes it clear that these influences extend beyond science and into the realms of 'pseudo-science.' There has been a considerable growth of community interest in the last decade in areas such as astrology, the rather unusual ideas of the author Von Daniken,* the supposed powers of the pyramid shape in keeping food fresh, razor blades sharp and so on. All of these topics, and many others, have been widely publicized in popular magazines, newspapers with a more sensationalist outlook, and television programmes. It is clear that at least some students (more particularly at the secondary level) enter their science classes believing that these currently popular interpretations are the truth. This is sometimes further reinforced by other subject teachers (e.g. English, social studies) discussing these pseudo-science topics in a way that reinforces the view given by popular magazines, newspapers and television.

In general, because of the rather simplistic and one-sided view gained by students, these pseudo-science influences from out-of school have rather negative effects on the teaching of science and technology.

The science and technology sources to be discussed below have more positive effects on the learning of science by school students.

Newspapers. The newspapers in Australia are a constant source of information about scientific discoveries, and applications of science including its misapplications and undesirable social effects. Much of this is rather haphazard news reporting so has limited but not negligible educational value. However, a number of the major papers do have regular science reporters who present very readable accounts of a wide range of pure and applied science.

The science reported in one metropolitan newspaper was monitored for five weeks. The list below gives an idea of the issues covered in this way.

News reports of science related events: (a) the return to earth of the Skylab satellite (a number of reports both before and after Skylab's re-entry); (b) fluoridation of water supplies (in the context of referenda in two communities about fluoridation); (c) Voyager II photograph of a Jupiter satellite; (d) USSR cosmonauts break the space endurance record; (e) an appeal to Australian scientists to accept greater social responsibility, made by a university philosopher; (f) a wide range of scientific/political/economic news reports involving energy (President Carter's United States energy policy, CSIRO developments in electric cars, energy generation via thermal gradients in oceans, reported movements in urban areas towards the city centre as a result of energy shortages, fuel costs in car travel);

* Von Daniken, Eric. *Signs of the Gods.* (Illus.). 239 p. 1980. Putnam.

(g) an Indonesian tidal wave caused by landslide; (h) an attack on the frequency of cosmetic surgery; (i) introduction of a phone service describing the dangers of smoking and venereal disease; and (j) reports of the effects of the current Australian drought.

Feature articles (these were usually in excess of a thousand words in length): (a) evolution–recent fossil finds on one hand and present controversies amongst scientists on the other; (b) Australia's energy future–a two part discussion of alternatives for the future; (c) Australian flies; (d) Solar power development–a report on United States research; (e) the science of yeast–presented in the regular cooking section; (f) Australian fossils–recent finds and their importance; (g) the next steps in space–report from the United States; and (h) should Australia have its own communications satellite.

Regular weekly features contained in the newspaper were a two to three page section on computers–largely with a business/commerce orientation and a one to two page section for school students and teachers–science articles presented in the period sampled covered genetic engineering and a competition requiring the answering of questions about the history of science.

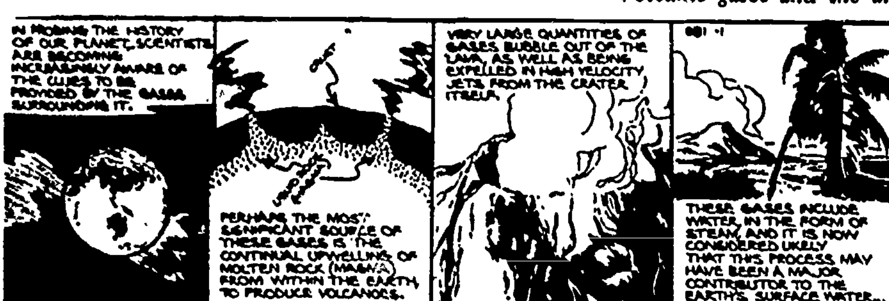
In 1977, visitors from abroad were surprised to find one major newspaper devoting half a page for more than a month to readers' questions and answers (from a university physicist) concerning uranium mining and all sorts of aspects of nuclear power. Alert teachers in schools find Australian newspapers a useful way to convince their students of the relevance of science education because of this high quality and common reporting.

A rather special aspect of this newspaper contribution is the syndicated comic strip 'Frontiers of Science' referred to in part two of this report. This was produced in Sydney by Robert Raymond and Stuart Butler and is a remarkable example of succinct and effective communication about science and technology. It is available in one of the newspapers in most states and has been a rare Australian success abroad including the United States. Examples of this skilful science education are given on the following page. Each topic is concluded in five daily strips.

Libraries. Most people in Australia have reasonably easy access to a free public library (even in country districts through mobile library vans). Although they will have a variable stack of books on science, it is the magazines on science that are stressed here. These are very regularly thumbed and read by all ages of people including many school students. Again, the range will vary from library to library but an example indicates the sort of scope for this sort of out-of-school science education.

A suburban branch library in Melbourne subscribed to *Amateur photography, Aero modelling, Australian plants, Chain reaction* (Friends of the Earth), *Choice* (Consumer Association); *Earth garden, ECOS* (Environmental research), *Electronics* (Australia), *Habitat, Mechanics illustrated, New scientist, Popular science, Science and technology, Scientific American, Skin diving, Sky and telescope, Wildlife in Australia,* and *Your garden.*

Television and radio. Australians are almost entirely dependent on the ABC for what few programmes on science and technology there are. The many commercial channels largely ignore these fields as possible sources of programme material. The ABC occasionally present some quality (but somewhat indigestible) science programmes from the British Broadcasting Corporation (BBC), and they do make some excellent nature programmes themselves. Australia's vastness and its unique flora and fauna lend themselves to spectacular viewing and it is common to hear people discussing these the next day. A very effective series called 'In the Wild' has recently been able to galvanize public opinion about some areas that were under consideration for exploitation or for preservation. Another series entitled 'The Scientists' is currently being shown. It presents the



Volcanic gases and the air

Oil shales: energy challenge

life and work of important contemporary scientists—a very worthwhile contribution to science education since so much of school and university science education involves depersonalized scientific knowledge only.

Some other more general ABC programmes have relevance to science/technology education. Examples of these are the continuing series 'The Inventors' (which demonstrates and comments on some of the latest Australian inventions) and the recently concluded 'Torque' (a history of the motor car). A few commercial channels include science-related segments in children's shows with an educational flavour, for example 'The Curiosity Show' and 'This Week has Seven Days'. There is a regular weekly programme of about one hour—'T' e Science Show'. At the time of writing, this is a six part series on t' history, science and technological use of rubber. The current affairs weekly magazine programme, 'Variation', also often includes science topics and a recent one presented an excellent discussion of the pros and cons of the multiple use of national parks—an important national issue that currently involves a number of forest areas and the Great Barrier Reef.

Community education classes. In each metropolitan centre and in many larger country towns there are fairly well developed programmes of informal community education, either through university extension, the Workers' Educational Association or councils for adult education. Many of these unfortunately exclude school age students even though the course they offer may not overlap at all with the formal curriculum of schools. Science and technology courses make up a small minority of the range of offerings, but they continue to occur and are well attended. In one state last year, the metropolitan science courses included 'Towards a sustainable society', 'Science and the energy crisis', 'Solar energy and its uses', 'Geological map interpretation', 'Evolution and the fossil record', 'Basic astronomy', 'Introduction to chemistry', 'Microscopic anatomy', 'Applied geology', 'Ecology at home', 'Introduction to biology', and seven courses about 'Birds and plants of Australia'.

From time to time such courses lead to excellent books for science learning. One example must suffice from a Canberra community education course on kitchen chemistry which led to the *Consumer chemistry* book by Ben Selinger and published by A.N.U. Press. Community education has in the last five years diversified and there are many grassroots centres which are more learning exchanges than centres for courses. These, too, are facilitating many opportunities for individual science education.

A tree identification exercise by adult matriculation students

A recent development has been out-of-doors education programmes that are conducted by various environmental studies groups for community and schools alike.

Participatory science groups. Throughout the country there are a small number of clubs and associations that are based on science related activities. These provide enthusiastic participation (and education) for members. Most of them fall within the field naturalists' orbit but there are astronomical associations and ones concerned with native plants, health and diet and alternative technologies as well.

In all these ways out-of-school science and technology education in Australia is alive and available. However, if considerably more can be reported now than would have been the case a decade ago, there is still much to do if these sources are to be used on a regular basis by more than a small fraction of the school population or the community at large. □

Bulletin of the Unesco Regional Office for Education in Asia and the Pacific Special issue, December 1982

BANGLADESH

by K.M. Sirajul Islam

Introduction

The People's Republic of Bangladesh is an independent state of about 81 million people and is one of the most densely populated areas in the world. There are few hills or mountains. The alluvial soil carried by mighty rivers, their tributaries and distributaries makes the land fertile. Bengali is the mother tongue of all the inhabitants and is the state language of the country, with English as the second language.

In the last half century, what is now called Bangladesh has achieved independence twice. On 14 August 1947, it achieved independence from British colonial rule and became a part of Pakistan, known as East Pakistan. Then it achieved full independence on 16 December 1971 through a devastating war lasting nine months. Now it is a sovereign state, having its own people in all sectors of administrative control.

Formal education system: past and present

The education system prevalent in the country before 1947 was not suitable for the needs of an independent nation. Its purpose was primarily to produce a number of educated people who could assist the British in operating their colonial administration. In fact, the small section of people who were educated under this system acquired a set of values which, on the one hand, alienated them from their own people and, on the other, developed in them a disinterest in all forms of manual labour.

During the period 1947-55, no appreciable change from this traditional system was made. After 1955, attempts were made to rectify this situation by adopting a programme of educational expansion. This programme partially succeeded in raising the absolute number of educated people in some categories but failed to respond commensurately to the manpower required in various fields. The supply of trained manpower in some areas went up without being matched by that of the other categories, thus causing an imbalance between the demand for and supply of trained manpower. Neither the philosophy of education nor its content were appreciably changed to suit the needs of a developing nation. The high priority given to higher education rather than primary and basic education has led to educated unemployment, thus creating an imbalance in the education sector and generating considerable social problems in the country.

After the war of liberation the Government of Bangladesh engaged itself in the task of repairing and renovating the damaged educational institutions. This was essential in order to ensure the people a secure place in the fast moving world of science and technology. An Education Commission was set up in 1972 to re-organize the education system of the country and subsequently the National Curriculum and Syllabus Committee was set up in 1975 and an Educational Advisory Council started functioning in 1978. The task was to evolve a system of education suited to the economic and cultural needs of the people, giving new emphasis on the scientific and technical education essential for economic development. In spite of all these attempts about 77 per cent of the population, that is about 65 million people, are still illiterate.

There are about 19,000 religious institutions in the country, called *Madrasahs*. Formerly there was no provision for science teaching in these institutions. It is encouraging that science education has recently been introduced on an experimental basis in some of the *Madrasahs*.

Most of the day-to-day technical jobs are done by self-trained persons having little or no formal education

Why out-of-school science and technology education?

This is the age of science without which the modern world is jeopardized. Behind the tremendous progress of the developed countries of the world there is the versatile gift of science and technology. To cope with the onward march of civilization every state must train its manpower in the field of science and technology. In a developing country like Bangladesh where the vast majority of the population is illiterate, and only a minute section of the literate mass is able to receive even basic education, institution-based formal education cannot satisfy their basic needs. Here, various mass communication media like television, radio, newspapers, magazines, film shows, field trips, science fairs, science clubs and science museums can definitely play a significant role. These are the basic tools for conducting out-of-school science and technology education (OSSE) and the Government is fully aware of this vital need.

Position of science education in Bangladesh—average enrolment at different levels in 1978

Levels	Science	Others	Total
Secondary level			
Classes IX and X	107,000	431,000	538,000
College level			
Higher secondary and degree (pass)	7,000	23,000	30,000
University level			
Honours and postgraduate	8,000	17,000	25,000
Engineering and Agriculture University			
Degree and postgraduate level	6,000	–	6,000
Polytechnic and vocational institute			
Diploma, certificate and vocational training	7,000	–	7,000
Total	135,000	471,000	606,000

The table above shows that formal science and technology education in Bangladesh is not in a strong position. This country with over 81 million people can scarcely cater for basic science teaching to 135,000 students. At present there are only about 30,000 scientists and technologists in the country and most of the day-to-day technical jobs are being done by self-trained persons with little or no formal education.

The role of various agencies and media involved in OSSE in the country may be discussed as follows:

Science museum. The only Museum of Science and Technology is based in Dacca. It is one of the main agencies co-ordinating the concerted efforts of the various organizations and media involved in OSSE in Bangladesh. It has also been carrying on its own programmes for this purpose.

The gap between the scientists and laymen in their knowledge and understanding of scientific principles and technology poses a great handicap to scientific, economic and cultural advancement in a developing country, like Bangladesh. Hence, in order to make the people science conscious and develop in them a scientific bent of mind, some positive measures are essential.

Bangladesh has limited, explored natural resources but a vast manpower. In order to survive as an independent nation and to utilize this vast manpower and its natural resources it needs to assimilate advanced technology. This requires the young people to be educated in the principles of science as applied to industry. The Museum of Science and Technology tries to achieve this goal through its exhibits and demonstrations of man's scientific achievements, together with educational programmes. It has been complementing the formal scientific and technical education programmes that are now under way in the schools, technical institutes, colleges and universities and also serves as a resource centre and a place for the exchange of ideas among science educators.

While the work of the Museum of Science and Technology has already been started on a small experimental scale a bigger scheme for the establishment of the Bangladesh National Museum of Science and Technology is in process. The main aims and objectives of the project are to:

a) Preserve the innovative work of local scientists as well as natural exhibits;

b) Display exhibits showing the history of scientific and technological advancement of human society;

c) Help people appreciate the contribution of science and technology and the work of scientists for human welfare and civilization;

d) Create a scientifically educated citizenry in the country;

e) Promote in the public mind an interest for science and technology and develop scientific awareness in the masses;

f) Supplement the teaching of science in schools and colleges;

g) Arouse in the students an interest in their study of science and technology;

h) Encourage the young scientists to carry out innovative work in the field of science;

i) Co-ordinate, encourage and help the science club movement in the country; and

j) Provide teacher training facilities to the science teachers of the country.

The functions of the present museum are to:

a) Demonstrate the exhibits in the galleries;

b) Arrange regular meetings and lectures on science with science clubs, science teachers and people interested in science;

c) Arrange for regular film shows and video tape presentations on popular scientific topics;

d) Provide a science library facility;

e) Serve as a centre of activities for science clubs and allied organizations or individuals to help develop their creative genius and preserve and display their innovation; and

f) Arrange, on request, for special demonstration lectures on selected topics from school science syllabuses.

The success of the activities of the museum which were started on an experimental basis has already inspired the authorities to chalk out a master scheme. The future plan includes:

a) Construction of the museum's own building complexes;

b) Arrangement of a special museum bus for Dacca city and mobile science exhibitions for other places;

c) Arranging annual science exhibitions and prizes for innovative work;

d) Arrangements for museum publications;

e) Construction and installation of a planetarium and an observatory; and

f) Establishment of Regional Science Museums in Rajshahi, Khulna and Chittagong.

The work of establishing the Museum of Science and Technology at Dacca was started about 12 years ago but before 1976 no appreciable progress was made. Since then the museum has functioned on an experimental basis and as a result it has made reasonable progress. This is now an Integrated Science Museum having such different branches as natural history, physical science, astronomy, transport and technology forming a 'Science Centre'. More than one thousand exhibits are set in its temporary galleries. The number of visitors has increased from about a dozen in a month to around 300 per day. The museum has also been playing a vital role in arranging the National Science Week, described later. The members of more than 250 science clubs of the country, as well as different innovators have been finding the museum a friend and guide. In fact the museum has started functioning as a common platform to promote and assist OSSE.

Science clubs. In Bangladesh all the school final examinations are guided by rigid central syllabuses, prepared by Boards or Universities. The education is rather examination oriented. Students aim to cover the topics of the syllabus and to get good marks in the final examination. Here there is very little scope for the original talent of the students to flourish. Except for the professional scientists very few younger people can develop their individual original thinking during their academic scientific work. This has led some of the younger people to form science clubs.

Members of a rural Science Club are working in their club workshop.

Before 1971 there were very few science clubs in the country. After liberation more younger people were attracted spontaneously to form science clubs out of their own initiative. Some of these clubs are now attached to educational institutions and some are not. In all cases some elderly teachers, research workers or scientists and technologists are on the advisory councils of the clubs. All the guides of the science clubs are voluntary workers.

The activities of the clubs include:

a) Original research work on local environmental problems;

b) Design of various instruments or machines with locally available materials to replace imported items;

c) Design of low-cost media for science teaching with local material;

d) Conducting Sunday classes on popular scientific topics for club members and outsiders. Volunteers from professional circles are also invited to contribute their experience;

e) Design and preparation of scientific toys;

f) Study of the local flora and fauna;

g) Collection of local medicinal plants and information about them; and

h) Arranging for field trips to places of scientific importance.

For a long time the Science Club movement in the country was cherished through the initiative and drive of some teachers and scientists. The monthly popular science magazine *Bignan Samaiki* has also played an important role in encouraging the Science Club movement.

The last two National Science Weeks and the present active interest of the Museum of Science and Technology have accelerated the Science Club movement in the country. Now the number of Science Clubs in various areas of the country stands at about 250 compared with a dozen or so in 1977. Whereas there was once very little central co-ordination or assistance, now 20 per cent of the clubs are provided with sets of essential tools by the Science Week Organizing Committee and about 15 per cent received small lump sum grants. In the last National Science Week every club was given the status of an educational institution in all its participation programmes. It is interesting to note that in each science fair the clubs have cut an exceptionally good figure and have earned high admiration from the public.

Some of the clubs even have their own publication and almost all have their own little workshop and library. Most of them arrange for their own science fair in the locality and organize their own field-projects. Big clubs have their own co-ordination and guidance cell. Contests are regularly arranged among the branches and a Central National Contest is being arranged through the activities of the National Science Week.

It is very interesting to note that some children and youth clubs at the national level have started to open science sections. Recently the Science Museum published a *Club Manual* giving detailed information of prominent Science Clubs in the country.

National science week, science fairs and science exhibitions

Of all the means for OSSE practised in Bangladesh, perhaps observance of a National Science Week has proved its worth in the shortest possible time.

To promote science and technology a high level council, the National Council for Science and Technology, was formed in 1976. The Council is headed by the Honourable President as Chairman. One of the functions of the Council is to popularize science and technology at all levels. Of the various steps taken by the Council for this end, the organization of

Science fairs organized in connection with National Science Week attract thousands of people

National Science Week has proved to be very effective. Some of the main aims and objectives of the week are to:

a) provide better public appreciation and understanding of science and technology, natural resources and the environment;

b) encourage students in creative activity and independent thinking;

c) train young people in instrument making and carrying out observations;

d) encourage the use of indigenous materials in scientific work;

e) search for young scientific talent;

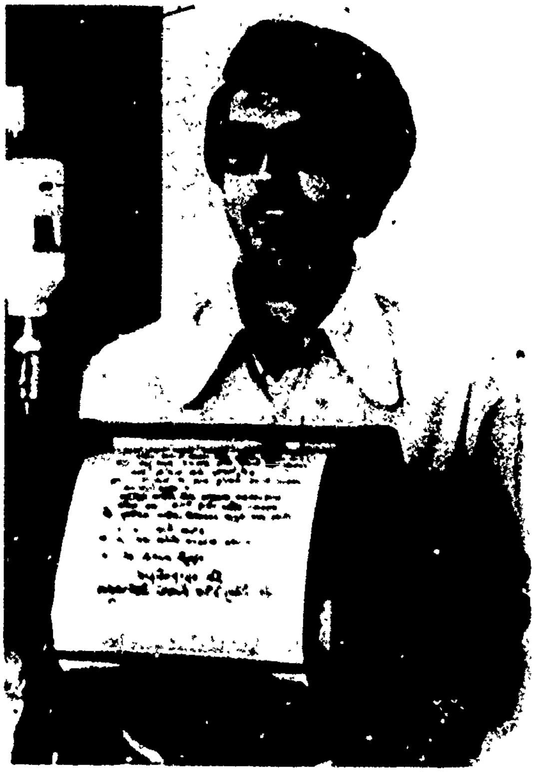
f) encourage scientists to relate their scientific education and activity more closely with the national problems;

g) bridge the gap between the general public, the young science students and the professional experts in respect of scientific knowledge; and

h) encourage the activities of the Science Clubs.

The first National Science Week was organized in two stages. In the first stage, a science fair and exhibition, symposia and seminars, a debate and an essay competition on scientific topics were held in each of the 19 district headquarters in 1978 and central activities were organized the same year in Dacca, the capital. Each of the centres attracted a huge number of people from all walks of life both as participants as well as audience. Many innovators displayed their talents through the exhibition of appropriate and alternative technology based on local resources which included a wooden cyclostyle machine, multi radio, family bicycle and wooden refrigerators. Moreover through the open exhibition of national level organizations such as the Bangladesh Council of Scientific and Industrial Research, and the Atomic Energy Centre, the common masses had a chance to come in contact with some of the professional research organizations and their work. This was definitely a rare occasion for the younger generation and general public to see at close hand professional scientists and their achievements. The whole activities were wound up with a central contest arranged in Dacca.

Being inspired by its success, the National Council for Science and Technology decided to arrange a second National Science Week in the same year. Science fairs, exhibitions, symposia and seminars on scientific topics were held with great enthusiasm in 64 centres covering various remote areas of the country. This has had a great impact on society by creating mass interest in science and technology. The Government has now decided to arrange a National Science Week on a regular basis. Next



This cyclostyle machine made of local indigenous material has vast potentiality.

time it is expected that the activities will be spread to about 500 district headquarters so that the national contest will include participants from the very grassroots level.

Not only did students, teachers and research workers add their contribution to the Science Week activities but also the members of the 250 Science Clubs.

Besides the science fairs and exhibitions organized in connection with the National Science Week, annual agricultural and industrial fairs are also organized by the state in each of the district headquarters of the country as well as in Dacca. Small scale science exhibitions are arranged by different universities and educational institutions. In addition the Bangladesh *Shishu* (Children) Academy arranges an annual exhibition in which special emphasis is given to the work of children in the field of science and technology. The Bangladesh Association for the Advancement of Science, the Bangladesh Medical Association and different science clubs also arrange annual science exhibitions.

Industrial exhibitions are enjoyed by both adults and children.

Field projects and trips. Field projects and trips are definitely a powerful tool for OSSE. Participants can get first hand experience through these programmes.

Bangladesh is a very densely populated country, where there is almost no virgin land but yet the study of flora and fauna, the geological condition of Chittagong hill-tracts, the study of marine life and visits to various scientific and industrial spots may usefully be included under this heading.

Field projects and trips are usually arranged by educational institutions while different faculties of the universities and colleges arrange special field projects on a limited scale to supplement the theoretical studies. About 75 college level educational institutions are given an annual grant by the Government to subsidize the costs involved in field projects. Some Science Clubs, youth organizations and associations also arrange their own programmes.

Popular lectures. In order to popularize various aspects of science and technology, different educational institutions, including the six universities, have been arranging lectures on different topics as extra curricula activities. The Science Museum arranges regular scientific film shows and

Young men and women are using the traditional system to level the agricultural land. (The dragging is usually done by bullocks).

popular lectures at its premises. Moreover, a dozen Science Clubs are involved in arranging regular demonstration lectures on scientific topics to give some idea of basic concepts as well as modern advancements in science and technology to the local people. Professional research organizations such as the Bangladesh Atomic Energy Commission, the Bangladesh Council of Scientific and Industrial Research, the Bangladesh Agricultural Research Institute, the Bangladesh Jute Research Institute, the Bangladesh Rice Research Institute and the the Bangladesh Medical Research Council also arrange regular lectures in their respective fields. Various national level associations such as the Bangladesh Association for the Advancement of Science, the Bangladesh Association for Scientists and Scientific Professions and the Bangladesh Medical Association, arrange annual conferences at which not only professional papers are read on various specialized fields but exhibitions, demonstrations and lectures are arranged. In addition the National Council of Science and Technology has been planning to send prominent scientists to rural areas to conduct a series of lectures on local scientific problems and the basic needs of science and technology.

Newspapers and journals. The newspaper is one of the oldest media for mass communication in the country. There are about 25 dailies and 200 periodicals published in the country. Due to the high percentage of illiteracy it is not as effective as it ought to be. Moreover, the circulation of the newspapers is limited to urban areas. A few newspapers publish news on scientific topics and there is plenty of scope for utilizing the media for OSSE. There are some monthly journals published to cover the science popularization programme in the country such as the *Bignan Samaiki*, *Popular Science Journal* of Bangla Academy, *Bignan Samaj Patrika*, and the *Bignan Charcha*. Besides, some science club publications such as *Sagnic*, *Bignan Parikrama*, *Anbesha* and *Cosmos* cover various aspects of science and technology. Moreover, universities, research organizations and other professional organizations publish their own scientific journals too.

The publication of books on popular scientific topics and experiments is gaining ground and the translated versions of a good number of books on the subject are also being published.

Girls are enjoying a demonstration of their exhibits in a Science Fair.

Motion pictures. The only place in the country where regular 16 mm film shows are arranged for popularizing science and technology is in the Science Museum. Bangladesh television occasionally shows films on popular scientific topics. There are about half a dozen Science Cine Clubs in the country which arrange 16 mm science film shows. In addition, Government publicity departments have been using 16 mm films for propaganda purposes in promoting health, hygiene and family planning, and the development of agriculture and fisheries and livestock. Sometimes the Ministry of Information and Broadcasting arranges short film shows in commercial cinema theatres before the commercial films are shown.

The only state owned film library in the country for lending educational films, is the film library of the Audio-Visual Education Centre at Dacca. It has about 400 sound films of which about 50 per cent are on science and technology. Different universities and other educational institutions have some collections of sound films on science and technology to supplement their classroom teaching. Moreover, different foreign organizations, like the British Council, the American Cultural Centre and the German Cultural Institute have good stocks of films which are regularly shown in their own premises or may be borrowed by the different institutions or agencies. Very few of the films are produced in the country as production of scientific documentary films is not yet a commercial proposition.

A local innovator made this improvised Sound Cine Projector

Radio. Bangladesh, a compact country with very few hilly areas, is widely covered by the Government controlled radio network. This media plays a vital role in mass communication to cater for the vast population of rural areas in imparting OSSE, especially in the fields of agriculture, health, sanitation and family planning. The regular science popularization broadcast covers basic science and technology. At present there is no separate operating cell or channel for science programmes. The radio authorities themselves usually plan the programme and invite different speakers to present the topics. The central broadcasting station at Dacca, the regional stations in Rangpur, Khulna, Chittagong and Sylhet not only relay the programmes from Dacca but also sometimes arrange for special programmes to suit the needs of the people of the locality. A special scheme is now being prepared by the Ministry of Education for an elaborate school broadcast system which is expected to be implemented very soon.

Television. Bangladesh television began in 1965. It is a one channel, black and white telecasting system broadcasting about six hours daily to cover national and international news, entertainment, educational programmes and commercial advertisements. At present there are about half a dozen relay stations covering approximately 80 per cent of the land mass. It is expected that by the end of next year the entire country will be covered by the television network.

Currently only two hours telecasting per week is devoted to the programme on OSSE. Here there is more emphasis on agriculture, health and hygiene. A limited number of good science programmes are being produced. In several programmes the achievements of young scientists of various Science Clubs are put forward. Sometimes popular science films are shown. There is ample scope for effective utilization of the media for

The traditional rural technology of Bangladesh, like folk-tales or folk-songs, is handed over from generation to generation through verbal communication and practical experience popularizing science and technology. More effective programmes may be developed in close co-operation with various educational institutions, research organizations, the Science Museum, the Audio-Visual Education Centre and the Science Clubs. The Government is very conscious of the effectiveness of the media and hence it is expected that from the middle of 1983 a second channel of Bangladesh television will be opened to cater for more educational programmes.

Verbal communication of traditional rural technology

Just like folk tales or folk songs which are handed over from generation to generation through verbal communication, in Bangladesh some traditional rural technology is being transferred from person to person, generation to generation through verbal communication. The science and techniques of domestic metalwork, woodwork, food preservation, house building and traditional agriculture are some of the typical examples of this.

Conclusion

OSSE can not only convey the basic concepts of science and technology to a vast mass in an economic way, but can also broaden the horizon of the participants. This system may gradually meet the requirements for creating a science conscious citizenry.

Bangladesh, with its vast manpower and limited facility for coping with formal science and technology education has to depend to a great extent on OSSE. The interchange of ideas between different developing countries could play a valuable role in improving the local systems in use. International seminars on this topic may be a useful way of bringing about this exchange of knowledge. □

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CHINA

by Wang Jingsheng

Prior to liberation in 1949, old China was extremely backward in culture and education. Eighty per cent of the population were illiterate while illiteracy in the rural areas was as high as 95 per cent. Since the founding of New China, much effort has been made in expanding education, science and technology in the course of developing the economy. By 1981, 94 per cent of the school-age children were in schools as compared with only 20 per cent in the past. An estimate of middle school students in 1981 revealed an increase of nearly eight times over the pre-liberation figures. In addition, much headway has been made in establishing different spare-time schools, pre-schools and schools for the handicapped.

Out-of-school science activities

Apart from developing formal science teaching, much importance is being attached to the rapid development of out-of-school science activities for more than 200 million students in the primary and middle schools. Children and teenagers are the expectations in scientific advancement and the hope for the future development of the country. The government has called on them to 'love, learn and make use of science', and urged the whole nation to be concerned about the wholesome growth of the young generation. As a result, close collaboration has been developed between the central and local governments, between communities and the schools to develop science activities for the young people.

In June 1981, with the approval of the State Council, a National Leading Group for Youngsters' Scientific Activities was formed by responsible persons from five major organizations; the China Association for Science and Technology (CAST), the Ministry of Education, the State Commission for Physical Culture and Sports, the Communist Youth League, and the All-China Women's Federation. The main task of the group is to: (a) work out a programme of science activities for young people; (b) coordinate the work; (c) identify and solve the problems involved so as to put forth proposals to the government; (d) organize exemplary activities on a national level and meetings to share experiences; (e) commend advanced units and individuals; and (f) stimulate international exchanges in this field. The group's headquarters are located in the Department for

Children and Teenagers, (CAST). Leading groups and offices at the provincial, municipal and autonomous region levels have also been set up. In addition, academic societies affiliated to CAST and their branches at lower levels have been established for science popularization. A variety of out-of-school activities have been organized. In Tianjing for example, 16 out of its 18 districts and counties have formed leading groups for children's science activities with eight groups chaired by top persons in the corresponding governments. This is a guarantee that the activities can be carried out smoothly.

In the course of the development of science programmes, activists in this field have emerged in large numbers, who have organized themselves either as associations of young amateurs in science and technology or associations of instructors for youngsters' science activities. Many provinces, municipalities and counties have formed young science amateurs associations in different disciplines such as astronomy, geology, biology, mathematics, electronics and model aeroplane building. The young members of the amateur associations can obtain instructions and guidance from scientists and technicians who are members of different academic societies.

On the basis of local associations, the Chinese Association of Instructors for Youngsters' Science Activities was founded in Beijing in June 1981. Its main tasks are to: (a) give guidance to local branches; (b) organize meetings for exchange of experiences; (c) run training courses for raising the academic level of the members; (d) do research on the theory concerning the activities; and (e) protect the interests of the members. There are altogether 40,000 instructors in the country, most of whom are teachers in primary and middle schools but also scientists, technicians and educationists who are helping the programme.

Content and form of the activities. Science enlightenment projects have been carried out to popularize science with young people in the light of local conditions. They have used various forms and means such as science and technology exhibitions, shows of science artifacts made by young people, summer science camps and study tours, sponsored contests in different subjects, science invention contests and science discussions.

A movement called a 'Love for Science Month' has been initiated in the country. Through these forms and means, more students are being attracted to such activities.

Summer science camps. The summer science camps, which generally focus on one particular subject, are one of the best ways to develop science activities. During the summer vacation every year, a variety of summer science camps are run at provincial, municipal, county and school levels. They include summer camps for young geology and meteorology amateurs in Lushan Mountain, Jiangxi Province; summer camps for amateurs in volcanic geothermics and biology run by middle schools in Tengchong County, Yunnan Province; and summer camps for young astronomy amateurs in Beijing. In 1980, more than 250 summer science camps were held with 110,000 participants. In 1982 a summer camp for young amateurs in geology was held with the support of the Chinese Society of Geology. It had its sub-camps set up in the provinces where 7,700 young amateurs took part.

Love for Science Month movement. During a designated month, pupils in primary and middle schools are asked to complete several 'one-thing's'. This means they learn something about the development of one discipline; they get to know stories about one scientist; to read one book dealing with science; to observe one natural phenomenon and describe it in writing; and to make one science artifact or to give an idea about how to do one technical innovation.

Team programmes oriented towards science amateurs

Many pupils have a keen interest in science and technology and have joined one of the several amateur groups organized by schools. Places outside schools which are specially built for the use of amateurs, such as children's palaces, children's homes, stations for children's out-of-school activities and spare-time sports schools, have provided these amateurs with opportunities at a higher level to actually build models. These premises also serve as centres in which training classes are run for science instructors and from which guidance and directions can be obtained by those working for amateur groups in schools.

Statistics gathered in April 1981 from 24 provinces, municipalities and autonomous regions indicate that more than 7,000 places of all kinds of out-of-school activities have been set up. Some are located in special buildings and equipped with comparatively good instruments, workshops and laboratories, and are directed by either full-time or part-time instructors: Admission to these places is based on brightness and creativity shown at the entrance check-ups. When admitted, students spend their spare time doing all kinds of activities relating to mathematics, physics, chemistry, astronomy, biology, geology, electronic computers, radio, model aeroplanes and ship-building. The Shanghai Children's Palace, for example, which belongs to the China Welfare Institute has a special building devoted to science. It has trained a large number of qualified personnel for the country in the past decades.

China has begun to establish centres which function both as bases for out-of-school activities as well as centres for guidance and research. The

National Children's Centre was opened to the public in Beijing on 5 August 1982. In the Centre there are three halls—Science Hall, Sports Hall and Hall for Arts and Literature. The China Association for Science and Technology prepared and set up the Science Hall, where the children can apply the hands on' concept on exhibits so as to get acquainted with certain scientific principles.

National activities. Some recent activities that have been carried out at the national level are the 1979 National Exhibition of Scientific Artifacts by young people where more than 8,000 artifacts of excellence made by young people throughout the country were displayed and 1,100 won prizes. During the two month show 280,000 people visited the exhibition. A national science discussion by young people was also held in the same year on a trial basis. Out of 114 papers submitted 56 were selected, the authors of which were invited to Beijing to attend the discussion sessions.

Since 1978, science summer camps have covered such subjects as navigation, geology, biology and biological protection in a panda reserve in Sichuan Province. A national summer science camp for young minorities was also held. Some excursions were organized for instructors to make a biology survey tour in Xi Shuang Ban Na Prefecture, Yunnan Province and Sheng Nong Jia Mountain, Hubei Province respectively.

In early 1980, a total solar eclipse was observed in Yunnan Province. Departments concerned in the province chose this occasion to organize young astronomy amateurs to watch it. National math-contests for young people were held in 1978 and 1979. In 1982, pupils in ten big cities took part in the Composition Contest on Outer Space Exploration run by the Second United Nations Conference of Research and Peaceful Usage of Outer Space. A composition titled 'Rejoicings over the new home' written by Fu Jie, a 14-year-old middle school girl in Wuhan, won the first prize in the Asian region. The first competition of the Scientific and Technical Innovation and Invention and Science Forum for Young People was held in Shanghai in August 1981. Two hundred and thirty objects of innovation and invention were selected from all parts of the country. This competition will be held once every two years. The National Meeting for commending outstanding Science Instructors is to be held at the end of 1982. All these projects have had a great impetus for the development of out-of-school science activities.

Principles guiding science activities for young people

Stress has been laid on how to foster among the young, the necessary temperament, knowledge and skills–qualities that are indispensable to scientists or technologists. From China's experience, the following facets deserve particular attention in fostering such qualities amongst the young.

1. Try to arouse their interest in science, which usually is the starting point and driving force in their study efforts. Being young and energetic, curious and active, young people are inclined to like, and be interested in, science activities which best suit these characteristics. What is needed is to help guide and lead their interest in science onto personal dedication and devotion.

2. Help young people to lay a solid foundation of science and broaden their knowledge. In making science artifacts and doing other activities, attention should be paid to training young people to make use of basic knowledge and grasp certain elementary technical skills. Training should develop from the easy to the difficult and be geared to students' attainments in knowledge. In this way, their scientific level will be gradually heightened and their knowledge broadened.

3. The central link in all these activities is to cultivate the competence of the young—the ability to observe, to think and to practise. The co-ordinated advancement of their abilities in these three respects is shown in their creativity.

4. Foster amongst the young people the scientific approaches of seeking truth from facts, strictness and meticulousness, indomitable will and creativity. If young people grow up with these fine qualities, they will be useful to the society, whether they go in for science or work in other trades and professions.

Existing problems

China has a vast territory and massive population with a rather weak economic foundation. As a result, marked differences in the development of youngsters scientific activities can be found in different parts of the country, even in different schools within a city. In the vast countryside and remote rural areas, the activities have developed comparatively slowly. The lack of equipment, facilities, grounds, funds and instructors still remains a problem and needs to be solved gradually.

China has just started the theoretical research on science activities for the young people. A lot of questions involved need to be studied in a planned way, such as the relationship between curricular teaching and extracurricular activities; the role of science activities in bringing up a new generation of scientific and technical personnel; how to conduct the activities in the countryside; how to combine popularization of science with the raising of standards; theoretical issues relating to pedagogy; and the science of personnel training. □

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INDIA

by A.N. Bose

Introduction

The need for universal scientific literacy has been felt in India as much as in any other corner of the globe.

In today's society, science is not merely the exclusive domain of the specialist: an ordinary citizen must possess some degree of scientific literacy to enable him to appreciate the general nature of scientific, cultural and intellectual endeavours and their potential for a better way of life. In other words, in a democracy, where it is the common people who make public decisions, the people should have enough scientific awareness before they make such decisions. Similarly, the output of scientists and technologists also has to be adequate in terms of modern economy and social dynamics.

With this end in view, science has been prescribed for Indian schools as a compulsory curricular subject up to the secondary level. Emphasis, however, has been laid on science as a process; as an operation of the inquiring mind. The internal conduct of science, rather than its external impact is what we have thought is important in the learning of science. Science is not merely a body of information, it is a process of acquiring knowledge. Obviously, as an activity of the human mind, it should be imbibed and cultured outside the curricular boundary. Here comes the necessity for large scale out-of-school scientific activities which widen the horizon of scientific culture.

In a multicultural and multilingual society like ours, science could well serve as a unifying force providing a common culture for all. The establishment of a wide scientific culture depends on the schools which have to provide effective science programmes for all students and foster development of scientific literacy. The extracurricular scientific activities and the experience of technological creativity are factors which complement some of the shortcomings of formal education. Through the out-of-school activities, new scientific talents and budding scientists, get the opportunity to express their creative ingenuity.

Out-of-school scientific activities

Out-of-school scientific activities have a long tradition in India. The Indian Association for Cultivation of Science, Calcutta established in 1876, had as one of its objectives, a component for the popularization of science. This was restricted to demonstration-lectures by such illustrious persons as Sir J.C. Bose and his eminent contemporaries. Science clubs and science exhibitions were common in some educational institutions of Calcutta. In Mysore, the *Prasharan* movement and in Gujarat, *Nav Jeevan Samaj* carried out non-formal science teaching; the latter organization took up non-formal teaching of agriculture through practical applications.

At the beginning of this century, M.K. Gandhi (Father of the Nation) tried for non-formal science activities at Wardha; Rabindranath Tagore started similar activities in his *Sree Niketan.* The first *gobar* (cow dung) gas plant in the country in 1940 was an outcome of the non-formal science activities of the Ramakrishna Mission in Calcutta.

The Science for Children Club of Calcutta, founded during the late 1950s was some kind of a model which stimulated interest in science among school children. It really started as humble hobby work in different science subjects and the club had a small library. Today the club holds periodical exhibitions, organizes scientific excursions and publishes an annual journal. A host of voluntary science clubs originated almost simultaneously and they have more or less similar programmes. The Vikaram A. Sarabhai Community Science Centre, Ahmedabad was founded in 1963 by local initiative. It has made a formidable contribution in the form of audio-visual aids and attractive publications both for formal and non-formal science. This Centre runs several community-oriented programmes to illuminate the process of scientific thinking amongst the common people and the children, to spread and understand new ideas and approaches in scientific and technological development. Some of the important activities of the Centre are as follows: (1) popular science lecture series; (2) night sky viewing; (3) science film-shows; (4) science for house wives; (5) do-it-yourself lab/puzzle boards; (6) science exhibitions; (7) open house programmes (every Sunday this programme gives laboratory facilities to students, teachers and those who wish to learn the rudiments of science); (8) science playground (the objective of such a playground facility is to bring home to the children some basic aspects of science through the medium of outdoor-play); (9) science playroom (different science toys and playthings are kept for primary level children); (10) hobby corner; (11) pets, birds and aquarium; (12) science puppet shows; and (13) nature club/environment study group.

The Centre periodically brings out a Wall Science Newspaper and also mini books covering various aspects of science in very simple understandable language for the students.

The Indian Association for Extracurricular Scientific Activities (IAESA) was founded in 1968 and in 1969 it was recognized as a national organization or organizing body by the International Co-ordination Committee (ICC). In fact the first All India Students' Science Fair was organized by the IAESA in 1970 in collaboration with the Indian Science Congress Association. In co-operation with the National Council of Educational Research and Training (NCERT), the IAESA organized the Unesco Regional Seminar for leaders of the youth science activities in Asia and the General Assembly of the ICC.

Hundreds of schools have become members of the Nature Clubs of India which are sponsored by the World Wildlife Fund–India. The clubs publish newsletters of wide circulation and they undertake nature trails in different parts of the country.

International organizations have been promoting science club movements in India for some time. The Conference on the Application of Science and Technology to the Development of Asia (CASTASIA) held in New Delhi from 9-20 August 1968, recommended that priority action was needed in Asia for promotion of an appreciation of science by the common mass through full utilization of mass media communication techniques, functional literacy programmes as well as science clubs and fairs, and aimed at the rural populace of India.

Growth of science museums. The development of a Science Museum Movement in India started some time in the late 50s. The first science museum was developed by the Government under the Council of Scientific and Industrial Research (CSIR) and was thrown open to the public in May 1959. It is known as the Birla Industrial and Technological Museum, Calcutta. The present Birla Museum, Calcutta, has several permanent galleries on subjects such as: (1) transportation; (2) motive power; (3) metallurgy; (4) mining; and (5) electronics.

The museum has a workshop attached to it housing the drawing and design section and the mechanical, electrical, art and photography workshops. The workshop takes up the development of models for the museum and also prepares models and exhibits for various organizations.

