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Science Education Programme for Africa

Volume I

A Report of Twenty Years of Science Education in Africa

E. A. Yoloye
S.T. Bajah

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Introduction

DATA GATHERING PROCEDURE

This is a "Review" document, rather than an "Evaluation," but we would like to assure our readers that the processes adopted for a review are quite similar to those used in an evaluation. Evaluation is the systematic collection, analysis, and presentation of information about the operation and impact of a programme. A review is a flexible evaluation which takes into consideration the unique nature of the programme. We see the African Primary Science Program (APSP), the predecessor of the Science Education Programme for Africa (SEPA), as an innovative and exploratory project which was characterized by shifting goals, changing implementation activities, and wide variations from site to site. Priorities and content are determined as staff learn from experience, participants enter and leave the programme, and the programme adapts to its organizational, political, and social environment. The evolution of APSP/SEPA epitomizes an adaptation to the social and political demands of the times.

"Pan-Africanism," an idea born in political circles and reared through declarations of self-reliance, is in itself an important element in a discussion of curriculum development in present-day Africa. Curriculum innovation in science, mathematics, and social studies within the African continent was introduced to a large extent in response to African aspirations for political as well as educational independence. The wave of curriculum renewal which swept through the continents of America and Europe in the fifties and sixties gathered sufficient momentum within the African

continent to create some ripples in the sixties. Since efforts in curriculum change in Africa have not been documented, there is need to generate a channel for information gathering in curriculum work in countries within Africa and, indeed, in Africa as one large geographic region. And so a "Review of the Science Education Programme for Africa and Curriculum Change in Africa" is of academic importance.

In realization of its function as a catalyst to science education activities in Africa, SEPA addressed itself to the need to gather information on science education development in Commonwealth Africa since 1960. SEPA developed its ideas into a proposal with a view to obtaining financial support from interested funding agencies. In a letter dated 12th July 1978, addressed to Mr. David Hood, Commonwealth Program, Carnegie Corporation of New York, and signed by Hubert Dyasi, Programme Director of SEPA, a formal proposal and request for funding of a Review was made:

> *Please find enclosed a request from SEPA for support of a review of science education programming activities in Commonwealth Africa in the past twenty years generally and of SEPA programming specifically. The review marks a watershed in science education programming for schools and colleges in Africa and sets the stage for new ideas, new ways, and new expectations.*

SEPA hoped that the Review would present insightful observations of educational development and perhaps culminate in a book which could serve as an important reference work for planners, educators, and students of science education. The SEPA grant proposal went further to outline some

of the issues which the Review would illuminate. These included the significance of the convergence of political and educational efforts in the 1960's; the roles played by different personalities and national groups; the use of joint planning and execution of programmes and networking as strategies; and the crucial decision not to develop a continental science curriculum, but an approach to curriculum development which focuses on the learner.

With positive response from the Carnegie Foundation, the Programme Director of SEPA, in consultation with a number of African scholars, identified Professor E. Ayotunde Yoloye, the Director of the University of Ibadan Institute of Education and architect of the International Centre for Educational Evaluation (ICEE), to direct the Review. Professor Yoloye had worked closely with those who developed both APSP and SEPA. Dr. Sam 'Tunde Bajah, another evaluator from ICEE, was identified to assist Professor Yoloye.

The Evaluators

1. Professor E. Ayotunde Yoloye (Leader)
   Director, Institute of Education
   University of Ibadan, Nigeria
2. Dr. Sam 'Tunde Bajah
   Senior Research Fellow
   Institute of Education
   University of Ibadan, Nigeria

A decision was made that the Review would focus on a span of twenty years, 1960-1980. That period represented a concerted effort in development of science education by diverse groups. In 1960, an International Conference on Science in the Advancement of New States was held in Rehovoth, Israel, where the idea to give attention to a relevant science education programme in Africa was underscored by the late Reverend Solomon Caulker, an African scholar of great repute. Reverend Caulker's ideas were supported by attending eminent scientists, including Professor Jerrold Zacharias of the Massachusetts Institute of Technology in the United States. In 1961, Ministers of Education in Africa held a meeting in Addis Ababa, Ethiopia, and named 1980 as the target year for universal primary education in Africa. It was also in 1961 that leading African, American, and British scholars and educators met in Dedham, Massachusetts, to outline a programme in Africa to implement aims set forth at the Rehovoth conference. The Dedham conference, popularly referred to as the Endicott House Conference, made several recommendations for mobilizing the talents of African scholars and educators in English-speaking Africa to mount curriculum reform in mathematics, science, languages, humanities and social studies, and in teacher education.