Various rural programmes like mobile science exhibitions, science demonstration lectures, the school loan service and the science teachers' training programme, spread the museum's activities to remote areas. The museum holds science exhibitions and fairs and undertakes training programmes for unemployed adults.

The second museum was set up in 1965 under the CSIR at Bangalore which is known as Visvasvaraya Industrial and Technological Museum (VITM), Bangalore. This museum shows the development of science and technology as well as displays on such themes as timber and paper, electrotechnics, and popular science. The museum has facilities for such activities as the production of exhibits, development of hobby centres and teachers training programmes.

This museum has a mobile exhibition unit and holds science exhibitions. One novel and important scheme started in VITM with the help of industries, has been polyvalent education for factory workers. This consists of exposing workers in industries to the recent advances in the particular trade to enrich the environment in which the workers live and work. The course includes lectures and discussions on topics such as 'Industrial growth', 'Citizenship' and 'Nutrition'.

The third science museum under the Council of Scientific and Industrial Research is known as Nehru Science Centre (NSC) which is located in Bombay. The first part of NSC was opened as a Science Exhibition in October 1977. The NSC has a planetarium and a mobile science unit.

Besides these museums there is a proposal to set up several more such museums by the Government.

The other prominent science museum of creative activity is in the Birla Institute of Technology and Science at Pilani. This museum trains science teachers to set up science clubs/science museums in schools.

'Mini scientists' engrossed in the science club activities

In Calcutta there is a planetarium run by the Birla Trust which is very popular.

Jawahar Bal Bhavans. Today no educator would argue against the contention that the teaching/learning situation cannot be confined to the four walls of a classroom. The education for fuller growth and development of the child is a responsibility that should be equally shared by the parents, the school and the community.

Therefore, a community conscious of its responsibility towards its children must encourage the development of out-of-school agencies and institutions to complement school education and provide children with the experience and opportunities that are beyond the scope of the usual academically oriented curriculum, and yet are vitally important to their physical, mental and emotional growth.

These institutions are necessary if our children are to live their life fully, if our children are to develop enthusiasm for living, delight in human interaction, and passion and curiosity for understanding the world around them. *Jawahar Bal Bhavans* are such institutions. They are in the name of the late Pandit Jawahar Lal Nehru, India's first Prime Minister after Independence and have the financial support of the Jawahar Lal Nehru Memorial Fund and the State Government. There are 12 such institutions situated in each of the 12 capital cities namely: Trivandrum, Bangalore, Pondicherry, Madras, Hyderabad, Bombay, Ahmedabad, Calcutta, Gauhati, Allahabad, Mandi village (Delhi) and Srinagar.

These institutions cater to the needs of children up to 14 years of age. Facilities for the following activities are available: (1) physical activities such as children's play, gardening, carpentry and dancing; (2) creative arts and crafts activities such as painting, clay work, pottery and ceramics; (3) dance-drama and music activities; (4) library activities; (5) service activities such as collecting leaves, stamps and coins; (6) group activities – such as group dance, drama and debating; (7) solitude activities such as visits to the museums, listening to music, star-gazing and bird-watching; and (8) science activities such as animal club (including care of live animals), plant club (including gardening), weather club with a small surface observatory, radio club and electrical club.

All these activities are quite popular with children. Besides these activities some of the Bal Bhavan's conduct training programmes for teachers in the above areas.

Science clubs. Government aid for science club activities began in 1957-58 and enabled clubs to cover much wider areas than the voluntary organizations had with their rather humble beginnings. By January 1962, there were about 500 clubs; each receiving central aid of Rs. 1,200* per annum. By the end of 1965-66, the number of science clubs had reached 910. The latest figure is not available, but there would certainly be more than a thousand science clubs in India today.

Organizing a science club. A science club is essentially a place for voluntary activity and its success depends largely on the endeavours of its members. Good planning, careful execution, and above all the organizational spirit, are all channelled in a successful science club towards the maximum degree of development.

A sense of affiliation, development of a purposeful programme and the joy of achievement help develop a team spirit among the members of the clubs. The nucleus of a science club is usually started by a school even if it does not possess a sophisticated workshop, laboratory or a proper working place. In most cases, the existing laboratory of the school with all its limitations, is convenient enough for science club purposes.

The role of the sponsor. The teacher-sponsor usually plays the most vital role. He takes the lead and propagates the idea of the club by gathering a group of science students and trying to kindle their interest in the programme. It should be the consistent aim of the teacher-sponsor to

A participant with his working model in the National Science Exhibition

* Approximately 9.21 Indian Rupees (Rs.) = One US dollar

share the responsibility for running the club with the members. In fact, it is not the sponsor who runs the club; it is the students who do so.

The main responsibility of the sponsor, however, is to maintain a sustained interest in the science activities. Since the club activities continue after school hours, the sponsor has to make himself available at the club sessions after regular teaching hours or sometimes during holidays to encourage and enthuse the club members. The sponsor is supposed to have the ingenuity to utilize local resources, being a resourceful person himself and knowing about the available resources in the locality, and to maintain contact with other clubs. This enables the members of different clubs to exchange ideas.

The clubs work on democratic lines and develop a feeling of participation among all the members. No hard and fast rule is laid down for membership. All students from the secondary classes (age-group 13-17) have the privilege of being members. But sometimes, in certain clubs, membership is restricted because of limited space and materials. In addition to the chief sponsor, often, other science teachers are also associated with the club activity. Quite often, the clubs are run on the basis of carefully prepared constitutions.

Activities of a science club. When the nucleus of the club has been established, attention is directed then towards creation of the proper climate for a club. Activities that are generally undertaken by a typical school-based science club are as follows.

General activities. Symposia or seminars are arranged on certain topics and problems. The members express their views and explain their individual points of view on the subject. Participation in a seminar is not restricted to a particular level of participant; seminars provide the opportunity to bring scientists and students together w' ereby the latter benefit from the discussions.

Often, such activities as symposia, seminars or lectures are followed by a quiz session. Essay competitions and debates are considered to be very potent means for providing opportunities to members to get first-hand experience of studying a particular topic in depth. This also fosters the habit of consulting reference material and library work. Suitable lectures on selected scientific topics within the comprehension of the members are often arranged. Film shows are arranged to explain scientific topics and difficult concepts.

Though time consuming and sometimes a little expensive, excursions provide a good opportunity for learning. They also keep the interest of members alive. Excursions to nearby factories, agricultural fields or to the zoo or botanical garden are enjoyed by the young members. Biological excursions in search of typical flora and fauna are widely undertaken and the development of nature trails is an exciting new activity.

Collecting, identifying and preserving biological specimens, preparing static and working models and improvised apparatus, performing new experiments and, above all, organizing investigatory-type projects are the most attractive activities for the children.

However the mere collection of insects, flowers, leaves, shells or rocks and minerals does not really mean much until some taxonomic work is undertaken as a follow-up project. This involves the study of some literature, discussions with others and library work. Many science clubs, in quite obscure places, have good collections of preserved biological specimens and rocks and minerals, displayed in laboratory racks and classrooms. Collection notes are available to others who want to undertake similar activities.

When properly guided, activities that teach the skills of collecting and preserving specimens and keeping and rearing live animals add to the value of a club museum.

Even without any sophisticated apparatus, manual skills like carpentry, soldering and sheet metal work or the use of clay and plaster of paris can be used to make modelling a fascinating experience in which the majority of students seem to be interested. Working models provide greater thrills but they need superior craftsmanship. Modelling, however, should not be mere replication of existing instruments, apparatus or ideas. Models which give concrete shape to abstract ideas are uncommon.

An increasing number of students are planning and performing new and interesting scientific experiments with available apparatus to experience complex scientific principles. This engrossing experience needs proper guidance which is not always available in rural science clubs. It provides laboratory skills and expertise in manipulation of laboratory apparatus, besides intellectual competence. Many clubs provide the opportunity to organize such experiments which are generally not possible in the classroom situation due to constraints of time. Interesting experiments related to growth of plants, for example, may need constant observation for several days, or weeks. Such experiments are often taken up by science club members.

Project work. It is constantly felt that too much traditional teaching of science is another way of confirming foregone conclusions. It is a kind of anti-science which is damaging to the lively mind. So, science education in this country, as in many other countries, is slowly changing its

Science club activity in a school

focus from recorded content of science to its operative content. The emphasis, as said previously, is on the process of science rather than its products.

Science projects taken up by the members of a science club are a corollary to this idea. Many of the projects may look a bit adventurous and ambitious at times, but this kind of open ended and experimental approach to science learning helps inculcate in the young mind the spirit of exploration in the field of science. Power of methodical reasoning grows out of such activities. The role of the sponsor or the guide is that of a catalyst, not of a 'know-all' dominant teacher. He takes on the role of a discussion leader and stimulates the enthusiasm of the student but never directly answers the questions which might arise during the project work.

In better organized science clubs, fresh ideas regarding projects generate from club discussions, study circles, experiments and general curiosity. Each project that is organized successfully generates fresh ideas for several others. The interest of the child, however, is the first consideration in establishing a project. The sponsor's duty is to make suitable adjustments in the investigation design to suit the capabilities of the student or to over come the laboratory limitations. Once the problem has been defined, and some study has been carried out, the next concern is to draw up a tentative design to attack the problem. The theme of the investigation will determine the hypothesis. Collection of data is systematically planned and the data are meaningfully organized for interpretation.

A happy change that is gradually emerging in the choice of projects by different science clubs is that they are becoming more and more directed towards the solution of specific problems faced by the community. This is a remarkable departure from projects having theoretical importance. The latter kind is still more preponderant but projects directed towards better methods of preservation of grains in the village, improved cowdung gas plants for cooking fuel, or preparation of a 'village refrigerator'—run without electricity, are now quite common.

Training difficulties. Lack of efficient media for dissemination is a major obstacle which prevents free communication between thousands of science clubs scattered throughout the country. Through the limited channels of communication that are available, it is evident that some clubs are doing very well. A large number of clubs are yet to evolve viable programmes but their difficulties, however, are mostly of local origin; many of them can be removed through the proper application of their local resources.

Training difficulties arise when the sponsoring bodies are not competent enough to organize an effective science club. This is because in many cases the sponsor or the teacher does not have adequate training. The Regional College of Education (Ajmer) under NCERT brought out a number of publications known as *Activities of science club sponsors.* These publications covered several aspects of the organization of Science Clubs, various types of projects and open ended experiments. There is a strong

Sc .ice club activity in a school

feeling that a part of the pre-service training of teachers should also include some training to organize science club activities. Several agencies, including NCERT are thinking in this direction.

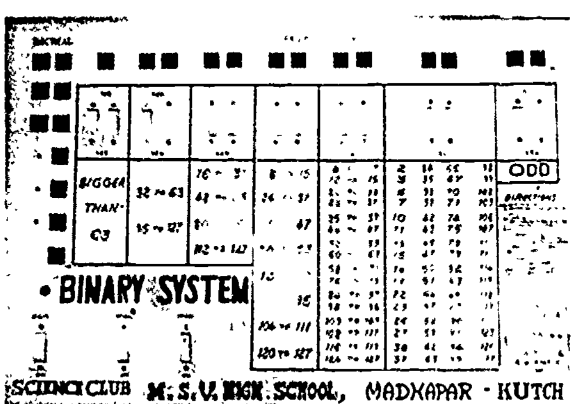
Motivational difficulties. It is discouraging that in addition to the heavy schedule that a teacher has to maintain, organization of science club activities really becomes a burden to him. But enthusiastic and properly motivated teachers take a keen interest in science clubs.

Financial difficulties. The funds allocated to sponsors are usually insufficient for the running of a living science club.

NCERT support. The Department of Education in Science and Mathematics, NCERT, has been striving to solve these difficulties. It has held training workshops for sponsors in various regions of the country to acquaint them and the State Departments of Education with the importance of sponsor training and also to lay down sample training programmes. It plans to bring out a science club newsletter to provide the required guidance to the sponsors and also to disseminate useful information about club activities.

Science fairs

Inspiration for year-round activities is provided by periodic science fairs held at district/zonal and state levels and the national level exhibition which is held annually. In addition to this, school science exhibitions are a constant feature. Such science exhibitions provide opportunities for exchange of ideas, competitions and wider recognition. These exhibitions are a forum for the dissemination of information and they set up the



A model illustrating 'Binary system'. This model was prepared in a science club and was exhibited in the National Science Exhibition for children standards for students. They are also a great motivation for the sponsor/teacher. While the primary objective of all this is to develop aptitude and creativity in science among students, the science clubs and science exhibitions also serve to identify the really talented students.

Students find science fairs or science exhibitions most attractive events. They are organized both by non-government agencies throughout the country on a voluntary basis, and by governmental agencies, particularly NCERT as an extension programme.

NCERT feels that a sound programme for science education should mean imparting an adequate quantum of scientific knowledge in various fields, taking into account the modern developments which are fast changing the life of the people. Even more important than this is to inculcate scientific attitudes towards life and living, free from superstitions, dogmas, taboos and prejudices. Free inquiry and an unbiased judgement should mark the guidelines.

The extension programme in science education aims at providing opportunities, guidance and facilities for fixation of scientific concepts through self-generated activities leading to useful projects and creation of leadership. Science fairs provide a forum for the proper recognition and encouragement of activities taken up by hundreds of science clubs throughout the country. Even the individual efforts are recognized.

NCERT encourages such activities in two ways. First, it does so through the extension centres in different parts of the country. Second it organizes the National Science Exhibition for Children, held annually in Delhi. This national level exhibition is the culmination of all the school, district, zonal and state level exhibitions. The best exhibits from these exhibitions are gradually screened and the exhibitors are invited to participate in the national level exhibition.

The main objectives of the national level science exhibition organized by NCERT are: (1) to give impetus and encouragement to students to try out their ideas and apply their classroom learning more creatively; (2) to provide opportunities to students to witness the achievements of their colleagues and thereby stimulate them to plan their own projects; and (3) to popularize science activities among a greater number of students so that further improvements in the standards of performance are achieved.

School science fairs. Organization of school science fairs has a very long tradition in India. The fairs are organized by respective schools and the students are the participants. This serves the basic purpose of providing encouragement to the students and at the same time offers opportunity to make selections for the district or zonal fairs that follow. After regional science exhibitions the best exhibits are displayed at the state science fairs.

National science exhibition. The first national science exhibition in the country, the All-India Students Science Fair, was organized by IAESA in 1970. The University Grants Commission (UGC) and NCERT organized the second national science exhibition in 1971. The subsequent national exhibitions have been organized by NCERT and the exhibition named the National Science Exhibition for Children. Most participants are school children.

In addition to the Indian participants, students from Bhutan, among the neighbouring countries, participate in the exhibition. Part of the financial assistance is given by the Jawahar Lal Nehru Memorial Fund.

In the early 70s, the national exhibitions were organized on a thematic basis, i.e., Eco-Crisis (National Science Exhibition, 1975) around which the exhibition was built. But there were some organizational problems in this approach. For instance, different states, regions, districts or schools did not choose their exhibits to fit in with the theme of the national exhibition. As many good exhibits on different themes were naturally discriminated against under this system, the thematic approach was abandoned.

An exhibit in a zonal science fair

Apart from the usual exhibition, scientific films are shown by the organizers. Eminent Indian scientists are also invited to deliver popular lectures during the exhibition. The exhibits are arranged in different pavillions comprising, for example, Rural Technology, Man and Machines, Fuel, Agriculture, Innovation in the Teaching of Science and Mathematics and Ecological Crisis.

Some universities, outstanding members of the public and renowned science clubs/museums are also invited to bring their exhibits. The quality of an exhibit is judged in the following way:

a) whether the thinking or planning of the exhibit/project is methodical;

b) whether the exhibit shows originality in planning and execution including the use of indigenous material;

c) technological skill and workmanship as well as the handling, preparation, mounting and display of the exhibit; and

d) exhibition value of the exhibit.

A personal interview is made to ascertain whether the exhibitor really understands the principles behind the exhibit. Children from rural, tribal and backward areas are given encouragement and all the children who present an exhibit are given a participation certificate.

NCERT publishes a booklet *Structure and working of science models* which contains the details of the exhibits of a particular year. The booklet is a good medium through which ideas are exchanged.

The search for talent

An important part of the total programmes undertaken by NCERT, and which has direct relevance to the countrywide spread of a new scientific culture, is identifying and developing scientific talents at various terminal stages of the secondary and higher secondary levels. Since its inception in 1964 and until 1976, NCERT operated what was known as a National Science Talent Search Scheme to identify pupils with a marked aptitude for scientific studies.

Up to 1976 NCERT conducted the search every year in all states and union territories for those students who were at the 11th year of their schooling. Talented students with potentiality were discovered through aptitude tests in science and mathematics, an essay examination and through the projects they submitted for the purpose. Those who qualified in these tests were subjected to a highly structured interview. Later on the submission of projects and the essay paper were dropped and pupils were selected through an aptitude test and interview. Question papers are set in 15 languages. Three hundred and fifty science scholarships were awarded under the National Science Talent Search Scheme to pupils all over the country in Science and ten special scholarships under the Mathematics Olympiads Scheme.

With effect from 1977, NCERT enlarged the scope of the Scheme. In addition to basic sciences and social sciences, professional courses such as medicine and engineering, have now been included within the scope of the Scheme, now known as National Talent Search Scheme. The tests are held at three different stages; Classes X, XI and XII. Classes X and XII are the terminal stage of the new 10 + 2 school pattern and Class XI is the old higher secondary pattern which is still being followed in some states. Some 500 students are selected through this competition process every year. New tools for evaluating talent have been devised and methods of selection are undergoing a major change. A new component, the General Mental Ability Aptitude Test has been introduced in the test paper supported by scholastic aptitude test and interview.

For follow-up programmes, NCERT arranges summer science camps for the selected students. These camps are of four to six weeks duration. Some 50 leading science laboratories at different academic institutions host these summer camps where the students participate in well organized programmes. The students are in fact exposed to an enrichment programme in science beyond the school curriculum and are encouraged to develop their own scientific projects under the supervision of specialist guides.

Experience reveals that the distribution of awards between students from rural and urban areas is not a balanced one and steps are being taken to encourage students in the rural areas.

Science Talent Search Programmes are carried out on a regional basis by some state governments, while the Union Territory of Delhi conducts a Junior Science Talent Search Examination for those students who are in Class VIII of the schools in Delhi. Science Talent Search Programmes are also carried out by non-governmental organizations. The Jagdish Bose Science Talent Search Scheme offers some 20 awards for science and technology to students in the state of West Bengal.

Media for dissemination

Science club activities linked to Radio Clubs have an advantage in disseminating their ideas through radio programmes. Television programmes in larger cities have regular features on amateur scientific activities.

Leading national dailies have weekly children's forums through which scientists communicate with the children and the latter exchange ideas among themselves. Local newsletters of limited circulation are published by hundreds of voluntary organizations which are actively engaged in out-of-school scientific activities.

There are some very effective and widely circulated journals which are enjoyed by the young scientists in the schools. *School science* is published by NCERT on a quarterly basis; this journal has a very attractive students' forum through which students can exchange their ideas. The *Science reporter*, published by the CSIR, New Delhi, contains articles by eminent scientists presented in simpler language. *Science today* is published by private enterprise and it has a very wide circulation. The newsletter of the Nature Clubs of India conveys the message of the youth movement of the World Wildlife Fund in India. The International Co-ordination Committee (ICC) for the presentation of science and the development of out-of-school scientific activities (Asia) publishes *ICC Asian popular science journal;* it has a very wide coverage.

Concluding remarks

The most encouraging trend in out-of-school scientific activity is that it is spreading to rural India at an astonishing pace. The barrier between the cities and the villages is fast dissolving so far as this movement is concerned. A little more efficiency in the communicating media will increase the exchange of ideas and the rural youth with all their talents will come to the fore.

The projects that are appearing often deal very specifically with local problems of the people, both rural and urban. This is another very encouraging trend and is certainly a departure from the purely theoretical exercises of the past. Exhibits showing better utilization of solar energy or on improved methods of culturing silk moths are becoming more common.

Through the medium of the museum, science fairs and mass media, people even in the rural areas—are becoming more aware of the problems in agriculture, food and nutrition, energy, environment, public health and family welfare. Government is considering the new role that science can play for rural development. It is proposed to set up several new museums. But even in this area we have yet to go a long way. There is also a strong movement in the country pleading for mathematics laboratories to act as centres for extra-curricular activities in mathematics, especially in the so-called 'new mathematics'.

It is fortunate that scientists from the Tata Institute for Fundamental Research and Bhabha Atomic Research Centre, Bombay, the Saha Institute of Nuclear Physics and the Bose Institute, Calcutta, National Physical Laboratories and Indian Agricultural Research Institute, Delhi are taking an active interest in the out-of-school movement. This should contribute to its continued success. □

Bulletin of the Unesco Regional Office
for Education in Asia and the Pacific
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INDONESIA

by S. Sastrapradja

Introduction

In Indonesia, science and technology have been introduced in the school curricula as early as primary school. Basically, the teaching of science and technology in primary schools is given in two subjects, namely: *ilmu pengetahuan sosial* (social sciences) and *ilmu pengetahuan alam* (natural sciences). It is in high schools that individual subjects such as history, geography, physics, chemistry, and biology are given.

Nowadays the utilization of science and technology in daily life is easily visualized. In agriculture, for example, the development of new high-yielding varieties for particular purposes is only possible if science and technology are used. The same holds true in the fields of medicine, transport and communication.

With the fast development of technology (the applied sciences) it is felt that formal education alone is insufficient to demonstrate what science and technology can do for our welfare. Therefore, out-of-school science and technology education is expected to supplement any formal teaching. The first serious effort in the field of out-of-school education was started concurrent with the beginning of the First Five Year Plan of Indonesia in 1969. This report, then, outlines the current efforts taking place in Indonesia, the ways the goals are being achieved, as well as the shortcomings encountered.

Organization of out-of-school education in sciences and technology

Out-of-school education at the primary school level is handled by the Directorate General of Out-of-School Education, Youth and Sport which comes under the aegis of the Department of Education and Culture. At the moment the out-of-school education of science and technology at other levels is handled by other agencies, not necessarily part of the Department of Education.

Among the government agencies active in the out-of-school education for science and technology is the *Lembaga Ilmu Pengetahuan Indonesia* (LIPI or the Indonesia Institute for Sciences). Through its bureau of public relations, LIPI organizes a lot of activities in the field of chemistry, physics, biology and modern technology, involving youngsters, university students, teachers and the general public.

The newly established Office of the Minister of Environment and Development Control is active in educating the public in environmental sciences, as are the Directorate of Nature Protection and Conservation (under the Department of Agriculture) and several private organizations.

There are a number of independent bodies which are active in disseminating information on science and technology. Among this group are youth clubs, student associations and scientific communities.

Current efforts

Non-formal education. As formal education alone cannot cope with the fast development of science and technology, non-formal education is needed to supplement the existing curricula. The following are the activities.

Science clubs. Under the sponsorship of LIPI, science clubs are established in Indonesian major cities. Up till now there are 466 clubs which are active in conducting lectures, discussions, and training. Outdoor activities are conducted in the form of scientific camping, mostly executed during the school holidays. So far, the interests of the clubs are in the field of electrotechnics, biology and chemistry. Most of their members are high school students.

Competition on chemistry for high school students

Once a year LIPI organizes the gathering of the University Students Association nature lovers. Over a period of about five days, many aspects of natural sciences are discussed.

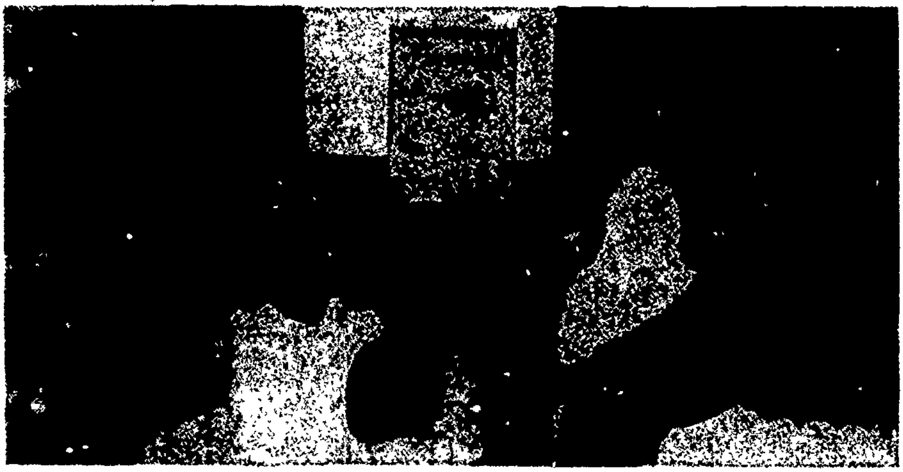
Science and mathematics teachers associations. In Jakarta (the capital city of Indonesia) and its surroundings (Bogor, Tanggerang and Bekasi) LIPI sponsors the establishment of Science and Mathematics Teachers Associations for high school level. The purpose of each association is to enable the members to communicate with each other about the latest information on new developments in science and mathematics. In return, the members are active in disseminating information in their respective fields of interest informally through radio and television.

To elevate their knowledge on current issues in science and mathematics, every year the association holds a scientific seminar. Giving papers at the seminar are those scientists who have a reputation in their field of specialization. Every member has the opportunity to discuss the topic with the speaker and the outcomes are incorporated in the courses which the participants teach.

Reporters for science and technology. It is realized that mass media should be actively engaged in and used to assist the spreading of information on science and technology. In the newspaper, for example, once a week there is a section especially allocated to articles dealing with science and technology. The quality of such information depends on the ability of the reporters to overcome the fact that many of the scientists and technologists have not mastered the art of communicating with the public. Therefore LIPI felt the need for an Association of Reporters for Science and Technology. Such an association was formed in 1978. The members are always invited to attend scientific symposia, workshops and meetings with the hope that they will be able to convert the technical information into a common language that the public can understand. They are also invited to visit research institutes and to have direct communication with the scientists. In this way the reporters get a better view of the work being done and hence can translate what they see into palatable articles for the public.

Man and the Biosphere (MAB)–Indonesia programme. The MAB-Indonesia programme is hosted by LIPI. Under this programme there is a project on environmental education dealing with aspects of science and technology. This project was launched in 1978 with two sub-projects (formal and non-formal).

The focus of the non-formal education is on the age group 7-13 years. This age group was chosen because the number of personnel involved in the project is small (five persons), they are part-timers and the fund is limited. The selection of this age group is based on the assumption that they are still responsive toward change and once the ideas are planted into their mind, they will stay there forever. Of course the supporting groups such as housewives and teachers are also included in the project.



Environmental education for housewives

The following activities are being conducted:

1. Slide and film shows: Twice a week, the team visits various primary schools to give the information about the natural resources available in Indonesia, how we use them, what the consequences of our activities are and what needs to be done if we want to maintain our existence. Following the show the team passes evaluation sheets to be filled up by the students. This way the team knows whether the students get the message or not. Also through the evaluation the team is able to improve its presentation.

2. 'Know-your-surroundings' for school teachers: In addition to school visits, the team invites school teachers to attend a day seminar on the Indonesian environment, especially on natural resources. A minimum of four speakers give their views on the subject. The examples given are those readily available in school surroundings, so that the teachers may use them to illustrate their courses. Following the discussion session, the team asks the teachers to say if such a seminar is useful for them. The team also welcomes any suggestion put forward as to how the team can be of any help to them. This kind of seminar is held once a month, attended by approximately 60 teachers from 30 different schools.

3. Writing contests: To supplement the above activities, which are at present limited to the Jakarta area, the team conducts a writing contest once every six months. This contest is open to school children aged between 7 to 13 years from all over Indonesia. Various themes have been selected from time to time and the children are free to choose the titles for their articles. Up to three awards are given for each contest.

The team also works together with one children's magazine. Once in three months, in this particular magazine, there are a series of drawings, mostly dealing with nature and its conservation, which the children can look at and then compose a story. Again, awards are given to the best three.

Popularizing science and technology through informal education. Much of the success of the out-of-school teaching of science and technology in Indonesia is due to the active participation of the mass media. Both the government controlled and private channels have been very conscientious about their role in educating the public at large. In general they are always eager to attempt any venture along this line, as long as they are convinced that there will be positive results.

The magazines. Many popular and semi-popular magazines in Indonesia have regular features dealing with science and technology. A children's magazine such as the weekly *Si Kuncung* has a gardener's corner, glimpses of Indonesian natural history, Indonesian temples, history of Indonesian navigation, food science, anthropology, a long series about mathematics and many other features. Considering that this magazine is intended for elementary school, the coverage on science and technology is wide and varied. *Si Kuncung* is also read by junior high school students. Other children's weeklies also have features on science and technology but they are not as astute and purposeful as *Si Kuncung.* A supplement of the women's magazine *Femina* now and again presents its young readers with scientific articles especially written for children under 9 years old, whereas the well-known magazine *Bobo* concentrates its articles mostly on stories, cartoon strips and the like.

Femina and other women's magazines do contain popular articles on technology, especially those regarded by their respective editors as useful and applicable to housewives. Gardening, food science, medical articles (written by competent government doctors!), tips dealing with housekeeping and many other fields appear to be very popular. *Intisari* (the Indonesian counterpart of *Readers' Digest*) has regular features on modem developments in science and technology, besides lexicographical types of articles on down-to-earth technology such as how to keep a fish pond or get rid of water hyacinth.

Scientiae is a semi popular monthly magazine issued by a group of students in Bandung. As its name implies, from its inception this magazine has only published articles of a scientific or technological nature, but they are written in popular form for the general public. This magazine takes the place of *Kemajuan, Teknik dan Hidup*, popular about 25 years ago, which month by month produced popular articles on natural sciences and technology. There are several more specialized semi-popular magazines available nowadays to the public in Indonesia, namely: *Trubus* (on agriculture), *Mekatronics* (on electrotechniques) and *M dan M* (for motorcars).

All the magazines mentioned above have circulations of 10,000 or more. There are others with circulations less than 5,000, issued by the orchid society or by government agriculture, health, forestry, and horticulture extension agencies.

Newspapers. The majority of Indonesian newspapers also accept contributions from their readers, so that a variety of by-lined articles are offered daily covering subjects of general interest on science and technology. Some of the well established newspapers such as *Sinar Harapan, Berita Buana* and *Kompas* run regular features on certain days about the environment, aeromodelling and other handicrafts, conservation, health and so on. The contributions of the Sunday papers are more apparent in this respect.

The Department of Agriculture sponsors the daily *Sinar Jaya* and as can be expected the stress of this newspaper is heavy on agricultural news and technology.

Radio. The use of radio as a mass media to disseminate science and technology to the general public has been well exploited ever since the establishment of the Radio Republik Indonesia (RRI) in 1945. Various regular programmes, each covering the special field of activities of existing government departments, have been broadcast daily. Notable among these is the so-called *siaran pedesaan* (literally meaning 'village broadcast') which concentrates on the many aspects of technology applicable to village or rural development. Understandably the heavy emphasis of *siaran pedesaan* is agriculture and its paraphernalia. All provincial radios have specially trained teams to run this programme so that the impact of this programme is really felt and its usefulness is fully acknowledged.

Many radio stations also have a weekly programme dealing with the popularization of science and technology. This programme normally represents the fruit of co-operation between the station concerned and the public relations or the extension section of any research or higher educational institute from the same city as the radio station. Bogor radio, for example, depends heavily on the willingness of the National Biological Council at Bogor to contribute regularly to this programme. Popular lectures and interviews on various aspects of the environment, agricultural modernization, food processing technology, and the role of biology in health and industry are broadcast nationally using this channel.

As might be expected all these central and provincial radio stations use Indonesian as their medium. In recent years, however, almost all districts in Indonesia have their own radio transmitter run by the local government agency using the local language. The flavour of the local broadcasts is very strong because these radio stations broadcast materials directly related to the development of their respective district. They normally use recordings of broadcasts from the central or provincial radios as the source of material for their science and technology broadcasts but they translate it into the local language. In this way, even the people who stay in remote places and cannot master Indonesian, can still receive education in science and technology in a language they understand very well.

At the moment there are a number of licensed commercial and non-commercial amateur radio stations all over Indonesia, run and managed by private concems or foundations youth clubs and associations. The latter groups normally select broadcasts that meet their specialization. They run programmes such as mountaineering, radio technology, natural history and the like. These amateur radio stations also tap the expertise of research and higher educational institutions in filling their programmes.

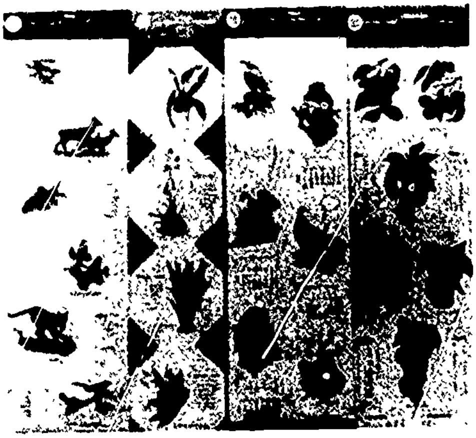
Television. All television stations in Indonesia are managed by the government and except for about one or two hours a day all of them broadcast a similar programme which originates from the central station in Jakarta. In recent years the distribution of television sets has become more widespread and in Java almost all villages now enjoy television programmes. Consequently the science technology education regularly broadcast by television reaches a large number of viewers. There is reason to believe that television programmes in this case will be more successful than radio if planned more meaningfully. As it is, the science and technology education is too often classroom-oriented and suitable for urban people only.

As is the case with radio, science and technology education programmes on television also depend very heavily on the co-operation of research institutions and other agencies interested in passing on information of a general nature to the public. At the moment, programmes on mathematics, physics, and chemistry seem to be more frequently broadcast compared to other disciplines or fields, largely because science teachers associations regularly use the channel as a kind of trial for using the television medium in non-formal education. The programme on popular science is broadcast once in two weeks. In between, a programme on technology for youngsters takes place. Agricultural extension services hardly appear on television but there is a weekly household programme which occasionally produces a show on such diverse topics as flower gardening, transmigration and the like.

Public education on the erosion of plant resources: root crops

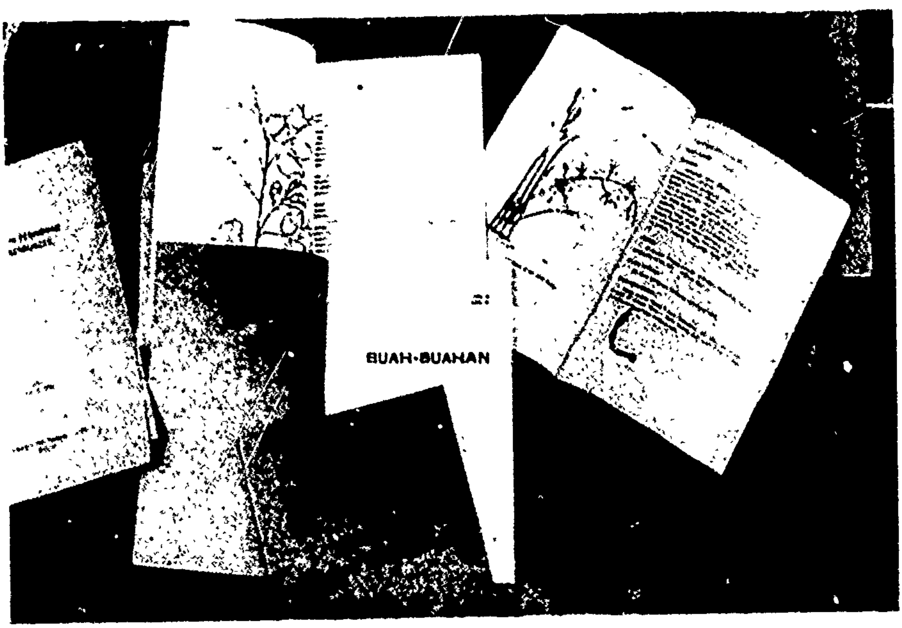
Posters. A number of posters on science and technology have been distributed especially on the natural sciences. The Director .te for Nature Conservation, for example, distributed posters on indigenous fauna, identifying those which are protected. The Directorate General of Fisheries publishes posters on Indonesian fish resources so that it will be known by the public what fish are available in our waters. A series of posters on the natural environment are printed and distributed to primary schools by the MAB-Indonesia programme. In addition to posters, LIPI publishes calendars featuring indigenous flora and fauna.

Books. Numerous popular and semi-popular books on science and technology have been written in Indonesian, but their quality varies considerably. There were books especially written for neo-literates mostly dealing with very basic agriculture, simple wood carpentry and needlework. Several private publishers in Bandung (like Ganaco and Tarate) produced a long series at a more advanced level. Treatises on home industry (such as handbooks dealing with *kecap, tahu, tempe* and other soybean fermented foods), specialized gardening (orchids, fruit farming, flower arrangement), car repairs, radio and other electronics for the



Biological resources in calendars

households, traditional medicines, bee-keeping and the like are available. More recently, technical books of this nature have received new impetus due to the activities of several big firms in translating into Indonesian books written in English, Japanese or Dutch. Thus now we have several popular series issued by Gramedia (Basic Library for Children containing over 60 titles), *Tira Pustaka* (a series from *Time-Life* and the *Childrens Treasury of Knowledge*) and so on.



Popular books on plant resources

Therefore people interested in science and technology can now quite easily obtain instruction and education without going to school.

Junior high school students listening to a lecture on insects

Conclusion

During the last ten years, out-of-school science and technology education in Indonesia has received more attention than it used to have. Various science clubs have been established for students or teachers to facilitate the spread of knowledge. Meanwhile science and technology education through mass media such as television, radio and newspaper is becoming fashionable.

Though much has been done in popularizing science and technology for development, satisfactory results have yet to be achieved. One factor contributing to this is the fact that illiteracy is still a problem in Indonesia. It was estimated in 1978 that among those aged 10 years and over, 26.9 per cent were illiterate. Another factor which needs to be considered as a limitation is the level of education of the literates. This varies greatly so that their ability to digest information varies also. To make the matter worse, reading is not a habit yet.

Based on these facts, an emphasis on visualization for out-of-school education is necessary. Film is by far the most effective means of communication. When school children are asked to make a choice between various methods of presentation, the choice is definitely film. The same holds true for the public at large. A TV programme on popular science which is shown on film is much more attractive than the lecture even if it is accompanied by audio-visuals. Unfortunately, most, if not all films on science and technology are of foreign origin and the narration is not translated.

Primary school students observing fish resources in a zoological museum

The use of botanical gardens and zoological museums for education on natural science is without doubt very useful. As the holidays approach, the visits of school children to both places significantly increase. The visits are meant for both education and pleasure. It is expected that they will recognize the biological resources available in the country. With the increase in the numbers of trained guides, more information is available about the plants and animals. However, more often than not, the educational part is neglected. To complement both botanic gardens and zoological museums, the establishment of a museum for science and technology is worth considering. A plan is being developed to establish one in Jakarta. Once such a museum is ready, the application of science and technology for development will certainly be well presented and easily understood.

It has been mentioned that books on science and technology do exist but their range is very limited. If and when the reading habits of the population improve, the availability of such books is essential to speed up the spread of knowledge. What is probably palatable to everyone right now is the presentation of science and technology in the form of comic strips. This assumption is based on the fact that even ancient subjects such as Mahabarata and Ramayana which were almost forgotten by the young generation have suddenly become popular because they are presented in comic form. These comic versions are at present among the best sellers.

Outdoor activity of primary school children in a botanic garden

While dolls and toys such as sport cars, rockets and guns are readily available, there are few really educational toys to play with in the form of building blocks or fruit or animal cards. Those that are available are too expensive. Thus, an effort must be made to encourage the development of such toys and games.

It is worth mentioning that 80 per cent of the Indonesian population live in the rural areas. The efforts made so far in the field of science and technology education are absorbed mainly by the urban population. To reach those living in the rural areas, with a lower educational attainment, a different approach needs to be developed. □

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JAPAN

by Hideo Ohashi

Introduction

The general trend in Japan is to divide the educational structure into three categories: home education, school education, and social education. Out-of-school education is related to both home education and social education.

Home is the basic foundation of spiritual development as a human being. It is in the home where one learns the basic practices, language, love and respect for one another, and attitudes toward life and work. Parents have a big influence on their children—the influence of the mother especially. Mothers hold the key to their children's understanding, including their first basic concepts of science and technology.

There are, however, few mothers with more than a limited interest in, or understanding of science and technology. Furthermore, in recent years, there are more children using their after-school hours for private tutor classes or for watching television so that the contact and dialogue within the family circle has tended to become less and less. This non-communication tendency is further enhanced by the nuclear unit family structure as well as the family structure whereby both parents are working. Although the home is an important 'setting' for science and technology education there are quite a few problems that need to be solved before it becomes a reality.

The first part of this paper explains the facilities available for science education and some of the associated problems, while the second part explains the media of science and technology education in all of the three categories of education—home, school and social.

Science education facilities for youth

- Science museums. The existing science museums are divided into museums of science and technology and museums of natural history. Though not proper museums, there are museum-related facilities, described later in this paper, that are included in the Japan Association of Museums where exhibits and activities related to science and technology can be seen.

Comprehensive museums of science and technology (3). These comprise the privately owned Museum of Science and Technology, located in Tokyo; the Science Museum of Nagoya City which is sponsored by Nagoya City; and the National Science Museum located in Tokyo which exhibits materials on the natural history, science and technology of Japan.

At the National Science Museum science education for the public is practised through the displays concerning technology in Japan and the classified natural history objects. A study room provides facilities enabling visitors to find out more about the objects on display. For the diffusion of scientific knowledge, the museum organizes classes, short courses and lecture meetings on natural history and technology. Open-air studies of such things as animals, plants and rocks are conducted in the field. Special exhibitions and travelling exhibitions are held whenever the occasion calls. The indoor exhibitions for social education are available only at the museum proper.

Nature class–observation of an insect on a leaf–at the National Science Museum

Beside these educational activities, research activities are also conducted. Departments of Zoology, Botany, Geology and Palaeontology, Anthropology, Physical Sciences, and Engineering are conducting research in their respective fields. In the field of natural history, there is a comprehensive investigation of the Japanese Islands in progress, which is a long-range project that started in 1967.

The National Science Museum comprises four institutions and the number of visitors in 1977 exceeded one million.