In 1965, a non-African agency, Education Development Center, Inc. (then Educational Services, Inc.), was funded by the United States Agency for International Development (USAID) to develop and manage curriculum innovation programmes in Africa; one was the African Primary Science Program (APSP). The year 1970 saw the birth of the Science Education Programme for Africa (SEPA) and the undertaking of cooperative SEPA/EDC programming activities.

An important purpose of this review was to be a concurrent assessment of needs, priorities, and resources in science education within member states constituting SEPA, and a correlation of them with activities provided by SEPA, in order to set effective directions in the 1980's.

The objectives of the review can be stated as follows:

(a) to gather, analyse, and collate information in science education development in Anglophone Africa since 1960;

(b) to describe, analyse, and review critically the role of APSP/SEPA in the process of science education development in Anglophone Africa since 1960;

(c) to present the outcomes from goals (a) and (b) above in a book for diverse audiences, with a view to aiding future education development activities.

In the grant proposal to the Carnegie Corporation, an attempt was made to state in precise form the strategy to be adopted during the review. It was envisaged that the entire review would take place in two stages.

Stage One: A preliminary stage, devoted largely to information-gathering and analysis to produce a research/narrative manuscript as the working document for the second stage but also to stand on its own as a reference book.

Stage Two: A representative review conference for the sharing of experiences and insights and for developing broad outlines of a science education program for the 1980's.

Based on the foregoing, the review activities were drawn up to: study files, documents, and related material of the SEPA Secretariat (in Accra, Ghana), at Education Development Center (in Newton, Massachusetts), at the United States Agency for International Development (in Washington, D.C.), and other relevant places; study the programmes carried out by APSP and SEPA; conduct interviews with key persons associated with the development of both programmes (university professors, teachers, administrators, curriculum planners and developers, former fellowship holders, and representatives of science education institutions); and collect data through questionnaires and on-site examinations of events in countries within Africa.

A preliminary meeting was held at the Carnegie Corporation office in New York. It was a tripartite meeting of donor agencies, program administrators from SEPA and EDC, and the evaluators.

Strong views were expressed about the focus the review should take. Donor agencies in particular were concerned that the approach would yield maximum results in producing a document useful for future planning. James Washington, USAID Representative at the Preliminary Meeting, said:

> *This is an African program and we want to see that aspect emphasized . . . Specifically, USAID is interested in how the experience of the Science Education Programme for Africa can contribute to basic human resource development, rural development, greater participation of women in development*

After deliberation on a number of important aspects of the review, a seven-point guideline was produced to emphasize the focus which the review

should have, especially with respect to the activities of SEPA.

- Identifying the impact (direct and indirect) of the SEPA method and philosophy;
- Analysing SEPA's strategies of intervention; which have been most effective, least effective, etc.;
- Considering the important factors for introducing curriculum change at a regional level;
- Discussing SEPA's resources on which it can draw in the future;
- Examining the degree to which science was chosen for its subject matter importance or as a convenient vehicle for introducing new teaching concepts and approaches;
- Identifying methods adopted for curriculum change in teacher training institutions in Africa;
- Analysing the impact of the SEPA approach on primary school leaving examinations in those African states adopting the SEPA materials.

The review also was intended to report on national science education activities in ten African countries which were members of SEPA. At the time of the Review, member states of SEPA were Botswana, Gambia, Ghana, Kenya, Liberia, Nigeria, Sierra Leone, Swaziland, Uganda, and Zambia. To obtain objective academic information from the member states of SEPA, and additional information about individual internal programs, in-country field data collectors were identified in eleven geographical areas.

In-Country Field Data Collectors

1.	F. Gbegbe	-	Liberia
2.	S. Katende	-	Tanzania
3.	D. Kiyimba	-	Uganda
4.	B. Kwansah	-	Ghana
5.	A. Labor	-	Sierra Leone
6.	C. Mkangaza	-	Zambia
7.	G. Owinoh	-	Kenya
8.	A. Padambo	-	Malawi
9.	M. Sebatane	-	Southern Africa
10.	M. Sonko	-	Gambia
11.	Kebbede Tiku	-	Ethiopia

A one-week meeting of all field participants with a SEPA representative and the evaluators took place at the International Centre for Educational Evaluation (ICEE) in Ibadan, Nigeria. The meeting provided a forum for the field officers from the various African countries to discuss the Review and to assess what their own input would be. Background materials about the Review were provided and the team then set about developing the data collection instruments. Each member of the team was assigned a specific aspect of the Review and was asked to develop a suitable instrument for collecting data on that aspect. At a plenary meeting, the completed work of each participant was discussed and a 38-page document entitled "Review of SEPA Activities-Guiding Questions"

was produced. Each data collector went back to his country with a copy for guidance.