Table 1. The size and number of visitors of the National Science Museum

Institutions	Total ground area	Total floor area	Number of visitors (in 1977)
National Science Museum proper at Ueno	13,223 m2	23,034 m2	1,004,583
Natural History Institute	8,154	9,801	–
Tsukuba Botanical Garden	140,166	3,151	–
National Park for Nature Study	198,644	1,419	78,928

Table 2. Major meetings and activities of the National Science Museum

Classification	Days of operation	Number of participants	Title
Museum class	13 types, 13 days	295	Observation of cherry blossoms, etc.
Science class	3 types, 17 days	488	Meeting to become acquainted with science, etc.
Nature class	2 types, 3 days	70	Enquiry of the sea-shore, etc.
Seminar on natural history	7 types, 25 days	824	Mineralogy seminar, etc.
Seminar on science and technology	1 type, 6 days	195	Introduction to history of science
Lecture meeting	4 types, 83 days	1,877	Lecture on astronomy, etc.
Astronomical observation	28 times	989	Astronomical observation

The following major periodicals are published by the National Science Museum: *Summary of the National Science Museum; Annual report of the National Science Museum; Bulletin of the National Science Museum; Series A (zoology), Series B (botany), Series C (geology and paleontology), Series D (anthropology); Memoirs of the National Science Museum; a Newsletter* three times a year in Japanese and English; *Miscellaneous reports of the National Park for Nature Study;* and the *National Park for Nature Study—natural observation series.*

Specialized museums of science and technology (78). These museums deal with such specialized areas of science and technology as:

a) Traffic, transportation, railroads, tunnels, automobiles, ships, harbour facilities, marine light houses and aeroplanes;

b) Communication and mass media fields of science and technology such as radio and television broadcasting, telecommunication, computers and postal services;

c) Astronomy, affiliated with planetariums and astronomical observatories;

d) Natural resources and energy such as power plants (hydro, thermal, nuclear), coal mining, petroleum, marine and natural resources;

e) Raw materials and their production process such as metal and textile materials;

f) Technological development of agriculture, dairy farming, fisheries and sericulture in respective areas;

g) Industrial safety measures, labour hazards and fire control as well as human science;

h) Pharmaceutical products, electrical applicances, liquor, printing, paper, city gas, (established by company museums that conserve and exhibit their technological development); and

i) Preserving scientific technology such as old methods of steel and salt production.

Museums of science education (19). These are teaching museums that cater for young people. They are called Youth Science Museums, Youth Science Centres or Children's Museums. The kinds of exhibits and activities of each museum differ according to the type of local industry and the natural surroundings. Many activities take place in their well-equipped workshops. All the museums in this category are sponsored by their local municipality (prefecture, city, town or village).

Other facilities of science and technology (9). There are private museums such as those in airport buildings that display materials related to aircraft and also planetariums and observatories where astronomical observations are made.

Youth facilities which exhibit materials on science and technology (48). There are Children's Cultural Centres and Children's Houses that provide museum-related facilities. A Children's Cultural Centre is a public facility which spreads scientific knowledge to children, provides a setting for experimental studies, develops personality, gives daily guidance and promotes sound, voluntary activities.

A Children's House is a welfare facility based on the Children's Welfare Law. The Children's Charter states that 'every child should be guided to love nature, respect science and art, and led to develop an ethical mind'. Therefore, a large-scale Children's House has many science exhibits and activities. Since these activities are closely related to play, they are settings easy for the children to familiarize themselves with. Thus, the Children's Cultural Centres and Houses provide social, educational and welfare facilities. Exhibits consist mainly of animals and plants, minerals, astronomy, local industry and nature. Assemblies and activities such as science clubs, workshop clubs, and observation clubs are very popular.

In the Deep Sea Surveyor—at the Tokyo Metropolitan Children's House

Museums of Natural History. There are 76 museums of natural history which have zoos, botanical gardens, aquariums, outdoor museums and facilities where exhibits are shown indoors. The museum exhibits comprise those that are solely about natural history or those that combine science and technology.

Present activities and problems

As mentioned earlier, some institutions belonging to the Japan Association of Museums, are not museums in the strict sense of the word. Those that satisfy specific requirements and have been registered by the

Prefectural Board of Education become 'registered museums' and those that are museum-related and have been appointed by the Ministry of Education or the Prefectural Board of Education are called 'museum-equivalent facilities'. The conditions and activities are surveyed for these registered or appointed museums.

The number of facilities in 1978 was 78 general museums, 59 science museums, 144 historical museums, 135 art museums, five outdoor museums, 30 zoos, 18 botanical gardens, eight animal and plant parks and 27 aquariums; in total 504 facilities. The size of these museums varies but the average size of those that are related to science and technology such as the science museum, outdoor museums, zoos, botanical gardens, and aquariums are indicated in Table 3. The National Science Museum mentioned previously is much larger than average.

Table 3. The average size of museums related to science and technology

	Science museum	Outdoor museum	Zoo and botanical garden	Aquarium
Average number of staff per museum	16.0	21.3	38.2	22.4
Floor space per museum	2,711 m^2	875 m^2	5,782 m^2	1,641 m^2

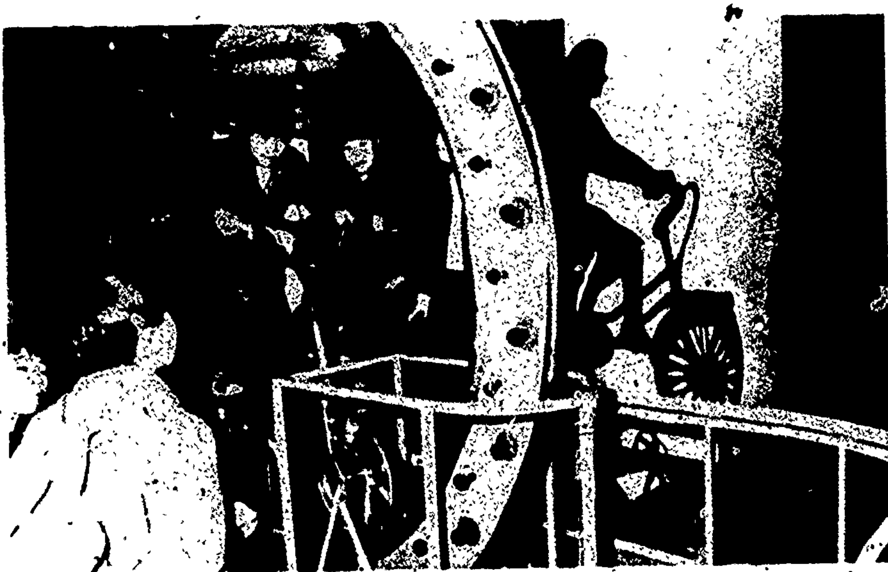
Activities. The annual statistics of the present activities of museums are as follows: 2.0 lectures per museum a year (176 persons per lecture), 2.6 study meetings per museum a year (78 persons per study meeting), 13.1 movie shows per museum a year (145 persons per movie show).

Only 1 per cent of the visitors to museums participate in the above activities. Approximately 27 per cent of the admissions are primary and lower secondary school students. Figures relating to museum visitors are shown in Table 4.

Table 4. Number of visitors to a museum

	Science museum	Outdoor museum	Zoo and botanical garden	Aquarium
Total visitors	206,700	96,700	877,100	318,600
Visitors (students in I-IX grades)*	201,100 (95,600)	96,700 (7,600)	868,100 (255,700)	317,000 (89,000)
Participants of seminars, lecture meetings, etc.	5,600	600	9,000	1,600

*The population of Japan is approximately 110 million of which 15 million are grade I-IX students.



Measurement of man's power at the Museum of Science and Technology

Results of a survey on consciousness about science and technology. The Japan Science Foundation, which operates the Museum of Science and Technology, conducted a 'survey on feelings towards science' in 1977 with all age strata from elementary school children to adults in order to obtain fundamental materials for planning and promoting activities of science and technology.

Types of questions. The examinees were asked to write their questions about the natural world and sciences. The questions were then classified and the results, by different age strata are shown in Table 5.

An exhibition on 'milk' at the Museum of Science and Technology.

Table 5. Classification of questions by age and by sphere (in percentage)

	Grades I-III students	Grades IV-VI students	Grades VII-IX students	Grades X-XII students	Univ. students	Adult
Earth science	26.0	33.3	30.7	23.7	22.2	26.0
Living things	16.0	21.5	15.4	11.2	12.1	9.4
Human body	11.1	13.6	17.1	10.7	10.0	6.3
Physics	18.2	14.7	15.3	26.1	23.0	35.8
Chemistry	1.0	5.4	1.9	1.5	1.1	3.1
Spiritual, mental	6.8	4.2	12.9	17.9	20.3	6.9
Social	14.4	5.1	5.9	7.9	8.3	9.5
Daily necessities	4.6	0.7	0.4	0.2	0.3	0.4
Others	1.9	1.0	0.4	1.0	2.2	2.1

Table 6 is a classification by the nature of the question, showing that the nature of the questions differs with age strata just as the types of questions differed with age strata in Table 5.

Table 6. Nature of questions (in percentage)

Question	Grades I-III students	Grades IV-VI students	Grades VII-XI students	Grades X-XII students	Univ. students	Adult
Meaning, definition	9.9	7.0	15.5	15.5	18.7	10.4
Cause and effect, relationship	11.5	4.4	5.7	6.3	6.7	6.6
Origin production	18.5	23.1	18.0	13.0	11.1	15.7
Condition, setting	33.3	34.7	24.8	22.9	26.7	18.9
Purpose, usage	2.0	1.8	3.4	3.5	3.5	5.0
Function, structure	17.9	21.4	18.1	25.3	20.8	30.0
Relationship, classification	1.1	0.7	0.2	0.6	1.2	1.6
Supernatural phenomena, fiction	3.7	5.6	14.9	11.7	9.5	9.3
Others	2.1	1.3	0.4	1.1	1.8	2.5

Actions taken for question-solving. Table 7 shows the actions taken by the examinees for resolving the questions. It is noticeable that the highest percentage of children asked others to help them solve their problem. The 'others' who were consulted differed with age strata. In the elementary school age strata, the 'mothers' hold the highest percentage whereas in the upper secondary strata, this percentage is taken over by 'friends'. Attention should be paid to the fact that fathers hold a lesser percentage rate than the mothers when the children are younger. Teachers hold an even smaller percentage rate.

Approximately one-fourth of the children solve their problems by themselves, obtaining their answers mostly from books but this declines in the higher grades. Less than one per cent of the children go to museums to find answers to their questions while 30-40 per cent of the children did not do anything about question-solving.

Table 7. Actions taken for question-solving (in percentage)

Action	Grades I-III	Grades IV-VI	Grades VII-IX	Grades X-XII
Asked:				
Mother	13.4 (38.3)	13.9 (31.6)	7.4 (16.6)	3.6 (9.0)
Father	9.7 (27.7)	11.0 (25.0)	7.5 (16.9)	5.4 (13.4)
Brothers and sisters	5.3 (15.1)	7.2 (16.4)	7.6 (17.1)	3.4 (8.5)
Friends	3.3 (9.4)	5.3 (12.0)	16.3 (36.6)	20.1 (50.0)
Teachers	1.8 (5.1)	2.8 (6.4)	3.0 (6.7)	2.9 (7.2)
Others	1.5 (4.3)	3.2 (7.3)	1.8 (4.0)	1.4 (3.5)
Total	35.0 (100)	43.4 (100)	43.6 (100)	36.8 (100)
Solved by oneself by:				
Book	16.0 (60.6)	23.6 (83.4)	21.5 (87.0)	19.5 (89.0)
Museum	0.5 (1.9)	0.8 (2.8)	0.8 (3.2)	0.1 (0.5)
Actual examination	4.2 (15.9)	1.6 (5.7)	0.7 (2.8)	0.6 (2.7)
Others	5.7 (21.6)	2.2 (7.8)	1.7 (6.4)	1.3 (5.9)
Total	26.4 (100)	28.2 (100)	24.7 (100)	21.5 (100)
Took no action	38.5	27.9	30.9	38.0
Total	100%	100%	100%	100%

Problems. Museums of Science in Japan, operate on a small scale and are underdeveloped compared with Europe and the United States (see Table 2). It is mandatory to increase the number of museums and also to develop and expand the facilities of each museum.

It is noticed that the comprehensive museums of science and technology are especially few in number. Japanese museums tend to concentrate mainly on exhibits with too few other activities.

Relationships between the museums and the community are still poor. Explanations and consultations for museum visitors by local volunteers are desirable but are rarely realized. It is also necessary to develop membership organizations which support museums. These organizations will be the foundation for closer relations with local communities and active publication. It is worthwhile to note that the Ministry of Education has a subsidy plan for promoting children's museums.

Establishing children's museums. Children's museums are promoted in order to enrich the ideas that come forth from the free activities of the children. They nurture the individual abilities and emotions of the children through scientific and creative activities. Children's museums require exhibits that the children can operate and experiment with by themselves.

The specifications for children's museums include an area of 2,000 m^2 with such amenities as exhibition rooms, workshops, experience corners, atelier, planetarium, observatory, auditorium, study room, library, storage room and office. Local municipalities do the construction and the government gives a subsidy of Yen 500 million* per museum.

Other facilities for social education

In addition to museums, the official organizations where social education is rendered are social education departments of the Board of Education and such places under its supervision as Citizen's Public Halls, Public Libraries, Facilities for Youth (Children's Nature Study Centres, Youth Houses, Children's Culture Centres), Women's Halls, and Social Education Halls.

Department of Social Education of the Board of Education. There are 3,238 boards of education in Japan where 23,000 persons are exclusively in charge of social education. The participants in the social educational seminars given by the Boards of Education are more than 70 per cent women. The average size of one seminar is 52 participants, and they vary in duration from 20 to 100 hours.

Among these seminars, about 20 per cent are for adults, 11 per cent for senior citizens, 28 per cent for women, 21 per cent for domestic education, and another 21 per cent for youths. The content of the seminars differs according to age strata; however, the majority of the seminars for youths are for liberal arts and for the cultivation of artistic appreciation, while 60 per cent of those for children are for physical education and recreation. Content related to science and technology for both youth and children is almost non-existent.

Citizens' Public Halls. The Citizens' Public Halls are social education facilities developed for the purpose of contributing to higher social welfare and the better cultural life of local residents, by offering various scientific and cultural activities related to their lives.

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* Approximately 230 Japanese yen (¥) = One US dollar

There are more than 17,000 Citizens' Public Halls, conducting various kinds of seminars and cultural activities. However, only 5 per cent of the total number of visitors to the Halls participate in these activities. The rest simply make use of the facilities.

Public libraries. The total number of public libraries in 1978 was 1,218 holding more than 40 million books—almost 40 books per 100 persons. The annual rate of increase of these books was about 10 per cent. According to the Japanese Decimal Classification, 38 per cent are classified as literature while 6 per cent are science, 5 per cent engineering and technology and 4 per cent industry.

Thirty-five thousand people used the libraries each year of whom 36 per cent were primary school children. Library services include lending books and audio-visual materials and reference services as well as activities such as reading meetings, study circles, movies, music appreciation meetings and exhibits.

Educational facilities for youth. There are facilities for the various seminars of youth which are also used as centres for other youth group activities. These facilities are called Children's Nature Study Centres, Youth Houses (some with accommodation facilities) and Children's Culture Centres.

The Children's Nature Study Centre is a facility which familiarizes children with nature, conducts overnight group training programmes, outdoor activities and nature inquiry. Its aim is to develop in each child a sound body and mind by enriching sociability and emotional aspects.

Youth Houses are divided into two different types. One type has accommodation where the spirit of discipline, co-operation, friendship and service is aimed to be nurtured and where also the healthy body and mind of youth is developed through residential training programmes. The other offers a meeting place in the youth's daily life and promotes study and the group activities of youth. Children's Culture Centres were described earlier. Tables 8 and 9 show the size of the various facilities and the activities they carry out.

Table 8. Floor space and ground area of educational facilities for youth

	Children's nature study centre	Youth house with accommodation	Youth house without accommodation	Children's culture centre
Floor space per facility	1,949 m^2	1,445 m^2	1,335 m^2	1,070 m^2
Ground area per facility	36,733 m^2	12,020 m^2	965 m^2	1,001 m^2

Productive activity—mushroom culture—at the Nasukashi National Children's Nature Study Centre (top left). Creative activity—handicraft with timber—at the Nasukashi National Children's Nature Study Centre (above).

Table 9. Number of activities sponsored by facilities for youth and their number of users (per facility per year)

	Children's nature study centre	Youth house with accom-modation	Youth house without accom-modation	Children's culture centre
Youth class	2.2	1.3	28.6	110.8
Youth group seminar	4.5	3.4	3.2	4.1
Leaders' seminar	1.0	1.4	1.6	9.1
Other seminar and lecture	2.5	2.5	5.3	29.2
Number of users	12,500	10,600	33,000	58,400

Women's halls. By providing a base for educational activities conducted by different women's organizations Women's Halls aim to develop women's ability and quality and to improve their knowledge and skill through various seminars and exchanges of information. About 100 such halls are in operation, providing the following activities: seminars, lectures and courses, physical education and recreation, and exhibitions. Some of these activities include mothers and children together.

Science clubs

Science clubs are the spontaneous, voluntary activity of youths. Many of them are sponsored but quite a few of them are operated independently. The Science and Technology Agency made a survey on the club activities and members' opinions in 1975.

Science clubs in this survey were defined as membership organizations of the youth for the development of scientific knowledge and ability, sponsored by social facilities (science museums, zoos, botanical gardens, children's culture centres, children's houses and citizens' halls are included; schools are excluded) and constructed and operated by the local municipality or non-profit organizations.

The survey classified the clubs into nine categories of which Nature Observation Clubs (24 per cent), Movie Clubs (17 per cent) and Astronomy Clubs (17 per cent) comprised 58 per cent of the total. The remaining clubs were Science and Technology, Science, Electric, Workshop, Invention and 'Others'.

The most frequent activity was the Invention Club, held 90 times a year. Memberships ranged from 50 to 200 persons and more than 50 per cent of the clubs charged no fees.

Opinions of club members and their parents on science clubs. Participants joined the science clubs for many reasons. Some because the club was recommended by a teacher or a friend while others joined after reading newspaper articles about them.

The feelings of both parents and children toward the experiences of the science clubs are outlined in Table 10.

Table 10. Feelings toward science clubs (in percentage)

Participant	%	Parent	%
Fun, interesting, workshop and laboratory work interesting	28	Developed spirit of inquiry	21
		Happily participating	15
Can do as I please	12	New interest in science	14
My question solved	8	Can learn with child	9
Can do what I cannot in school	8	Can learn what school and home cannot offer	8
Learned how to use tools	6		
Made friends	5	Developed positive attitude; concentration and patience	6
Useful for school science	4		
New interest in school science	5	New interest in handicrafts, experiments	6
		Learned how to use tools	1
		Learned to take good care of things	1
Others	26	Others	19

Parents and children were invited to make recommendations about the future operation of science clubs. Most requested increased time and facilities for workshop and laboratory activities. Other recommendations included more observation activities, raising the content level and providing more activities unavailable in school.

Media of out-of-school science and technology education

Television and radio. Television has a great influence on the daily lives of the people in Japan. According to the results of a survey conducted by the Public Opinion Research Institute of the public broadcasting organization (NHK), both children and adults spend two to four hours every day for viewing television as shown in Table 11. In terms of time, television occupies a substantial portion in the daily lives of the Japanese people.

Table 11. Analysis of television viewing hours of Japanese people by sex and age group (1975)

Age	10–15	16–19	20	30	40	50	60	70–
Male								
Weekday	2.16	2.21	2.27	2.37	2.47	3.13	4.13	4.24
Saturday	3.16	3.05	2.58	3.22	3.17	3.25	4.29	4.34
Sunday	3.35	3.58	3.59	4.06	4.01	4.26	4.55	4.56
Female								
Weekday	2.05	2.13	3.40	3.59	3.54	4.26	4.23	4.51
Saturday	3.02	2.46	3.55	4.12	4.15	4.43	5.01	4.21
Sunday	3.53	3.39	4.10	4.05	4.25	4.34	4.59	4.31

Japan has one public broadcasting organization and over 100 commercial corporations broadcasting locally or nationwide. The Japanese Broadcasting Law states that stations should '. . . broadcast well-balanced, high-quality programmes in the fields of news reporting, education, culture and entertainment in order to meet the various needs of the people'. Consequently, all stations provide these four different kinds of programmes.

Some of the news programmes from time to time handle the recent developments and problems of science and technology and some of the culture programmes are related to the field of technology. However, this report will centre its focus on educational programmes.

Educational broadcasting. Educational broadcasts are produced and broadcast as follows: nation-wide production, broadcasting and educational use of programmes such as made available by NHK and certain commercial stations; television programmes (VHF and UHF) and radio programmes (medium wave and FM) broadcast at the prefectural level, many of which are frequently sponsored by the prefectural board of education; cable television (CATV) programmes made available by use of coaxial cables, such as seen at Tateyama City in Chiba Prefecture, which are more local than the above-mentioned prefectural programmes, hence more suited for providing community-oriented educational information to the classrooms as much as it is needed; and intramural broadcasting programmes made available within one school or social education institution. In addition to audio programmes, visual programmes, even in colour, are being produced and made available in the classrooms, as video-tape recorders (VTR) and handy television cameras become widely used.

Educational programmes of NHK. The television networks of NHK cover the entire country with two different programmes. The general programme is broadcast for 17 hours 30 minutes a day of which more than 20 per cent is news, more than 10 per cent educational, more than 20 per cent culture, and more than 20 per cent entertainment. The educational programme is broadcast for 18 hours a day. Education takes up more than 75 per cent of the time and culture over 15 per cent.

More than 30 per cent of the time on No. 1 Radio is devoted to education and more than 80 per cent of the time on No. 2 Radio – a total of more than 20 hours per day. The radio is widely utilized for educational purposes with the emphasis on music and foreign language education. As far as science and technology are concerned, television has replaced radio. Hence, the remainder of this section refers to educational television programmes only.

Prior to the composition of the programmes, the main items are decided upon. Among these main items are found those which are related to science and technology (marked *). The main items and their respective programmes broadcast in 1977 are shown below.

*	a) natural resources, energy	67
	b) economic situation, prices	134
*	c) population, food	52
*	d) pollution, environment	65
	e) welfare	37
	f) election for House of Councillors	30
	g) natural disaster	49
	h) year-end donation campaign	26

Popularity rating of the science programmes. The popularity rating for most of the educational programmes, especially science programmes does not ever reach one per cent whereas entertainment programmes enjoy ratings of 10 per cent or more. However, it still means that the programmes are being used by 800,000 people.

Educational films

About 10 to 15 per cent of all films made in Japan are categorized as science or technology and they are all 16 mm. There are a number of public relations films considered to be of superior scientific and educational quality.

The Ministry of Education selects good films and slides each year in the pursuit for higher quality educational aids and promotes their usage by distributing the printed synopses of the films to schools and social organizations. There are also private organizations which sponsor annual contests for making science films and present awards to the winners.

Although science films have a longer history than television and there are many of good quality, they are not widely utilized. This implies a necessity to improve the quality and selection of the films, and suggests the need to improve the complicated utilization system of science films.

Audio-visual library. Each prefectural board of education runs its own audio-visual library for the loan of films to schools and social education establishments. Some 500 film libraries throughout the country, including those established by town and village authorities provide services to schools and social education establishments within their jurisdiction in the form of loans of films and travelling film shows. Several of them, however, are facing financial difficulties.

Along with the modernization of instructional equipment and teaching materials and the growth of educational information, audio-visual libraries must continue to operate in close co-operation with schools and social education establishments in order to provide suitable equipment and materials and to promote their active use.

Printed media

Publications of books and magazines. There were 25,148 new books published in Japan in 1977. Of these, 2,047 were books on natural science, 2,171 on engineering, 1,137 on industry and 1,924 for children. Among the books for children were 166 on natural science and 51 on engineering.

There were 2,960 magazines published in 1977 excluding academic journals and official magazines. Of the general magazines sold in the market, 60 were on natural science, 455 on engineering, 93 on agriculture and fishery, and 64 on traffic and communication.

Newspapers. Several nation-wide newspapers have a daily circulation of over one million. They contain news and explanations on the development of science and technology as well as weekly science columns that provide easy-to-understand explanations on new topics of science and technology. These nation-wide newspapers make great contributions on developing the scientific knowledges and attitudes of their readers.

The newspaper companies also sponsor various cultural activities some of which are related to science and technology. For example, the Yomiuri Newspaper Company gives science awards for students and holds a science fair each year asking students for studies, intentions and new ideas in the field of science. Mainichi Newspaper Company rewards good inventions and new ideas presented by teachers and students. These activities are a good stimulus for the further promotion of science club activities for youth.

Reading survey results. Printed media are very rich in quantity and variety; however, this does not necessarily mean that they are put to good use.

The International Association for Evaluation of Educational Achievement (IEA) conducted a science survey in 1970. The result showed that out of the 19 countries participating in the survey, Japanese elementary and lower secondary school students spent the longest hours on television-viewing on week days, and also showed that those same students spent the shortest hours for leisure-reading (excluding comic books). It can therefore be assumed that despite the huge number of new publications each year very little out-of-school science education takes place through the medium of books; and this poses an educational problem.

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MALAYSIA

by M.P. Prabhakar

Introduction

Out-of-school science and technology education in Malaysia has to be viewed within the context of two significant developments; (i) recent innovations in the curricula of mathematics, science, vocational and technical education; and (ii) plans for national economic development. An appreciation of the place assigned to school science, technical and vocational education within the whole system can be obtained by identifying the general curricula and then the national development trends. The links between education and national development are fairly clear; the manner in which this is brought about needs careful study. This paper examines the relationships that exist between young people in this country, within or outside the formal school system, and the organizations and agencies that have been involved in promoting various aspects of out-of-school science education. In outlining these relationships, the strategies employed, the media used and the overall aims of various programmes are considered. Unifying themes, if any, are identified. In conclusion a forecast is made of possible future trends in this area of education.

Some clarification seems necessary in the use of terms such as out-of-school and non-formal education. In the Malaysian context much of the activity involving youth of school age is organized by the school. Though specific activities may be held outside the classroom situation, many of these activities, until now, have been inspired by the curriculum itself. Out-of-school, in the context of this report, refers to all activities organized outside the school situation but which may involve pupils within or outside the school system.

Activities of youth outside the school system are initiated mainly by youth organizations, clubs and associations sponsored by the government, private interests and the community. This is no doubt an area that is receiving greater emphasis in government plans.

Curricula trends in science and mathematics education

In recent years the Malaysian school science and mathematics curricula have been revised both at primary and secondary levels in order to make them more meaningful to the pupils in relation to their environment. The three main changes have been in teaching and learning methods, in the integration of content and in the relevance of content material.

Malaysian science syllabuses have been developed for the lower secondary (Forms 1, 2 and 3) and the upper secondary levels (Forms 4 and 5). The teaching and learning approaches recommended at the secondary level in the new courses are designed to improve the understanding of concepts and principles in science and mathematics through supervised activities related to selected situations. Procedures and techniques that are basic are introduced and reinforced during these activities, and an inquiry and discovery approach is adopted if possible. The application of concepts and principles to real-life situations is also encouraged and attempted. A similar approach, based on inquiry and discovery, but in a simpler form, is encouraged at the primary level where an attempt is made to integrate all branches of science as they occur naturally. An integrated approach is attempted for the integrated science course at the lower secondary level and the general science course at the upper secondary level. The single discipline, pure science courses in physics, chemistry and biology at the upper secondary level, also allow for some integration at certain points.

Curricula trends in technical and vocational education

Technical education programmes in Malaysia have evolved within the framework of higher level manpower requirements relevant to national development. Technical education at the upper secondary level provides a technically based academic education leading to advanced engineering studies. The emphasis is not so much on trade skills but rather on the foundations considered necessary for higher technical education. Besides the general subjects such as languages, mathematics, science and social studies, students are introduced to engineering workshop practice, geometrical and mechanical drawings, surveying, building construction, geometrical and building drawing–subjects which are basic to mechanical and civil engineering. Besides engineering studies, other branches of technical education lead to advanced studies in agriculture, accounting, business administration and economics.

Vocational education at upper secondary level is concerned with equipping students with employable skills. It does not cater for advanced studies at polytechnic or university level. The common core subjects are science, mathematics, social studies and languages. In addition, the following electives: agriculture, commerce, home science or engineering trades are available.

The engineering trades course covers the following areas in each of which there is an emphasis on skill development: (1) electrical installation and maintenance; (2) radio, television and electronics servicing; (3) fitting and machining; (4) sheetmetal work and welding; (5) woodwork and building construction; (6) motor mechanic; and (7) air-conditioning and refrigeration training.

Project on 'solar energy'—Selangor State-level science exhibition

The vocational agricultural course also stresses farming skills and farm management practices. The home science course aims at imparting knowledge and skills in specialized areas of home science for employment, the management of the family resources, the improvement of family health and the inculcation of good working habits.

While the new curricula encourages inquiry and discovery through activity within the context of the syllabus, such engagement leads the students to interests outside the formal school programme where the application of what is learned in the classroom can become relevant and meaningful.

National economic development

The period 1971-1990 represents an important phase of national development especially in economic development and education. Over this period the objectives of the New Economic Policy (NEP) are being implemented. In essence the twin objectives of the NEP are the eradication of poverty and the restructuring of society. The Third Malaysia Plan

(1976–1980) represented a five year development plan designed to implement the objectives of the NEP.

Part of the Third Malaysia Plan emphasized production targets by major economic sectors such as agriculture, forestry, livestock and fishing, mining and quarrying, manufacturing, construction and the tertiary sector which comprises government services. A very important aspect of the Third Malaysia Plan centred around efforts to meet the manpower needs of the nation especially in science and technology and towards this end, the education system as well as some training programmes were further developed and oriented.

Out-of-school science and technical education

Curriculum requirements and national development blueprints make it necessary to examine the role of education in general and science, vocational and technical education in particular, in accelerating national development. The Third Malaysian Plan stressed the need for manpower training especially in science and technology. Implied also was the need to improve the general quality of life of the people.

Clearly, in-school and out-of-school science and technology education had much to contribute towards this. What is being asserted here is that there is only a thin line demarcating in-school and out-of-school activities for the schoolgoing population. Other programmes, are available for those who have left school, under the sponsorship of the government, independent organizations or institutions of higher learning. Science educators may like to explore this theme further. If the science studied in schools is to be made meaningful it has to be seen to be relevant to everyday life by putting it to use in its practical form. The opportunities available within the confines of the classroom or laboratory are limited. To enable further extension to the outside world, out-of-school links have to be sought. What are the best ways of achieving this? A very significant aspect concerns the value of in-school and out-of-school science and technology education on prospects in self-employment and the ability of those so exposed to improve their immediate environment at home, at work or at the community level. These aspects might, in the long run, serve as a broad base from which specialized training to meet manpower requirements for selective skills might be conducted. The creation of a reservoir of general scientific and technical skills would be a long term objective. It is expected that specialized training to meet immediate manpower needs would proceed simultaneously.

Numerous organizations and agencies are now involved directly or indirectly in promoting out-of-school education. These may be broadly classified as government, independent or statutory organizations and institutions of higher learning. While some have arisen as part of and within the context of national development plans, others have arisen independently out of public concern for the environment, health, consumerism and a number of other felt needs. These organizations have a direct or indirect influence on out-of-school activities involving youth. In the following pages some of the activities undertaken by different organizations and agencies are outlined under three headings; government agencies, independent and statutory organizations and institutions of higher learning.

Government agencies

It is within this field that the concerted efforts of the government to achieve the objectives of the NEP of eradicating poverty and restructuring society is best illustrated. The prime target of government efforts is the rural community primarily engaged in agriculture and fishing. A great proportion of rural folk consists of young men and women, who depend upon agriculture directly or indirectly. Rural wives are expected to play a leading role in the changes that are envisaged in this sector. Science and technology contribute in one way or other to the improvement of agricultural practices. In a rural setting, science and technology have to be introduced in such a way that they become part of the culture of the community. The following descriptions of some of the activities of the Ministry of Agriculture and its agencies help illustrate this.

Ministry of Agriculture. Agricultural centres have been established throughout the country in order to provide the training necessary to help farmers and their dependents improve their standards of living. More specifically such training includes exposure to new farming methods through practical work with machines and materials that would help in the modernization of agriculture. These centres also educate women in the principles of agricultural consumerism. Study visits and short- and long-term courses are regularly held to disseminate information and provide training. Some specific programmes are mentioned here.

Farm management. Guidance is given to the farmers on various aspects of farm management such as the proper use of land for maximum production, optimum levels of effort, capital and management techniques such as simple farm planning, practical budgeting and feasibility studies.

Dissemination of information. The mass media is used extensively to disseminate information to the farmers and their families—brochures, guidebooks, posters, reports, news items, films, slides, television and radio programmes, are but some of the media used.

The farming family. A direct approach is made at village level to assist the farming family improve its standard of living. The government through its state-level advisory services provides technical knowledge and trains family members to acquire specific agricultural skills needed for growing crops and rearing poultry and livestock.

In order to improve the income of farmers and also to eradicate poverty, a national campaign called the 'Green Book Project' was launched in the mid-70s. More specifically, this project was designed to increase national agricultural production in stages, to bring more land under cultivation and to encourage the rearing of poultry and livestock with a view to attaining self-sufficiency in food production. The planting of vegetables and fruit trees is being promoted around the homes and school children are encouraged to use vacant land in their schools for growing vegetables and planting fruit trees. Housewives and young people in the villages are also given guidance in the techniques of processing, preserving and storing foodstuff.

Community development projects. Recognizing the importance of overall community development in achieving a higher standard of living, the Ministry of Agriculture established a Community Development Division in 1961, to promote and consolidate several essential aspects. Initially the activities of this division emphasized adult literacy but since 1969 the emphasis has been on community development with the NEP in view. A great deal of co-ordination between government agencies is achieved through this division. Such programmes involve youth and housewives a great deal and very often are directly related to the utilization of science and technology at family or village level or serve as a conceptual physical, psychological and a moral basis for such utilization. The activities of the Community Development Division may broadly be divided into three main areas, namely: Community Development, Community Education and Community Service.

Community development. Self-reliance at the family and village level is highly valued. In order to do this, an area of a village is selected and some of the more pressing problems are identified. A team of consultants and experts assists the community to adopt an integrated approach to problem solving especially in matters concerning agriculture. Demonstration teams visit villages to explain farming methods and the importance of cleanliness, nutrition and the part played by education. The concept of a complete home with adequate ventilation and high standards of cleanliness is emphasized.

Community education. The womenfolk, including a large proportion of young people at village level, are given courses in home economics and social and health education. Training in basic skills for employment is provided. Literacy and religious classes are also conducted.

Community services. Certain services are provided, which are designed to improve the quality of life. Pre-school classes (kindergarten) are conducted by teachers who receive special training. The discovery approach is emphasized, making it possible for young children to react naturally with nature.

With a fairly high proportion of young people in the villages and with the impact of technology gaining ground the need for reading materials has been met by setting up libraries in the villages. Reading material compiled by the agricultural centres finds its way into these libraries.

Change requires dynamic leadership and such leadership has to be found within the local situation. Courses are held at village level to train young people to assume leadership roles and help bring about the necessary changes, especially in agriculture. The concept of development in the rural and national context is a theme that is constantly emphasized in the villages.

Ministry of Education. The part played by the science, vocational and technical curricula in stimulating out-of-school science and technical activities has already been mentioned. The Ministry of Education is involved in two projects that are aimed at encouraging project work for school pupils. Work of this nature would normally be undertaken outside the formal school timetable. The first of these projects is the Malaysian Secondary Schools Science Exhibition held biennially. Alternating with this is a television series known as 'The Young Scientist'.

Section of the national level Secondary School Science Exhibition held in Kuala Lumpur, 1979

Malaysian secondary schools science exhibition. This is a national event open to all upper secondary (Form 4–6) schools in Peninsular Malaysia, Sabah and Sarawak. This project is jointly sponsored and financed by the Ministry of Education and local industry. Entries for the exhibition are received from two levels; Forms 4 and 5, and Form 6. Each level caters for projects in physics, chemistry, biology and mathematics. Entries are invited from schools early in the year and, in the first instance, written descriptions of the projects are received. These are shortlisted by a vetting committee. The selected participants are invited to exhibit their projects at a central location. Travelling and accommodation expenses are met by the sponsors.

The exhibits are judged by a panel of judges drawn from local universities, research institutes, and relevant government agencies. There are four criteria adopted for judging the projects. The first is the scientific approach to the problem as shown by the application of scientific methods to the problem in question. The problem itself needs to be identified and outlined and the experimental approach adopted, together with the data collected and the analysis done, have to be clearly shown. Second, the importance of the project is established by relating it to local application, its contribution towards the development of the young scientist's approach in research and on the specific value of the products of the research to science and the community. Third, ingenuity of construction, technical skill, workmanship and thoroughness are stressed and finally, the presentation of the exhibit in a clear and concise manner is evaluated.

The judges, having made individual assessments in these areas, proceed to identify the first three winners for each subject area at each level. The overall winner is then selected and cash prizes and certificates are awarded. The overall winner receives a trophy in addition. Consolation cash prizes are awarded to the rest. The exhibition is normally open to the public, and school children in particular visit the exhibition in organized parties.

Since 1970 a number of these national-level science exhibitions have been held. Schools have begun to regard project work more seriously as new themes with longer periods for investigation and research are required. Many of the recent projects are interdisciplinary in nature and attempt to understand and solve local environmental problems such as pollution, the recycling of wastes, the cultivation of useful plants under controlled conditions to name just a few. A selection of project titles is given in the table on the following page.

Titles of projects entered for the Malaysian Secondary Schools Science Exhibition

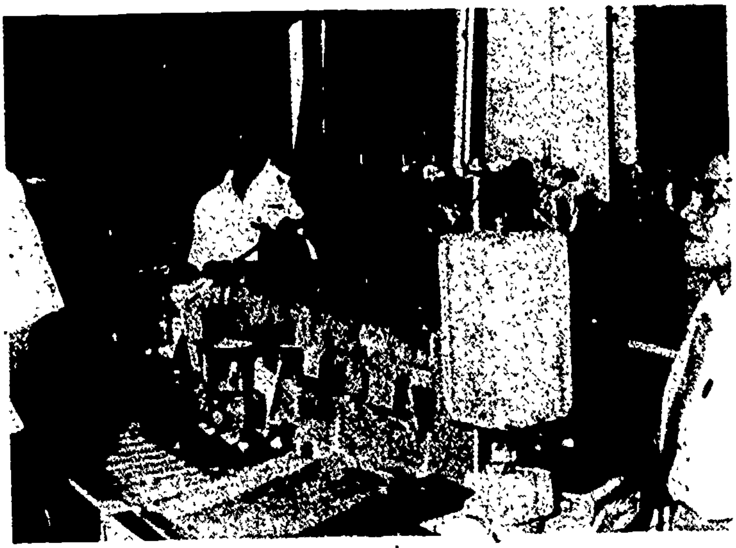
Physics	Chemistry	Biology	Mathematics
Project 'hydro complex'	Insecticide from tobacco leaves	Cultivation of freshwater fish in pretreated effluent ponds of rubber processing factories	To make a perpetual calendar
'Home-made' egg incubator	A faster and more economical method of salting eggs and utilization of by-products	Sound pollution	A mathematics investigation into a game of chance using the theory of probability
Electricity generation, transmission and its uses in Kota Kinabalu, and its role in the development of tourism	Indicators from plants	An example of biological control of pests	Logic and its applications
Making paper from padi stalks and kapok	Determination of vitamin C in fruit and drinks	Effects of natural substances on various bacteria	'Counting system: modern mathematics approach'
Production of magnetic tape from sugarcane fibres	Coconut husks to photographic film base (acetate)	Poison in vegetables	Ternary and the 12 balls problem
The exploitation and utilization of rubber seeds to consolidate the economy of the nation	Producing insecticide from cigars	Prawn culture	Fantasy of maths
Utilization of car exhaust gases	Plastics from lallang	Mushroom culture	Computer
Utilization of agricultural waste	Extraction of sulphur from sawdust by different methods	Pollution: its effect on living organisms	Basic operations of a computer
Solar energy converter	Making softboard from pineapple skins	The pond—an ecosystem	
Removal and prevention of spilled oil on water	Manufacture of phosphate fertilizer from cockles		

The young scientist programme. This project is jointly sponsored by a local firm, the Ministry of Education and Radio Television Malaysia. It alternates with the national science exhibitions and basically attempts to meet similar aims as that of the national science exhibitions but reaches out to a wider audience using television as a medium. In addition it provides the opportunity for indepth discussions by experts over television.

Schools are encouraged to embark on non-formal projects and activities and to submit the descriptions of the projects. A committee selects about 27 suitable projects based on criteria similar to that for the science exhibition. The selected projects are filmed at the schools by Radio Television Malaysia. Participating schools are given a cash award. At a later stage another panel of judges drawn from local universities, industry, research institutions and so on select five of the best projects. Originality, the scientific approach, relevance and innovation in the design and use of equipment and material are looked for. Cash prizes are awarded on a sliding scale to the five winners and consolation prizes to the others. The projects are televised and a panel of experts discuss the projects providing valuable suggestions.

Project on 'Fouling organisms in the Johore Straits' declared overall winner in the National Secondary Science Exhibition 1979

Both these projects have encouraged schools to plan their work more seriously so that they can participate at national level. There is evidence that in some schools project work has become a long term undertaking spread over several years. The national secondary schools science exhibition and the young scientist programmes have served as focal points for project work. There is a great potential for school-based project work to be directed towards community needs.



Pupils explaining a project on a thermomechanical generator at the National Secondary Science Exhibition

Ministry of Culture Youth and Sports. A programme of youth training in trade skills and disciplines has been launched by this Ministry. The National Youth Pioneer Corps and the National Youth Development Corps provide training for school-leavers to acquire agricultural and industrial skills in animal husbandry, photography, tailoring and other vocations and trades. Discipline is an important component of the training courses.

The National Museum (*Muzium Negara*) offers a comprehensive programme to the general public. The Educational Services and Information Sections of the National Museum particularly cater to school children. Special efforts are made to publicize the activities of the museum in the fields of history, culture and natural history. Efforts are also made by the museum to establish nature clubs particularly for primary school children. A number of approaches have been adopted to achieve these aims. In order to enrich the experiences of the large numbers of school pupils who visit the national museum regularly, the museum organizes talks and lectures and art classes for pupils, arranges for guided visits and conducts courses for teachers in taxidermy, the preservation of animals and in the identification of trees. Special exhibitions are held on specific themes and for those who are unable to visit the national museum a mobile exhibition visits rural schools. There is also a loan service of exhibition material for schools and film shows and quiz programmes are held regularly.

Special efforts have been made by the museum to establish nature clubs for primary school pupils. In this way pupils are encouraged to appreciate the beauty of nature and to get to know the surrounding plant and animal life more closely. Though the museum covers a wide area in the arts and culture there is a strong emphasis on natural history. Efforts are constantly being made to identify relevant themes and to present them in a form that is attractive and thought-provoking.

Department of Wildlife and National Parks and the Department of Forestry. In recent times there has been a great deal of concern for the protection and conservation of the environment. This is reflected in the emphasis given to this area in the school curricula and in university courses of studies. There is also much public concern over these issues. Efforts are being made to enable a larger proportion of the population, specially school and university students to get to know the natural environment better. The tropical rainforest is a good place to start. Two such facilities are described below.

Pasoh Forestry Research Centre–Department of Forestry. This centre is a substation of the Forest Research Institute at Kepong, Selangor, Malaysia. The Pasoh Research Centre stands on 2,000 ha of forest reserve, the majority of which is lowland and dipterocarp forest. Much of the core is still untouched by man but in some of the surrounding areas logging has taken place and there are many examples of regenerating lowland forest. This reserve exhibits a typical rainforest ecosystem of Malaysia.

The tropical rainforest, due to its rapid exploitation, is a fast dwindling resource. In a situation like this the management of forests is very important. For such management to be effective, knowledge of the ecosystem is essential. Some of the studies undertaken are on the phenology of trees, regeneration and mortality factors of forest tree seedlings, insects and their relationship to the reproductive biology of trees, plant succession studies, termites and their role in decomposition, small mammal and bird population dynamics, to name but a few.

Part of the forest at the centre is being set aside for educational services, catering for school children, university students and the general public. The Forestry Department intends to take this opportunity to create public awareness of and an interest in forests in general not only in showing its rich natural reserves but also in some ecological aspects as well through talks, guided tours and slide film shows. Accessible by road and with some facilities for research and accommodation, school pupils and members of the public, besides university staff and students visit this centre in greater numbers.

Nature Study Centre—Taman Negara, Department of Wildlife and National Parks. Taman Negara is the only national park in Peninsular Malaysia. It includes virgin rainforests, secondary forests, scrubland and a river system. The Department of Wildlife and National Parks jointly with the Ministry of Education established a Nature Study Centre which has been functioning since 1979. With accommodation available for about 48 students and eight teachers, the centre offers loop trails and other longer trails for the observation of a variety of specific situations within the tropical rainforest environment. Accommodation is spartan but the facilities include a lecture area and outdoor theatre. Arrangements have been made for the centre to be fully utilized by school children particularly during the school holidays in April and August.

With the assistance of a park naturalist and forest rangers, visiting parties are able to get to know the jungle environment better. During the recommended three-day stay at the centre, students are involved in walks, hikes, canoeing, film shows, slide presentations and lectures. Through these activities it is hoped that the people of Malaysia, especially the young, will make better use of the park facilities and benefit from the opportunity of obtaining an informal environmental education on rainforests. The Ministry of Education is encouraging schools to make full use of such facilities.

The Ministry of Health has launched the Applied Food and Nutrition Project providing health education including a project on nutritional surveillance. Training programmes at the para-medical level are provided. Programmes on population, family health care, nutrition and child and maternal health have been initiated.

Other ministries and government agencies. Other ministries and government agencies are also actively involved in training those who have left school, in skills that would enable them to find suitable employment at different levels. Again such programmes represent strategies at achieving the objectives of the NEP especially in meeting manpower requirements.

The Ministry of Labour and Manpower provides skill training for school-leavers at its two Industrial Training Institutes, one in Kuala Lumpur and the other at Prai, Pulau Pinang. The National Industrial Training and Trade Certification Board has been established to certify skilled workers from public and private training institutions. In all, about 26 industrial trades have been included. New trades are constantly being added. The Department of Fisheries provides training for fishermen in basic navigation and engine maintenance at the Fisheries Training Institutes in Penang and Trengganu. Training courses in fish culture are provided at the Inland Fisheries Training Centre at Bukit Tinggi in Pahang.

The Department of Veterinary Services provides training for farmers and departmental personnel at the Animal Institute in Kluang, Johore, the Veterinary Research Institute at Ipoh, Perak and at various other poultry training centres in the country. Training in logging practices is provided for at the Logging Training Centre at Kuala Trengganu organized by the Department of Forestry.

Independent and statutory organizations. A number of independent and statutory organizations have been established in order to provide a variety of services to cater for and draw attention to certain public needs and issues. The efforts of these organizations have had the effect of educating the public and contributing towards the improvement of the quality of life. Some of these organizations have been directly accessible to youth.

Federal Land Development Authority (FELDA). As a federal statutory body FELDA has embarked on land settlement schemes for the resettlement of the landless. Besides conducting training programmes in agriculture and providing basic facilities such as housing, transportation, water supply, health services and education, the FELDA authorities have launched a population education programme among these communities. The population education programme aims at acquiring basic knowledge in population matters, developing national and responsible attitudes and behaviour towards family size and decision-making.

Science and mathematics associations. Such associations have been founded in several states in Peninsular Malaysia and in Sabah and Sarawak. Membership is mainly for teachers. The association's activities are primarily designed to improve teaching competencies in science and mathematics and to promote a general interest in and appreciation of science. To achieve these aims, discussions, workshops and seminars are held in order to improve teaching skills and techniques which are communicated to other teachers through newsletters, periodicals, journals, bulletins, books, the mass media and films. An example of such work is the preparation of guidance material for teachers. Curriculum committees are also established in order to study and interpret the school syllabi and other related curricula needs. Though such activities are mainly aimed at the teacher, they do however, draw in school pupils and other youth for programmes that are non-formal in character. Science exhibitions, study tours, film shows, loans of exhibition material, science and mathematics quiz programmes, essay writing competitions, book and apparatus lists, are some of the activities undertaken and services provided.

The Geological Society of Malaysia. The society was founded in 1967 as a forum for discussion and to promote the advancement of geo-science in Malaysia. It is also the only organization representing the interests of professional geologists in Malaysia. Besides a bi-monthly news-letter called *Warta Geologi* which contains geological articles, an annual bulletin is also produced containing geological papers. Technical talks and seminars as well as field trips are organized. The tin industry in Malaysia and other tin producing nations are particularly catered for.

In recent years the environment has received a great deal of attention especially in the wake of developmental activities. A number of environ-ment-related organizations have been established not only to draw public attention to environmental issues but also to enable corrective and preven-tive measures to be undertaken by all concerned.

Environmental Protection Society. In order to stimulate public con-cern for the state of the Malaysian environment the society organizes forums, water pollution campaigns, and talks for pupils. It also conducts environmental journalism courses for members of the press and mass media, holds film shows and produces a magazine called *Alam Sekitar.*

The World Wildlife Fund. The World Wildlife Fund and the Inter-national Union for the Conservation of Nature have initiated a number of programmes for Southeast Asia. For Malaysia in particular it has been proposed that new protected areas be established in order to give high priority to the conservation of the forests and their wildlife. Another proposal is the provision of an educational unit. Schools could then be visited by qualified personnel to give talks on a range of topics.

Rubber Research Institute of Malaysia. This institute, besides under-taking research in order to improve latex yields and processing techniques, also disseminates information on the natural rubber industry to interested parties including school children. Services provided include guided tours of the factory at the Rubber Technology Centre, talks and slide presen-tations, publication of material related to the industry and also the loan of exhibition material especially to schools.

Standards and Industrial Research Institute of Malaysia. An import-ant aim of the institute is to promote and undertake industrial research in order to raise the national level of technology. Among other specific objectives the institute offers scientific and technical advice to the public, industry and the government. It also strives to promote industrial welfare, health and safety and contributes generally towards consumer protection. Together with an industrial liaison and information service, the institute provides technical and scientific backup services. The training of research and industrial personnel is also undertaken. Through some of these measures the institute establishes and promotes national standards and maintains the quality of industrial products.

The institute has often been consulted by students preparing for the national secondary school science and mathematics exhibition. Personnel from the institute have served on advisory committees for organizing the exhibitions and served as judges as well.

Industry. A number of leading industrial concerns provide scientific books, films and other publications as background information. Such materials, relating to local conditions, are widely sought after by schools and organizations.

Consumer associations. Just as there is a great deal of concern over environmental issues in this country, the need for consumer protection against abuses has also been strongly felt. A number of associations have been established during the last few years for this purpose. The Consumer Association of Penang is described in some detail below.

The Consumer Association of Penang, formed in 1970, is a non-profit voluntary organization manned by full-time and part-time volunteers. The association strives to educate the public on existing business practices. Of the number of divisions that make up the organization, a few are particularly relevant to non-formal science education.

A complaints section receives and examines complaints from consumers. The research section conducts surveys, tests products, and monitors environmental problems. Particular attention is given to health resources, prices and the supply of goods. The consumer education section works with students, youth groups and women's organizations in trying to increase consumer awareness. A separate environmental section deals specifically with complaints on pollution, environmental problems and undertakes research work. For the benefit of rural folk a rural section has been established in order to bring consumer awareness to the rural areas. All printed materials are handled by a publications section which publishes and disseminates relevant information. Besides printed materials the association organizes talks, exhibitions and home counselling.

The activities of the consumer associations, in one way or the other, involve youth within and outside the school system. Schools are encouraged to form consumer education societies.

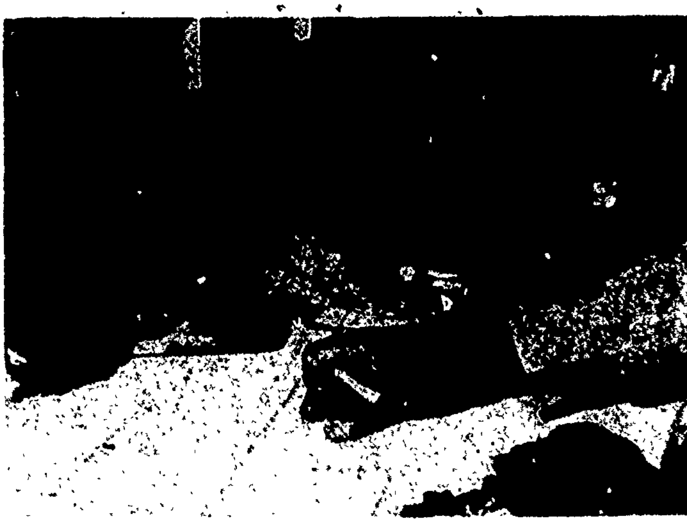
The National Zoo. Besides the usual attraction zoos have for all age groups, the National Zoo has a particular contribution to make towards non-formal education. Conducted tours and talks are available to school parties upon request. Teachers may use the zoo, with assistance from the authorities, for field trips. Information regarding protected animals, and help in identifying animals are available. Zoo authorities are willing to liaise with the National Museum and the Game Warden's Department for relevant information on natural resources and conservation. Very recently an educational centre was set up and plans are under way to extend educational services and facilities to schools in a more structured way.

Institutions of higher learning. Institutions of higher learning have taken positive steps in order to reach the public, especially youth, on certain themes that are gaining importance nationally. Included in this list are issues such as conservation of resources, anti-pollution measures, protection of wildlife, environmental protection and population education. The contributions of some of the universities are highlighted below.

Discussing collections at Gombak Field Study Centre

University of Malaya. The University of Malaya herbarium, of the Department of Botany provides assistance in identifying plants and providing information concerning their occurrence, growth products and related matters. Schools have received assistance from the University on matters concerning suitable teaching materials and the supply of botanical material for practical examinations besides also routine help in plant identification.

The Ulu Gombak Field Study Centre of the University of Malaya has approximately 120 ha. of forest reserve. This centre has been acquired to cater for the needs of research and to compile ecological information. Facilities for field studies are available with a hostel offering accommodation for about 30 people. Besides the staff quarters there also exists a well-equipped laboratory. University undergraduates frequent the centre on field trips. Organized parties of school children also make use of the centre. Jungle walks, closer studies of stretches of the river, of animals and of plants provide a better understanding of what the undisturbed natural environment is like.



Examining collections in the laboratory of the Field Study Centre, University of Malaya

University of Science, Malaysia, Pulau Pinang. This university on the island of Pulau Pinang has founded the Malaysian Society of Marine Sciences. With the general aim of promoting and advancing all aspects of marine sciences in Malaysia and in the neighbouring regions some specific objectives have been identified. The society specifically aims at: (i) promoting an awareness for the need to conserve marine resources; (ii) providing recommendations for the conservation of the marine environment and for the establishment of specific areas for conservation; (iii) advising government bodies; (iv) fostering interest amongst the general public; (v) organizing periodic meetings or seminars at local or national levels; (vi) establishing contacts with organizations and institutions; (vii) providing information concerning marine sciences; and (viii) producing regular publications on marine sciences. School pupils and youth organizations are able to make use of the facilities and services of the society.

University of Agriculture, Serdang. The Centre for Extension and Continuing Education of the University of Agriculture at Serdang near Kuala Lumpur is very much involved in community service. This centre represents the service arm of the university where university students put into practice their research findings and practical information. Included in such services are aspects of home science and agriculture. Certain villages are identified and adopted by the university. Teams visit the villages and new agricultural techniques are demonstrated to the farmers. Housewives are exposed to effective housekeeping practices. From time to time farmers are brought in to the university for more specific courses on a variety of agricultural practices such as bud grafting and fertilizer usage. In addition the university conducts the in-service training in environmental education for officials of government departments.

Future trends

The present momentum arising out of the goals of national development is expected to further intensify efforts by the government and the private sector to widen and strengthen the infrastructure needed to initiate, organize, develop and sustain development programmes designed to increase the standard of living especially in the rural areas.

It can be seen that there are already a variety of established organizations and agencies to provide grassroots support. However, the main problem will continue to be the full utilization of these services, economically, effectively and without waste or duplication. At the same time it will be necessary for existing facilities to be reviewed regularly to ensure consistency of policy and relevance. The public, especially in the rural areas, needs to be brought into contact with the facilities available. In the same way the people need information about which agencies can best assist them. In achieving this two-way communication, the importance of leadership at grassroots level has already been recognized. Co-ordination must be strengthened not only through the improvement of existing government agencies but perhaps also by the establishment of new ones. Non-government co-ordinating agencies will also have their part to play. In order to tie all this together more effective national campaigns adopting multi-media approaches will need to be launched.

The enrichment of the school curriculum is expected to continue. Much more emphasis is expected to be given to a knowledge of the environment including wildlife; and its conservation. Population education and the prevention of pollution are expected to receive more attention. Through more imaginative project work, schools might be better able to contribute towards bringing simple technology to the community. □

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NEW ZEALAND

by Phillip Alve

New Zealand has had a well established state educational system, that is free, secular and compulsory, for just over a century. In its earlier period it was closely patterned on the English system and in more recent decades it has been influenced by American trends, but it has also evolved to meet its own particular needs. In addition there are a number of private schools, usually owned by or associated with different religious groups. Children may enrol at 5 years of age, and usually do; they must enrol by 6, and attend until 15 years of age. Almost all children have at least two years of secondary education.

Ongoing out-of-school scientific activities for young people

Field trips. Most senior primary and secondary classes do three, four and five day field trips each year. These must have specific aims related to some aspect of the curriculum that cannot be covered at school, such as forest studies, climate, soils, geography or geology. The teacher plans a programme, including aspects of safety, and the children practise safety skills. Approval from the local educational authority is needed. An adult/child ratio of 1 to 6 is required for supervision. They are usually housed at field lodges, some of which are owned by groups of schools. Some lodges have a teacher permanently stationed at the lodge. One-day field trips are also arranged which required only the headmaster's approval.

Education by correspondence. New Zealand is a long, hilly mountainous country, so that there are many isolated families living on farms or in places like lighthouses, who are remote from any school. They are served by a very effective Correspondence School based in Wellington. The children, both primary and secondary, under the guidance of their parents, work from set 'assignments', sent regularly by mail and supplemented by radio lessons each morning. Their work is then sent in for comment and assessment. Hence their science lessons are taken in their homes, by using the assignments, textbooks, kit-sets of apparatus, and the local environment. Crippled children and children in hospital are also served by this school.

Similarly the Technical Correspondence Institute, also in Wellington, offers tertiary service to apprentices and students studying for the New

Zealand Certificates, but who are unable to attend a local institute. Most of these courses have some science content. In particular, there are the New Zealand Certificates of Science, with biology, chemistry, food science, geology, metallurgy, paramedical, physics and water technology options. There is also the New Zealand Certificate in Forestry. These certificates are examined by the Authority for Advanced Vocational Awards. To meet the laboratory requirements, the students must come to Wellington for one-, two- or three-week block courses for each unit.

Museum and allied services. In less than 150 years of European settlement, several metropolitan museums have celebrated their centennials, and there are over 150 museums and art galleries open to the public at present. Most provide services for school children when requested. The curator or volunteers show children round and give talks on local history and on their collections. When annual attendances at a museum become significant, museums apply to the Department of Education to appoint a trained teacher to cater for the needs of visiting schools. These work part-time for 15 hours per week until increased demand for their services warrants a full-time appointment. Thirteen museums and both zoos have such teaching staff. In the four metropolitan museums, these teachers have staffed education services for over 40 years. Each has two or three teachers, called education officers, a technician to make and service loan displays for schools in their region and some clerical assistance. Of the other nine museum education services, one is located in a large museum of transport and industry, and the other eight are in provincial museums, some of which combine museum and art gallery collections. A few of these prepare loan kits to lend to schools, or act as depots for displays prepared by the National Museum. These are borrowed by the schools in their regions.

A feature of visits for children has always been the provision of materials from museum collections for the children to handle. Similar services are restricted to adult groups attending by appointment. Casual visitors do not as a rule have this privilege. They also provide replica materials in the form of period clothes for dressing up, tools, weapons and domestic utensils in replica form for use in drama and role-playing situations.

New Zealand has also run a training programme for young student teachers in the practical use of museums as teaching resources. Established first in 1938, this has attracted considerable attention from museums in other countries where this has long been advocated. It has been remarkably successful. At present, ways are being investigated to see how it can be continued in current training programmes. The presence of student teachers means that much of the teaching in the museum galleries can be done in very small groups. It is an ideal way for young students to learn to relate to children, and enables them to receive more personal attention.

Museum education officers are responsible directly to the education authorities and are not members of the museum staff where they work. While they teach pre-school children as well as some adult groups, they work most intensively with school groups and in school hours. They observe school working hours and holidays.

All are trained teachers, but few have university qualifications. Most of the art gallery education officers are university graduates, and a few are also trained teachers.

Children's agricultural clubs. Many schools, both urban and rural, establish community committees to organize agricultural clubs to encourage children to adopt and care for calves, lambs, and suitable small animals at their homes. They are also encouraged to start small home-gardens to learn horticultural science and also to provide food for the home-table. Flower gardens, herb and alpine gardens, are also encouraged.

Open days. The various divisions of the Department of Scientific and Industrial Research (DSIR), the Ministry of Agriculture and Fisheries, the New Zealand Meteorological Office, and the universities hold regular 'Open Days', where the general public and school parties are invited to see displays in the various sections, which are explained by the section staff.

Radio broadcasts and television programmes. There are regular radio and television programmes on science and technology, many being especially made for the young listener and viewer, and screened at an early evening hour. Some radio lessons are prepared by the Department of Education, especially intended for use by school classes, and, as already mentioned, there are other programmes for the Correspondence School pupils. Similarly, special television programmes for school use are being started.

Conservation organizations. New Zealand has long been geologically isolated from other land masses and has therefore developed unique plant and animal species. These have suffered severely at the hands of man especially since European settlement. Fortunately many organizations have been formed to study and help protect the remaining invaluable life forms as much as possible. Probably the best known and active of these is the Royal Forest and Bird Protection Society, formed in 1923. Much of its success is due to its children's education programme and encouragement to take a protective interest in this natural heritage. The Society has many branches that arrange talks and excursions, and also form school and class groups. More recently the Government has established the Commission for the Environment that is already encouraging people, especially children, to study conservation techniques.

Gifted Children Associations. A number of Gifted Children Associations have been formed by parents over the last decade, to cater for the needs of very fertile and inquiring minds. Various activities are arranged over weekends and holidays, with particular attention to scientific and technological interests. These activities go under the name Explorers' Club. The parent body, the New Zealand Association of Gifted Children has arranged national conferences, the second being held in 1982.

A major out-of-school science activity

Science fairs. Science fairs or science exhibitions for school children are apparently becoming a world-wide trend. Science fairs may be described as places for demonstrating the creativeness and abilities of the new generation of young scientists, and showing how science may be applied to solving the problems of the everyday world. They certainly generate much interest, enthusiasm, knowledge and experience in scientific research, both in the participants and the visitors.

Wellington has held 18 annual Science Fairs, the first being held in 1964. Auckland, the largest city, held its first fair three years earlier. The initiative for establishing these two fairs came from the local Science Teachers' Associations (an association of science teachers mainly from secondary schools, but with members from intermediate schools, universities, teachers' colleges and polytechnics).

Getting started. The then chairman of the Wellington Science Teachers' Association approached a well-known chemistry professor to form and lead a committee to plan and organize a fair. The committee formed included science teachers, university lecturers, Royal Society and Association of Scientists members, and businessmen. The first hurdle was to raise the required amount of finance to fund the fair. The mailing list of the members of the Wellington Manufacturers' Association was obtained and all its members received a letter requesting a donation to help the project. At the same time an entry form was designed, with competition rules, and conditions of entry, and also a poster for school notice boards. The rules specified the maximum base size, measures to ensure safety, how to avoid annoyance to people, not to damage property and that the care of any animals displayed should be ensured. Offers of donations came in slowly and it was by no means certain that there would be sufficient funds when the deadline set for sending entry forms, posters and the covering letter to schools was reached. However, the project went ahead. Some of the donations were goods, which were used as prizes. It became clear that business firms have annual budgets and do not always have surplus money to give at short notice.

The classes that would make up the fair were decided, namely: physical sciences and natural sciences, with junior and senior groups (up to five members) and individual entries. One of the sponsors, the Association of Scientists suggested having an essay class to emphasize the importance of writing skills, and offered prizes. (This essay class has continued and until recently only the Wellington Fair made provision for such a class).

Entry forms and posters were addressed to the head of the Science Department of all schools in the Wellington area, with the expectation that these would be made available to likely fair entrants in their school.

For the fourth and subsequent fairs the classes were changed to biological sciences, physical and mathematical sciences, and applied sciences, with junior and senior divisions in each, plus of course, the essay class. There are now three divisions, namely: Junior for Forms I, II and III (12 to 14 years), Intermediate for Forms IV and V (15 to 16 years) and Senior for Forms VI and VII (17 to 18 years).

There are now Science Fairs in 16 New Zealand centres which altogether display nearly 3,000 exhibits. In addition some schools are now organizing Science Fairs of their own.

New Zealand science fairs. It was not until six years ago that the first Annual New Zealand Science Fair was organized, to display the best exhibits from the local science fairs. This had not previously been possible because of the high cost involved. Fortunately, first one and now a second large international company have fully funded these fairs and assisted with their organization. A National Committee, with representatives from all local fairs, was formed to set the general guidelines, with a temporary local committee to carry out the local organization and management. Each fair is held in a different centre each time. The exhibitors accompany their exhibit, so to contain costs, the total number of exhibits is limited to 25 or 26, each local fair being limited to a set number of entries, in proportion to the number of entries in their fair. As with most of the local fairs, the judges not only assess the exhibit but discuss the experimental work involved and what they have discovered with the exhibitors in a fairly 'searching' manner.

Evaluation. There have been no written objectives formulated for the fairs except as suggested by the Criteria of Judging which was introduced in the third fair, with a marking scale.

Creative ability	30 points	Technical skill	10 points
Scientific thought	30 "	Clarity	10 "
Thoroughness	10 "	Presentation	10 "

and the judges also take into account the number of exhibitors working on the exhibit. The fairs:

1. Give the exhibitors the opportunity to select some suitable theme, question or problem, to think, plan, experiment, form conclusions about what will or will not work, or to find a solution to the problem, and finally present and explain their work to visitors to the fair;
2. Give visitors to the fairs some knowledge and insight into a variety of scientific activities, methods, concepts, and results; and
3. Bring together a number of young people (the exhibitors) with similar interests and abilities for a period, so that they have a stimulating effect on each other.

Problems and issues

Funding of science fairs. Earlier Science Fairs had more than adequate finance, but with inflation it has become difficult to keep pace with increasing costs.

Venues for the fairs. The first few fairs were held in public halls or display areas, but since the eighth fair, school halls have been used, moving to a different hall every two or three years. The hall needs to be reasonably central, with an adequate display area, good natural and artificial lighting, have sufficient electrical power points, good toilet facilities, and ready access to water. Also an adequate parking area is desirable.

Time of the year to hold the fair. The best time of the year to hold the fair is difficult to decide—whether to hold it in term-time or holiday periods. Fairs held in the holidays avoid interrupting school attendance, and give the exhibitors free time to complete their final preparation, but when held in school time, school parties are able to visit them.

Production of the programme. Organizing the printing of the programme after the closing date for entries requires close liaison with the printer, so that it is available ten days before the fair opens. This allows its distribution to the judges, the various advertisers, sponsors and the news media.

Special prizes. One feature of the fairs, is the number of special prizes offered. There are now 22. These require close liaison with the donors to ensure that the prizes are being offered again for the current year, they are listed on the entry form to attract prospective entrants, and as many prizes as possible are awarded by judges from the staff of the donor.

This enables the preparation of the prize-list, prize cards, and the cheque prizes, to be ready in time for the prize-giving. The prize-list is also made available to the news media. □

Bulletin of the Unesco Regional Office for Education in Asia and the Pacific Special issue, December 1982

NEPAL

by Ganesh B. Mali

Introduction

Presenting a case for out-of-school science and technology education, R.A. Stevens writes:

> Every country in the world requires more science and technology, and every country requires that they shall be better trained, broader in their outlook and better able through wider understanding to cope with the interdisciplinary complexities of so much of modern science and technology. Every country in the world is striving to improve its formal science education so as to overcome these difficulties and yet it is a losing battle.[1]

It has been a losing battle because formal education has failed to equip even a small fraction of the total population of the developing nations with the minimum scientific and technological knowledge and skills needed for their national development programmes.

The need for rapid development in science and technology has compelled these nations to seek other avenues of instruction for the unschooled population or the rural community in matters of science and technology. As Stevens further notes:

> Science and technology are moving so fast that it is impossible for formal science education to keep up with progress. In addition there is such a volume of knowledge to be acquired that there is a marked tendency for understanding to be buried under the moving mountain of fact—understanding of how the various bits fit together to make the whole picture of science and its applications and of the impact of science upon society through its applications. At present, and so far as can be foreseen for many years to come, out-of-school activities present the best hope, indeed the only practicable hope, of dealing with some degree of success with this enduring problem.

1. R.A. Stevens. *Out-of-school science activities for young people.* Paris, Unesco, 1969.

The choice of the right type of science and technology has remained a problem for curriculum developers. So much of the information in science and technology has accumulated within the last few decades that a high school science graduate seems unable to cope with even the barest of the scientific and technological requirements of his surroundings. The remedy hopefully lies, as Stevens suggests, in out-of-school science and technology for the common people.

Science education in Nepal

Nepal, a peaceful land in the lap of the Himalayas, remained unaffected by the development of modern science and technology until around 1920. Higher education, in the western sense formally began in this country in 1918 and included some social science. Until 1945, there were only three schools in the whole of the country, and by 1956 only one science college. The main reason for introducing science during that period was to create a few technical hands in the country in order to replace the foreigners then serving in that capacity.

By 1972, there were more than 1,000 science graduates and their numbers were increasing at a greater rate than those in liberal arts. However, up to that period science education just served as a spring-board for getting scholarships for study in foreign countries in fields such as medicine and engineering.

A revolutionary change came with the launching of the National Education System Plan (NESP) in 1970. The goal of education as envisaged in the plan was to develop, preserve, expand and extend science and technology education and the skills necessary for the development of the country and to produce a cadre of able workers who could shoulder responsibilities in every development sector. With that plan launched, Nepal was already on the way to industrialization, like the other developing nations in the Asian subcontinent.

Since 1970, there has been rapid expansion in the application of science and technology for the development of the country. As a result, apart from regular science education programmes, several governmental and non-governmental agencies have been working actively to educate the common people in diverse areas of science and technology, related to on-going developmental projects.

The most important organization set up at the national level for the purpose is perhaps the National Council for Science and Technology (NCST), established in 1973. Policies formulated by this council regarding scientific and technological advances are translated into action by other related institutions including the Institute for Applied Science and

Technology and the Research Centre for Applied Science and Technology (RECAST). Within the decade 1969–1979, there were several talks, symposia, conferences, seminars and workshops on science and technology; science clubs were established and science fairs organized throughout Nepal. Radio, newspapers, magazines and other media and the activities of volunteer teachers actively disseminated scientific and technological information, knowledge and skills among the people.

The objectives, programmes and activities of such important organizations as well as other efforts to impart out-of-school science and technology education are described below. In doing so, chronological order is sought to be maintained. Related events, however, are tied together.

Peace-corps volunteers. Peace-corps volunteers from the United States of America started coming into Nepal during the early 1960s and have acted as pioneers in carrying messages of modern science and technology to the common people. Trained to speak Nepali and often assigned to inaccessible parts of the country, they taught simple science by providing actual examples. Many village people, for example, were shown how to make water safe for drinking.

One volunteer, who came to Nepal in 1960 to teach science and geography stayed on to build a personal, artistic museum of science, technology and natural history at Pokhara, a scenic midland valley of Nepal. This museum has recently been integrated with Prithbi-Narayan Campus of Pokhara. It contains butterflies, birds and animals of Nepal, rocks and minerals as well as geological maps of Nepal, Sikkim and Bhutan. As a result of extensive travel throughout the kingdom many rare specimens have been collected. The museum also contains some attractive projects in science and technology. Whoever visits Pokhara for its scenic beauty also visits this museum, and gains knowledge from its rich collection. Peace-corps volunteers have also written books and booklets on science and technology.

Science Club. The Science Club was founded in 1969, through the sponsorship of the American Culture Centre. Its objectives were to:

1. Promote a broad exchange of scientific ideas through science fairs, debates, lectures, field-trips and other appropriate programmes;
2. Encourage scientific curiosity through various programmes;
3. Improve and strengthen the scientific outlook and knowledge of the members;
4. Mobilize and apply, wherever feasible, scientific information from theoretical to practical fields;

5. Encourage scientific learning for the development of the country; and
6. Convince people about the necessity and utility of science and technology.

Objectives 1 and 6 are particularly noteworthy with respect to the dissemination of scientific and technological information among the Nepali people in general. In 1972, more than a hundred members belonged to the Science Club and all Kathmandu Valley Science Campuses, including the university, were represented.

The club organized science fairs, field-trips, lectures, discussions, quiz contests, I.Q. tests and cultural exchanges, all aimed at propagating a knowledge of science and technology among the people, with a view to contributing substantially to the development of Nepal.

The club conducted numerous activities during its active period, 1969-1977. Each month, the science club arranged activities related to science and technology, which included an essay contest, a quiz contest and talks by prominent scientists, educators or professors. Winners of the various contests were awarded prizes at the end of the year.

Science fairs. A science fair was held at a different venue each year to popularize science and technology in different sections of the country. They have been held in Kathmandu, Birgunj, Pokhara, Biratnagar, Nepalgunj, and other important cities all over Nepal.

The following items were amongst those displayed in the fairs: earthquake detector; traffic-light system; instant-photography; local telephone

system; solar water heater; solar water distillation plant; cow-dung gas plant; collections of insects, plants and birds from different parts of the country; dissection of common animals like rats, frogs and rabbits; experimental demonstration of Newton's Laws of Motion; and soap making.

The Science Magazine. The club published an attractive monthly journal, *The Science Magazine*, on the editorial and advisory boards of which were almost all the prominent figures in the fields of science and technology.

The need to make science and technology accessible to the common people is voiced strongly in the magazine. The Science Club, with the help of its *Science magazine*, aimed at creating a scientifically oriented society. It aimed, ultimately, at making concrete gains by encouraging the practical application of various theoretical scientific activities. The magazine presented interesting articles on science and technology including reports on club activities and synopses of talks, contests and symposia.

Using the mass media. Since the launching of the National Education System Plan, Radio Nepal has emerged as one of the most effective media for out-of-school dissemination of knowledge in science and technology. The Departments of Agriculture, Health, Education, Forestry, Hydro-Electricity and Tourism have been using Radio Nepal not only to popularize their programmes, but also to educate the people and prepare them technically for development programmes under these departments. Every day, about an hour is devoted to the rural development programme. New ideas in agricultural renovation using improved technology are introduced through the media of conversation between a junior technical assistant and *Budhi-āmā* (the old mother). Almost invariably, the *Budhi-āmā* becomes convinced of the superiority of new technologies over the traditional.

Radio Nepal devotes about ten minutes, three or four times a week, to broadcasting special programmes on science and technology. These programmes occasionally cover sensational news about new discoveries or improvements in the field of science and technology. The 'Radio doctor', in conjunction with the rural development programmes introduces issues on current health problems. For example, during an outbreak of epidemic diseases the radio doctor gives information about the nature, symptoms, prevention and cure of the diseases. The programme also helps in fighting superstitions and national prejudices about the functions and care of the human body. The Department of Forestry broadcasts programmes on conservation of forests and wild life.

Newspapers also keep parallel activities with Radio Nepal in informing the people of developments in science and technology in various fields.

Articles by experts on their respective areas appear in the national dailies, *Gorkha Patra* and *Rising Nepal*. The Saturday special issue of *Gorkha Patra* devotes a column to science and technology.

Science fairs in the schools. The idea of having science fairs in schools probably started with the science teacher training workshops first held in Kathmandu, Birgunj and other places of the country in 1960, and conducted by educators, including science experts from other nations. The *Unesco source book for science teaching*[2] was one of the books used in those workshops. Since then several schools of Kathmandu Valley such as Bhanu, Kanya, Adarsh Kanya and Laboratory Secondary Schools, plus a few from Okhaldhunga, Nepalgunj and Dharan, have vied with one another in setting up a science fair on parent's day, school anniversary day, or other special occasion during the year. On display are science projects prepared by students under teacher supervision, usually consisting of devices to illustrate scientific phenomena, principles or laws, and biological, geological and astronomical charts and models. Sometimes two or three schools in a community join together to set up such fairs. Persons from the local community queue up on such occasions to have a look at the displays and gain some first-hand science experience. The educative value of these fairs on the local community is unquestionable. The only thing to regret is that the frequency of such fairs has been decreasing over recent years.

Films on science and technology. Although Nepal has not produced films on science and technology, help from other countries in this regard is noteworthy. Two important sources for such films are the British Library and the United States Information Service. Films on various topics of science and technology are made available not only to educational institutions but also to other organizations, associations and local community groups.

The British Library has occasionally arranged film-shows on science and technology to distinguished groups of visitors. Unfortunately however, the films are in English which limits the size of the audience. Translation of the narration into Nepali would help the local community to appreciate these films better.

Books and periodicals. The last two decades of development in science and technology have seen the publication of several books, journals and periodicals, related to educational and industrial development in the country. The launching of the National Educational System Plan activated several agencies, organizations and institutions, to publish related

2. *Unesco source book for science teaching.* Paris, Unesco, 1962. 252 p.

books and newsletters to inform and educate the people in general. A few publications in the area of science and technology are highly professional and technical and are published in English. This can be understood in the context of exchange of information on research and development with other nations, but such publications are poor value so far as the non-technical reader is concerned. However, most such publications are in Nepali and are easily understood by the general reader.

The organizations and institutions that publish material related to science and technology are: (a) Nepal Agricultural Association; (b) Curriculum Development Centre (CDC), Tribhuvan University; (c) Nepal Geological Survey, Ministry of Industry and Commerce; (d) Royal Nepal Academy; (e) United Nations Development Programme (UNDP) and the United Nations Children's Fund (UNICEF); (f) Institute of Science, Tribhuvan University; (g) Tri-Chandra Campus Science Association; (h) Institute of Medicine (Health Education Division); (i) World Health Organization (WHO); (j) National Development Service (NDS); (k) Nepal Pharmaceutical Association (NPA); (l) Centre for Research, Innovation and Development (CERID); (m) National Council for Science and Technology (NCST); and (n) Research Centre for Applied Science and Technology (RECAST).

The publications are generally too numerous to be described in detail but an attempt is made here to give them a very brief introduction. Activities under CERID, NCST and RECAST are described separately.

The Nepal Agricultural Association publishes a journal: *Nepal journal of agriculture* in which current problems in agriculture are discussed. It publishes several books and small booklets on current topics in agriculture. The small booklets are distributed free of cost.

The Curriculum Development Centre (Tribhuvan University) is in charge of developing curriculum and publishing text and reference books for the university. Incidentally some of the reference books have become widely popular with the general public. Titles of such publications include the following: *Traditional technology of Nepal; Wild life of Nepal; The environment of Sukla Phanta;* and *The general ecology, flora and fauna of Nepal.*

Nepal Geological Survey, Ministry of Industry and Commerce, has produced two publications, *An outline of geology and mineral resources of Nepal* and *Radiometric dates of some Nepalese rocks* which reflect the results of vigorous efforts by the geologists of Nepal, and provide an excellent introduction to the geology and mineral resources of the country. The Royal Nepal Academy has a division of science and technology and incorporates literary activities in science and related areas. Articles on science and technology have been appearing now and then among its publications. The division has undertaken an assignment to accomplish the following within a few years:

a) Publication of questions and answers on science and technology matters for children under 10;

b) Publication of research theses on science and technology;

c) Publication of symposia/talks by researchers;

d) Establishment of a scientific information system;

e) Publication of scientific terminology in Nepali (a portion of which has already been published);

f) Publication of a science series on topics related to Nepal, (such as, snakes of Nepal and plants of Nepal); and

g) Translation of important works on science into Nepali.

The Academy has so far published books in Nepali on: *Darwinian theory of evolution; Science terminology in Nepali; Fish culture; Farm irrigation and water management;* and *Boar-rearing.*

Nepal has participated in several UNDP/UNICEF programmes such as, Man and the Biosphere (MAB) and International Biological Co-operative Programme (IBCP). Besides, UNDP/UNICEF has produced books and booklets related especially to health and childhood education. Some of the publications include: *Examination of child's health; Revised twelve child care messages; Use of hydraulic rams in Nepal; An approach to technology;* and *The diaphragm pump.* UNICEF has also translated useful books on science and technology, published in other countries, into Nepali.

The Institute of Science, Tribhuvan University, publishes an annual journal, *Journal of science.* This journal deals mostly with research theses on various science topics. Tri-Chandra Science Campus, Tribhuvan University, publishes an annual journal related mostly to college science and technology.

The Institute of Medicine and Health Education Division has published several books and booklets dealing primarily with rural health care and needs. The booklets, written in plain and simple Nepali, are distributed free of cost. This Institute has also brought out a journal, as well as a medical bibliography of Nepal.

WHO has published several study reports on the state of health and of WHO projects in Nepal. These studies were undertaken in consort with governmental and non-governmental agencies. The publications include: *Country health programme in Nepal* (vols. I and II); *Greater water supply and sewerage project* (for Kathmandu and Bhaktapur); *Project profile of* *leprosy control in Nepal; Project profile of health planning and programming; Project profile of tuberculosis control in Nepal;* and *Project profile of the project for malaria eradication.*

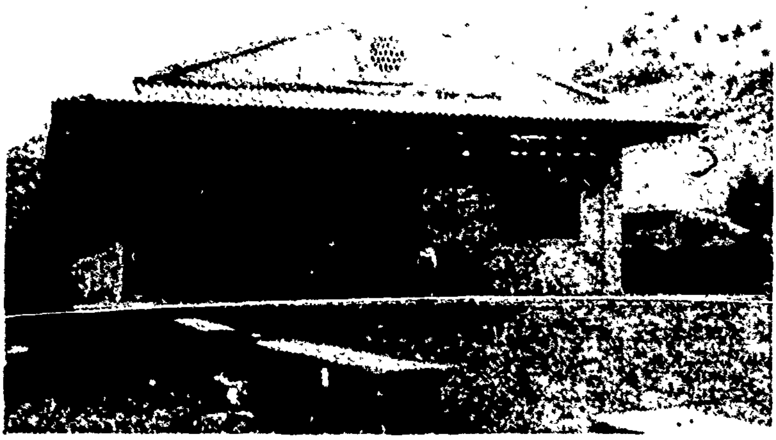
The NDS was started in 1975 under university regulations that require groups of students, just a year before their graduation, to go to villages or remote areas of the country and spend a year there doing project work (besides teaching in schools) useful to the village community. Science students of Tribhuvan University have contributed significantly in educating the villagers in matters related to simple village science and technology. RECAST has already started giving six weeks orientation to NDS students in applied science and technology so that they become better equipped to help the village people.

The NPA publishes a semi-annual popular journal on pharmacy, pharmaceutics, pharmaceutical products, medicinal plants and allied sciences. It also organizes talks and seminars on topics such as 'Traditional medicine and the role of medicinal plants'.

The Department of Medicinal Plants has published several books mainly dealing with the plants of Godavari, Phulchowki, Nagarjun, Ranikunj, Lamtang and Himal.

The Natural History Museum. This museum (established 1975) is located near the famous Swayambhoo Hill. It is a valuable annex to the Institute of Science and plays a prominent role in out-of-school education in natural history and related sciences of the country.

This museum has been enriching a number of its collections of specimens of Nepal's natural history for the last few years. It has also been



disseminating information about the country's natural wealth to different parts of the kingdom through exhibitions, film shows and publications. The journal of the Natural History Museum has been favourably received in research circles both at home and abroad.

The present activities of the museum include: (a) collection and preservation of specimens of flora, fauna and geology; (b) study and research on specimens of flora, fauna and ecology; (c) education of the people regarding the country's natural wealth; and (d) documentation of literature and specimens relating to Nepalese natural history.

The museum collections include plants, birds, butterflies and other insects of Nepal; invertebrates and lower chordates, fish, amphibia, reptiles and mammals of Nepal; preserved bones of fish, reptiles, birds and mammals and several mounted skeletons; fossil specimens of mesozoic mammals and holotypes of insects; and many new records of different groups including fungi, bryophytes and butterflies. NDS students have helped to collect specimens for the museum from remote areas.

The museum occasionally exhibits articles produced as a result of various projects related to science and technology organized by other agencies like CERID. In 1978, in the course of a project on the 'Use of local materials in science teaching in schools', the museum exhibited equipment and devices for science experiments that were prepared as part of the project, along with other specimens. The exhibition was open for several hours per day and hundreds of people visited it.

In a very short period, following its inception, the Natural History Museum launched several educational programmes. It also implemented a mobile exhibition for the benefit of those who were unable to visit the museum or unaware of its activities. Exhibitions of syllabus-related materials as well as those of general interest to the public have been mounted in the past with the following objectives in mind, to: (a) introduce the natural heritage of Nepal to primary and secondary students, as well as to the common masses of the locality; (b) combine theoretical studies with practical examples; and (c) encourage general interest in the natural history of Nepal and the functions, aims and objectives of the museum itself.

The museum has several publications to its credit. These publications are designed for the general public and deal chiefly with the scientific and technological aspects of the museum specimens, their nature, collection and preservation.

CERID. Started as a research centre under National Education Committee in 1976, CERID has devoted a considerable portion of its attention towards innovative projects concerning science and technology for out-of-school education. Some of the projects with a bearing towards science and technology education are:

Education for Rural Transformation. This project was conducted in early 1976 to make education instrumental in improving the life-style of a village community at Lahachowk (in Kaski district). One of the objectives of the project was to mobilize the local people, with the school playing a central role, to develop education-oriented programmes whereby the members of the community could participate in and benefit from the total programme of rural development as their common goal. The project also sought to develop attitudes and skills among the people to enable them to use local resources to the best possible extent and utilize community facilities and establishments as pivots of teaching/learning experiences. Two of the programmes presently in operation are: (1) Health Education and Services; and (2) Non-formal Agriculture Education for Adults. New agricultural technologies are introduced through the latter programme.