Data from the countries provided information on the context and status of science curriculum development as well as the impact of SEPA activities on the educational scene in each of the countries.

Since the second phase of the data collection involved the scrutiny of records and interviews of key persons who had participated in the APSP/SEPA activities, two sets of questionnaires were developed. These questionnaires focused on the development of structured interview questions and, with these, one of the evaluators set out for the United States of America, East, and then West, Africa.

In the United States, visits were made to the agencies who had, at one time or another, been involved with the APSP/SEPA programming activities. These agencies, Carnegie Corporation of New York, the United States Agency for International Development (USAID) in Washington, D.C., The Ford Foundation in New York, and Education Development Center (EDC) in Newton, Massachusetts, made available relevant documents and also designated persons appropriate for interviews.

At Carnegie

Fritz Mosher

At Ford Foundation

Frank Sutton

At USAID

Janet Carson
Denny Conroy
James Washington

At EDC

Eugene Godfredsen
Chris Hale
Bob Johnson
Adeline Naiman
Mary Jane Neuendorffer
Jerrold Zacharias

During this phase of data collection, key persons (other than those in agencies) connected with APSP/SEPA in the formative years were also interviewed.

Others Interviewed

Per Christiansen	Lynn Margulis
Eleanor Duckworth	Ralph Robins
Jack Goldstein	William Warren

Bernie Zubrowski

The trip to East and West Africa provided the evaluator with the opportunity to visit the Kenya Institute of Education (KIE), the Kenya Science Teachers' College (KSTC), and the SEPA Secretariat in Accra. Also, key persons, mainly Africans who had participated in APSP and SEPA activities, were interviewed.

Marian Addy	Ebenezer Laing
Rufus Alabi	Frances Nettey
Daniel Chaytor	Rowland Nyaku
Babs Fafunwa	Gilbert Oluoch
Victor Johnson	Akindele Osiyale
Allieu Kamara	Miguel Savage
Francis K'Opiyo	Margaret Tawia

The APSP/SEPA programming activities had as one objective "the building of a trained manpower pool in Africa." Did these APSP/SEPA activities have any significant impact on academically trained university scientists in Africa? Did such scientists in fact learn anything by

participating in APSP/SEPA activities? We spoke to a Ghanaian university research scientist whose background is in genetics but who has been actively involved with APSP/SEPA activities, and to our question on impact, he had this to say:

> *I found myself gradually learning educational methods, educational psychology, philosophy of education, and educational technology, some of which began to influence my own university teaching. I have had to acquire these informally through my working with APSP/SEPA.*
>
> - Professor E. Laing
> Accra Interview, 1979

A meeting was held by the review team in February 1980, previous to the Botswana Review Conference, principally to examine the materials assembled from the two data collection phases and to consider a first draft of a report. A detailed draft report with a clear and acceptable format for the Review was produced by the end of the week-long meeting.

A large-scale conference such as the one in Botswana in May 1980 was considered vital to the whole Review. Apart from providing a forum for consideration of highlights of the Review given by the evaluators, it was also an opportunity to bring together once again a number of the key persons who were architects and builders of APSP/SEPA programmes, representatives of donor agencies, and policy-makers from the various African countries. The main focus of the Review Conference was to consider insights and prospects for SEPA activities and make relevant recommendations for programmes to address the educational needs of African countries in the 1980's.

The story of APSP and SEPA which we have investigated and attempt to tell here is one of birth and nurture of a philosophy. Indeed, the whole story of APSP and SEPA revolves around an identifiable philosophy and approach to curriculum development and educational programming. The subsequent portions of this Review will include a detailed account of the origin, development, and impact of APSP and SEPA, first in various countries and then on the continent of Africa.

Persons Interviewed

Marian E. Addy
Rufus O. Alabi
Daniel E. B. Chaytor
Per. A. Christiansen
E. Dennis Conroy
Eleanor Duckworth
Hubert Dyasi
Aliu Babs Fafunwa
Eugene A. Godfredsen
Jack S. Goldstein
Christopher R. Hale
Victor O. I. Johnson
Allieu I. Kamara
Francis M. O. K'Opiyo
Ebenezer Laing
Lynn Margulis
Frederic (Fritz) A. Mosher
Adeline Naiman
Frances Nettey
Mary Jane Neuendorffer
Lt. Col. Phanuel R. Nyaku (RTD)
Gilbert P. Oluoch
Akindele O. Osiyale
Ralph H. Robins
Miguel B. R. Savage
Frank Sutton
Margaret Tawia
William S. Warren, Jr.
James Washington
Jerrold Zacharias
Bernard Zubrowski

I

DEVELOPMENT OF SCIENCE EDUCATION IN AFRICA: AN OVERVIEW

An analysis of the reports from the thirteen African countries that participated in this survey showed that the patterns of development of science education in these countries were very similar. Political and economic considerations introduced variations in some matters of details but is is possible to identify unifying trends that cut across countries.