Science Activities using Simple Materials. CERID started this project with the purpose of developing and undertaking educational activities that are realistically warranted by the local situation and are pertinent to the general living condition of the local people. This project was prepared to prop the pilot project of Education for Rural Transformation described above. Science experts from various governmental organizations including a UNICEF representative participated in the workshop.

A film has been prepared about the Lahachowk project. Primarily aimed at acquainting the teachers of science with the need for and the methods of using local materials, this project offered an excellent opportunity for the village people to have first-hand experience of the science projects.

CERID in consort with the Unesco Asian Programme of Educational Innovation for Development (APEID), organized a national seminar on the Development of Low-Cost, Simple Educational Materials in 1978. Twenty-six participants comprising teachers, supervisors and specialists from various educational institutions took part in it.

The seminar was conducted to: (1) popularize the concept of the development and use of low-cost, simple educational materials; (2) design and produce samples of low-cost, simple materials; and (3) display low-cost, simple materials and toys produced within the country.

The participants engaged themselves in designing and developing educational materials which were based on the availability of resources in the locality. During the workshop the participants demonstrated the use of the materials they had prepared.

NCST. The government of Nepal constituted this council in order to formulate a national policy for science and technology and to carry out all related activities accordingly. The main objectives of NCST are:

a) Formulation of a national science and technology policy;

b) Promotion of scientific and technological research activities;

c) Establishment of co-ordination in the research programmes of various ministries and departments of the government; and

d) Dissemination and popularization of scientific and technological knowledge among the mass of the people through the educational use of the communication media.

During the year 1977/1978, NCST made policy recommendations in relation to: (1) basic principles of science and technology development for the Sixth Five-Year Plan; and (2) the mechanism for co-ordination in research activities.

The council organized a National Science Convention in Kathmandu in 1978. Nearly 300 Nepali scientists, technologists, industrialists and people from consultancy services participated. Major discussions at the convention were on such topics as: 'Food and agriculture', Health and nutrition', 'Industrialization', 'Natural resources', 'Construction materials', and 'Development and management of science and technology'.

With the aims of promoting the publication of scientific articles and literature in the country, NCST initiated a system to provide financial remuneration on a merit basis for authors, editors and publishers of all the scientific journals of Nepal. Within the period of one year, 11 journals in the field of science and technology were registered. It also initiated regular publication of scientific and technological knowledge among the common masses. The publications are in Nepali in national dailies.

Acting jointly with the Asia Society of New York, NCST sponsored an important seminar on Science and Technology for the Development of Nepal. The prevailing situation and problems as well as the possible roles of science and technology in future development were outlined during the seminar.

The major topics discussed at the seminar dealt with: (a) 'Development of agriculture'; (b) 'Horticulture and animal husbandry development'; (c) 'Irrigation'; (d) 'Forestry'; (e) 'Hydropower'; (f) 'Industrial development in Nepal'; and (g) 'Policies for development of science and technology in Nepal'.

The seminar concluded that in a situation of competing demand for limited resources, science and technology can contribute to the development of Nepal by helping to create an atmosphere for rapid economic growth. This could be done by the identification of fruitful areas of research and development and by adapting imported technology while improving the best indigenous techniques. The seminar suggested the establishment of better linkages between researchers and ultimate users. To maximize economic efficiency and technical benefits, the seminar recommended that programmes of science and technology should be technically sound, economically feasible, and culturally acceptable. NCST and the Asia Society of New York also co-sponsored a seminar in Pokhara, on Development of Small Scale Hydroelectric Power and Fertilizer Production in Nepal.

RECAST. Established in 1977, RECAST is a research organization devoted to the development of appropriate science and technology for different levels. RECAST is also the secretariat of the National Council for Science and Technology. The aims and objectives of RECAST are to:

a) Undertake research activities in the areas of science and technology and to identify useful research findings for socio-economic development;

b) Generate local capability for the development and application of science and technology;

c) Develop conditions and environments for exchange of knowledge and information among scientists and technologists for problem identification in the country's development;

d) Render co-operation to the educational and training institutes for the production of lower and middle level technicians needed for the successful implementation of the country's plan; and

e) to collect information on details of the country's resources, to conduct necessary research for the utilization of these resources and to render suggestions and advice to the industrial sector for the use of the research findings.

RECAST is engaged in laying down a basis for the development of appropriate technology, with special reference to rural development. In its activities it is placing emphasis on the exploration and utilization of local resources including traditional skills, within the conceptual framework and spirit of a programme approach rather than a discipline orientation.

In addition to the establishment of basic infrastructures like research laboratories, workshops and instrumentation and documentation facilities, some of the research and development activities conducted by RECAST are concerned with the:

a) Utilization of agricultural and industrial wastes like tobacco, sawdust, woodchips and rice husks for some useful products like alternate cements, caffeine, citrate and nicotine sulphate;

b) Development of post-harvest technology for the preservation, storage and processing of foods and cash crops;

c) Rationalization of traditional techniques in the preparation of local food and pottery;

d) Development of processing technology for the production of low-cost construction materials, entirely based on locally available raw materials;

e) Development of quality ceramics and pottery goods from different types of clay available in the country; and

f) Design and fabrication of appliances for harnessing solar energy as an alternative source of energy for domestic and industrial drying, heating, cooking and distillation in places where the immediate availability of electric power is still remote or where forest conservation is a necessity.

Exhibitions by RECAST include: the production of alternative cements and roofing, ceiling, walling and flooring materials; water filter candles out of indigenous clay; designing and fabrication of solar dryers, solar stills, solar cookers (up to one kilowatt energy capacity) and the storage of solar energy; dehydration of fruit and vegetables by solar energy; and isolation and preparation of pharmaceutical raw materials (caffeine, citrate) and insecticide (nicotine sulphate) from tea and tobacco wastes respectively. Through these exhibitions thousands of visitors were informed about the situation in applied science and technology in the country.

The extension programme of the centre is concerned with dissemination of the technologies particularly for rural areas. For these activities it is contemplating the establishment of centres in different development regions for specific programmes. In this context, the Nepalese Food Study Centre in Pokhara was established for the promotion and popularization of various traditional food preparations of different ethnic groups particularly among the foreign tourists. Further, it also acts as a disseminating agency for the demonstration of appropriate technology developed in RECAST.

Seminars and talk programmes of the Research Centre included a discussion programme on 'Solar Energy Programme for Nepal'. Participants from various government institutions, Tribhuvan University, and private organizations came forward with new ideas for harnessing solar energy.

Conservation education for the people. To make conservation management of the country's valuable but fast diminishing wild life resources more effective, the government initiated a conservation project in collaboration with FAO/UNDP, in 1973. A conservation education and publicity scheme to involve participation of the local people has been launched. The scheme primarily is directed to make the local people aware of the value of their natural environment. Since 1974 the National Parks and Wildlife Conservation Office has established a conservation education and publicity unit. The publicity programmes include:

a) A programme in co-operation with news media, journalists and radio Nepal in which articles are being fed to local newspapers and press releases are distributed to various news agencies;

b) Publication of booklets on the conservation needs of the country;

c) Essay competitions and poster competitions from time to time to create interest by the general public and among the students of various institutions;

d) Film shows and other activities that are regularly conducted to acquaint the nation with the country's conservation and environment requirements and problems; and

e) Production of wildlife films in English and Nepali.

Unesco/UNICEF seminars, conventions and projects in science and technology. These activities although not directly linked with the common people, have played a key role in enlightening and upgrading the top science and technology personnel of the country thus aiding the development of the country as a whole.

Conclusion

Science and technology education in Nepal is still in its infancy. It is only since the establishment of NCST that Nepal has begun to systematically apply science and technology to explore and utilize its natural resources in order to fulfil its needs. Prior to that, the move towards industrialization was rather uncoordinated, unsystematic and, in some cases, just accidental.

However, Nepal is now realizing that development proceeds from within, that is, from exploration and the utilization of natural resources of the country and the fulfilment of community needs through the use of appropriate science and technology designed for and by the people themselves. Nepal has had bitter experiences in the past of the failure of uncoordinated and sporadic attempts at development, imposed and manipulated from without, before the formation of any basic infrastructure. As a result of such experiences, the need for the establishment of research in applied science and technology, and organizations like NCST and RECAST was realized. These organizations are, for the first time, helping Nepal to: (1) bring learned and experienced personnel together to plan development based on first hand, detailed information of the country's resources, developmental state and needs; and (2) educate the common people in matters concerning the development of science and technology.

The need for out-of-school education in science and technology in Nepal was there even in the days of traditional technology when the transfer of knowledge and skills necessary for small scale industries and developmental projects used to be made non-formally from one generation to the next. The need for such education is now even greater as the country is facing the problem of rapid industrialization and insufficient funds to educate the masses in modern science and technology through formal education. In future, the need for out-of-school education in science and technology will be even greater.

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PAKISTAN

by M. Akmal

Introduction

In Pakistan, the integration of science with the teaching curriculum does not begin until a er the eighth class. Even then, since all students do not elect to study science, there is only a small fraction of the population exposed to formal science education. There is a smaller number yet, who pursue the study of science at professional and vocational levels. Thus there are millions whose awareness of science and technology, however limited, results from out-of-school sources.

In this report an attempt has been made to identify such sources and describe the efforts being made for the science education of those who do not get formal education.

Classification of activities

The out-of-school science and technology education activities in Pakistan can be classified as those that:

1. Supplement and complement formal science instruction—such as the Science and Technology Museum and the Natural History Museum (being developed);
2. Foster creative ability through such activities as science clubs, science fairs, hobby competitions;
3. Promote industry and commerce through industrial and commercial exhibitions;
4. Encourage professional interaction between the professional institutions such as the Institute of Engineers and the Pakistan Medical Association;
5. Spread general scientific knowledge through the mass media, e.g. newspapers, radio and television;
6. Preserve traditional skills and crafts—and endeavour to service and maintain scientific tools, equipment and appliances; and
7. Continue science and technology education through specialized training.

Museum of Science and Technology, Lahore. In a country like Pakistan where science education is handicapped by inadequate facilities, a science museum, which is accessible to the common man, can make a meaningful contribution in promoting mass science education. Being aware of this the Government of Pakistan, in 1965, authorized the first science museum at a national level. The National Science Museum which is being developed in stages, will have, on its completion, three distinct sections, namely, physical sciences, biological sciences, and technology. In addition it will have a planetarium and a good reference library.

By the end of 1975, the museum had 27 complete exhibits on the topics of electricity, engines, fluid mechanics, light, magnetism, mathematics, and mechanics and on 7 July 1976, its doors were opened to the public. One of the star exhibits was an animated life-size figure of a human body. A sample of available exhibits is provided in the table on the following page. As well as these there are a number of items depicting behavioural psychology, weather forecasting, and the concept of time. In addition there are a few games of skill and dexterity for the educational recreation of the visitors.

The museum building consists of one exhibit hall (East Gallery), a laboratory and basements which include workshops to develop the capability of indigenous development and production of exhibits. The workshop

A sample of the exhibits found in the National Science Museum

Fluid mechanics	Mathematics	Mechanics' energy	Engines	Magnetism electricity	Light and sound	Biological sciences
Torricellis' theorem	The number pi	Centripetal force	Steam	Magnetic field	Lenses and mirrors	Transparent human figure
Archimedes' principle	The Mobius strip	The gyroscope	Petrol	Van de Graaff generator	Light polarization	Human eye
Vacuum chamber	Conic sections	The piezo-electric crystal	Diesel	Oersted's experiment	Holography	Human ear
Bernoullis' theorem	The probability machine		Motor-car	A.C. and D.C.		
Water at work			Wankel engine	Spot welding		
				Eddy current brake		

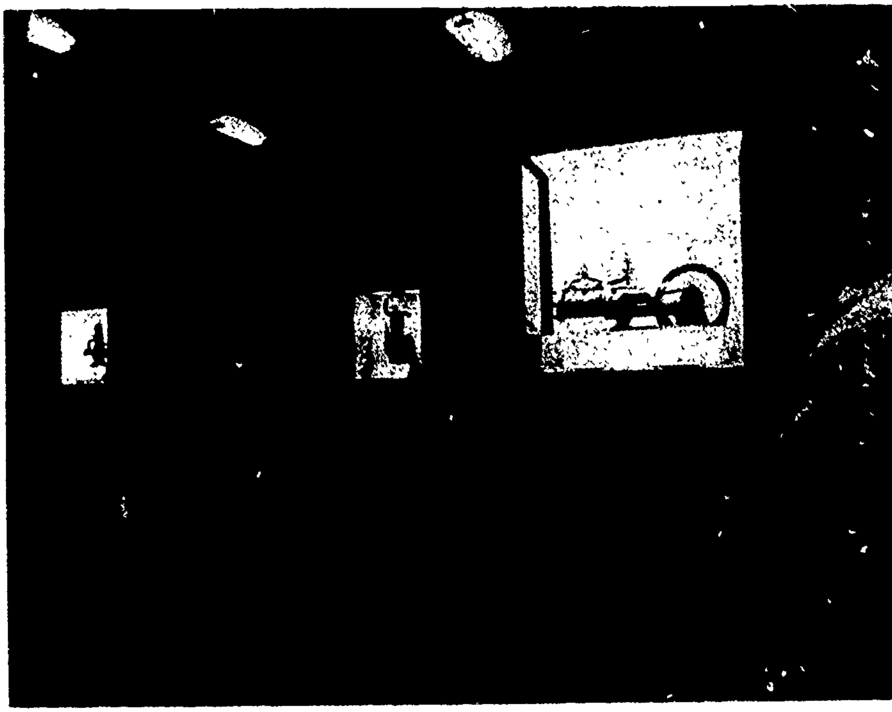
machinery includes metal-working tools, wood/plastic working machinery, and tools and equipment for the electrical/electronics shop. There is also a library with over 2,000 volumes and a conference room.

A museum is a public place and an educational institution. In order to make it play a dynamic role, its presentations need to be well conceptualized and rational, factual and participatory. Its exhibits must appeal in one way or another to a large number of people, and thus make it worth their visit.

Museologists of experience are aware that the time lag between the concept of a scheme for a science museum and its total implementation is long and involved. In developing countries it would be even more so due to factors such as lack of previous experience, non-availability of trained personnel, shortfalls of the technical know-how and the lack of funds; particularly foreign exchange. Even in the advanced countries, the development of museums has taken years. What we find in the museums of Europe and America today is the result of sustained efforts by dedicated men backed by liberal financing.

A new museum must develop, keeping in view the needs of the community it is to serve. As many visitors will have a lower level of education, special presentation techniques must be adopted.

The Museum of Science and Technology in Lahore will not, no matter what its size or quality, fulfil the needs of the entire country. More science museums are needed, beginning with at least one ... each of the provincial capitals.



Army and Air Force Museums. In the cities of Rawalpindi and Peshawar respectively the Department of Defence has established Army and Air Force Museums. The museums deal with the history of armaments and equipment relating to the country's armed forces.

Industrial and commercial museums and display centres. The Department of Industries, Government of the Punjab province, set up an Industrial and Commercial Museum about 30 years ago. Originally specimens of crafts the products of indigenous cottage-industries, and ingenious applications of technological skills were housed under one roof for exhibition to the public. Over the years the original collections have been maintained and supplemented with occasional items prepared by individuals for consideration by the patent office.

Attached to the museum are a reading room, lecture hall and a growing technical library. Its lecture hall is equipped with audio-visual aids and bi-weekly film shows cater to the technological and educational needs of the adolescent and adult visitors.

In the 60s, a Small Industries Corporation was created by the Government. The objectives were to strengthen the existing manufacturing potential available in the various sections of the country, to revive the traditional skills and crafts, to improve the quality of products, and to organize continuing optimum production. The products include such items as cutlery, pottery, handloom fabrics, calico prints, carpets, wood carving, brass and ivory inlay and leather products. Display centres for the products of cottage industry exist at various commercial centres and major airports. The organization participates in international trade fairs and exhibitions in collaboration with the foreign office.

Museum of Natural History, Islamabad. Museums of archaeology have existed in Pakistan for several decades. The collections in such museums have originated from the sites excavated near the towns of Moenjodaro in Sind province, Harappa in the Punjab province, Taxila north of Islamabad and in the Punjab. They cover the period between 4000 BC and AD 300-400. There are site museums that characterize the archaeological significance of the respective areas and central museums located in the provincial capitals. Archaeology and physical anthropology, both related to man and his historical development, are concerned with man's use and modification of his natural environment. There exist in Pakistan fossil collections that were probably ancestral to man himself. Man has changed his environment considerably since he first learnt to use stone tools. Since palaeolithic times he has added other raw materials to his 'tool kit' and until recently, has deliberately mined the earth (often to exhaustion), and restlessly modified his environment, frequently by initiating changes. One of the roles of a natural history museum is the depiction of man in his natural environment; another is to teach future generations to conserve their heritage and make better use of the earth's minerals, landscape, wild-life and natural resources than their predecessors.

The Geological Survey of Pakistan has a permanent display of the mineral resources of the country at Quetta. The Universities of Karachi, Punjab and Peshawar also maintain collections in their respective Geology Departments. Besides, there are a few traders and collectors of stones and gems who do so for profit and as a hobby. Public awareness of the country's mineral resources is lacking, however.

Equally important is the knowledge of the flora and fauna of the country. The Agriculture Universities of Tando Jam (Sind), Faisalabad (Punjab) and the Research Institutes of Pakistan, notably the Agricultural Research Council and the Pakistan Forest Institute, maintain a fairly good record of their research activities. Departments of Botany at universities and many colleges develop and maintain botanical gardens of their own, mainly to supplement teaching. Some individual scholars use them for research. Public zoological gardens exist in the cities of Karachi and Lahore. Only recently a large area has been developed east of Lahore for wild-life conservation. There is no institution, however, which is charged with the responsibility of collecting information on the distribution, identification, habits and behaviour of wild-life. Two public zoos are not enough.

The material importance of taxonomic research done in natural history museums has gained significance in many fields where an exact knowledge of the identity of an organism is essential to success. The problem of pest control, notably the mosquito, has been tackled through this effort. The Pakistan Malaria Institute, in collaboration with the University of Maryland, has a good collection of specimens and related information for dissemination to the public at large.

The Universities of the Punjab, Karachi and Peshawar and a few colleges of Lahore have maintained museums of biological sciences with good collections. However, such museums are attached to the teaching departments and thus are not accessible to the general public.

To promote general awareness among the public and to co-ordinate and consolidate the findings of researchers in the fields of biological and earth resources an organization for the early establishment of a Pakistan Museum of Natural History was created at Islamabad.

The Pakistan Science Foundation, the body responsible for the development of the Museum, has authorized the creation of various sub-sections in each of the three sciences in its first phase, viz., zoological sciences, botanical sciences and earth sciences. These sub-sections are grouped under the respective sections as follows:

Zoological sciences	Botanical sciences	Earth sciences
Ornithology	Angiosperms	Palaeontology
Mammalogy	Gymnosperms	Mineralogy
Ichthyology/ Herpetology	Mycology and Plant Pathology	Stratigraphy
Entomology	Economic Botany	Prehistory

Collections consist of oriental termites, vertebrate fossils, helminth parasites, fossil plants, angiosperms, fungi, spiders, whales, insects, rocks and minerals, and archaeological finds. The first phase was completed during 1980.

Science clubs. As most educational institutions in Pakistan are located in the urban centres this is where the largest concentration of students pursuing studies beyond the eighth class, are to be found.

Universities and similar institutions are traditionally much better equipped and staffed than the schools. They are able to pick and choose students for instruction in science subjects from among a great number of those who wish to study science. As part of extra-curricular tivity, science clubs and hobbies clubs of various kinds exist in most these institutions. Such activities enjoy the patronage of the local administration. They are formally approved and have a regular pattern of financing.

These science clubs consist of groups of students who are stimulated enough to expand their own scientific knowledge as well as display their individual or collective talent through experimental work, lectures and seminars. Some science clubs promote interest among others through 'open house' exhibitions and science and technology film shows.

A motivating factor in the effective operation of such clubs has been the presence of a few students who have had the privilege of indulging in hobbies at an early age. Since the pursuit of hobbies and the use of educational toys and games involve substantial cost; in a developing society individuals with such interests come only from affluent, educated families. Some other interested and talented ones join in but interest in such clubs is maintained only as long as the affluent students continue to be interested.

The most active clubs are found in universities and professional colleges. Notable among these are the Engineering Universities of Lahore and Karachi where this aspect of the promotion of science is on a continuing basis.

Certain privileged institutions such as the Cadet Colleges, have shown some interest in science clubs but generally the interest has been discontinuous and is somewhat proportionate to the overall science consciousness among the literate. However, occasional completed projects have been displayed with pride in some institutions at Karachi, Lahore and Faisalabad.

One 'out of school' science club has existed in the city of Karachi for a number of years. Its membership consists of young people, not all of whom are students. They are encouraged to pursue their scientific and technological interests through regular meetings at a place reserved for this purpose. The single motivating factor for its existence has been the lone organizer, who has been able to provide the means for its continued operation.

The popularity of commercial aviation has generated interest among the few who wish to engage in flying as a hobby or intend to adopt a professional career in aviation. In recent years the activities of flying clubs have been expanding and new ones have been established. The membership is however restricted since it is an expensive pursuit. The members learn the skill of flying and familiarize themselves with aircraft maintenance and servicing of related equipment. Formal training and education in aeronautics is available only at the Government established college located at Karachi.

Science fairs and competitions. A science fair was held in 1973 by the Board of Intermediate and Secondary Education, Lahore, in association with other Boards of the country. The objective was to organize such fairs annually and create display centres for selected materials at central locations in the cities where the Boards existed, primarily to inspire students and parents to learn science. Unfortunately neither the centres of display were created, nor was the activity repeated.

The Scientific Society of Pakistan sponsored a science exhibition in 1974, also held at Lahore. The participants were more or less the same except for the addition of polytechnics and vocational schools. One distinct difference was that a book exhibition also formed part of this activity.

Industrial and technological exhibitions. Industrial and technological exhibitions have been frequently held in Karachi and Lahore to promote commerce and trade. Such exhibitions are organized by the city government, often with the support of the Chamber of Commerce, factory production units and some government organizations. The most successful exhibitions are those held at national level. These entertaining exhibitions have followed an established pattern and attracted the general public. Government agencies like the Departments of Agriculture, Animal Husbandry, Defence, Housing and Physical Planning, Water and Power Development Authority, Oil and Gas, Atomic Energy Commission and Railways have taken an active interest by displaying information through visual aids and models that display their operations and progress.

On a smaller scale and mainly to emphasize the importance of agriculture, public health, and the related needs of the millions who live on farms, 'county fair' style exhibitions are held at district level in the larger centres serving rural areas, almost yearly.

Occasionally some promoters have also organized exhibitions relating to some international events. One such exhibition was held at Lahore and another at Karachi to celebrate Marconi's Centennial. Similar exhibits on 'Moon rock' and 'Apollo 17' have been exhibited with the courtesy of the United States Information Service in major cities. Two exhibitions; the 'Bauhaus', and 'Energy' were held in Lahore with the co-operation of the Goethe Institute.

Professional organizations. There exist in Pakistan a number of organizations and associations of scientists and technologists. They hold conferences, seminars, symposia, workshops, annual meetings, and make group visits to selected development projects. Sometimes scientists from other countries are included among the participants. Their main objective is to exchange professional and technical information among the members. Such organizations include the Pakistan Engineering Congress, the Pakistan Medical Association, Pakistan Association of Scientists and Scientific Professions, Scientific Society of Pakistan and the Pakistan Association for the Advancement of Science.

Using the media. Radio, television, films and newspapers provide an effective means for the dissemination of information and knowledge of all kinds, science and technology included.

Newspapers and periodicals. The English language newspapers, on the average of once a month, publish scientific articles of general interest mainly related to current events. Energy, 'skylab', lunar and solar eclipse, floods and earthquakes, are some examples of the subject matter. The materials are either contributed by local authors or adapted and reproduced from elsewhere. Generally the English language articles are meant for the educated and the professional readers.

On the other hand, the Urdu (national language) newspapers publish or reproduce articles on topics mainly of general interest. More commonly, they tend to cover such topics as health and hygiene (common diseases, causes and prophylaxis), public health (sanitation and water supply); agriculture (use of fertilizers for greater yield) and so on.

The periodical *Science for children* is published in Urdu by the Scientific Society of Pakistan. Most of its materials are either adaptations or translations from other sources.

Agricultural information services and livestock and dairy development departments of the government issue scientific materials on topics such as crops, fertilizers, poultry and cattle farming. The Water and Power Development Authority, Pakistan Council for Scientific and Industrial Research, Pakistan Atomic Energy Commission, Agricultural Research Council, Institute of Electrical Engineers, Pakistan Engineering Congress and the Universities of both Engineering and Agriculture, publish journals of their activities. *Science nama,* an Urdu language bulletin, is published by the Scientific Society of Pakistan.

Radio and television. Radio Pakistan broadcasts egular feature programmes on popular science, holds group discussions and quiz programmes involving scientists and students and keeps the rural listeners informed of solutions to their seasonal agricultural problems, such as the use of fertilizers, pesticides and irrigation.

Pakistan television, besides activities of a similar nature, shows films on science, and occasional feature programmes relating to industry in Pakistan. Science fiction films in English are regularly televised and are popular with children.

Technical services and continuing education. Building Research Laboratories, the Pakistan Council for Scientific and Industrial Research (PCSIR), Pakistan Industrial Technical Assistance Centre (PITAC) and other similar agencies established by the government help communities, industry and the scientific professions through the introduction of appropriate technology.

For example, Building Research Laboratories has successfully developed and promoted low cost materials for the construction of cheaper housing a major need in a developing country. The PCSIR has developed and introduced bio gas production from animal waste, for rural communities. PITAC offers advice for solving problems encountered in the indigenous metal products manufacturing industry.

The University of Engineering at Lahore offers training in computer technology. PITAC periodically offers short training courses in die-making and precision welding technologies. Universities of Agriculture conduct special workshops for greater agricultural output, and the techniques for preparation of food preserves, poultry farming and dairy development.

Dissemination of technological skills. Eighty per cent of the population of Pakistan live in rural areas. In earlier days, due to lack of suitable transport, there was very little long distance travel. As a matter of necessity, village communities had to become self-reliant in their everyday personal and farming needs. Thus a contemporary village included in its population such artisans and craftsmen as blacksmiths, carpenters, weavers, cobblers and barbers. These tradesmen were subservient to the landowner on whose goodwill they survived. Their social status in the community was based on the economic significance of their trade. In a village they were confined to their kinsmen socially and the skills remained within the clans, passing from father to son and so on. As the size of such families grew, their economic needs and improved communications and transport facilities induced in them the desire to get education, move out of the village preferably to an urban centre - better their lot and acquire a new social status in another place.

Many continued in their professions, advancing their skills through apprenticeship, or association or partnership with their urban counterparts who were better trained. Thus carpenters became cabinet makers; blacksmiths acquired the trades of technician, mechanics and fitters; and weavers became drapers and tailors. The new knowledge and better skills were applied to the home-base as well where the motor driven replaced the ox-driven grinding wheel. It became necessary to learn the art of engine and machine maintenance to keep this new business going, which brought in more cash because of the additional services made available to the farmers.

Side by side with this transformation and through the gradual influence of his relatively better-educated and more informed successor, the affluent farmer became aware of the benefits of modern but more costly living enjoyed by the city-dwellers. He became interested in learning better farming methods for greater crop yields that would provide him with additional cash. He brought to his village, tools and equipment required for mechanized farming and installed a water well to increase his resources of water for irrigation. Tractors, power tillers and diesel engines replaced the conventional equipment. The village blacksmith, now turned mechanic, came in handy for the operation and maintenance of the new equipment. The artisan of the old days acquired a new status, and with it a desire to learn more.

As a result of this process there has emerged a class of mechanics and technicians both in the villages and the cities that has acquired the ability, knowledge and technical skills of a professional nature. The maintenance and servicing techniques are now applied to all sorts of equipment, whether it is electrical or electronic.

In order to meet the growing demand created by the rapid inflow of alien technology through items of common use such as air-conditioners, automobiles, motorcycles, appliances and electronic equipment, the ingenious method of employing children (out-of-school) and other professionally oriented but less educated young men as trainees has provided the country with a ready supply of technical experts. □

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PHILIPPINES

by Soledad Lagera-Antiola and Liliarose Elevazo-Jose

Out-of school science education (OSSE) in the Philippines is programmed independently of but in co-ordination with the school system and other youth institutions. It caters to various categories of youth and other population groups for the presentation and use of science and technology in resolving environmental issues met in daily life. It is undertaken outside classroom hours with in-school groups; or during uncommitted free time for others. It uses every feasible means of interaction to motivate the concerned groups towards a desired outcome.

The Science Foundation Programme

The principal agency for promoting public understanding of science, technology and environment through OSSE is the Science Foundation of the Philippines (SFP). Its programme consists of:

1. Continuing research and development studies on the strategies and activities for the effective promotion of public understanding of science, technology and environment and the constraints such as environmental aspects; correlating specific science club activities with various environmental aspects; and adapting the activities for use by a specific population group, and developing handbooks on standardized science club activities for use by OSSE leaders.
2. Development and organizing continuing OSSE activities such as organizing and vitalizing science clubs, a series of science fairs from local to national levels, a series of science quizzes, scientific workshop-seminars and film-forums, youth science camps, and youth research apprenticeship action programmes.

It is envisaged that through these activities the youth will acquire science and research skills and an appreciation of the application of these skills in their daily lives.

3. The developing of the Philippine Science and Technology Museum (PSTM), for the presentation of Philippine and world achievements in science, technology and environment to the general public.

The SFP utilizes the science clubs as its co-operating arm in undertaking OSSE activities. These science clubs serve as the leverage for the total community outreach programme.

The science club movement

Although young people interested in sports and other outdoor activities could easily come together in clubs such as the Girl Scouts/Boy Scouts and other youth movements, there was nothing for young people with a scientific inclination until 1956 when the SFP established science clubs.

Science clubs aim to: (1) cultivative science awareness; (2) develop skills in scientific investigation; (3) encourage critical thinking; and (4) instill the desire for involvement in scientific activities or events that lead to science careers. The members' interests are enhanced by participation and interaction in group activities that buoy up independence, persistence, originality and curiosity.

Science clubs extend learning beyond class hours. Although members meet during free periods in school, activities are encouraged to take place after school and out-of-school, because the outdoor science club laboratory offers numerous opportunities for enrichment.

As an offshoot of the science club movement two big organizations were formed—the Philippine Society of Youth Science Clubs, Inc., (PSYSC) and the Science Club Advisers Association of the Philippines, Inc. (SCAAP).

The PSYSC is the mother science club. It co-ordinates the activities of the many science clubs in the country. It also initiates or motivates the organization of science clubs and eventually their affiliation with this national co-ordinating group. While originally confined to school science clubs to get the movement started, PSYSC has now extended its services to out-of-school youth *barangay*[1] science clubs with a membership of 105,000.

SCAAP aims to assist or complement SFP in its drive to promote the public understanding of science, technology and environment. Specifically, it aims to:

1. Promote and strengthen science consciousness among its members, in particular, and among the people in general;
2. Plan and co-ordinate research and other activities for the science clubs in the country;

1. Barangay—a kinship group composed of 30 to 50 families which was the basic socio-political organization in pre-Spanish Philippines.

3. Assist SFP and other co-ordinating agencies in the advancement of science and technology;
4. Foster friendship among science club advisers throughout the country;
5. Provide leadership in organizing science clubs and assist those already in existence to give due recognition to outstanding achievements of science club advisers; and
6. Establish science club advising as a profession.

Membership of SCAAP is not limited to those actually advising science clubs. Any scientist, teacher or other professional interested in becoming a science club adviser or intending to organize a science club or to sponsor the cause of SCAAP may join the association.

The out-of-school science education laboratory (OSSEL) scheme

The youth science clubs as the vehicle in scientific literacy are now developing self-direction. Science club members are encountering truly meaningful experiences in analysing and resolving community problems. OSSEL (a research laboratory outside the four walls of the classroom) provides opportunities for the meeting between the natural sciences and the social sciences; studies ways and means by which science and technology can fuse with traditional practices thereby softening the impact of science and technology on our society; investigates strategies and activities for the promotion of science and technology and environmental watching through pilot studies; demonstrates through the science club movement that a scientific culture can be developed particularly in our traditional communities; and develops handbooks on OSSEL procedures.

At present, there are three types of science clubs in the OSSEL concept; in-school, out of school and high school students of special science high schools and colleges in the country. Nevertheless, whether an OSSEL group is in-school or out-of-school, the activities are designed to fit within the thrusts and priorities of the national development plan.

OSSEL is in itself a social-natural science laboratory. It is a natural science laboratory because regular activities consist of investigatory studies or experiments in the natural sciences from which the members learn the processes of research and experimentation, and a social science laboratory as well because a science club becomes a potential delivery system for enhancing rural development.

The OSSEL's overriding principle is to promote an understanding of the science technology environment through organized projects and activities for both in-school and out-of-school science clubs. Members become aware of what they can do to enhance their way of life, and that of their fellow-men, through the use of self-proven measures in their own environment. The organization of similar science clubs or groups for the purpose of undertaking environmental development projects geared towards the countryside is also encouraged and promoted.

The science club movement and OSSEL develop science concepts that are basic and universal in application. What the participants learn from their basic environmental experiments, especially the processes and procedures of science and technology, can be applied to other problems and situations, enabling them to participate in other ventures like carpentry, fisheries, cattle raising, or as research or laboratory aides in private agencies as added sources of income. What is really important is their having been able to acquire the attitudes, knowledge and skills essential for intensive and extensive national development activities, which require actual exposure to the nature of science, technology and environment.

OSSEL projects are planned and organized taking into consideration the available local resources–manpower, finance and facilities. If for example, an OSSEL is based in a barangay or village of rice producers, the investigatory projects are mostly agriculture-based. Simple projects are in vegetable crop production studies, aquaculture, vinegar/wine making, cottage industries, recycling studies and other activities appropriate to the science club's locale. The main objective is to harvest sufficient produce in marketable quantity and display it at a science fair. This is the basic reason for science club members joining a science club. In the process, the members acquire the skills of a scientist and science consciousness becomes a part of their system, making them aware of strategies for resolving daily problems in life and in the community. In all of this it is hoped that these persons will have discovered that they can improve their way of living through self-discovery.

There are instances where a science project has some requirements beyond the normal capacity of a science club; space on unoccupied lots, in urban sub-divisions for instance, might be used for OSSEL vegetable gardens. A 200-500 square metre space with an irrigation facility and protected from stray animals can support other sub-projects like applied nutrition, tree-planting, vegetable seed banks, a nursery for ornamental plants, and a nursery for local medicinal plants for extract analysis. Fish-ponds or spaces appropriate for the purpose can be operated by rural science clubs, where the members can easily design simple investigatory experiments on aspects of culturing aquatic resources, plants and animals. The provision of space in a municipal or barrio hall can be the government officers' share in the community project. It can be converted into a regular meeting place and at the same time be used as a laboratory and study corner. Property owners in the country are sometimes willing to lend their unused land to the science club, especially for good purposes, for several years without rent.[2]

In formal science education, theories and principles in the basic sciences are repeated and verified in the laboratories using laboratory manuals for directions given in cookbook style. In the OSSEL scheme, the members of the science clubs undertake their experiments or studies in a 'natural setting' where the action is, so to speak. The members implement their experimental designs right in their fish-ponds, vegetable gardens, marine ponds, and so forth–their own laboratory, based on methodologies that they themselves work out with the guidance of their respective science club advisers or resource persons, in their own vernacular.

Presently, SFP financially and technically assists two OSSELs. The first is located in Balucuc, Apalit, Pampanga. None of the members attend school and so have a very limited exposure to experimental and investigatory procedures. The Balucuc based OSSEL is presently working on a crop production project. It does this on a borrowed 200 square metre lot owned by the barrio captain and grows legumes, cucurbits, okra and cabbage for test purposes. Earlier the group worked on mushroom culture but mostly for experimental purposes, studying the differences in yield using varied kinds of mushroom beds. Another major science club project on hand is the study of varied habitats in fresh-water aquaculture (fish). Several owners volunteered their empty fish-ponds for the purpose of controlled studies. The science club members hope to stock these ponds with the native hito (catfish)[3] as soon as the ponds are prepared for stocking. At the time the Balucuc Out-of-School Science Club was being activated one parent asked if the projects of the science club would bring financial returns. After 12 months of operation that question was answered 'Yes', with tangible proof from his own son's written progress report on the following page.

Investigatory studies undertaken by the Balucuc science club members provide the medium for increasing the understanding of science and technology by these out-of-school youngsters and for earning money. Some of the experiments performed were:

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2. The first out of school science club laboratory (OSSEL I) in Balucuc, Apalit, Pampaga about 50 km. from Metro Manila was encouraged when the land-owners lent their land for use by the club–free of charge.

3. The preferred species is the local *Clarias macrocephalous*, although the imported *C. batracus* is more resistant to pollution and is readily available in the market.

Adventor Neri, Progress Report on OSSEL

Yield	Quantity in kg.	Selling price per kg. in ₱	Amount in ₱ *
Cabbage	60	2.50	150.00
Tomatoes	10	2.00	20.00
String beans	5	1.20	6.00
Okra	50	0.50	25.00
Ampalaya	40	2.00	80.00
Total:	165		281.00
Expenses:			
Labour/services		–)	
Seeds		50.00)	
Fertilizers		35.00)	112.00
Insecticides		12.00)	
Others		15.00)	
		Net return:	169.00

Vegetable seed viability. The members of the science club subjected all the purchased seeds to a germination test. In a school laboratory, expensive apparatus would be used, but here ordinary kitchen utensils and improvised equipment were employed to obtain the desired results. Volunteers assisted in computing the percentage of germination.

Off-season trials on strictly seasonal crops. The members selected at least three seeds of traditionally known seasonal crops, namely: tomato, known to grow well only during the summer months; corn and *monggo* (mung bean), known to grow well only during the rainy season. The science club members planted these seeds during their off-season to find out their productivity. The result: the three crops produced yields comparable to that during the crops' known growing season.

The second SFP-assisted OSSEL is the school science club of Rizal Standard Academy, Nagcarlan, Laguna 50 km south of Metro Manila. Some members have some formal training in scientific experimentation; other members do not. The Nagcarlan science club is presently working on fresh water resources investigatory projects such as catfish culture, tilapia culture, and frog culture of local species. Most of their activities start with observations and follow with implementation of their simple research designs on culturing aspects. Compared with Balucuc, this group

* Approximately Philippine Peso (₱) 8.40 = One US dollar

is given more freedom in planning and implementing their investigatory studies.[4] The ponds and the science club's meeting place are provided by a fish pond operator for a period of five years. Fortunately, the ponds are within walking distance of the school and so the members can easily do their out-of-school observations and data recording. The activities are in essence designed to enhance the member's formal science education.

Activities and strategies

Activities that further the OSSEL concept are science fairs, science camps, science quizzes, youth seminars and lecture demonstrations and the youth apprenticeship programmes.

Science fair. The Philippine science fair is a public exhibition of scientific projects by young people, giving them the means to establish confidence in their own ability to establish and check interesting hypotheses, to express themselves clearly, and to discuss with visitors questions on the methods used in the project and on the value of their conclusions. It is organized with a two fold purpose. The first is to uncover the hidden scientific talent that is developing among the youth. The second is to raise their scientific literacy and interest.

Because it is based on pedagogical and psychological principles, the science fair animates the young with ideals and reachable aspirations suited to their level. This develops their analytical minds, stimulates their initiative and originality, and enhances self reliance and independence.

It is in science fairs that the youth achieve the fruits of their zeal and enthusiasm for science. Participants who have had the opportunity to display the results of their efforts in public become interested doers in any scientific activity. Their zest and inclination for creativity and research grows. With their inquiring minds, they find themselves on the threshold of scientific opportunities. Ultimately, their ability for organization, leadership, and direction is enhanced.

Science fairs are structured vertically from local to provincial to national to cater for school science clubs. They are also structured horizontally whereby community science clubs get together not to compete but to sell the produce from their investigatory studies. Science fair exhibits are categorized into science and environment, mathematics and technology. Ten outstanding youth scientists are selected from the participants during the yearly national science fair. They are acknowledged with awards and their projects are displayed permanently in town halls.

4. Usually, the student members of the science club prepare their experimental designs based on their biology lessons, but on a broader perspective.

With a handful of participants when it was experimentally launched, participation has grown to over 100. Science fair authorities, particularly the members of the Board of Evaluators, have observed that investigatory projects have improved from year to year. Three exhibitors won international recognition on three different occasions in the United States of America between 1966 and 1973.

Science quiz. The science quiz is a 'brain game', which is held to encourage science club members to undertake more intensive studies in science and mathematics along their specific lines of interest, than they regularly undertake in school. It is hoped that this recognition of their talents, and the material rewards they receive will make them realize their potential in science and lead them to choose scientific careers to which they are best suited.

The provincial, regional and national science quizzes originally covered four subjects. biology, physics, chemistry and mathematics. Now the subject matter is limited to various aspects of the environment within the four science disciplines. The regional and national science quizzes consist of two phases: the written, multiple choice, objective test and the practicum phase, designed to involve the participants in activities where they demonstrate the application of what they have learned in the classroom and laboratory.

The annual science quizzes have attracted a total of almost 9,000 participants at the regional and 300 at the national levels.

Science camp. The science camp - 'a gathering of youth to carry out scientific pursuits',[5] is a culminating medium for training the youth in the skills of scientific inquiry. The campsite is a scholarly environment – a university campus – with adequate living and laboratory facilities with access to the sea and the mountains for out-of-door explorations into the mysteries of nature.

A science camp is sub-divided into sub-camps as follows:

1. *Feasibility studies, extension studies or parallel studies of some science fair projects.* Usually, these studies are on projects relevant to the science camp theme. The expected outputs here are revised project designs, or project proposals from studies of science fair projects finished during the science camp.
2. *Determining local situations for succeeding investigatory studies.* This is the biggest camp group. There are as many sub-camp

5. Asian Training Course for Leaders in the Promotion of Public Understanding of Science, Technology and Environment (PUSTE), 1976. *Final report.* Manila, SFP Printing, 1976.

divisions as a pre-camp survey group suggests after it has made a site survey. In one national science camp, for example, the sub-camp divisions were: (a) drying of rivers; (b) ecological outcomes of a swamp turned into a fish-pond; (c) pollution of a bay by a mining firm; (d) soil erosion in hillside sugar farms; (e) feasibility projects, from coconut and sugarcane throw-aways; (f) comparative statistical survey of marine life; and (g) an ecological study of a mountain lake. The outputs of the various sub-camp work units were project designs and/or project proposals.