1. Objectives of Science Education

There was a gradual evolution in the stated objectives for science education from pre-independence to post-independence eras. In the fifties, the objectives of science education in primary schools and teacher training colleges may be categorised into two.

- The development of clean and healthy habits
- An understanding of nature (plants and animals) and some elementary facts of science

In some of the countries, especially West Africa, there arose what has been described as the *Rural Science* movement in an effort to make science more relevant to the predominantly rural environment of Africa. The objective may be stated as an understanding of the principles and techniques of farming. It was a movement aimed at making primary school leavers competent farmers.

In the secondary schools, the objectives of science education were seldom explicitly stated and because science in the secondary schools was geared to overseas examinations - mainly the Cambridge Overseas School Certificate examinations - the stating of objectives was left to the examining body. Ethiopia and Liberia were exceptions in this respect. It was, however, generally understood that knowledge of science was important for certain kinds of middle level jobs such as agricultural and engineering assistants in the departments of agriculture, public works, survey and the like.

The coming of independence in the sixties seems to have inspired the policy-makers in the various countries to seek new objectives for the teaching of science in schools, especially as science was seen as the key to industrialisation and modernisation. Objectives of the following kind then appeared in the curricula of practically all the countries.

- To develop the spirit of enquiry
- To teach problem-solving using the scientific techniques of observation, experimentation, analysis, etc.
- To impart scientific literacy
- To transform the environment
- To make citizens better consumers of the products of science
- To contribute to the country's development

These objectives became general for all levels of education.

The rapid expansion of education especially at the primary and

secondary levels in the sixties soon drew attention to a new problem - the problem of unemployed school leavers. Thousands of school leavers, especially at the primary school level, who had expectations of white collar jobs on the completion of their courses found to their disappointment that these jobs were non-existent. The migration of youths from rural areas to the cities where they wandered, jobless and constituting a social problem to society, became one of the major concerns of many countries. Invariably, the policy-makers sought the solution to the problem in the teaching of science. The terms "rural transformation" and "rural integration" began to be featured frequently in educational discussions. It was felt that the brand of education given so far had alienated pupils from their local environment and it was necessary to find ways and means to integrate them back into the rural environment.

Rural transformation means more than that, of course, but one of the objectives of science became the promotion of rural transformation through rural integration. The objective was stated in different ways in different countries but the intention was clearly the same. In Uganda, for example, one of the objectives of the Namutamba project which was science-based was to produce "job-makers" rather than "job-seekers." In practice, this meant encouraging the pupils to embark, while in school, on feasible occupations in their rural environments such as crop farming, poultry, piggery and other forms of animal husbandry. In Tanzania, the policy paper *Education for Self-Reliance* states in part as follows:

> *Each school should have as an integral part of it, a farm or workshop which provides the food eaten by the community, and makes some contribution to the total national income . . . The farm work and products should be integrated into the school life . . .*

In a sense it was a re-emergence of the rural science movement on a more comprehensive scale.

A fairly general development in the statement of objectives of science teaching (as indeed of other school subjects) in the seventies is the use of behavioural objectives. The various countries were quick to try out the most recent practices in curriculum development in the industrialised countries. The kinds of objectives listed above have tended to be categorised as *goals* while each is broken down into several specific objectives related to the components of science.

2. Subjects Taught

The subjects taught in the schools within the discipline of science have followed closely the evolution of objectives in the various countries. At the same time they have reflected the impact of educational developments in the industrialised countries.

There are close parallels between what is taught in the primary schools and what is taught in the teacher training colleges. In the fifties, both institutions taught basically two subjects.

- Nature study
- Hygiene or health science

However, since the secondary schools were tied to external examinations, the basic natural sciences of Biology, Chemistry, and Physics were taught in the secondary schools. The practice of teaching general science in the lower forms of the secondary schools was also universal.

Rural science and/or agricultural science made an appearance in primary schools and teacher training colleges in the late fifties, notably in Botswana, Ethiopia, Gambia, Lesotho, Nigeria, Sierra Leone, Swaziland, and Tanzania. By the sixties, general science began to replace the old nature study and rural science but health science and agricultural science have continued into the seventies. By the late sixties and seventies, the teacher training colleges began to diversify their curriculum and their science subjects came close to those of secondary schools by the inclusion of Physics, Chemistry, and Biology.

The worldwide Integrated Science movement of the late sixties and early seventies was not without an impact on the African educational scene. During the seventies, practically all the countries taught Integrated Science especially in the lower secondary schools. The current emphasis on environmental education also has led to the inclusion by a few countries of environmental science as a school subject in primary and secondary schools.

The science in the secondary schools has continued to be tied to the requirements of external examinations which have now in most countries been taken over by local or regional examination bodies, notably the West

African Examinations Council in West Africa and the East African Examinations Council in East Africa.

The increasing concern for rural transformation led to a greater emphasis on agricultural science at all school levels in the seventies. The subject, however, has tended to be taken more seriously at the teacher training institutions and primary schools than at the secondary schools. This is most probably a reflection of the fact that primary school is perceived as terminal for the majority of African children and it is hoped that the majority of them would opt to remain in the rural areas and engage in agriculture.

3. The Teaching of Science

Three aspects of the teaching of science are of particular interest here, namely: (1) time allocated to science in the schools, (2) facilities for teaching science, and (3) methods of teaching science.

3.1 Time Allocation

There were considerable variations from country to country in the amount of time devoted to the teaching of science. In the primary schools, the time varied from 60 minutes a week (Gambia) to as high as 225 minutes a week (Ethiopia, Liberia) with the average being about 120 minutes a week. The amount of time allocated to science at this level has remained surprisingly constant through the years from the fifties to the seventies.

In the secondary schools, there were also wide variations in time allocated to science per class. Variations occurred by class level as well as by country. In the lower classes where mostly general science or integrated science is taught, there are naturally fewer class periods allocated than in the higher classes where science is taught by particular subject (e.g. Physics). Time devoted to science ranged from as low as 120 minutes a week to as high as 960 minutes a week. Again the amount of time allocated has remained surprisingly constant in each country through the years.

In the teacher training colleges, there is less variation across countries, the lowest being 120 minutes per class per week and the highest being 225 minutes per class per week. The situation in the teacher training colleges is thus very similar to the one in primary schools.

It is clear that science was, and still is, regarded as basically a secondary school discipline rather than a primary school one. Irrespective of level of education, however, science seems to receive at least as much attention as other school subjects in terms of time allocation. In secondary schools, at least five countries indicate that science receives much greater attention than other school subjects.

3.2 Facilities

In most countries, the primary schools still do not have science rooms or laboratories. Provision of science equipment is also either very poor

or non-existent. The situation in teacher training institutions is little better, but most teacher training colleges do have a science room.* A few have laboratories for different subjects, but these rooms or laboratories are very poorly equipped. A few, like the specialised teacher training colleges in Ghana, are very well equipped. The situation in the secondary schools has always been much better. Not only has the provision of laboratories been more common, but the laboratories also have been comparatively better equipped. It would seem, therefore, that from the point of view of facilities, science has received more attention in the secondary schools than in the primary schools and teacher training colleges.

3.3 Methods of Teaching

Science teachers use a combination of expository (chalk-talk-discussion) and activity (demonstrations and individual experiments) techniques in their teaching. The extent to which activity methods are used has been largely a function of the level of training of the teachers. As the countries have moved through the sixties to the seventies, however, there are clear signs that teachers in general have moved increasingly towards the use of activity methods in their teaching. A number of countries

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*Teacher training institutions referred to in the discussions in this chapter are mainly those that prepare primary school teachers. Those that prepare secondary school teachers such as the advanced teachers colleges in Nigeria, the Milton Margai Teachers' College in Sierra Leone, and the Kenya Science Teachers College are closer to the universities and polytechnics in terms of staffing and facilities.

(notably Sierra Leone and Kenya) report that this development is greatest at the primary school and teacher training college levels and is due largely to the impact of APSP/SEPA materials and training. In Sierra Leone, indeed, APSP/SEPA materials form the core of the syllabuses at these levels.

4. Curriculum Development

Perhaps the aspect of science education in which the most remarkable changes have taken place since independence is in the process of curriculum development and the content of the curriculum. In the fifties and early sixties, the curricula of primary schools and teacher training colleges were determined by officials of each Ministry of Education. The curricula typically consisted of a list of topics compiled into a syllabus which was more or less uniformly taught in all the schools at that level. Books for teaching these syllabuses were typically written in the United Kingdom or the United States of America. At the secondary school level, the syllabus was determined by the examining body - the Cambridge Overseas Syndicate or later the West or East African Examinations Councils. These bodies typically produce their examinations syllabuses through subject panels which meet periodically to review the syllabuses.