3. *Science popularization through the print media.* This is ordinarily the smallest group in a science camp. The participants are given the rudiments of science reporting for the masses. They put out the camp newsletter. They also submit resolutions on enriching and vitalizing public understanding of science and technology as well as project designs/proposals on more effective mass science promotion systems in areas typical of the campsite.

4. *Programme planning.* This sub-camp is composed mainly of science club leaders, school administrators, community officials and SFP promotions officers. They evaluate the out-of-school youth science activities of the past year and hammer out an improved or revitalized programme on activities for the succeeding year.

The expected outputs of the science camp can be summarized as follows:

Main outputs

Sub-camp 1 Project designs or proposals on feasible extension studies of science fair projects.

Sub-camp 2, Project designs, proposals or actual project studies and investigatory projects utilizing local resources addressed to local needs and situations.

Sub-camp 3 - The science camp newsletter which chronicles camp activities with possible evaluative commentaries, and a local project design on the feasibility of a regional/provincial/science club publication.

Sub-camp 4 - Programme planning. An evaluation of the last year's activities and recommended items for the national action programme and regional/local action programmes on the public understanding of science, technology and the environment.

Allied outputs

Science clubs. In the camp, science clubs (PSYSC/SCAAP) are given the chance to meet on organizational matters. These meetings make observations and recommendations for club vitalization. The SCAAP usually elects its officers in the science camps. The camp provides a venue for development of camaraderie among science club members throughout the country.

School/community officials. These officials who are vested with the authority that is needed in the successful operation of science clubs learn more about the aims and relevance of science clubs to national development goals.

Science promotion officers. The science promotion officers of SFP come to discuss common concerns and problems, compare achievements and benefit from each others' promotional experiences. Interaction among science club members, school and community officials and science promotion officers is an effective catalyzer of interests, ideas and resources on the institutionalization of science clubs and the promotion of public understanding. It is in the science camp that more of a two-way information feedback or dialogue is experienced by the participants.

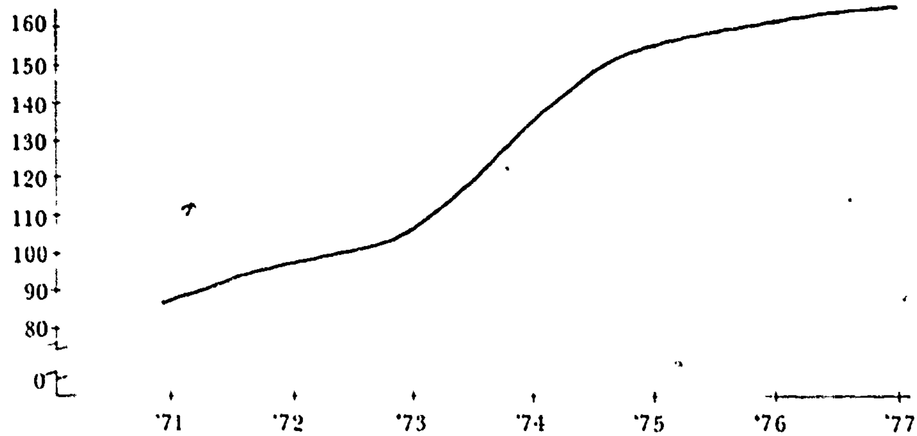
The community. The people in the local community benefit from the projects investigating local needs. Sometimes they see the microscopic world for the first time. For example, they might be shown that their clean, sweet and refreshing brook or well-water is polluted and therefore must not be drunk.

Varied approaches to the organization of sub-camp activities have been tried out. These include the non-rotation method where each sub-camp sticks to its chosen problem from start to finish; the full-rotation method where participants work on a sub-camp problem, start the project operations, partially accomplish the expected sub-camp output and then move over to the other sub-camps and produce the expected outputs of the new group; and the partial rotation method where participants move from one sub-camp to the other, continuing work from where a previous sub-camp has left off. SFP experience shows that it is the second approach, the full rotation method, which produces the most output.

Youth Research Apprenticeship Action Program (YRAAP). This programme gives opportunities to young people to acquire first-hand experiences in various fields of research; become acquainted with scientific instruments; and acquire an insight into the working methods of scientists, and their way of thinking.

The YRAAP is so designed to give youth a feeling for science and spur their natural curiosity. It aims to expand and enrich the in-school experiences of youth in scientific research through their apprenticeship

Figure 1. Science camp participation, 1971–77 (National level)



under leading scientists of the University of the Philippines at Los Baños (UPLB). The YRAAP had its beginnings in 1972 when the Society for the Advancement of Research (SAR) submitted a project proposal to SFP. Starting with the fourth YRAAP, science club advisers were included to professionally guide the science club members in the conduct of their club activities and effectively mould their young scientific minds.

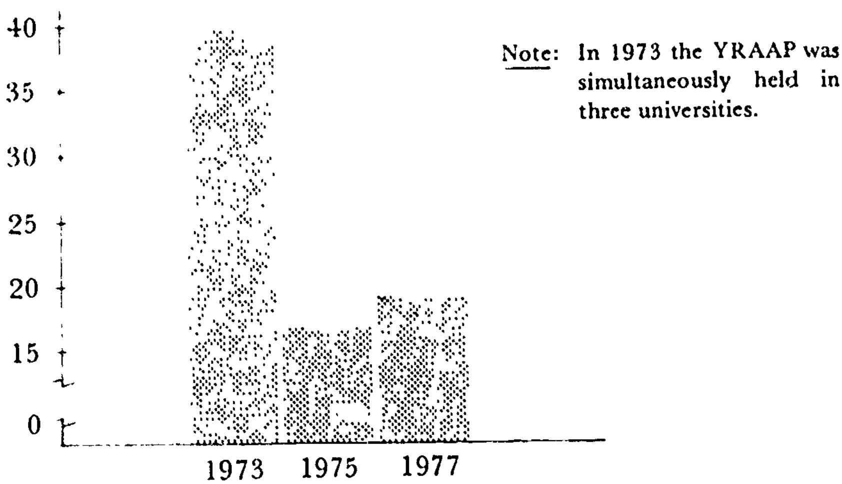
Preliminary training at UPLB takes six weeks. Three weeks are devoted to a series of lectures in philosophy, foundation and structure of science and research. The next three weeks is the workshop period which enables the participants to come up with the expected outputs, namely:

1. A research project proposal for each science club member and adviser;
2. A science club adviser's handbook formulated by the science club advisers; and
3. A YRAAP handbook formulated by the SFP science field officers.

After this preliminary work at UPLB, one year is given in which to complete the research. During this time the participants conduct research in their schools with guidance from their science club advisers. The UPLB advisers are also given the opportunity to visit the ongoing research projects of the participants during the year. The rationale for this is that young scientists should be given ample time to perform their research.

The year's labour culminates in a Science Congress which is an additional feature of the National Science Fair and Quiz, where participants present the results of their research. Awards and prizes are given to the authors of the most outstanding YRAAP research papers. One cannot over-emphasize the motivation and challenge the Science Congress presents. Its motivation lies in the knowledge that however insignificant, the participants' work will be brought to the attention of their own peers and their superiors. Nothing can take the place of recognition as the number one incentive to budding scientific minds. The Science Congress presents a challenge to excel and make good, not only for the awards one can obtain but also to prove that the six weeks training, the one year's labour, and the efforts exerted by the YRAAP summer apprenticeship staff were not in vain.

Figure 2. YRAAP participation, 1973, 1975 and 1977



Prognosis by the SAR scientists on the general pattern of interest exhibited by the 'cream of science club members' using the Kuder General Interest Survey reveals that YRAAP participants are motivated by their innate interest for science reinforced by their exposure and involvement in SFP, OSSE activities and scientific undertakings.

Science writing and reporting. Science newsletters are potent communication avenues among science clubs in the country. This is a means to share scientific knowledge and inspiring science club experiences and to acknowledge achievements worthy of emulation by outstanding science club members. Well-known local science club newsletters are the *Kapisanang agham ng lunduyang timog katagalugan* (KALTIK) which is the acronym of a provincial science club; *Seven cycle*, a bi-monthly publication financed by a private foundation and the *Science club reporter*, a national publication.

In all these OSSE activities the immediate clientele are the youth. Yet, the beauty of the SFP strategy lies in the fact that this same clientele becomes in turn the means of reaching the community. Through this natural association, the public becomes conscious of the benefits of science and technology and the scientific way of solving their daily problems.

Developing the science club adviser

While the OSSE programmes have been considered successful, there is no doubt that the participation of young people depends to a great extent on the support they receive from their science club adviser. As a result of the activities, more and more adolescent students are eager to co-operate directly in the scientific progress of Philippine society through active participation in OSSE. But they also need preliminary advice and guidance to nurture their interest. Out-of-school science education activities give the young people the opportunity to express their creative talents in coping with the demands of scientific investigatory studies. Even if they have the intellectual ability to carry out a scientific project, they do not always find it easy to choose a suitable subject.

It is therefore necessary that science club advisers undergo training in out of school science education lead ship for it is they who must stimulate science club members to start their projects, who must nurse their enthusiasm and curiosity, be their guide and counsellor, and lead them to achieve their goals.

The ultimate science club adviser, who is the agent of the real development goals of the OSSE programme, does not yet truly exist. Previously people have come from the professions allied to out-of-school science education work. They were believed to possess the proper attitude and willingness to work with people. They have been subjected to a series of training, visitations and involvement in accredited courses. They have come up to expectations, but their number is insignificant and the process of assimilation is much too slow.

SFP through the Ministry of Education and Culture has provided incentives for the science teachers to spare part of their day to work with science clubs. But getting the co-operation of science teachers is feasible only insofar as they work with their own students. And the youth in school is only 2.4 per cent of the total population.

Besides this in-school group, the scientifically illiterate found in all fields of endeavour, scattered in far-flung barangays, must be reached. Like the school children, communication with them is only possible during their uncommitted free time which is irregular. For these two reasons, the science teacher/science club adviser, no matter how well qualified, is unable to be of much use because of constraints of time and resources.

What makes this condition truly aggravating is that, while the lack of truly trained, well-disciplined professionals for out-of-school science education is strongly felt, there is no accrediting institution that has yet developed a programme to meet this need. A survey made in 1978 by SFP of 106 colleges and universities in the country carrying programmes at the graduate level showed that no courses or subjects along this field of specialization were offered.

Simultaneously a SFP Special Committee undertook a study of the need for a degree programme at graduate level on out-of-school science education. It concluded that: (1) there is a pressing need for the fully trained professional, the out-of-school science education leader; and (2) only this kind of leader is able to plan, co-ordinate and assess various strategies aimed at the development of the scientific mind and technological creative imagination among the youth and adults within the context of their culture.

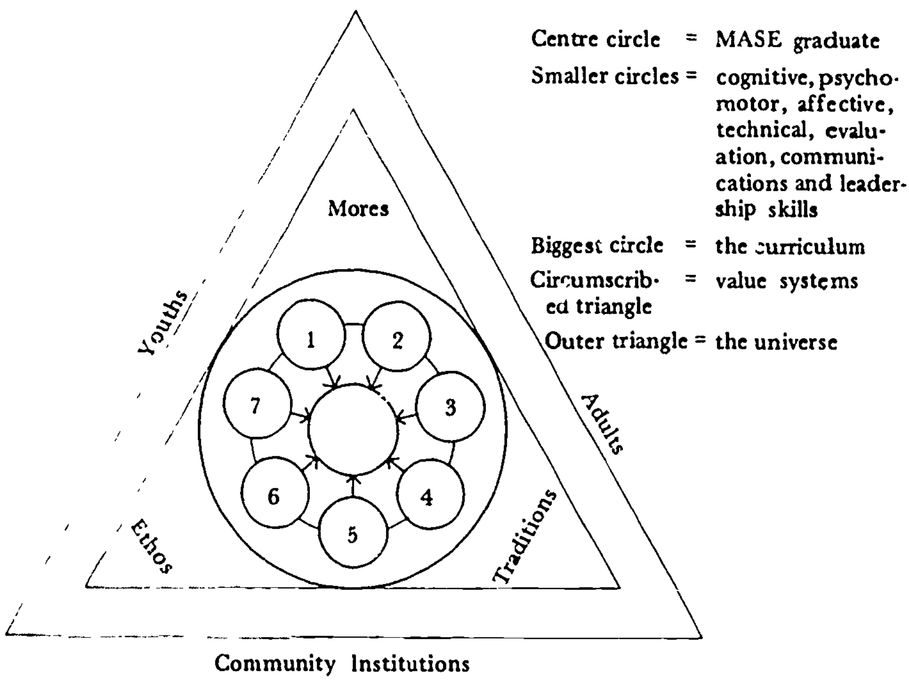
The Special Committee recommended to the SFP Board of Trustees the adoption of a master of arts degree programme with specialization in OSSE (MASE for short). The expected outputs in this plan are professionally trained leaders committed to the goals of out-of-school science education who at the same time are research oriented. As such, they are expected to possess seven skills arranged in ascending order as follows: cognitive, psychomotor, affective, technical, communications, evaluation and leadership.

The model of the MASE output (Figure 3) is based on the three following premises. the output is affected by mores, ethos and traditions; the output is a product of both the higher education and the community environment; the output operates on a leadership role. This upgrading process returns to society a system of scientifically improved ways of doing things in a continuing fashion through these trained leaders.

In the MASE model the MASE graduates, represented by the centre circle, are the end result of forces bearing on the developing out-of-school science education leader (the graduate student). These are: (1) the curriculum (represented by the biggest circle), which is geared to the development of the skills mentioned earlier and represented by the seven smaller circles; and (2) the value system mores, ethos, traditions (represented by the circumscribed triangle).

The supra system (outer triangle) is the universe made up of three sectors namely: community institutions which have organizations as their common characteristic; adults, and youth respectively, represented by the base and the sides of an equilateral triangle.

Figure 3. Model of the MASE output



The special committee further recommended that a project be undertaken to determine the applicability and relevance of the degree programme. Through this pilot study, the feasibility of its implementation by a consortium of universities will also be determined to maximize the use of otherwise scarce human and physical resources.

Role of research in OSSE

Research gives the needed 'vitamins' in the growth of the SFP programme on the public understanding of science, technology and the environment. One comprehensive study on science and society was completed in December 1975. This comprehensive study of Environmental factors that enhance or hinder public understanding of science, technology and environment'[6] was the first made on selected Philippine barrios located strategically in three different places–Luzon, Visayas and Mindanao–isolated from the rest of the country by their similarly characteristic terrain. The study found that their isolation is an aspect which has led to

6. Antiola, Solédad L. [et al.] "Environmental factors that enhance or hinder Public Understanding of Science, Technology and Environment (PUSTE)," *Out-of-School Science Education Magazine*:2-85, October–December 1975.

the difficult entry of science and technology into the daily life of the people there. Isolation due to their very different terrain has led to low educational and literacy levels and also to low earning capacity. These are found to be constraints to a meaningful understanding of the 'How's, why's and wherefore's' of the scientific method. The discovery of this situation has enabled SFP to study how its strategies and tools may be vitalized to suit this particular Philippine situation. Studies on other Philippine environmental aspects—such as urbanized living, occupations, educational systems, religious practices and beliefs, communication systems, and ethnicity can be expected to give light on how to hasten the development of a scientific culture in the Philippine society and establish bench-marks considered helpful in making the SFP programme more responsive to the people's needs.

Other research studies completed include: 'Status, trends and problems of science clubs', 'Study on participants of the 1971 national science fair', and 'Study on the criteria for evaluating science fair projects'.

Revolutionized science museum

School education for an individual is a process which is completed but not repeated, but true education, which is an awareness and appreciation of man and his environment, is never completed. It is the visual presentation of this concept of education that lies within the realm of science museums to encourage and stimulate.

The Philippine Science and Technology Museum Development (PSTMD) programme is an intensified venture in the presentation of science and technology. It addresses itself to the task of building an appreciation of science and technology that supports grassroots and countryside development and ultimately national solidarity.

When completed, the PSTM will (1) be a show-case of the tremendous progress and vital contribution of science and technology in the uplift of the Filipino, (2) become a learning laboratory through participatory discovery and exploration activities in its galleries and other educational facilities, and (3) translate itself into a nursery for fostering interest in science career development.

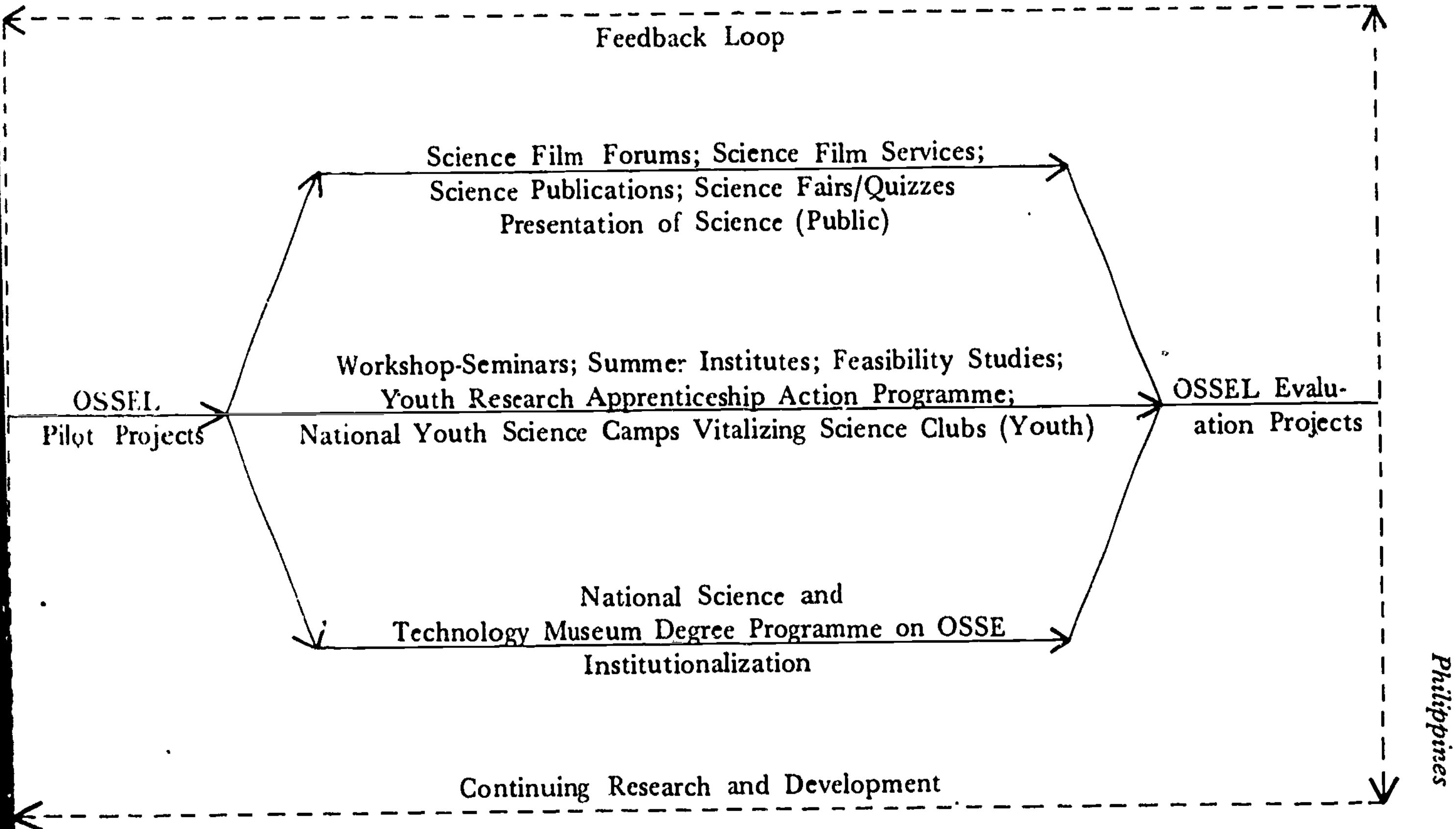
The PSTM will have exhibits that are manipulative, animated and dynamic. It will have devices that will be operated by the viewers so that their curiosity is aroused to a point that they are led to ask the probing question in science—'why?' It will have displays that explain in simple language the great laws of science upon which technology depends and the significant achievement of Filipinos in science and technology. It will have prototypes and models of some industrial processes and equipment

Year-round calendar of activities in out-of-school science education in the Philippines

	1st Quarter			2nd Quarter			3rd Quarter			4th Quarter		
	Jan	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Science Club Members												
Promotion/Assessment		x	x	x		x	x	x	x			
Organizing Science Club							x	x	x			
Leadership Development S-W*							x	x	x			
Investigatory Studies		—		—	—		x	x	x	x	x	x
Community Involvement				x	x							x
PSYSC		x	x	x	x	x	x	x	x	x	x	x
Science Club Advisers Leadership												
Training S-W				x	x		x	x				
Science Club Projects				x	x		x	x	x	x	x	x
Professional Development (SCAAP) SI**		—	—	—	—	—	—	—	—	—	—	—
Science Journalism/Science Writing/Skills Development/CSWGP Newsletter			x			x			x			x
Science Fairs/Congresses		x	x	x	x	x	x	x	x	—	—	—
Local									x	x		
Regional											x	
National												x
Science Quizzes												
Local									x	x		
Regional											x	
National												x
Science Film Forums							x	x	x	x	x	x
Science Camps												
Local							x	x	x			
Regional								x	x			
National				x	x					—	—	—
YRAAP		—	—	x	x		—	—	—	—	—	—
Interlinkages		x	x	x	x	x	x	x	x	x	x	x

* S-W = Seminar Workshop ** SI = Summer Institute — = self activities x = culminating activities

Figure 4. OSSEL/R. & D. programme on out-of-school science education: a three-pronged approach (science foundation of the Philippines' model)



which can be manipulated by the viewers to enhance their understanding and appreciation of the scientific principles and concepts involved in the day-to-day production of goods and commodities.

Threading up

In a nutshell the Philippine OSSE programme is a continuing functional literacy scheme that dovetails the national programmes on education and manpower development. The table on page 174 indicates the different aspects of OSSE as they appear in a calendar year. At the conceptual level out-of-school science education in the Philippines can be represented in terms of the model that is set out in Figure 4 on page 175.

With these OSSE activities the knowledge and skills acquired by those who participate through actual performance are learned and developed more meaningfully—in a functional manner so to speak. They not only have a sense of involvement but they also take pride in their achievement because it is a product of *their* 'young' minds. □

*Bulletin of the Unesco Regional Office
for Education in Asia and the Pacific
Special issue, December 1982*

REPUBLIC OF KOREA

by Jong Ha Han

Science museums

In-school education cannot cover all the rapidly changing and expanding knowledge of science and technology nor will it reach the out-of-school general public. In order to adapt to the rapidly changing world, it is necessary to provide a learning environment for students and the general public where they may gain scientific and technological knowledge and apply it to their daily lives.

Science museums were built to provide such an environment for the people and today the Republic of Korea has one national science museum, eight student science museums, and two children's museums across the country. (A map on page 178)

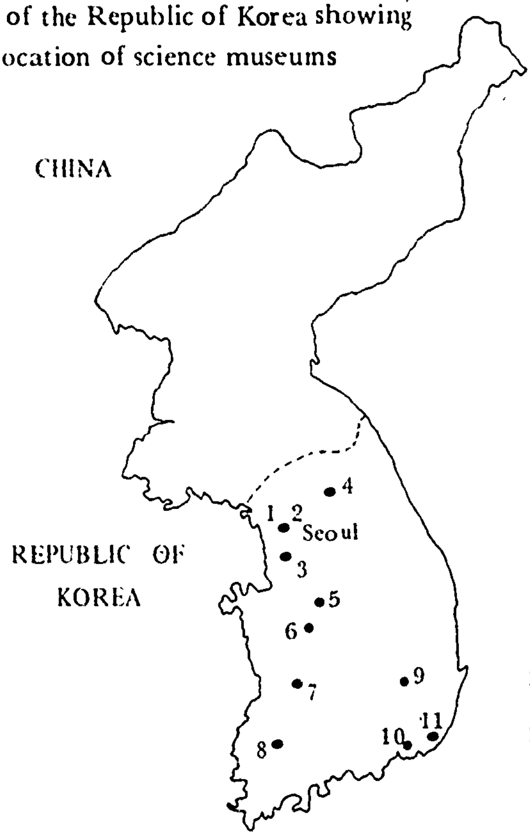
Science museum system. The National Science Museum in Seoul is under the control of the Ministry of Science and Technology, while the eight student science museums have been erected in the provincial capital cities under the control of the Ministry of Education. One children's science museum was established in the Great Children's Park in Seoul under the management of the Korean Children's Centre and the Yook-young (education) Foundation, during the years 1974 and 1975. The other children's museum was erected in Pusan in 1976.

The museums vary somewhat in size and scale, but they contribute increasingly to the people's better understanding of science, technology and industry, and especially they stimulate and influence the younger generation in the cities.

The National Science Museum has a close relationship with the student and children's museums and seeks to serve as a vehicle for the overall effective operation of the science museums, the exchange of information, the organization of travelling exhibitions and co-operative projects and the sharing of exhibit materials. It also seeks to further public understanding and appreciation of science and technology. In addition, the National Science Museum promotes and manages the annual National Science Fair.

Internationally, the museum will continue its relationship with the Association of Science Technology Centres (ASTC) and the International

Map of the Republic of Korea showing the location of science museums



1. National science museum
2. Children's science museum in Seoul
3. Gyeong-Do student science museum
4. Gangwon Do student science museum
5. Chung Cheong Bug Do student science museum
6. Chung Cheong Nam Do student science museum
7. Jeonra Bug Do student science museum
8. Jeonra Nam Do student science museum
9. Gyeongsang Bug Do student science museum
10. Gyeongsang Nam Do student science museum
11. Children's science museum in Pusan

Council of Museums (ICOM). Since affiliating with ASTC in 1973, the museum has received much useful information and material concerning museums of science, technology and industry from ASTC headquarters and its member museums.

Museum activities. The two main functions of museums are to diffuse scientific and technical knowledge and to promote a scientific way of living for all. Science museums devote themselves to collecting, preserving, studying, and exhibiting materials and information in the fields of science, technology, industry, and natural history. Each museum consists of an exhibition section, an engineering and maintenance section, a research and planning section and a general affairs section.

Exhibition section. The National Science Museum commenced operation in September 1972, when it opened its halls on the first, second and third floors with 220 exhibits in an area of 5,300 square metres. The original museum which was established in 1926 was destroyed during the Korean war. The exhibits cover such various fields as electronics,

Young visitors demonstrating a nuclear power plant model at the exhibition hall (top left). Visitors viewing a 1896-1958 running street car displayed by the National Science Museum (left). A young girl touching the head of a Van de Graaff generator displayed at the exhibition hall (top).

electricity, energy, machinery, space and aviation, oceanography, geology, and even animals, insects and human biology.

Since the beginning of 1974, the museums have placed emphasis on preparing participatory exhibits to demonstrate basic science principles and their technological applications so that the general public can gain first-hand experience with man-made devices and in order to foster interest in scientific, engineering and industrial careers. With this basic aim, the museum remodelled more than 30 exhibits to make it easier for visitors to understand them, and added more than 50 new exhibits in the fields of electronics, electricity, machinery and chemistry during 1974 and 1975. Some of the outstanding exhibits are housed in the Daily Home Life Science Exhibit Hall, opened in September, 1975. The hall encourages families, especially housewives, to learn the appropriate uses of electric and electronic home appliances, and how to conserve energy. Consequently, the number of exhibits is now more than 300. The museum encourages all visitors to touch, manipulate, and become involved with the exhibits.

Science classrooms. The museums conduct educational programmes in classes for children and adults of all ages and backgrounds including school science teachers. The National Science Museum maintains one 72-seat classroom and two with 24 seats. The other ten museums have four or five classrooms. People are welcome to come to the classrooms to conduct their own experiments in chemistry, physics, electricity, electronics and biology and also to assemble scientific models with assistance and advice from museum staff members.

Some chemicals for the experiments in chemistry and physics, and the basic tools and materials for assembling such things as radios and other scientific models are provided free of charge by museums.

National Science Fair. The National Science Museum holds an annual National Science Fair to promote the scientifically creative power of the general public and to encourage scientific and technological innovation. This project also helps to create an environment in which the general public can participate in the promotion of science and technology through their direct efforts.

Projects are prepared in such fields as physics, chemistry, biology, geology, industry, agriculture and aquaculture. After it has been selected through local fair competitions, the work of teachers and students, other than college and university students, is displayed at the fairs conducted by the student museums in all parts of the country.

Almost 200 projects are put on display at the National Science Fair each year. Exhibits have improved progressively each year, and are evaluated by 30 screening committee members, who are mostly college and university professors.

The best work recommended by the evaluation committee wins the Presidential award including a cash prize of about US $4,000. Other creative works are awarded Premier's and Ministers' prizes such as those of the Minister of Science and Technology, and the Minister of Education.

In 1978, at the 24th National Science Fair the exhibit selected for the award of the Presidential prize was a digital capacitance meter designed by a middle school science teacher. Unlike the old meters which make more than 10 per cent error to measure the capacitance of the pico-farad level, this one reduced the error factor to only 0.2 per cent. It also made it possible to measure the water content of grains without powdering them. Many tons of rice can now be saved annually by substituting the new measuring devices for the old ones.

Travelling exhibition. About 50 prize-winning exhibits, selected from the National Science Fair, travel to two or three different provincial capitals each year after the fair has ended. The travelling exhibition visits the student science museums in the provincial capitals to stimulate local interest and better understanding of science and technology.

The National Science Museum plans to continue to extend the travelling exhibition's scope, possibly with more exhibits, and to send it not only to provincial capital cities but also to other large cities throughout the country.

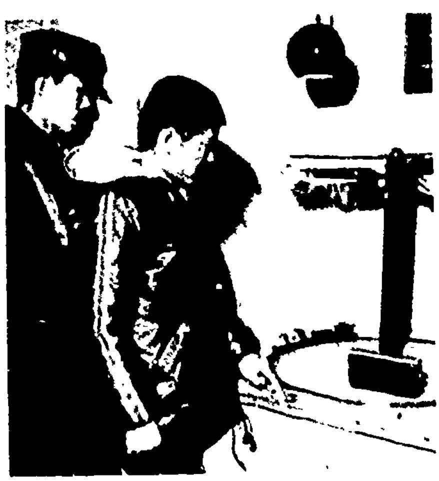
Science film service. The National Science Museum normally shows science films four times a day at its 360 seat museum theatre. One or two films are shown to the public each session. This museum has 200 films in various fields associated with natural science and technology. Student and children's science museums in local areas have their own theatres in which science films are shown to students and the public.

One day science activities. The National Science Museum and the Chang Kyung Won Palace, two adjacent organizations, jointly operate one-day science activities in Seoul.

After enjoying a tour of the zoo (the largest one in Korea with about 800 animals and birds of 200 species) the botanical garden and many other recreation facilities at the 200,000 square metres Chang Kyung Won Palace, people can visit the science museum through the Science Gate from the palace without any additional fee.

The Children's Science Museum in Seoul also provides similar activities for children and the public since it has its own zoo, botanical garden, and various recreation facilities.

A young girl demonstrating a model computer with her father (left)



Young visitors demonstrating a toy-train steered by solar energy cells (top)

Holiday science activities. Scientifically deprived families can have fun with various basic science theories and phenomena in the holiday science activities programmes offered by science museums. Everyone can enjoy spending a holiday pushing buttons, touching and operating the exhibits and participating in experiments in physics and chemistry. Also they can, amongst other activities, assemble science models, radio kits, and prepare insect specimens in the museum. It is a wonderful way for a family to spend a day off. In this way they can experience the scientific way of thinking and expand their knowledge of science and technology.

Radio and television programmes for science and technology education

Radio. There are five radio broadcasting enterprises: one state-owned Korean Broadcasting System (KBS) and four private broadcasting systems such as Moon Wha (MBC), Tong-Yang (TBC), Dong A (DBS), and Christen (CBS).

Educational programmes for the primary school students. The KBS network broadcasts educational radio programmes provided by the Korean Educational Development Institute (KEDI). This Institute has its own production division, which makes programmes for teachers and students on a regular schedule. The network covers 100 per cent of the country by using a ground network system which consists of 19 local broadcasting stations and 20 local relay stations.

Beginning in mid 1960, for two hours a day the KBS network broadcast educational radio programmes to provide teachers and students in the primary and secondary schools with more information and knowledge in subjects related to their school curricula. At that time the programmes were produced by the Central Educational Audio visual Centre which was later amalgamated with KEDI. The programmes covered various subject matter including the various fields of basic sciences like physics, life science, chemistry, astronomy, meteorology and oceanography. These programmes were broadcast once a week and lasted 15 20 minutes. Since 1974, the educational broadcasting time has been extended from two to four hours a day. Although an emphasis has been placed on primary school education, there are still some programmes for secondary school students and teachers.

Science education programmes are designed to stimulate student interest in science and to expand their understanding of natural sciences taught in school. The content covered in these programmes includes plants, animals, physiology, astronomy, meteorology, earth, electricity and magnetism and nuclear power.

The following 15-minute broadcasts have been used with fourth to sixth grade students: 'Kinds of Plants'; 'Kinds of Animals'; 'Photosynthesis'; 'Food Chains'; 'Structure of the Human Body'; 'Nutrition'; 'Natural Resources to be Preserved'; 'Pollution'; 'Electricity'; 'Direct and Alternate Currents'; 'Domestic Electricity'; 'Electric and Magnetic Fields'; 'Which one is Turning Around—Earth or Sun? '; 'Universe'; 'Crust of the Earth'; 'Inner Side of the Earth'; 'Transfer of Energy'; 'Use of Nuclear Power'; Atoms and Molecules'; and 'Development of Science and Technology'. These programmes can be introduced as instructional materials in the classroom by the teacher as required in school time, since every classroom is equipped with a radio receiver system.

Science programmes for the general public. In addition, the KBS network broadcasts some other early morning and afternoon science and technology programmes for the general public. These are created by KBS to provide people with everyday scientific and technological information including new technologies of farming, new ideas of fishing, sciences in everyday life, nature preservation, kingdom of animals (how to raise pets), health, and easy sciences. The farmers' hour, broadcast between 5 a.m. and 7 a.m. every weekday, is quite popular among people in the rural and coastal communities.

Television programmes for science and technology education. The three television broadcasting systems are the state-owned Korean Broadcasting television station (KBS-TV) and two private television broadcasting enterprises. They broadcast to nearly two million households.

The KEDI staff producing television programmes for education

There is no special television network for educational programmes so broadcasts to schools are transmitted over KBS-TV and ITV during school hours. These programmes are designed to both impart knowledge to students and teachers and to demonstrate teaching techniques. More than 300 basic science programmes for primary schools were in use in 1978, some of which were in trial form.

Other programmes of a more general nature are broadcast daily in the early morning and late afternoon. These programmes cater particularly for children and farmers. For example, the 'Classroom for Farmers' is a popular daily broadcast giving useful information about farming practices.

Newspapers

There are five widely circulated newspapers across the country, some with over 700,000 subscribers. They have been playing a great role in providing the general public with scientific knowledge and information. These newspapers have a fixed column for culture (including science and technology) dealing with various topics such as digests of scientific research reports, ideas of advanced technologies, variations in nature, agriculture and fisheries, health and pollution.

Korean Nature Conservation Association

In 1963, the Korean Nature Conservation Association was organized for the purpose of surveying natural environments and providing people with information about nature and its conservation. This association was initiated by college and university professors engaged in science (mainly life science) teaching and research. The association publishes the *Journal of nature conservation*, quarterly, and reports of research studies about Korean nature and its conservation. Along with this publishing activity the association: (a) conducts seminars and symposia on nature and its conservation; (b) provides lectures for school students and teachers; (c) arranges exhibits for the general public and students; and (d) guides students' field trips to nature conservation areas designated by the government.

The main purpose of such activities is to call people's attention to nature preservation and to make them recognize the importance of nature conservation.

The government officially declared the Nature Preservation Charter on 5 December 1978. This Charter underlines the public duty to protect nature. The Charter was written and screened by 120 environmentalists, who are mostly associated with the Korean Nature Conservation Association and by leaders of all social strata.

In it the general public are urged to renew their recognition of the importance of nature and are warned about the seriousness of the neglect of living environs. It outlines the duty of all the Korean people to protect nature. The preamble says in one part:

> The contamination of air and water and the desolation of green fields resulting mainly from the development of industrial civilization and the swelling of population have combined with the reckless spoiling of nature committed by men to disrupt the equilibrium of nature and degenerate environments, posing a threat to the very existence of human beings and all other living creatures.

It also says that it is a duty of all of the people including the state and public organizations to love nature and to protect living environs.

The seven-point code, meanwhile, urges that students, workers and housewives translate the nature charter into action in a sincere manner. It says that the preservation of nature should take precedence over development. As to side effects of the nation's industrialization, the action code says: 'The desolation and devastation of nature stemming from various kinds of garbage and waste and the over-use of chemicals should be done away with.' □

Bulletin of the Unesco Regional Office for Education in Asia and the Pacific Special issue, December 1982

SINGAPORE

by R.S. Bhathal

Introduction

Most developing countries are painfully aware of the relationship between science and economic growth. More scientists, engineers and technologists are needed to tackle the complex jobs of an industrial society and they should be better trained and have a broader outlook than ever before. In most cases countries, including Singapore, have taken steps to make the necessary changes in their formal education systems by introducing more science into their school and university curricula.

However, science and technology are moving so fast that it is quite impossible for the formal education system to keep abreast of the latest developments. In addition, there has been a knowledge explosion in science, so that it is becoming increasingly difficult to fit the various bits of knowledge together to obtain a whole picture of science and its applications and of the impact of science on society.

Out-of-school activities appear to present one of the best and most practical ways of dealing with this problem. In a world which is becoming more technologically orientated it is necessary for everyone, whether or not they will eventually become scientists or engineers, to acquire an appreciation of science and technology and its societal implications. It is all the more important in cases where science interacts with political and social issues, for example in the introduction of family planning methods or of new energy sources with potential pollution hazards.

This report describes how out-of-school activities are being used in Singapore to overcome some of these problems. Singapore is a developing country that is passing through its initial stages of industrialization. It has no natural resources and in order to survive it had no choice but to industrialize. In the early 1960s the government decided to restructure the economy by concentrating on the more technological activities of manufacturing and repair-cum-support services and by the mid-1970s industrialization had taken root. At this time Singapore also embarked on a new phase of industrial development with emphasis on higher technology and skills. For the transfer and assimilation of science and technology into the country, no efforts have been spared to ensure that an adequate supply of trained scientific and technical manpower are constantly available. To this end the formal education system in the schools, colleges and universities was revamped to take cognizance of the needs of an industrializing society. Non-formal science education programmes were also launched to motivate youth to take up careers in science and technology, so out-of-school science activities have to be looked at against this background of trying to merge both new and old technology and popularize science with the general public and youth.

In the context of this article 'out-of-school' activities are educational activities undertaken outside the formal teaching periods and the formal curriculum. An activity may still be considered as 'out-of-school' even if it takes place within the framework of the school. This could also be so even if it takes place in a free period during the school working day. The last definition really refers to science club activities since most science clubs are in fact directly connected with the schools.

Science clubs

It is important to nurture and sustain the interest of youth in the world around them and to help them acquire scientific knowledge and develop a scientific attitude.

This can be done in an effective way by setting up science clubs in schools to enrich the school science programme. The activities and programmes of science clubs are usually not tied down to a syllabus and are carried out in an atmosphere of informality. It is here that pupils can be guided to pursue their own interest and thus fulfil the aims of a proper science education.

A well organized science club can provide rich opportunities for both the teachers and pupils to explore areas of science that cannot be covered adequately in a normal school science programme. A science club has advantages over classroom lessons because it:

a) offers the pupil an opportunity for specialization;
b) provides for activities to be carried out in an informal atmosphere;
c) allows the pupil to choose his own activity;
d) allows the pupil to carry out his own experimentation;
e) allows the pupil to work on a project at his own pace; and
f) provides for freedom of expression which is so essential for a scientific enterprise.

In Singapore, as elsewhere, science clubs and science societies are closely associated with the schools. Science clubs are found mainly in the primary schools and are organized for the pupils by the teachers. On the other hand science societies are found in the secondary and pre-university schools where each society elects its own officers while the teacher acts in an advisory capacity. The teacher advises the students on various organizational aspects and encourages members to undertake new activities.

Science Club activity: primary school pupils performing an experiment on simple electrical circuits

Although the science clubs and science societies vary both in size and in the nature of their activities they normally share their experiences. They are not organized on a national basis as it is generally felt that the present loose structure encourages initiative and creativity in the organization of their own activities. The clubs and societies meet outside formal school hours as part of the extra curricular activities of the schools; normally on Saturday mornings.

The activities of the science clubs include performing simple experiments, visiting places of interest (e.g. the zoo, bird park, science centre), film shows, exhibitions, gardening and simple projects. The activities of the science societies include talks, film shows, projects, and visits to places of scientific interest.

The Science Centre *Bulletin* (a quarterly publication of the Singapore Science Centre) devotes a section to Science Club activities. The section includes articles on how to run science clubs, simple descriptions of scientific discoveries, puzzles and descriptions of simple experiments for the children to perform on their own.

Science fairs

Science fairs provide an excellent opportunity for students to satisfy their creative urge by working on scientific projects. The fairs also give the students a taste of what it would be like to devote themselves to a scientific career. This is important as it enables the students to find out very early in life if they have an aptitude for science. In carrying out independent research-type projects students have to read widely to probe into new fields as well as to master and apply all they have learned previously in their classrooms.

Science fairs have been organized on a competitive basis since 1969 by the Science Teachers Association of Singapore. The Science Fair is held biennially and is open to secondary and pre-university students. Students submit some of the projects they have been working on in their science clubs or science societies. Non-competitive science fairs for primary school children have also been held every two years since 1977.

About 80 to 120 projects are usually submitted on a competitive basis for the Science Fair for secondary and pre-university students. They are group rather than individual projects. Usually two to seven people form a group. Prizes are awarded and all students who take part in the Science Fair are awarded certificates of participation.

Science fair: students viewing projects on 'solar heaters'

The projects are varied both in their scope and in the complexity of the subject discipline. A list of project topics from a recent science fair is given below:

Topic	Discipline
a) Algae as a source of food	Biology
b) Effect of a hormone (thyroxine) on tadpole development	Biology
c) Anodizing of aluminium	Chemistry
d) Manufacture of paper products from vegetable fibres in the school laboratory	Chemistry
e) Solar oven	Physics
f) The refractive indices of solutions	Physics

The fair lasts for two days and on the average 4,000–5,000 students visit it in school parties according to a planned time-table.

Science kits

The science kits that are available on the market in Singapore are mostly imported from technologically advanced nations. They are expensive and not within the means of the general student body. Science kits are an excellent way for students to learn science and do simple experiments at home and if they are properly planned and constructed they can help in introducing science concepts, in an informal way, to young children. The Singapore Science Centre is in the process of constructing simple science kits which will be cheaper and within the means of a great many more students. The kits will be accompanied by a four- or five-page leaflet which describes the experiments that the students are to perform by themselves. Some of the kits which are being planned for construction deal with light, magnetism, and simple electrical circuits.