In the early sixties, a significant new feature emerged on the curriculum scene. It was the creation of special centres or units to deal with the preparation of school curricula. Examples are the Kenya Institute of Education in 1964, the Curriculum Development Centre in Monrovia, Liberia,

in 1964, the Curriculum Development and Research Unit and the Elementary Science Unit of the Ghana Ministry of Education in 1965, the Nigeria Educational Research Council in 1965, and the Science Curriculum Development Centre at University College, Njala, Sierra Leone, in 1968. These various Curriculum Development Centres began to adopt modern curriculum development techniques. Although subject panels were constituted, as in the procedure of the external examining bodies referred to earlier, the centres went beyond the production of syllabuses. They produced student texts, teachers guides, audio-visual equipment, etc., which were tried out in the schools, evaluated, and revised before final production for use in the schools.

Science was perhaps the first discipline to profit from this move. A substantial impetus for this approach to curriculum development came from the African Primary Science Program Science Centres which were set up in several African countries (Ghana, Kenya, Malawi, Nigeria, Sierra Leone, Tanzania, Uganda) from 1965 onwards.

Besides the APSP materials, a number of other science programmes emerged in due course in various African countries. Examples are the Secondary School Science Project (SSP) in the East African countries, the Core Curriculum Integrated Science (CCIS) project in Sierra Leone, and the Nigerian Secondary School Science Programme (NSSSP) in Nigeria.

The movement towards producing curricula at curriculum development centres is now practically universal and every one of the countries surveyed in this report has active curriculum development centres or

units* which are producing new educational materials including science materials for various levels in the educational system. The result of this movement on science education is that the content and materials have become more relevant to the society for which they are meant. It also has promoted experimentation in curriculum development.

Another impact of the movement is that external examining bodies now have to take into consideration not only the syllabuses developed by their own subject panels but also the curricula emerging from the curriculum development centres.

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*These curriculum development centres go under different names in different countries as the following list shows.

1. Curriculum Development and Evaluation Unit, Ministry of Education, Gaborone, Botswana
2. Curriculum Development and Book Production Division, Ministry of Education, Addis Ababa, Ethiopia
3. Curriculum Development Centre, Ministry of Education, Banjul, Gambia
4. Curriculum Research and Development Division, Ghana Education Service, Accra, Ghana
5. Kenya Institute of Education, Nairobi, Kenya
6. Division of Curriculum Planning, Ministry of Education, Monrovia, Liberia
7. Mathematics/Science Centre, Ministry of Education, Maseru, Lesotho
8. Nigeria Educational Research Council, Lagos, Nigeria
9. Curriculum Revision Unit, Institute of Education, University of Sierra Leone, Freetown, Sierra Leone
10. National Curriculum Unit, Ministry of Education, Manzini, Swaziland
11. Institute of Education, University of Dar-es-Salaam, Dar-es-Salaam, Tanzania
12. National Curriculum Development Centre, Kampala, Uganda

5. Efforts to Accelerate Production of Scientific and Technological Manpower

The Addis Ababa Conference of African States on the Development of Education in Africa, held in 1961, made some far-reaching recommendations in respect to science and technology. In line with what was envisaged as a precondition for scientific and technological development in African countries, the conference proposed an increasing emphasis on scientific and technological education at both the second and third levels of education. Specific targets were set at both levels.

At the third level, the percentage of science students as compared with total enrollment was expected to rise according to the following targets.

1960 - 41.6%
1965 - 44%
1970 - 50%
1971 - 51%
1980 - 60%

At the second level, the percentage of enrollment in technical/vocational education as compared with total enrollment was expected to increase according to the following targets.

1960 - 9%
1965 - 12%
1970 - 17%
1972 - 20%

The conference of African Ministers of Education (MINEDAF)* held in Lagos, Nigeria, in 1976 assessed the achievements and found to its disappointment that the percentages at both levels had fallen rather than risen according to the following observed statistics.

At the third level, the actual percentages of science students were

1960 - 41.6%
1965 - 31.9%
1970 - 34.7%
1971 - 34.7%

At the second level, the actual percentages in technical/vocational institutions were

1960 - 9%
1965 - 9%
1970 - 7%
1972 - 6%

These disappointing statistics notwithstanding, it is known that the various countries made efforts, sometimes very great efforts, to achieve the targets set at Addis Ababa. A variety of techniques were used by the countries in this respect.

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*UNESCO: *Regional Educational Targets and Achievements in Africa, 1965-1972*, Paris, ED-76/MINEDAF/REF/2

- Some countries built specialised institutions for science, technology and science education. The following are some examples.

In *Ghana*:	(i)	The University of Science and Technology, Kumasi
	(ii)	The University of Cape Coast, set up to produce graduate science teachers
In *Kenya*:	(i)	The Kenya Science Teachers College (KSTC) for training teachers of science, mathematics and industrial education An adjunct of KSTC is the Science Equipment Production Unit (SEPU) set up in 1967 to produce low-cost science equipment
	(ii)	The Kenya Technical Teachers College
	(iii)	The Egerton College for training teachers of agricultural science in secondary schools
In *Nigeria*:	(i)	The Federal School of Science in Lagos to increase the A-Level output in the sciences for university admission
	(ii)	Several technical colleges and polytechnics in various parts of the country
In *Sierra Leone*:	(i)	The University College Njala which had an agriculture and science education orientation

- Some countries gave special inducements to science teachers in order to attract more people into the profession. In Nigeria, for example, teachers of mathematics and science at secondary school level were paid a special allowance which placed their salaries at a substantially higher level than those of teachers of arts subjects.

- Many universities operated admission policies which gave a higher quota of admissions to science students than arts students. Unfortunately, it was often difficult to fill the science quotas because of inadequate output from secondary schools, and the shortfall was often made up with arts students. In Tanzania and Kenya such admission quotas were used even in secondary schools.

- Practically all the countries provided increased opportunities for learning science at the secondary school level. The case of Gambia is particularly striking. During pre-independence in the fifties, one specialised science school offered science instruction for the only two high schools in the country. In the sixties, the science school was abolished and the teaching of science was introduced into all high schools throughout Gambia.

- As industries increased, many of these industries set up training programmes to produce technological manpower for their industries. Such training was often carried out in schools set up within the industry but sometimes it was through scholarships awarded for studies in appropriate institutions outside the industry. The industries thus contributed significantly to the production of scientific and technological manpower.

6. The Role of Professional Teachers Organisations

A powerful kind of organisation that stimulated development in science

education in practically all the countries was the association of science teachers. Every one of the countries studied had such an association in one form or another.* There were variations in the magnitude of contributions by these organisations from country to country. Gambia, Liberia and Lesotho report negligible contribution. At the other end, the Ghanaian and Nigerian associations have exerted tremendous influence on the training of science teachers, the curriculum, and educational policies. STAN in Nigeria produced its own books in integrated science for the first two years of secondary schools.

In general, the science teachers associations contributed to science education through conferences, staging of exhibitions and science fairs, conducting in-service training courses for science teachers, and publishing scholarly journals.

Besides the science teachers associations which draw their membership

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*_Botswana_ Science Teachers Association
Ethiopia Teachers Association for Curriculum - with subdivisions for different subjects including science
Gambia Science Teachers Association
Ghana Association of Science Teachers (GAST)
Kenya Science Teachers Association
Lesotho Science and Mathematics Teachers Association
Liberia Science Teachers Association
Nigeria Science Teachers Association of Nigeria (STAN)
Sierra Leone Science Association
Swaziland Science Teachers Association
Tanzania Science Teachers Association of the United Republic of Tanzania (STAURT)
Uganda Science Teachers Association (USTA)

mainly from the ranks of secondary school teachers, there are some science associations that draw their membership from universities and industries, for example the Science Association of Nigeria, the Nigerian Academy of Science, and the Ghana Academy of Science. These organisations concern themselves with third level science teaching, research, and technological development.

7. The Role of External Agencies

As many as twenty different organisations were mentioned as having contributed to the development of science education in the different countries. The most outstanding influence has understandably come from *UNESCO* and the related UN agencies of *UNICEF* and *UNDP*. The contributions of these organisations have included financial aid, supply of equipment, supply of books, supply of teachers and experts, and the training of curriculum specialists and teachers. In a number of cases, UNESCO or UNESCO/UNICEF sponsored specific educational projects with strong science components, for example:

- The Namutamba project in Uganda
- The Midwest (Bendel) State primary science project in Nigeria
- The Bunumbu project in Sierra Leone

UNESCO has made substantial contributions in every one of the countries covered in this survey.

The *British Council* also made important contributions in most of the

countries. Its most outstanding contribution was in the organisation of in-service training programmes for science teachers. The council worked closely with ministries of education and is well known for organising the so-called "Ashby Courses" which brought teams of U.K. experts to work with local counterparts in running these courses. The British Council also has supplied books, equipment, and expert personnel.

The *World Bank* contributed substantially to the provision of equipment and other physical facilities.

The *U.S. Peace Corps* provided a large number of science teachers in secondary schools in the sixties and the seventies. Similar contributions came from the Canadian *CUSO* and the British *VSO*.

The Swedish International Development Agency (*SIDA*) was responsible for the provision of the Kenya Science Teachers College which has, for over a decade, supplied science, mathematics, and industrial education teachers to Kenya secondary schools.

Other organisations mentioned include NORAD, DANIDA, IDA, USAID, EEC, ODM, Ford Foundation and Rockefeller Foundation. Their contributions varied from the provision of equipment and materials to the awarding of scholarships.