Science camps.

Singapore is fast becoming an industrial and urban city. Today about 60 per cent of the people are living in high-rise buildings. It is thus important that students are exposed to nature and begin to appreciate the principles of ecology. In order to introduce students to nature the Singapore Science Centre tried out an experimental science camp with about 25 pre-university students during the December 1978 school vacation. The three-day camp was held in the grounds of the Singapore Science Centre. The programme included a study of the ecology of a fresh-water pond in the grounds of the Science Centre, introductory lectures on ecology and science film shows on ecology and the environment followed by a discussion. The students also submitted a research report of their study of the ecology of the pond.

Science fortnight

The first Singapore Youth Science Fortnight was organized in September 1978 by the Singapore Science Centre and the Science Teachers Association of Singapore as one of the major science activities for youth. The aims were as follows:

a) to give youth a deeper insight into science and technology;

b) to allow young scientists to discuss scientific problems, and the implications of science on society, among themselves and the senior members of the scientific community; and

c) to allow educators of youth to exchange views and experiences in science education.

The programme included a science fair, science forums, lectures, lecture demonstrations, student research presentations, (or junior science congress), science film shows, "meet the scientists' and a seminar on primary science.

For the science fair, students from secondary and pre-university schools were invited on a competitive basis to set up projects in physics, chemistry and biology. The students were also asked to submit a report on their projects. The projects were both varied in their complexity and subject matter. This is evidenced by the topics of the projects which were: (a) preparation of century eggs; (b) solar heater; (c) study of tubifex worms; (d) an analytical survey of the quality of water in Singapore reservoirs; and (e) electron microscope.

A junior science congress was held for invited students. Two sessions (one for secondary and one for pre-university students) were held. Each session was attended by about 200 students. About ten adult scientists and science teachers acted as moderators during the sessions. The papers were presented by the three prize winners from the physics, chemistry and biology sections of the fair. The junior science congress gave the students an opportunity to explain and defend their projects before a student and adult scientist audience. It gave them a chance to participate in an activity which is part and parcel of the scientific enterprise of adult scientists. It also gave the students a sense of excitement in being able to discuss freely in the atmosphere of a science congress.

In order to show the implications of science on society two forums on pertinent contemporary topics were held. The speakers were from the universities, government departments and industry. The first forum was on population. The speakers discussed the social and economic implications of population in the Singapore context. Both the present and future trends of population policies and their impact on various sectors of society were discussed. The second forum was on noise pollution. The problem, control and effects of noise on the community were discussed. It was indeed encouraging to note that the young participants not only asked searching questions of the speakers but also discussed the topics very intelligently.

Science fortnight: participants at forum on noise pollution

A series of lectures on topics such as 'Science and crime', 'Man and machines', 'Food production' and 'Queer things in the sky', were presented to invited secondary students and lecture-demonstrations to explain the principles and applications of science in daily life were also given.

Science film shows on topics such as energy, food, computers, ecology and population were shown during the fortnight. As always the science film shows attracted a large number of students. A social function called 'Meet the scientists' was held during the fortnight. About 100 prominent local scientists from government departments, universities and industry were invited to meet the selected students over a cup of tea. The idea of the function was to allow students to meet and discuss scientific problems in an informal gathering. The fortnight ended with a seminar for primary school teachers to discuss the problems of teaching science in the primary schools.

Science on television

Television Singapore transmits science films for the popularization of science which are obtained from Western nations and deal with pertinent and contemporary topics. The popular British programme, 'Don't Ask Me' is one film presented on television and it attempts to explain in laymans terms some everyday science occurrences.

Since 1972 the Science Council of Singapore, in conjunction with other scientific organizations, has been running a science quiz on television. The principal objectives of the quiz are to popularize science among school children and bring science into the home. The quiz stimulated so much interest among youth and was so popular that the name became 'Science and Industry Quiz' to reflect the close relationship between science and industry.

In order to stimulate interest in the 'Science and Industry Quiz' series, the Science Council also published quiz-books to provide students with additional reading materials based on selected questions from the quiz. Answers to these questions were expanded to provide information of interest, particularly information not normally found in school textbooks.

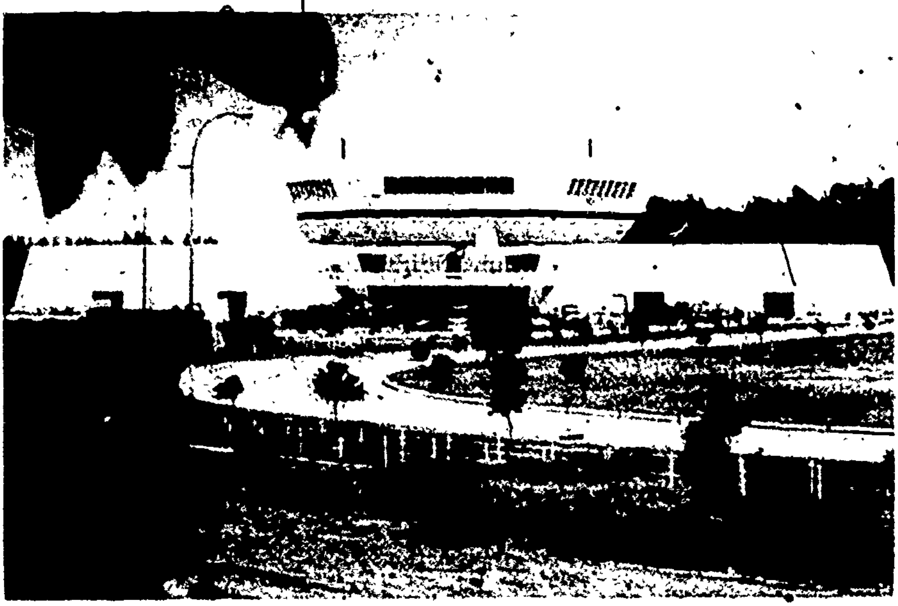
The Science Council, the Singapore Science Centre and Radio and Television Singapore organize a television series to explain science concepts in a simple way. It uses pre-university students to set up projects on science topics of their own choice. The students are then asked to explain and demonstrate their projects in simple language.

Science Centre

The Singapore Science Centre was opened in 1977. Between 800-1,000 people daily enjoy one of the best forms of out-of-school science activity. It provides a whole new field of self-motivating experiences in learning through exhibits which appeal to the senses, emotions and intellect. Unlike traditional museums, the Science Centre is a much more active place and attempts to involve the visitors in learning through discovery or a 'learning is fun' approach. The Science Centre has been responsive to a growing public demand for knowledge and information and provides a unique opportunity to enrich, extend and complement the programmes in schools. The informal educational techniques employed may have implications for other types of institutions.

Most traditional museums have evolved as depositories of collections that may be admired by the public and studied by scholars in private. They seem to be content to display static objects and artifacts. They tend not to worry too much about explaining science or making it understandable to the public. On the other hand science centres follow the more dynamic philosophy of the Chinese proverb:

"I hear and I forget,
I see and I remember,
I do and I understand.



Singapore Science Centre Building

The Singapore Science Centre provides experiences that are not available anywhere else. Visitors go to satisfy their curiosity on scientific subjects that have an impact on their daily lives such as solar energy, test-tube babies, genetics, food supply, population, environmental pollution and other issues. Information on all these topics is presented in an understandable manner.

Exhibits

The Centre has exhibit galleries, lecture theatres and laboratories. There are four exhibit display areas. A plan of the display areas appears on the following page.

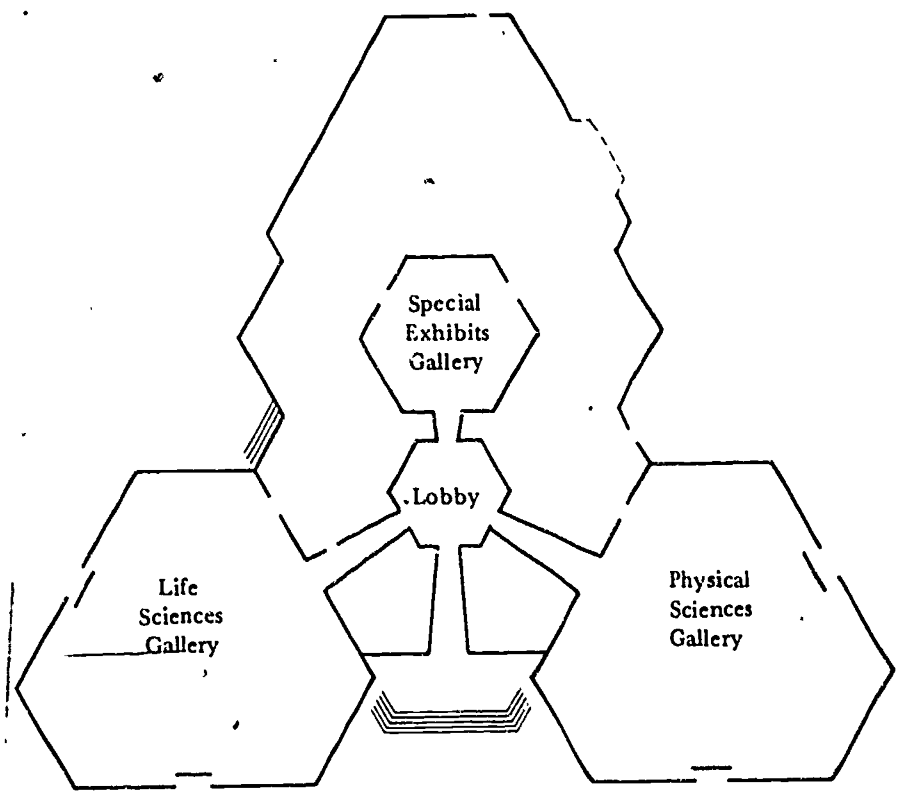
The exhibits in the galleries are arranged in a thematic form to give the visitor a coherent picture of the ideas and concepts which are on display. The exhibits are built around two main ideas, energy and life. About

40 per cent of the exhibits on display are participatory. The areas and themes are given below:

Exhibit gallery	Area	Exhibit theme
1. Lobby	270 m^2	Solar radiation
2. Physical Sciences Gallery	2,000 m^2	Energy, nuclear power, automotive engineering, communication and information systems, time and universe
3. Life Sciences Gallery	2,000 m^2	Cell, human birth, genetics, evolution, ecology and population
4. Special Exhibits Gallery	600 m^2	Waves, light, sound, fluidics, and young scientists corner.

Lobby. The exhibits in the Lobby illustrate the fact that the sun is the source of all energy and without the sun there would be no life on earth. They show the various aspects of solar radiation, with one on solar

Plan of galleries at the Singapore Science Centre



cells showing how light energy can be converted into electrical energy which in turn is converted to mechanical energy. This exhibit is participatory and allows the visitor to gain an insight into recent developments in the field of energy conversion devices. An exhibit on mice living in a cage submerged in water helps to bring out the interdependence between plants and animals.

Physical Sciences Gallery. The exhibits in the Physical Sciences Gallery have been designed to explain the laws and applications of science in industry and everyday life. Through participation visitors learn the basic principles of science by lifting a weight, pushing a button, listening to a taped message or by watching a multi-media programme.

World of energy. One of the highlights of the exhibits in the World of Energy section is the group of exhibits on petroleum. Models of the tiny micro-organisms which are associated with oil bearing areas are displayed in such a way as to allow the visitor to begin to understand how oil was formed aeons ago. The visitors can turn a device which simulates how oil flows through a porous layer of rock and gets trapped deep within the earth or look through an instrument to see how petroleum geologists search for oil bearing areas. Other highlights in this area are the exciting multi-media show on the principles of nuclear energy, and an electrostatic machine which works on the attraction and repulsion between unlike and like electric charges. There are also exhibits on forms of energy and energy transformation devices and graphic panels on future energy sources and transmission systems.

Nuclear power. The Nuclear Power Technology section deals with nuclear energy and how it can be used to benefit mankind. Visitors are able to see rock samples and uranium minerals from all over the world, how uranium is extracted from the ore, how it is used as reactor fuel and how the radioactive wastes are disposed of. An animated, technical display shows the desalination of sea water by light water reactors. The main attractions in this area are the various types of nuclear power plants.

Automotive engineering. The Automotive Engineering section exhibits give useful information on engines for both the layman and the technically proficient, where the most important, striking and trend-setting technological developments in the manufacture of motor cars are shown. Visitors are able to see a model of the first petrol powered automobile and follow its subsequent development. There are also exhibits on road safety and accident research, particularly on the development of the 'safety cell' and 'air bags'.

On a visit to the Science Centre: students viewing the hot air balloon exhibit. Physical Sciences Gallery; exhibits on World of Energy.

Communication and information systems. The Communication and Information Systems section explains how modern communication systems work. Several communication devices, such as a telephone set and a telephone switching system are exhibited. The visitor can also see a demonstration experiment on the properties of microwaves and how they are used in communication systems for the transmission and reception of information. Another display shows how computers work.

Time. In the series of exhibits on time, the mechanics of timepieces and how man developed methods for measuring time from the early sundial to the advanced technologies to be found in quartz watches are explained.

Universe theatre and man into space. The story of the origin and evolution of the universe we live in is told by means of a dramatic multimedia show which includes sound and visual effects. Six screens and 12 projectors are used simultaneously to tell the story of the universe.

Graphic panels on 'Windows into Space' and 'Cosmic Dimensions', and an audio-visual show on 'Man into Space' give an insight into the instruments used by scientists to study the universe. The visitor can push a button for a demonstration of the principles of the rocket and learn how advances in the science of rocketry made it possible to land man on the moon.

Life Sciences Gallery. The exhibits in the Life Sciences Gallery explain biological principles and their applications in daily life. They consist of graphic panels, audio-visual shows, models and life specimens.

Cell. The exhibits on the cell show the different parts and functions of animal and plant cells. A model of a cell magnified 300,000 times its ordinary size gives an appreciation of the complexity of the basic unit of life.

Human birth. This section deals with the processes of childbirth, showing the size of a human embryo from 4.2 weeks to 9 months. There is also a two minute film loop on the actual birth of a baby. This section allows parents to explain the birth process to their children without embarrassment. In fact, this is one of the most popular exhibits in the life sciences gallery.

Genetics. Mice, tomato plants and periwinkle plants are used in this section to illustrate the basic principles of genetics which were discovered over a century ago by Gregor Mendel. The genetic phenomenon of sex linkage is used to show the practical application of genetics for the sorting of chickens into males and females. There is a chick hatchery in the exhibition gallery where this sorting of chickens by sex takes place. Visitors can participate in an experiment to see whether they carry dominant or recessive genes by their ability or inability to taste PTC (phenylthiocarbamide). The exhibit on miracle rice shows how scientists have been able to use the principles of genetics to produce a new breed of rice which has both social and economic implications.

Evolution. Animals and plants are used in the evolution section to show the evolution of organisms from simple to complex forms. The adaptation of different types of organisms to a specific environment are also displayed. There are exhibits on the 'Evolution of man', 'Evolution of plants', 'Evolution of locomotion', and 'Functional physiology'. In the section on the 'Evolution of locomotion' the visitor is able to see how different animals have adapted themselves to live and move in different environments.

A seven screen multi-media show on evolution traces the story of the evolution of life from the formation of the planet earth to the present. It shows the various forces which have conspired in one way or another to wipe out certain species from the face of the earth and how some species have survived to dominate and control nature.

Ecology. The exhibits in the ecology and population section show some of the problems that man has created for himself. The effects of using DDT and its disruptive influence on the ecological balance of nature are demonstrated. A large mural shows the relationships of plants and animals in a tropical rain forest.

Population. The problems of food production and over-population in the world are displayed in a series of graphic panels, transparencies and illustrations.

Special Exhibits Gallery. The exhibits in the Special Exhibits Gallery deal with the fundamental properties of waves and illustrate the fact that light and sound also constitute wave phenomena. Visitors see ocean waves breaking in a wave tank and how the energy of waves can be harnessed for the generation of electricity. The exhibits on light demonstrate the laws of optics and how the phenomenon of polarization is used in the study of structures for bridges and buildings.

Exhibits designed by Singapore's budding scientists and chosen from the winners of the latest Science Fair competition are in the young scientists corner.

Talks, lecture-demonstrations and film shows. The staff of the Science Centre conduct guided tours of the exhibits in the galleries for groups of students. Workshops are also run for teachers so that they can use the exhibits effectively to enhance their teaching.

The Schools Service Section of the Centre conducts a number of education programmes for the schools, including talks, lecture-demonstrations, industry visits, seminars, workshops and science film shows.

The centre screens interesting science films, dealing with topics of current interest such as energy, population and pollution, for students and the general public. The films also deal with the latest advances in science and the impact of science on human societies.

Publications. The Singapore Science Centre's main publication is the Science Centre *Bulletin*. It is an inexpensive quarterly publication distributed in schools, colleges and universities. It is also available to the public at most news-stands. It serves as an extremely useful source of information, covering most aspects of science. The demand for the bulletin has been tremendous and its circulation increased from 1,000 copies to over 15,000 copies in the space of a few years.

A major portion of the bulletin is devoted to feature articles covering various achievements and contributions made in the different fields of science. Some of the topics in the past issues dealt with solar energy, family planning and drug dangers. Space has also been allocated to Science Club activities. For the younger readers this is probably the most popular section of the bulletin. The reader can find a large number of thought-provoking questions and puzzles as well as descriptions of simple experiments that can be tried out at home.

The Science Centre also publishes science education wall charts which are very popular with children and adults. Some of the wall charts that have been published are the following: 'Singapore butterflies', 'Singapore sea-shells', 'Singapore birds', 'The endangered species in South-east Asia', 'Study of a frog', 'Food chains' and 'Life cycle of a chick'.

The aim of all these publications is to make both school children and the general public aware of science and the role that science plays in their daily lives. □

Bulletin of the Unesco Regional Office
for Education in Asia and the Pacific
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SOCIALIST REPUBLIC OF VIET NAM

by Nguyen-Quang-La

Science and technology requirements

The Central Committee of the Communist Party of the Socialist Republic of Viet Nam[1] has made it clear that the main task of science and technological development is to eliminate poverty and backwardness and to shorten the period of socialist construction.

To be efficient, science and technology must not only meet existing requirements but it must be open to new trends; it must not only contribute knowledge directly related to production but also pay adequate attention to the relations between natural science and social science. The country must become independent in the field of science and technology and the intelligent and talented students encouraged. At the same time note must be taken of the achievements recorded elsewhere in the world so that time is not lost experimenting and developing what has already been successfully applied. All efforts must be used to solve the most important problems. Schools and institutes of research should co-ordinate their activities with those of the bases of production and combine teaching and scientific study with productive activities. Scientific workers and technicians must be trained; the mass movement for science and technology requires development; and scientific and technical organizations should be strengthened by improving the system of management and style of work in order to make the best of all potentialities.

The immediate tasks

The second Scientific and Technical Conference for Agricultural Development [2] decided that all scientific and technical activities in the country would be organized under a programme called Programme for the Promotion of Science and Technology.

1. Lê Duân. *Báo cáo chính trị của Ban chấp hành Trung Uong Đảng đọc tại Đai hội Dang toàn quốc lần thứ IV (Political report of the Party Central Committee read at the 4th National Congress of the Communist Party of Viet Nam)* Hanoi, Sự Thật Publishing House, 1977. p. 102-104.
2. Viện Khoa học Viet Nam (Viet Nam Scientific Institute) "53 du' án chương trình tiến bộ khoa học kỹ thuật" (53 draft programmes of scientific and technical progress) *Review "Science and Life"* No. 9(33), 1 May 1978.

Each programme deals with a specific subject (plant, animal) or a concrete element (soil, implements, climate) to be fulfilled in a determined area and time, with clear content recognized by the organs concerned. These programmes are not only carried out by researchers, managerial cadres, and teachers of various branches and localities, of research institutes and schools, but also by people engaged in scientific and technical activities.

Fifty-three programmes were drafted in 1978 for the whole country, including 25 programmes reserved for production (plants, animals), of which 18 serve the foodstuff branch and two the clothes-making branch and 13 programmes on elements of production.

The programme for the application of science and technology to the improvement of arable land includes such work as mapping forest land and protecting six million hectares of sloping land, two million hectares of brackish and saltish land, two million hectares of waterlogged fields and 200,000 hectares of sandy soil.

There were also 15 programmes of general scientific and technical progress including: carrying out scientific and technical work at district level, reorganization of forest exploitation and fishing, land clearing, building of new economic r- ..ons, investigation of forest resources and investigations of the Mekong delta, the Central Highlands, the North-west region and the coastal region from Thuan Hai to Minh Hai.

Out-of-school science and technology education. This education must serve the development of science and technology in the whole country, must have both a mass and a modern character and also must suit the practical conditions of Viet Nam, a tropical country. This can be summed up as follows:

1. Propagate the fundamentals of science and technology among the masses. Most of this knowledge is contained in the curriculum of general education such as afforestation, animal husbandry, fishery, industry, handicrafts and prophylactic hygiene;
2. Disseminate science and technology for application as a result of current scientific research. This knowledge can be used to help workers, farmers and scientific workers improve their skills or gain work experience and so improve the process of production; and
3. Popularize the trend and content of out-of-school science education, and guide the method of scientific research in order to induce the masses to take part in scientific and technical work and draw experience from it.

Implementing the out-of-school science programme

General programme. This programme[3] of propaganda and information on present and future trends and content of scientific and technical development in Viet Nam, includes:

1. Basic investigation of natural resources and conditions;
2. Study of scientific and technical applications and introduction of advanced techniques in production;
3. Study of inventions and scientific and technical innovations; and
4. Application of science and technology to organization, guidance, projects and management.

Disseminating science and technology information. An important element for the assimilation of science and technology is the organization of labour and production.

The propagators of science and technology are the teachers, students of universities and secondary vocational schools, engineers and technicians. They disseminate this information to the broad masses of the people, including school students.

Because of the different objectives and conditions from one region to another, it is necessary to disseminate science and technology step by step, from low to high level, to avoid complicated problems beyond the grasp of persons with limited education, and to avoid uninteresting subjects or those which are aloof from reality. Therefore the programme of dissemination of science and technology in each locality should be prepared in such a way that it is within reach of the listeners and the lecturer as well.

What characterizes Viet Nam is that it is embarking on the stage of transition to socialism. Scientific and technical development should rely on the human and material resources of the Vietnamese people coupled with the assistance of advanced countries in the world. The country is rich in natural resources which offer many advantages for building an independent, comprehensive economy and for developing key scientific and technical branches. However, favourable conditions for the development and propagation of science and technology must be created.

There are many forms of organization for out-of-school science and technology education.

3. Ủy ban Khoa học và kỹ thuật Nhà Nước. (State Scientific and Technical Commission) *Tạp chí Hoạt động khoa học số* 4, 5, 6, 7 nam 1978 (*Review "Scientific Activities"* Nos. 4, 5, 6, 7, 1978).

Newspapers and periodicals. Several newspapers include general articles on science and technology as well as information on political, cultural, educational, economic and diplomatic affairs, national defence and the situation in the country and abroad. Usually page two or three of these papers is reserved for the diffusion of science and technology. As each issue is printed in a large number of copies, these papers have a great informative and educative influence on the masses of people who read them every day.

There are periodicals of two types specializing in science and technology.

a) *Scientific activities*, published monthly by the State Scientific and Technical Commission; *Science and life*, published bi-monthly by the Viet Nam Scientific Institute; and *Scientific and technical information from foreign countries*, published monthly by the Viet Nam News Agency, deal with science and technology in general.

b) There are others that deal with particular branches of science and technology which are issued by ministries and departments such as the Ministry of Education, the Ministry of Agriculture, the Ministry of Heavy Industry and the Ministry of Light Industry. For example the Ministry of Agriculture has the *Agricultural science and technology* bulletin edited by the Central Agricultural Commission to be used for the whole branch, while the bulletins *Veterinary work*, *Animal husbandry* and *Cultivation* are published by the departments and institutes concerned. At present there are nearly 100 such periodicals.

Television and radio. Science and technology radio programmes are broadcast every day through the 'Voice of Viet Nam' radio on the 297, 75, 63, 49 and 31 metre bands.[4] These broadcasts include: agriculture; culture and life; industry; science and technology.

As all the workers' quarters, construction sites, schools, co-operatives and hamlets are provided with a public address system, these broadcasts can be heard regularly and have a good influence on the listeners. Besides, the central broadcasting stations in Hanoi, Hue and Ho Chi Minh City, the provinces and towns have their own broadcasting system to give useful information to these localities including the propagation of science and technology.

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4. Đài tiếng nói Việt Nam (the "Voice of Vietnam" radio) *Chương trình phát thanh của Đài Tiếng nói Việt Nam* (Broadcasting programme of the "*Voice of Vietnam*" radio). Printed on 8 October 1979.

The central television station carries out a large programme of propagation of science and technology. It usually includes agriculture, industry, public health, management and other fields of basic science. These broadcasts are usually most lively and interesting. As the provinces far from the central television station have built relay stations, the television broadcasts now reach a greater number of people.

Each ministry prepares its own information and education through the radio and television broadcasting systems. A close relationship has been built up between the ministries and the central television and radio stations. This guarantees the rich content and effectiveness of the programme for the dissemination of science and technology.

Films. These include basic science and technical science. Many films deal with science and technology in the tropics. They are shown in movie theatres, in the open air or at symposia. The State Scientific Commission, the Viet Nam Scientific Institute, the institutes of research of the ministries, departments and universities have greatly contributed to the elaboration of content and have shot many valuable scientific and technical films. Typical films are those that have been produced on the value of national parks and forests, agricultural techniques and animal raising techniques.

The locally made films are supplemented with hundreds of foreign scientific and technical films every year, particularly in agricultural co-operatives. Lantern slide programmes dealing with specific subjects such as 'Damage caused by flies and mosquitoes', 'Life of an ascarid', 'Crop destruction by locusts', 'Anopheles', and 'Trachoma–prophylactic and curative hygiene' have been shown in many localities and particularly in agricultural co-operatives.

Scientific clubs. Clubs exist in many towns, hamlets, communes and districts and have a rich content of political activities, scientific and technical reports, information, entertainment and artistic performances. The scientific and technical activities are carried out in the clubs under three forms: (a) scientific and technical reports; (b) scientific and technical films; and (c) scientific and technical recreation. They cater for all classes of people.

The dissemination of science and technology outside school is carried out among children with the Vanguard Pioneers' Brigade and its organizations as the core in the activities of the Children's Clubs and Children's Cultural Houses. The clubs which distinguish themselves in this dissemination, have held symposia on many topics such as cultivating, growing and protecting plants. One activity is 'picking science and technology flowers';

each flower hung on a twig of a plant grown in a pot contains a question on a scientific or technical subject to which the picker has to reply. The one who gives the best answer will receive a prize.

Adults who have finished complementary education first cycle, regularly hear detailed reports about a field of production which appeals to them. For instance, in rice-growing regions, there are reports on the use and preservation of chemical fertilizers, on the fight against erosion, against salinity, and on rice-pest control. In forest areas the reports deal with the use of plastic basins as seed beds for extensive cultivation, or with the protection of forests against erosion.

Farmers in Nghe Tinh province guided in the operation of internal combustion engines

Scientific museums. There are special scientific museums, such as the Oceanographic Museum at Nha Trang, which has a collection of 40,000 species of sea products, and the Army Museum in Hanoi which displays mainly weaponry, maps of military operations and military lines. There are also general museums which cover many fields—political, historical, cultural, scientific and technical—such as the Historical Museum in Hanoi.

The provinces have their own museums and almost all the districts and communes each have a 'traditional house', which is a simple form of local museum.

Scientific and technical exhibitions. Every year, at the central level or in the provinces, there are exhibitions of short and long duration for a definite purpose. We have many exhibition sites including Van Ho and Giang Vo in Hanoi, and in Hue and Ho Chi Minh cities. The recent displays are:

a) Achievements of 30 years of economic, scientific and technical progress;

b) Achievements obtained in public health, agriculture, industry and national defence (in the five-year plan).

In the towns and provinces, exhibitions are frequently held on the scientific and technical achievements recorded in each year of each five-year plan, like an exhibition on the development of handicrafts.

Exhibitions are also organized every year by each branch of activity. The educational service has held exhibitions in Hanoi and Ho Chi Minh cities on the initiative of teachers who made teaching aids for the school year 1978-1979 in which 2,000 articles were displayed. Light industries have held an exhibition on the manufacture of consumer goods from local raw materials.

The effects of these exhibitions in the dissemination of science and technology are very great. The experts, technicians and skilled workers, have the occasion to exchange their rich experiences, improve their technique, raise their labour efficiency and curtail production cost.

Exchange of experience in the manufacture of teaching aids at the exhibition of school articles held in Haiphong city at the end of 1978

Zoos and botanical gardens. Zoological and botanical gardens are useful places of natural science education as well as being good places for recreation. The well-known gardens are the botanical garden in Hanoi near the Western Lake, the botanical and zoological garden in Ho Chi Minh City, the botanical garden in Hue and the Cuc Phuong National Park, Ha Nam Ninh province, which is a natural forest where many species of plants and animals typical of a primeval forest are found.

Visits to production bases. Visits are made to outstanding production bases to study and draw experience for managerial and productive work. These production bases are, for example, Dinh Cong Agricultural Co-operative in Thanh Hoa province; Vu Thang Agricultural Co-operative in Thai Binh province; Cai Lay Co-operative, Ben Tre province; and Nam Ninh Co-operative in Ha Nam Ninh province, which receive a great number of visitors, particularly on summer holidays or festival days.

Visits to natural sites. These sites are mainly interesting for geographical and biological reasons but some have historical and cultural importance. Visitors increase their knowledge of nature and gain broader scientific views; their love of nature and of the fatherland is also enhanced. These sites provide places for camping and recreation to improve the physical and spiritual welfare of the participants.

The best known of these sites are Ha Long Bay, Quang Ninh province; Tham Dao, Vinh Phu province; Huong pagoda, Ha Son Binh province; Sam Son, Thanh Hoa province; Cao Ca, Nha Trang province; and Dalat in Lam Dong province.

Viet Nam has many natural sites which can be turned into beauty spots because of the long coastline, lush vegetation and beautiful mountains and rivers; in short, a tropical country having a picturesque landscape.

Technical labour for teachers and pupils. Every year, teachers and pupils enjoy two-and-a-half months of summer holidays. During this period, the Viet Nam Communist Youth Union in the schools organizes for its members and other youths, 10-15 days work at construction sites, and agricultural farms to enable them to take a direct part in manual labour and to produce material wealth for the society.

This opportunity to make a practical contribution to industrial and agricultural production gives youths an idea of what they will do in future and enables them to apply their scientific knowledge to productive work. Harvests, irrigation work, pest control and flood control are the best occasions for teachers and pupils to link their knowledge to production and real life. With their huge force of 13 million children attending general education schools, nearly one million children from vocational schools and over half-a-million teachers, the participation of pupils and teachers in production and social life has a marked significance.

Teachers and pupils are the force propagating science and technology among the population. Through them, many new scientific and technical approaches have reached the countryside, factories, construction sites, forest exploitation yards, and state farms. Among these are the techniques of growing *azolla pinnata*,[5] of pest control, of wiping out flies and mosquitoes, and of preventive hygiene for men and animals. Schools play such an important role among the local population that they are the mainstay of the local authorities in this work. It is precisely for this reason that they have been recognized as cultural, scientific and technical centres in their regions. This applies particularly to the secondary schools, where there are a body of teachers graduated from universities and senior students who are in a most favourable position to do this work. In all there were 700 such schools in the school year 1979–1980 spreading from the deltas and towns to the mountainous regions and islands.

Primary schools also play an active part in the dissemination of science and technology. They are the core of the movement on pest control, of elimination of superstitions, and building a civilized life in the localities. With one primary school for each commune, they total over 12,000 establishments for the whole country.

Because the teachers and pupils study and experiment with science and technology they can help accelerate production. Many general education schools have made worthy contributions or served as a branch line for institutes of research and universities in scientific and technical work. For instance, these schools have participated in the study and application of micro-elements to the growing of *azolla pinnata* in Thai Binh and Ha Nam Ninh provinces, and the increase of productivity of rice, maize and beans in Ha Son Binh, Vinh Phu and Thanh Hoa provinces. The first congress to 'study the effects of micro-elements in cultivation and animal farming' held in Hue in 1979 cited many general education schools as having made great contributions to this movement. The movements for afforestation in Ha Bac, Vinh Phu and Nghe Tinh provinces and for mushroom growing by the schools in Tien Giang province and Ho Chi Minh City are gaining momentum.

After a successful study, the schools have then popularized these methods among agricultural co-operatives and farms in their region for application to production. Many cattle, pig and poultry fairs have been

5. Duck weed growing in ponds or paddy-fields to help nitrogen fixation.

held in Ha Nam Ninh, Hai Hung and Vinh Phu provinces with the participation of school youth. The 'young shoot' co-operatives of primary school children have played an active role in the tending of cattle and *azolla pinnata.*

Guidance given to co-operative members to select rice seeds on an experimental plot of Cam Binh secondary school, Nghe Tinh province

After finishing general education, some will continue their study at universities and vocational schools, the rest will remain in their regions to form the core in carrying out the 'programme for scientific and technical progress'. Every year, those who remain in their localities account for 80-85 per cent of the total number of pupils finishing general education, and consequently play an important role in the increase of labour efficiency in agricultural co-operatives and farms. □

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THAILAND

Therachai Puranajoti

Introduction

In developing countries like Thailand, scientific knowledge and the applications of science and technology are very important in all types of production, especially agriculture and industry. Science and technology are considered as having an essential role in national development. Unesco has always emphasized that the most essential factor in promoting science and technology is to make science a popular concept among the population by creating a generally receptive atmosphere and an understanding of its importance. Almost 80 per cent of Thailand's population, most of whom are out of school, live in farming communities. Out-of-school science and technology education is of increasing importance to them.

Out-of-school science and technology programmes

Both government and private organizations provide out-of-school science and technology education. The Adult Education Division of the Ministry of Education is developing and expanding several programmes for out-of-school populations, particularly those who live in rural areas. It provides individuals with the opportunity to develop skills that enable them to improve their living conditions, earn supplementary incomes, and prepare for job training or changes in occupation.

Some adult education programmes[1]

Interest group programme. This programme was organized to provide training to any group of at least 15 people on any subject. The topics for study are based on the problems, needs, and interests of the people. At present, the duration of study ranges from 5 to 30 hours on topics such as how to choose fertilizers, how to castrate pigs, how to grow mushrooms, how to manage a farm and how to repair radios.

Mobile vocational training programme. This programme provides short vocational skill training in various fields relevant to the people's needs. For instance agriculture, radio and television repairing and food

1. Thailand. Ministry of Education. Adult Education Division. *Adult education in Thailand, 1976.* Bangkok, Kurusapha Ladprao Press, 1976. p. 8–18.

preservation are some that have been held. After completing the course the learner receives a certificate from the Ministry of Education.

Village newspaper reading centres project. All kinds of reading materials are provided to the rural population at the Village Newspaper Reading Centres. The villagers can read and learn about science and technology from these materials as well as about other fields of knowledge.

General education project. Classes are set up in schools or in other buildings. Local resources of the day-school system or other agencies are employed in educational activities. This project has its own curricula including science and technology, which are equivalent to elementary and secondary levels of education. Graduates from these courses will be entitled to certificates equivalent to those from the regular school system.

Vocational adult education project. People are helped to improve their occupational skills with the provision of short-term training courses such as agriculture, mechanics, electrical repairing and radio and television repairing. These and many more subjects are provided according to the needs of the people. The project consists of stationary schools which use secondary vocational school facilities at night and mobile vocational units which are moved to distant villages.

Radio, correspondence lessons and television for non-formal education. The Ministry of Education realizes the important role of both radio broadcasting and television in spreading knowledge and information. Radio can reach areas where other means of communication cannot and because of the low price, most rural families can afford to possess one. Although television has some limitations because of the high cost of television receivers and the lack of electricity in some areas, it is accepted that television can still be used as an effective educational tool.

The Ministry of Education, therefore, organized the Radio Correspondence and Television for Non-formal Education Project which is the responsibility of the Centre for Educational Technology, the Department of Educational Techniques, and the Department of General Education in co-operation with existing radio and television stations. The programmes are intended to serve the needs of the people. For example, programmes for rural populations use local dialects and simple language. The continuing education programme also prepares radio and television programmes for those who are unable to enrol in the formal school system.

The Education Broadcast Station, organized by the Centre for Educational Technology, provides educational programmes for the general public in various fields of knowledge including science and technology education. The broadcasts include both basic and applied sciences such as chemistry, biology and physics, and nutrition, health and agriculture.

The Adult Education Division has also organized an experimental project called Out-of-School Education by Radio and Correspondence. The methods of teaching include radio broadcasts, correspondence lessons and conferences with teachers for about three hours a week. The project includes three programmes called functional literacy, general education, and interest group programmes. The latter two also provide a knowledge of science and technology according to the needs and interests of the learner.

The Centre for Educational Technology has provided science and technology education through two well-known television programmes. A programme called 'Help', invites resource persons to discuss selected topics. Slides and films are also presented. Another, called 'Advanced Technology', is a monthly programme that presents science and technology education especially relevant to industry.

Most television programmes are for entertainment. Those regarded as educational comprise about 14 per cent of the total. Some of the educational programmes which include science and technology education are: 'College for People', 'Dear Housewives', 'The Science Society of Thailand TV Programme', 'Life and Nature', 'Harmful Drugs', and 'Family Planning Association Programme'. Some programmes are presented daily and others once a week for 30 minutes to one hour each time.

Newspapers and journals. A number of Thai language newspapers play an important educational role. Most well-known newspapers have some permanent columns devoted to science and technology advancement. They include the *Daily Time* with two permanent columns concerning science and technology, 'Consult the doctor', and 'Lovely animals'; *Thai Rath* includes 'About medicine', 'Animal games', 'Beautiful animals', and 'World of children'; the *Daily News* has permanent columns titled 'Clinic at home', 'Knowing little by little each day around the house', and 'Wonderful life of wild animals'; and in the *Siam Star* the permanent column is 'Universe of knowledge' which presents all fields of scientific knowledge. Besides the permanent columns, there are usually some daily reports or articles that present science and technology education.

There are several journals concerning science and technology, such as *Science*, of the Science Society of Thailand; *Chaiyapruk science*, Thai Watanapanich Publishing Company; *The fourth dimension*, Co-education Company; and *The Thai scientist*, of the Science Book Company.

Extension and Training Centre of Kasetsart University. This Centre has several functions but the major ones are to encourage and publicize every field of knowledge which has been studied and researched in

Kasetsart University through various means such as radio and television programmes, newspapers, printed materials, exhibitions, and training courses. Most of the training courses and radio or television programmes are about agriculture. The training courses are conducted occasionally during the year as summer programmes for interested people. They include animal raising, mushroom farming, use of fertilizers, soil utilization and improvement, radio repair and the use and control of insecticides.

The radio programmes are presented daily for one, three and five minutes through Kasetsart University Radio Broadcasting Station. A television programme is presented every Saturday for 30 minutes on 'Life and nature'. The Extension and Training Centre has also conducted several village-level exhibitions concerning agricultural education.

Out-of-school research in rural technology. The concept of rural technology gained much attention after Schumacher published the idea in his book *Small is beautiful* in 1973.[2] Rural technology means 'any scientific technology that the rural population can adapt and utilize to fit their conditions and needs with no serious negative impact on their environment'.[3] The term 'appropriate technology' may also be used for 'rural technology'.

Many agencies, both private and government, including universities, are conducting research studies and experiments on rural technology. The Institute of Traditional Studies, Thammasat University, with financial aid from the United Nations University, has launched a research project on 'Traditional technology' which is being conducted in three villages to: (1) select project sites; (2) carry out surveys and collect data; (3) analyse traditional ways and so determine advantages and disadvantages of a technical resource; and (4) experiment in transferring suitable technology from one village to another.

The Sanitation Division, Department of Health, Ministry of Public Health, is involved in research, experimentation, and promotion of biogas and human waste fertilizer production. The Sanitary Division shows how animal and human waste can be converted into natural cooking gas and fertilizer.

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2. Schumacher, E.F. *Small is beautiful; a study of economics as if people mattered.* London, Abacus, 1973. 255 p.

3. Thailand. Ministry of Education. Adult Education Division. *Developing vocational and rural technology education programs; a report on a Field Operations Seminar held at the Northeast Regional NFE Development Centre, Ubol Province, 7-30 August 1978.* Bangkok, Kurusapha Ladprao Press, 1978. p. 17

The Department of Agriculture, Ministry of Agriculture and Co-operatives, engages in research concerning topics such as the selection of high yield seed varieties, plant diseases and insect control, the improvement of farm machinery, biogas production, soil analysis, and fertilizers. The Department of Agricultural Extension will disseminate this information to farmers.

The Rural Technology Project

The Adult Education Division, Ministry of Education ran this project with some financial support and technical assistance from Unesco. The project identified: (1) local, foreign and international agencies working in rural technology; (2) rural conditions that might be improved by the use of new simple technologies; and (3) simple technologies available in Thailand and developed elsewhere which might be brought to bear on these conditions and sources which could provide a regular flow of such information.

Learning materials were developed that provided information and other stimuli so that the rural learners decided to use simple technologies; designed the appropriate technology for their conditions; and constructed, used and maintained the technology.

After field-testing there was a follow-up seminar to: (1) evaluate the strengths and weaknesses of the learning packages and the appropriateness of the technologies; (2) set guidelines for programme expansion; and (3) review plans for inter-agency co-operation in the identification, development, and dissemination of rural technologies.

Population and Community Development Association (PDA)

The PDA is the largest of the private registered, tax-exempt, nonprofit organizations engaged in the training and support of indigenous personnel for family planning, parasite control, general health and community development at the village level and some urban communities working in close collaboration with government agencies. The Association is expanding its scope of activities to include appropriate technology and development services. In December 1978 the Community-Based Appropriate Technology and Development Services (CBATDS) was established. Its objectives are to:

1. Simultaneously reduce fertility and increase employment and income generating activities for Thai villagers; and
2. Markedly expand access to appropriate technologies through utilization of indigenous personnel, local materials and channels of distribution.

The CBATDS provides non-formal training, technical assistance, low interest credit and loans to active family planning acceptors of the Association. These are for adaptations of appropriate technologies for feed, fuel and fertilizer production, better marketing and environmental sanitation. It operates pilot pig breeding stations which supply villagers with healthy, immunized piglets; operates a Health and Economic Development Centre for primary health care products and services, the marketing of local produce and demonstrations and training in chicken raising, pig raising, biogas production and integrated farming.

The woman is an active family planning acceptor of the Population and Community Development Association. She has just received simple training on pig raising and is taking home a two month old piglet from the supervisor of the Family Planning and Pig Growing Project in Vieng Pa Pao District, Chiengrai Province, Northern Thailand (left). A biogas digestor at the Health and Economic Development Centre in Banglamung District, Chonburi Province (right).

Active family planning acceptors of the PDA rented these buffaloes for field ploughing at discount rates.

The CBATDS also sponsors a Farmers' Radio Programme which provides non-formal education on new agricultural principles and answers letters and technical inquiries concerning farming and other agriculture activities.

Booklets published by the Food and Agriculture Organization of the United Nations for use by farmers, housewives, school children and others engaged in small animal rearing and home gardening, are being translated and adapted by the CBATDS.

The CBATDS also conducts field study tours for local school children to observe the activities of the Centre and learn the process of methane gas generation and fertilizer production through anaerobic digestion of pig manure in the biogas digestor.

Bangkok Planetarium[4]

The Bangkok Planetarium is an institution under the Non-formal Education Department, Ministry of Education. It opened to the public on 19 August 1964. It is located close to the Ekamai Bus Terminal, Prakanong, Bangkok.

The sky theatre can accommodate 460 persons. About 9,000 stars are shown, along with some brighter star clusters, nebulae and external galaxies. The sun, the moon and the five naked-eye planets are also shown. One show lasts about an hour. It is open to the public daily except Monday and Tuesday.

Front view of the Bangkok Planetarium

4. Quoted from *Bangkok Planetarium*, a pamphlet printed by Kurusapha Ladprao Press.

There are four normal shows daily . . . and . . . special shows . . . may be arranged in advance for groups not less than 40.

There are many interesting exhibits being displayed outside the theatre:

1. The real size replica of the Apollo Lunar Module;
2. A giant size map of the moon indicating the landing sites of all Apollo Lunar Modules;
3. The diorama of King Rama IV viewing the total solar eclipse at Wah Ko in Southern Thailand;

The King Rama IV statue at the planetarium (top). A giant size map of the moon (right). The solar system model (below).

4. Transparencies and photographs of celestial bodies displayed along the corridors of the main building;
5. The spectacular black light paintings of planets, nebulae and galaxies which are occasionally shown at the other end of the corridors;
6. Star map indicating the positions of the sun, moon and planets in the current month;
7. Several bulletin boards showing the advances made in space and astronomy; and
8. Temporary displays which are in accordance with the current sky shows and highlights in astronomy.

Science Museum[5]

The Science Museum is an organization under the Centre for Educational Museums, Non-formal Education Department, Ministry of Education. It is located . . . in the same area as the Bangkok Planetarium. It opened on 9 August 1979. It is a central source of information on science and technology and is open to the public daily except on Monday and Tuesday. It is to serve people and students from all levels, helping them to understand science and its applications through simple exhibits and demonstration lectures, as well as films, television and slide programmes.

Front view of the Science Museum

About 60–70 per cent of the exhibitions are permanent and reveal basic scientific ideas and concepts. About 30–40 per cent of the exhibitions are temporary exhibits and activities which change every one to two months. Special programmes will be arranged for school groups as required.

5. From *Science Museum*, a pamphlet printed by Kurusapha Ladprao Press, 1979.

All of the exhibits are arranged systematically and each one is complete in itself. Most of the exhibits are designed to be operated by visitors so that they will not only get involved discovering the concepts of science but enjoy themselves as well.

The objectives of the Science Museum are to:

1. spread the knowledge of science and technology for the benefit of students and people of all ages;
2. supplement the science education provided in schools and colleges;
3. take part as a catalyst for science teaching and the acquisition of science learning;
4. demonstrate the application of science and technology in industry and daily life;

5. collect the products which portray the growth of science and technology; and
6. provide people with a place for study as well as for recreation.

The exhibitions in the Science Museum can be divided into four groups:

1. Basic concepts in science, which consist of mathematics, tools and measurement, simple machines, magnets and electricity, energy conversion, waves, atoms and substances, life and ourselves, and the life sciences including evolution, genetics and ecology;
2. Technology, such as man and his necessities, population, transportation, and technology in agriculture;
3. Teaching units, comprising an auditorium presenting films, demonstrations, seminars and a discovery room containing direct touch activities of science processes; and
4. Outdoor exhibits, such as an appropriate technology windmill, a hydraulic ram, a bicycle-wheel pump, the uses of solar energy and primitive technology.

Bangsaen Zoological Museum and Marine Aquarium

The Bangsaen Zoological Museum and Marine Aquarium was organized in 1969. It is located on the campus of Srinakharinwirot University at Bangsaen, Chonburi Province. Its objectives are to be a:

1. Centre for study and research in biology, especially in marine biology;
2. Demonstration zoological museum for other educational institutions; and

Bangsaen Marine Aquarium

3. Recreation place for the general public.

The three sections of the Museum are the Zoological Museum; Marine Aquarium; and Natural History Museum. The Bangsaen Zoological Museum and Marine Aquarium is now of great interest to school and university students and to the general public. The number of visitors since the opening of the Museum is over four million.

National Inland Fisheries Institute[6]

The National Inland Fisheries Institute (NIFI), Department of Fisheries was organized in 1975. It is located on the campus of Kasetsart University in Bangkok. Its objectives are to:

1. Conduct applied research on freshwater fish and undertake small scale development projects to provide information for the effective culture and development of Thailand's inland fishery resources;
2. Provide information that is necessary to protect and restore the essential habitats of freshwater fish and their food organisms;
3. Instruct and inform Fisheries Department personnel, commercial fish farmers and the interested public on techniques for effective culture and management of freshwater fish; and
4. Develop and conduct training programmes to improve the skills and knowledge of NIFI staff and of other groups and institutions as required.

The NIFI facilities include modern wet and dry laboratories including those fully equipped for specialized studies on water pollution and fish

6. From *National Inland Fisheries Institute*, a pamphlet distributed by the Institute.

diseases. There are also extensive aquaria and facilities for fish culture. The large new library is becoming one of the most comprehensive fisheries science libraries in the region.

The Institute also maintains a total of 12 earth and 66 concrete ponds having a combined area of 1,400 square metres for holding both brood stock and young fish of many species as required for studies by the NIFI staff and for stocking both natural waters and commercial fish ponds.

The NIFI has ten organizational units. Three of the units provide some training.

The Aquaculture Technique Unit develops fish culture techniques and provides information on practical and economic methods for culturing fish in ponds and baskets; advises on breeding methods, stock selection and hybridization, and provides seed stock to fish farmers.

The Taxonomy Unit contributes knowledge on taxonomy of important vertebrate and invertebrate animals in relation to their life histories and environment, and maintains an extensive museum which is open to the general public daily.

The Extension Unit provides fisheries officials and fish farmers with information and techniques to be used in solving fish culture problems, and supplies fry to fish farmers. This critically important service provides the primary interface between NIFI and the field stations, and NIFI and the general public.

National Council of Women of Thailand

The National Council of Women of Thailand has two projects concerning out-of-school science and technology education. The first is the Non-formal Education Project which provides non-formal education including science and technology education to the general public through printed materials and a radio programme. The radio programme is called 'Science and Daily Life' and is presented every week through three radio stations. There is also a consumer education programme broadcast once a month.

Siamese Association of University Women

This association operates the Non-Formal and Continuing Education Project which provides non-formal education including some knowledge in science and technology (food preservation for instance) through printed materials.

The Science Society of Thailand

The Science Society of Thailand founded in 1948, with the objectives of promoting scientific literacy in the general public and promoting the scientific and technological advancement of Thailand is a private organization under the patronage of His Majesty the King. The Society takes responsibility for many activities.

The Science Club of Thailand. This club is a section of the Science Society of Thailand, founded in 1959. Its objectives are to encourage young people to be interested in science and to know more about science. The Science Club of Thailand:

a) encourages and helps secondary schools all over the country to organize science clubs within each school and gives them the necessary information and suggestions about their management. It also gives some suggestions to teachers to help them take out-door science activities;

b) is a centre for co-ordination between any international youth science organizations and all school science clubs. It selects Thai students to participate in scientific activities out of the country, at science fairs and science camps for instance;

c) organizes a science fair almost every year in order to encourage both elementary and secondary school children to invent something new and creative involving science and prepare a science project for exhibition at the science fair; and

d) organizes a summer science camp every year in order to train the participants who are studying in the upper secondary schools how to carry out some aspects of scientific research under the close supervision of laboratory scientists.

Some activities of students in the summer science camp.

The Science Teachers Section. Organized in 1951, the Science Teachers Section promotes higher standards of teaching science and helps science teachers become more effective. The activities include:

a) summer teacher training in physics, chemistry, biology, environmental science and the methods of teaching science;

b) seminars on some special topics, such as the problems of teaching science, for example;

c) science lecture tours for a group of resource persons, three to four times yearly, to give special lectures to science teachers outside Bangkok;

d) a science textbooks project consisting of books about science that have been prepared by the science teachers section. These are the *Encyclopedia of science, Modern chemistry* (translated from CHEM Study), *Biological science* (translated from BSCS), *Biology laboratory manual,* the *World of carbon,* the *World of nitrogen,* and the *Apollo project;*

e) organizing a television programme which is broadcast by TV Channel 5 once a month in order to contribute current scientific knowledge to the science teachers, students and general public.

Other Sections of the Science Society of Thailand are the Chemistry, Biochemistry, Biology, and Physics Sections. They also promote higher standards in their professions and act as centres for interaction and exchange of scientific knowledge and ideas among scientists and their own members. Some have also conducted workshops and training programmes for science teachers on special topics in order to help them become more effective.

The Society has conducted academic conferences or symposia on scientific research almost every year. It also founded the first Museum of Natural History in Thailand but this had to be given up because of a lack of financial support.

The Dusit Zoo, the Snake Farm in Bangkok, and the Crocodile Farm in Samutprakarn, are examples of other places where out-of-school science and technology education is provided for the general public. □

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WANG JINGSHENG has been serving as the Deputy Director of the Department of Youngsters, China Association for Science and Technology, Beijing, since 1978. Prior to this, he worked as a Reporter in Xinhua News Agency, and then Deputy Dean of the Faculty of Chemistry, China Science and Technology University, and later on as Head of the Research Division, Institute of Chemistry, Chinese Academy of Sciences.

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LILIAROSE ELEVAZO-JOSE was the Senior Executive Assistant of the Science Foundation of the Philippines, Manila.

JONG HA HAN is a physicist by training. He has been senior researcher at the Korean Educational Development Institute (KEDI), Seoul, Republic of Korea, and is currently Head of its Department of Curriculum Development.

R.S. BHATHAL was the first Director of the Singapore Science Centre which was officially opened in December 1977.

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SECTION THREE

BIBLIOGRAPHICAL SUPPLEMENT

UNESCO photo by A. Shaw

Bulletin of the Unesco Regional Office for Education in Asia and the Pacific Special issue, December 1982

BIBLIOGRAPHY ON OUT-OF-SCHOOL SCIENCE EDUCATION ACTIVITIES

This bibliography has been compiled from the library holdings of the Unesco Regional Office for Education in Asia and the Pacific. Through the annotations an attempt has been made to identify programmes and projects which include out-of-school science education activities. The objectives and activities of these programmes are also reported as this information is available.

The Educational Documentation and Information Service (EDIS) of the Unesco Regional Office for Education in Asia and the Pacific will appreciate being notified of documents of Asia and the Pacific on and related to out-of-school science education in the region published within the last five years which are not included in the bibliography. Better still, readers may wish to send the actual documents to Unesco EDIS, Bangkok.

INTERNATIONAL AND GENERAL

Bachert, Russel E. and Emerson L. Shooks. *Outdoor education equipment; plans for easy-to-make items.* Danville, Illinois, Interstate, 1974. 204 p. 371.32 BAC

Easy-to-build field equipment for outdoor investigation is included in this resource book. Students become involved in various aspects of the learning process and understanding skills and attitudes are derived as students build their own equipment.

Baez, Albert V. "Projects stressing work done in the field and home experiments" in *Innovation in science education—world-wide.* Paris, Unesco, 1976. p. 189–194. 507 BAE

The Australian Science Education Project (ASEP), the African Primary Science Programme (APSP), the Open University of the United Kingdom and the Brazilian Institute for Education, Science and Culture (BIESC) are described.

Daniloo, Victor J. "Museums as educational partners," *Childhood Education* 52(6):306-311, April/May 1976. P

This article is a plea to school officials and teachers to accept museums as partners in the educational process. It points out that museums present an excellent opportunity to supplement course work with first-hand contact with fossils, new technology, historic relics and art and with attractive exhibitions such as "Working for a better environment", "A science playhouse" and science book fairs.

Bibliographical supplement

Dreyfus, A. and E. Jungwirth. "A comparison of the 'prompting effect' of out-of-school with that of in-school contexts on certain aspects of critical thinking", *European Journal of Science Education* 2(3):301–310, July–September 1980. P

A study on the validity of the recommendation to teachers that teaching science be closely linked to everyday situations to achieve stronger motivation and bring about easier cognitive development. The 'prompting effect' of everyday situations turned out to be significantly weaker than that of logically equivalent situations. While the author points out the limitations of the study, the findings encourage researchers to inquire into the problems of the validity of everyday and real-life teaching strategies.

Museum; a quarterly survey of activities and means of research in the field of museography. 7 place de Fontenoy, 75700 Paris, Unesco, to-date. P

New Unesco source book for science teaching. Paris, Unesco, 1976. 270 p. 570 UNE

This book is intended to serve as a source of ideas for devising simple scientific activities, investigations and experiments which can be carried out by pupils themselves, and for the construction of simple science equipment, using materials available in the particular locality where the science teaching is taking place. This book may also be used by groups of pupils engaged, for example, in science club activities, or by individual pupils wishing to carry out personal science activities and investigations.

Out-of-school Scientific and Technical Education (Quarterly) Vekemansstraat 71-73, 1120 Brussels, Belgium. International Co-ordinating Committee (ICC), to-date. P

The School Science Review (March, June, September, December) College Lane, Hartfield 67411, Herts AL10 9AA, U.K., Association for Science Education, to-date. P

The Science Teacher (Monthly September through May) 1742 Connecticut Avenue, NW Washington, D.C. 20009, National Science Teachers Association, to-date P
US $ 2.25

Stevens, R.A. *Out-of-school science activities for young people.* Paris, Unesco, 1969. 129 p. 507.2 STE

Experiences of countries in conducting science clubs, science fairs, camps, meetings, museums and nature conservation are reported in this handbook.

[Unesco] Meeting of Experts on the Co-ordination of School and Out-of-School Education Concerning the Problems Associated with the Use of Drugs, Lisbon, Portugal, 8–12 September 1980. *Report.* Paris, Unesco, 1981. 26 p. ED/MD/62

In the discussions on training for preventive education it was pointed out that initial training should be sufficient to enable students to understand the basic pharmacology of drugs and to understand the psycho-social context of drug use among young people.

White, Roger and David Brockington. *In and out of school, the ROSLA Community Education Project.* London, Routledge and Kegan Paul, 1978. 200 p.

This book describes the outcome of practical experimental work with groups of adolescent school leavers based outside the school but working in co-operation with

schools. Community resources are experimented with to see how they may be better employed, and how education could be taken out of the classroom to extend 'schooling' beyond the school walls.

ASIA AND THE PACIFIC

* [APEID] Preparatory Working Group Meeting [on Science Education] Seoul, Republic of Korea, 7–12 July 1975. *Science in basic functional education, philosophy, approaches, methods and materials.* Bangkok, Unesco Regional Office for Education in Asia, 1975. 49 p. 507 APE

Report of a meeting held in the Republic of Korea in July 1975 to discuss issues in science education, to develop a 'philosophy' of science education and to suggest guidelines for instructional programmes and for the preparation of modules.

APEID Study Group Meeting on Science Curriculum and Instructional Materials Development, Bangkok, 10–18 November 1981. *Towards a better science education; report.* Bangkok, Unesco, 1982. 85 p. (Asian Programme of Educational Innovation for Development) 507 APE

The Study Group Meeting calls for the utilization of out-of-school facilities in addition to science equipment and audio-visual aids and materials. The country paper of Sri Lanka, which is included in this report, describes in detail the use of the environment for practical science experiences by six of its Field Study Centres.

APEID Sub-Regional Workshop on Designing and Developing Innovative Science Curriculum and Instructional Materials, Bangkok, 8–20 December 1980. *Curriculum development: linking science education to life; report.* Bangkok, Unesco, 1981. 72 p. (Asian Programme of Educational Innovation for Development) 507 APE

Included in the programme of this Workshop was a field trip to make an on-the-spot study of some science teaching and teacher training activities which are attempting to establish links with real-life situations. The field trip enabled the participants to see various natural environmental resources which could be used profitably for making science education more relevant to daily life needs.

APEID Sub-Regional Workshop on Designing and Developing Innovative Science Curriculum and Instructional Materials, Colombo, 10–12 December 1979. *Linking science education to real life—curriculum design, development and implementation; report.* Bangkok, Unesco, 1980. 90 p. (Asian Programme of Educational Innovation for Development) 507 APE

Among the suggestions made for improvement of science programmes is to direct efforts towards identifying the many resources in the environment which would provide meaningful real-life experiences and which so far have not been considered as educational sources.

"Environmental education in Asia and the Pacific", *Bulletin of the Unesco Regional Office for Education in Asia and the Pacific* (22) i-xx, 1-326, I-LXI, June 1981. P

* APEID stands for Asian Programme of Educational Innovation for Development; the acronym is used in this bibliography.

Bibliographical supplement

In the teaching of environmental education a number of countries include in their teaching strategies provision of opportunities for the learners to interact with the community through field trips, visits to developmental sites and exhibitions. These strategies are also infused in literacy and adult education programmes as well as in agricultural extension programmes. A ten-page article, "Out-of-school environmental education", is included. There is also a bibliography with a section on teaching/learning materials.

Journal of Science and Mathematics Education in Southeast Asia (Twice a year) Penang, Malaysia, SEAMEO Regional Centre for Education in Science and Mathematics (RECSAM) to-date. P

Maddock, Maxwell N. *Some trends in the evolution of science curriculum centres in Asia.* Bangkok, Unesco, 1982. 49 p. (APEID Occasional paper no. 12)

This paper first reviews some recent trends in science education associated with the evolution of science curriculum development centres in the Asian region and some influencing factors at work and then looks in more detail at the role in promoting these trends at three of these centres, namely, the Science Education Centre of the Philippines (UPSEC) and the Institute for the Promotion of Teaching Science and Technology of Thailand (IPST), as examples of national centres, and the Regional Centre for Science and Mathematics Education (RECSAM) which was set up as a training institution for key science education personnel throughout the region.

Efforts of science education through informal and non-formal education for rural development are reported.

"Out-of-school science and technology education, activities of science clubs and museums", *ACEID Newsletter* (14): 16-17, October 1979. P

This is a review and synthesis of six national studies covering Bangladesh, India, Japan, the Philippines, the Republic of Korea and Singapore.

"Population education in Asia and the Pacific", *Bulletin of the Unesco Regional Office for Education in Asia and the Pacific* (23): 1-346, I-LXX, June 1982. P

The discussions covering curriculum and materials development involve inculcating sound scientific attitudes and understanding both in school and out-of-school. The bibliography includes a variety of teaching/learning materials.

"Science education in the Asian region", *Bulletin of the Unesco Regional Office for Education in Asia and the Pacific* (18): I-X, 1-257, i-xxii, June 1977. P

Out-of-school science programmes in such forms as science clubs, science fairs, science centres and zoological parks are described in a number of the country reports. A 22-page annotated bibliography is included.

"Southeast Asia's bright new science centres", *Asia 2,000 [Scenarios: fragile visions of the future]* 1(2):29-31, October/November 1981. P

This article introduces the science museums (now more popularly known as science centres) in Bangkok, China, Hong Kong and Singapore. The article points out that 'science museums have come a long way from the musty, dim edifices of being repositories of artifacts from the past to becoming laboratories to demonstrate principles of natural science to the working of the latest technologies, and which often invite active participation of the visitor'.

STAS–ICASE Asian Symposium . . . . Singapore, 3-7 June 1981. *Out-of-school science activities; proceedings.* Singapore, Science Teachers Association of Singapore (STAS)/ London, International Council of Associations for Science Education (ICASE), 1981. 88 p. 507 STA

Contents. Speeches.– Reports.– Summary and recommendations.– Educational and social values of OSS. –OSS experiences of children with nature. –OSS activities in Japan.– OSS in India.– Field trips and school camps.– Organization, structure and administration of OSS activities.– Role of International Co-ordinating Committee for the Presentation of Science and Development of Out-of-School Scientific Activities (ICC).– Continuing professional development of teachers for OSS science activities in Australia.– Community and school science activities.– Role of International Council of Associations of Science Education (ICASE).– Science for better living.– Science centres for non-formal education.– OSS and technical activities in Zambia.– OSS activities in the Philippines.

_______. "_______". *Biological Newsletter* (7):7, January 1982. P

Unesco Regional Meeting on the Trends and Problems in Science and Technology Education, Singapore, 20-26 July 1976. *Trends and problems in science and technology education in Asia, report.* Bangkok, Unesco, 1976. 47 p. 507.2 UNE

Current trends and problems in science and technology education in Asia were reviewed and examined for both in-school and out-of-school populations for the primary and secondary levels of education.

AUSTRALIA

Australian Science Education Project (ASEP) *ASEP Units.* Collingwood, Education Department of Victoria, 1974. 49 booklets and accompanying audio-visual materials.

The materials enable adolescents to become more aware of and participate more fully in the world around them. The materials include service booklets, a teacher's handbook and audio-visual materials.

Hodge, John C. "Museums and children in Australia", *Museum, Quarterly Review . . .* XXXI(3):160–163, 1979. P

The article makes useful observations as to how children, as well as adults, derive pleasure out of museums. The article points out that besides having the experience of seeing real objects at first hand, children like doing things such as making a plaster cast from a real fossil impression or learning a new skill associated with some aspect of the museums collection.

Meyer, G. Rex. "The continuing professional development of teachers for out-of-school science activities in Australia." in STAS–ICASE Asian Symposium. . . Singapore, 3-7 June 1981. *Out-of-school science activities; proceedings.* Singapore, Science

Teacher Association of Singapore (STAS)/London, International Council of Associations for Science Education (ICASE), 1981. p. 56-61. P

Reports on and analyses various programmes of field study, environmental education, community involvement and work experience with aims that contribute to the out-of school ideal, for which teachers can be given the generalized skills to organize and implement. A self-evaluative checklist of the skills required for the development and implementation of out-of-school science activities is appended to the paper.

BANGLADESH

Bangladesh. Ministry of Education. *Intensive out-door education programme.* Dacca, 1977. [unpublished project proposal]

_______. _______. The Education Directorate and Institute of Education and Research, University of Dacca. *Out-door primary education—syllabus and teacher's guide.* Dacca, 1975. (In Bengali)

Dacca, University. Institute of Education and Research. *An evaluation of the Out-door Primary Education Project.* Dacca, 1976. [unpublished report]

Latif, Abu Hamid and M. Khasruzzaman Choudhury. "[Open education in] Bangladesh," *Bulletin of the Unesco Regional Office for Education in Asia and Oceania* (19) 15-23, June 1978. P

Museum of Science and Technology, Dacca. *Bignan club Parichaya.* Dacca, 1978.

INDIA

Bose, A. N. "Out-of school science activities in India," *School Science* 17(4).26-30, December 1979. P

The article describes out of school science activities in India dating back to 1957 when science clubs were started as a movement The author observes that out-of school science activities which were until recently an urban phenomena are now becoming popular in rural India and are having an impact in helping solve community problems. Scientific organizations and laboratories are also taking an active interest in promoting out of-school scientific activities.

School Science (Quarterly) New Delhi-110016, India, Sri Aurobindo Marg, National Council of Educational Research and Training (NCERT), to-date. (Rs. 2.00) P

Science for villagers. Wardha-442001 [M.S.] Centre of Science for Villagers, to-date. P

UNICEF, New Delhi. *Preparation for understanding, helping children to discover order in the world around them,* text by Keith Warren, drawings by Julia Warren. New Delhi, 1975. 25 p. 507 UNI

The activities in this book avoid the use of too many words. The introduction to each activity is brief and is addressed to the children, it is for the adult who is teaching,

to speak just as the book is written, or to modify the activity to suit the children according to the materials available and the local situation. It is suggested that two or three children work together on the activities so that they can share and help each other, and learn co-operation. The book is intended to help children to understand science and to discover the patterns and arrangement of the world around them by using their hands, senses and minds.

Dig a deep pit at a proper place and put the garbage into it. Cover it with soil. It will make your surroundings clean. The garbage will decompose in the pit. It can be used as manure.

Source: India. National Council of Educational Research and Training *Environmental studies, a textbook for Class III: Pt. II. Learning science through environment.* New Delhi, 1979. p. 47

"Vikram Sarabhai Community Science Centre," in *APEID Inventory of Educational Innovations in Asia,* EIA no. 19, December 1975. 371.39 UNE

One of the important features of the programme is that it is an adventure in discovery, developing and using inquiry skills. The key words of the programme are 'question', 'explore' and 'discover' in an attempt to know how a scientist works rather than merely knowing what the scientists know.

Wanchoo, Prof. V.N. "Out-of-school science in India," in STAS-ICASE Asian Symposium. . . Singapore, 3-7 June 1981. *Out-of-school science activities; proceedings.* Singapore, Science Teachers Association of Singapore (STAS)/London, International Council of Associations for Science Education (ICASE), 1981. p. 33-36. 507 STA

The paper describes the role of various organizations and centres in the promotion of diverse types of out-of-school activities such as. exploration of the neighbourhood, bird watching studies, environment activities, investigations, demonstrations and working models, nature tours, science talent searches, science exhibitions and museums, and linking science with productive work.

JAPAN

Imahori, Kozo. "Out-of-school science activities in Japan," in STAS-ICASE Asian Symposium. . . Singapore, 3-7 June 1981. *Out-of-school science activities; proceedings.* Singapore, Science Teachers Association for Science Education (STAS)/London, International Council of Associations for Science Education (ICASE), 1981. p. 25-32. 507 STA

The problems of children living in artificial circumstances, faced with a school curricula overemphasizing mental 'grilling', result in youngsters being unfamiliar with, and disinterested in learning about nature. These problems also affect economic growth, conservation, the harmonization of society and popularization of education. This paper describes how the Ministry of Education is trying to enhance the role of science museums, nature study centres, zoos, botanical gardens, aquariums and other visiting facilities of nature to contribute to the formation of human nature which brings about "harmonized humanity".

"Kyoto Municipal Science Centre for Youth," in *APEID Inventory of Educational Innovations in Asia,* EIA no. 16, December 1975. 371.39 UNE

The background, objectives and programmes of the Centre are presented. Study programmes for children, further education courses/open lecture meetings for the public and research projects are organized. The Centre is equipped with laboratories, exhibition rooms, a planetarium and workshop facilities.

"Science kits assembled from waste materials," in *APEID Inventory of Educational Innovations in Asia,* EIA no. 63, July 1976. 371.39 UNE

Recognizing that for creative science teaching/learning, children have to be provided opportunities to have first hand science experiences and investigate problems, make their own hypotheses and draw their own conclusions, some staff members of Johoku Elementary School, Hemeji-shi started a project for providing simple science kits for each child in all the grades I–VI of the school, so that they could perform a number of science experiments. However, looking at the large number of kits that were required and also considering the limited financial resources of the school, the group decided to assemble these kits from a large variety of waste materials which were available either at home or in the community.

Apart from the above two considerations, the philosophy behind adopting this approach was that such kits being within the average experience of the child are easily acceptable and tend to make science an integral part of the child's experiences. The use of such self-assembled kits also encourages the child to carry out experiments outside the school. Further, this allows the school to utilize its limited available resources for providing expensive formal equipment when and wherever necessary. The children make up their own kit and this changes their attitude towards such kits from one of indifference to that of careful maintenance. Children also provide ideas for improving the kits, find new uses for the kit or find new ways to perform experiments.

MALAYSIA

"Out-of-school training," in *APEID Inventory of Educational Innovations in Asia and Oceania,* EIA no. 121, August 1980. 371.39 UNE

In Malaysia, out of school training programmes comprise a number of activities. One of them is the out-of-school training for vocational and technical skills which include mechanical, electrical, woodworking and building, air-conditioning and refrigeration, sheet-metal and welding, fitting and machining, radio, television and electronics and related industries. There is also the out-of-school training of farmers and rural families through the agricultural and home economics extension programmes. The aim is the improvement of the farm, the home, the women-folk, youth and the community as a whole. 371.39 UNE

NEW ZEALAND

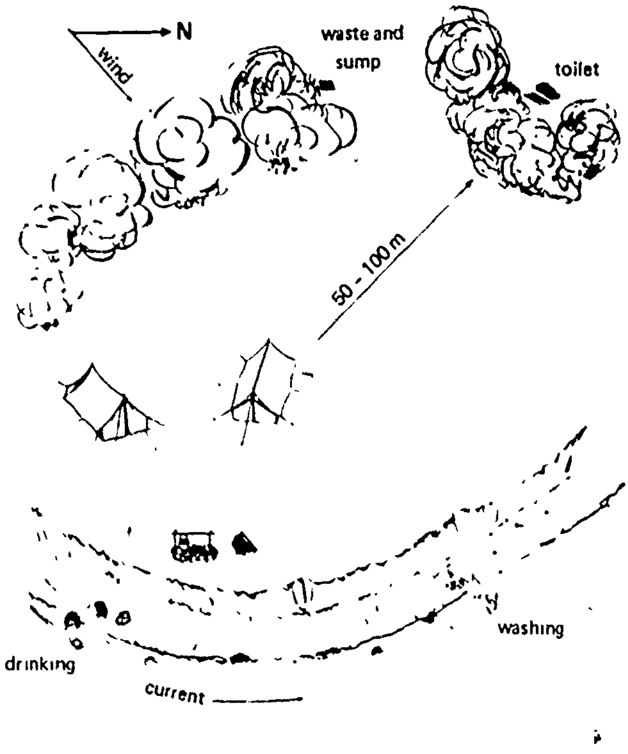
New Zealand. Department of Education. Curriculum Development Division. *Campcraft (outdoor education); a guide book for teachers, instructors and students.* Wellington, Government Printer, 1979. 56 p. 796.07 NEW

This book covers the basics of safe and simple camping for those wishing to make close contact with the natural environment.

_______. Education Institute. *Outdoor education.* Wellington, 1979. 308 p. (Yearbook of education no. 7) 796 NEW

The foreword of this book states that Outdoor Education has always been with us. From infancy man uses his environment as a source of important learnings. Teachers have increasingly used outdoor education to educate pupils first-hand in matters related to social science, social studies, leisure and recreational activities, this is documented by experiences of the authors of materials in this yearbook.

Keep it as you find it,
Organize its layout

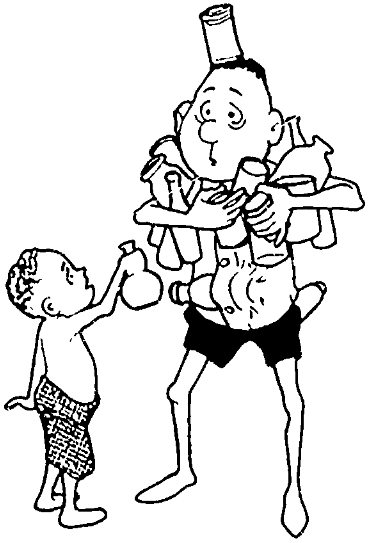


Source: New Zealand. Department of Education. Curriculum Development Division. *Campcraft.* (see above)

PAPUA NEW GUINEA

Papua New Guinea. Department of Education. *Primary science teachers handbook: three phase primary science.* Port Moresby, 1969. 2 v. 507 PAP

Lessons are presented on cards and are illustrated. Many of the lessons show how to conduct science activities in fields, gardens, brooks, seaside and other places outside the school. The lessons also show the use of waste materials for teaching/learning aids such as empty tin cans, bottles and plastic bags as mentioned below.



Once you have them, life will be very much easier for you.

PHILIPPINES

Antiola, Soledad L. "Establishing in-school out-of-school linkages," *Science Club Reporter* VIII(1):10–14, November 1977–March 1978. P

Report of National Seminar Workshops which met to develop strategies for strengthening the formal/non-formal science education linkage.

Carale, Lourdes. "Observing the community in a lake," *UPSEC Newsletter* 5(2):26–27, December 1981. P

One of a series of activities designed for a teacher training programme for elementary school teachers for study of a group of plants and animals living together as a community. The article provides an observation guide and questions for study of organisms in the lake.

Cleto, Emmanuel M., Jr. "Popularizing science clubs and its activities," *Science Club Reporter* 6(2):5–6, November 1975–February 1976. P

The author explains how science clubs may operate to serve as workshops for youth interested in science as well as to provide the facilities to solve community problems.

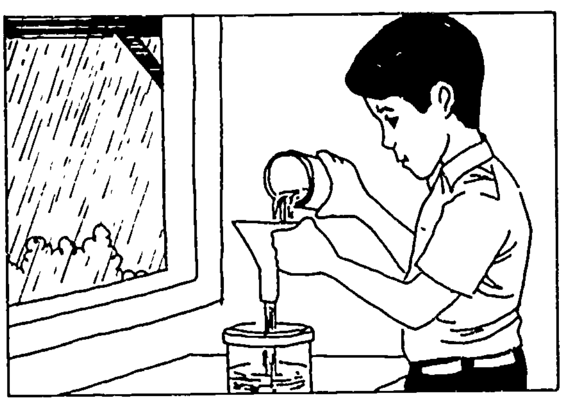
X

Foundation for Youth Development in the Philippines. *Training youths out-of-school to become citizen producers, a review of the first six year program. . .* Manila, 1981. 150 p. 362.7 FOU

The contents of this volume are organized in eight chapters. the first three tell the story of FYDP, how it came into being, how it was organized and structured to carry out its programme of activities in the development of out-of-school youth into intelligent, literate, and productive citizens, and how its funds are being raised and managed. The next four chapters discuss the establishment and operation of each of the four Centres for Young Citizen Producers and their achievements during the period under review. The final chapter recapitulates the history and development of the Foundation, identifying its high points and projects, and its future prospects. (FYDP)

Lolarga, Erlinda G. "Helps for teachers," *The Modern Teacher* XXIV(1):26-27, June 1975. P

The author states that the best scientific discoveries are often made by children outside their classrooms—in their homes, outside their homes, on the street or in the field. The main part of the article covers activities, with step by step procedures, which pupils can do outside of school during weekends or short vacations and discuss upon return to school.



How clean is rain

You can find out a lot about air pollution by collecting rainwater. Collect about a glass of rainwater in a clean bottle or bottles. When putting the jars outside, keep them elevated and away from trees and buildings so that no dirt from the ground, trees, or buildings gets in. After you have collected the water, filter it through filter paper and a funnel. What's left in the filter paper? Where did it come from? If you have a chance to collect rainwater in the city and suburbs or country, you'll have an interesting comparison.

Source: Lolarga, Erlinda G. "Helps for teachers," . . . (see above)

Manalo, Juanita A. "Out-of-school Science Activities in the Philippines" in STAS-ICASE Asian Symposium. . . Singapore, 3-7 June 1981. *Out-of-school science activities; proceedings.* Singapore, Science Teachers Association of Singapore (STAS)/London, International Council of Associations for Science Education (ICASE) 1981. p. 81-83. 507.2 MAN

Bibliographical supplement

Science and technology clubs handled by secondary schools and co-ordinated by the Science Foundation of the Philippines and the Technology Research Centre not only encourage and motivate youth in the development and cultivation of their creative talents, but are instrumental in providing villagers with scientific know-how, popularizing the use of simple technologies and increasing the use of community resources. There are more than 2,000 clubs over the country all involved in out-of-school science activities.

Neri, Adventor C. "The out-of-school science education laboratory and countryside development", *Science Club Reporter* VIII(3).27–29, 51–57, June–October 1977. P

A report of the organization, activities and accomplishments of four Out-of-School Science Education Laboratories (OSSEL) set up by the Science Foundation of the Philippines. The investigatory projects and science oriented activities are undertaken by the science clubs right in the community, which is the principal and ultimate beneficiary of the laboratory outputs for social development.

Philippines, University of. Science Education Center. *Teaching modules* [on applications of science concepts in some livelihood projects or in daily rural activities] Diliman, Quezon City, 1978, 1980. 6 booklets. 507.2 PHI

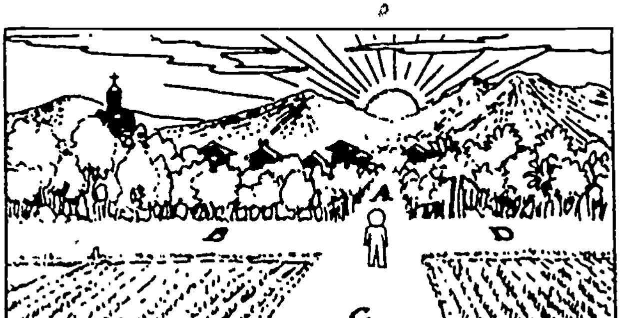
Contents. Less air pollution in charcoal making.– Fish conservation and preservation.– Money from rabbits? Certainly! — Nata de arroz [a delicacy].– Water, water everywhere.– Go, grow, glow with vegetables.

Science Club Reporter. P.O. Box 1412, Metro Manila, Bicutan, Tagnig, Science Foundation of the Philippines, to-date. P

Sebastian, Antonio C., and Nilo N. Rosas. "The In-school Off-school Approach, is OS a case study," *INNOTECH Journal* 1(1):15–28, March 1977. P

UPSEC Newsletter (2 times a year, June, December). Diliman, Quezon City, D-3004, U.P. Science Education Center, 1977– P

Contents. From the Director's desk [Reflections, stock-taking whether education and science education are serving the common man, the country . . .].– Features: Reports of projects, research, teaching/learning methods and materials.– UPSEC news.– Impressions of conferences.– New UPSEC publications.



Source: *UPSEC Newsletter* 5(1):44, June 1981.

Common and science sense

The word 'science' sends many a people running. They don't want to have anything to do with it. So be it. The situations here require only common sense and an observant eye. Try to answer them.

The time is early morning and you want to go south. In which direction is south?

"Utilization of the environment in developing viable life science curricula," *APEID Inventory of Educational Innovations in Asia;* EIA 17, December 1975. P

The problems or situations motivating this project in the Jose Abad Santos Memorial School in the Philippines were. (a) paucity of materials for classroom use, (b) limited experience of many teachers with respect to inquiry and discovery approaches; (c) too few chances to perform laboratory work in classrooms, (d) subjects taught being divorced from concrete life experiences of the child, (e) need for ecological awareness in the use and care of the environment.

The facilities available to the project were. one hectare of land, 280 square metres of ground water pond, fish stock, pigeons, rabbits, chickens housing for broilers and hens, an incubator, garden house with laboratory, hand tractor, water pump and other equipment.

SINGAPORE

Ang Kok Peng. "The community and school science activities," in STAS-ICASE Asian Symposium . . . Singapore, 3-7 June 1981. *Out-of-school science activities; proceedings.* Singapore, Science Teachers Association of Singapore (STAS)/London, International Council of Associations for Science Education (ICASE), 1981. p. 81-83. 507 STA

Singapore's prime objective is to develop the country into a modern industrial economy based on science and technology. To achieve this objective, this paper identifies institutions and establishments which could play a role in reinforcing science learned in schools. In addition to sponsoring exhibits, lectures, field trips, industrial establishments should provide opportunities for pupils during their free time to investigate problems faced by industries or projects with potential for practical application.

Bhathal, R. S. "Singapore Science Centre programmes," *Museum; Quarterly Review . . .* XXXIII(4):253-254, 1981. P

The Centre disseminates and popularizes science to the student population and the general public through exhibit programmes, school service education programmes and a science publications programme. The Centre also organizes a yearly science camp for students to study various eco-systems and collect specimens for analysis in the laboratories of the Centre.

Jackman, Kenneth V. and R. S. Bhathal. "The Singapore Science Centre," *Museum; Quarterly Review . . .* XXVI(2):110-116, 1974. P

Science Centre Bulletin (Quarterly) Singapore, Singapore Science Centre, to-date. P

Science Centre News (Bi-monthly) Singapore, Singapore Science Centre, to-date. P

THAILAND

Bangkok planetarium, background information. Bangkok, Centre for Educational Museums, Department of Non-Formal Education, Ministry of Education, n.d. one foldout, illustrated.

The foldout points out the facility for study of astronomy.

Bibliographical supplement

Niched Suntornpithug. "Children and the science museum, Bangkok," ***Museum; Quarterly Review***... XXXI(3):189–192, 1979. P

The article describes how Thailand's science museum serves as a seat of learning in pure and applied sciences on an out-of-school basis.

Pranakorn Teachers Training College. Department of Mathematics. ***56 Games of mathematics.*** **Bangkok, n.d. 121 p**

Collection of 56 games which can be played in and out-of-school. Gives objectives, level and number of players, materials used and instructions at the beginning of each game.

Preecha Naoyenpol. ***Mathematical toys and games.*** Petchburi, Teachers Training College, n.d. 510 PRE

Science museum; a source of science and knowledge of technology for all. Bangkok, Centre for Educational Museums, Non-Formal Education Department, Ministry of Education, n.d., 1 foldout, illustrated.

A brief description of the museum, its objectives and the types of exhibits prepared.

Seminar on the Maximum Application of Creative Materials In and Out of School, Bangkok, 4–5 July 1982. ***Report.*** Bangkok, The Centre of Educational Museums,. The Ministry of Education, 1982. 112 p. (In Thai)

Gives types and examples of materials for creative thinking appropriate for different levels of pupils. The maximum application of creative materials in and out-of-school is also discussed.

Summer Camp for Science Research of the Science Club for Thailand, Chulalongkorn University. ***Report.*** Bangkok, The Science Society of Thailand, 19- (In Thai)

Reports of a number of summer camps held by the Science Society of Thailand for youth from different school science clubs all over the Kingdom. Examples of some of the activities are. extracting of caffeine from soft drinks, study of 'cocoonase' enzyme from silk worms, oil pollution, study of herbs and culture of algae.

Thailand. National Youth Bureau. The Working Group for the Development of Children's Toys. ***Games and toys for child development.*** Bangkok, Chulalongkorn University Press, 1981. 133 p. 371.3 THA

Wichai Boonjua. ***Mathematics for fun.*** Chonburi, Faculty of Science, Srinakharinwirot University, Bangsaen, n.d. 510.7 WIC

ABOUT THE BULLETIN

The Bulletin was established in 1966, then published twice annually from 1967 to 1972. It is now an annual publication. A special issue was published in January 1982. Each issue contains a bibliographical supplement. Copies of Numbers 21, 22 and 23 of the Bulletin, and the Special Issue, are still available. All previous issues are out of print but may be consulted in libraries.

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Educational Planning

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Science

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Isaac destroys Tonga schools. Nuku'Alofa, Tonga, 12 March 1982. 17 p.

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APEID Finalization Meeting on Integrating Subject Areas in Primary Education Curriculum, Bangkok, 9-15 December 1981. *Integrating subject areas in primary education curriculum—a joint innovative project; report.* 76 p. US $ 2.00

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