Conclusion

It should be clear from the foregoing that science education in Africa has come a long way from the situation in pre-independence days to the

present. Contributions to the development have come from various sources; national, regional, and international. One of the significant sources was the APSP/SEPA one which the rest of this volume will examine in greater detail. The discussions in this chapter presented a picture of the context in which APSP/SEPA had to interact.

II

CONVERGENCE OF EVENTS

1. Introduction

Historically, we believe that two diverse but not unrelated circumstances in the late 1950's and early 1960's provided the climate, the desire, and the capability to inaugurate and carry through the African Primary Science Program and, later, the Science Education Programme for Africa. The educational ferment in newly independent African countries was the most important of these circumstances, but the advent of foreign aid which could be used by these countries to reform their inherited colonial educational systems was also of importance. In addition, an organization had been formed in the United States to carry out innovative curriculum development work in science education. This was Educational Services, Inc. (ESI)* which was to become the vehicle for administration and coordination of the African Primary Science Program on the African continent.

Thus, the desire for educational independence, the opportunity to gain international technical assistance, and the framework for bringing these things to fruition converged with a series of conferences in

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*ESI later (1967) became *Education Development Center, Inc.* (EDC) and will be referred to in that way throughout to avoid confusion.

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Africa, the United States, and Europe to deal with the reformation of education in the new African countries.

2. Ferment

Of the twelve countries studied in this review, only two were independent before 1950 - Liberia (1847) and Ethiopia (17th Century). The new generation of independent nations in Anglophone Africa began with Ghana in 1957, followed by Nigeria (1960), Sierra Leone and Tanzania (1961), Uganda (1962), Kenya (1963), Malawi and Zambia (1964), Gambia (1965), Lesotho, Botswana, Swaziland (1966). In the Arab areas of North Africa, Libya became independent in 1951, followed by Sudan (1956), Tunisia (1956), Morocco (1956), Algeria (1962). In other Francophone areas, Guinea set the pace in 1958. By 1962 only French Somalia, renamed Afars and Issas, remained dependent. A similar pattern began in Belgian colonies with Congo (Zaire) in 1960. The Portuguese were later in granting independence to their colonies.

With the newly independent status of African nations, two new drives arose - for national unity and identity, and for modernization. They had implications for education.

National identity called into question anything inherited from colonial rulers, and one of the first things to be examined was the educational system. Questions were raised as to the relevance of the inherited systems to the needs and imperatives of sovereign states, a subject discussed on a pan-African ministerial level at a conference in Addis Ababa. Complementary

issues were the emergence of national ideologies and the equalization of opportunities for all.

In the drive for modernization, science and technology were important considerations. Most new African nations saw industrialization and scientific and technological advance as the route to modernization. Impetus was accordingly given to scientific and technological education in schools.

In their efforts to meet these challenges, many of the African nations began in a systematic way to seek answers through a variety of means.

New ideologies on the political level were proposed by some countries. Ghana, Tanzania, and Kenya each proposed some form of African socialism to replace British capitalism. Perhaps the most significant effort at making political ideology the springboard for social reform is that of Tanzania led by President Nyerere.* From TANU's policy on socialism and self-reliance emerged the now well known policy of "education for self-reliance" which has guided the educational development of Tanzania for over a decade.

Acts of parliament were sometimes passed to correct what were seen as clear injustices, or to give groups greater control of their educational development. In Kenya, for example, an act of parliament in 1963 abolished racial schools. A new education act in 1968 also effectively put the

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*(a) The Arusha declaration and TANU's Policy on Socialism and Self-Reliance, Dar es Salaam, 1967.

(b) Nyerere, J.K., *Education for Self-Reliance*, Dar es Salaam: Government Printer, 1967.

control of education in African hands. In Ghana, the education act of 1961 put the supervision and funding of universal primary education under local authorities.

Special commissions were set up in most of these countries to review the state of education and recommend new directions for development. Examples are Ashby (1961) in Nigeria, The Higher Technical Education Commission (1961) in Liberia, Sleight (1962) in Sierra Leone, Castle (1963) in Uganda, Ominde (1964) in Kenya, Sleight (1965) in Gambia, and Kwapong (1967) in Ghana. Most of the commissions addressed themselves to broad issues such as control of education, universalisation of education, training of middle and high level manpower, and curriculum relevance. One of the inevitable results of the commissions was the rapid increase in the number of educational institutions especially at the primary level. There was tremendous effort to meet targets set at Addis Ababa, one of which was the attainment of universal primary education by 1980.

Development plans became a feature of all countries. These tried to plan for society as a whole. The introductions to the plans invariably contained statements of national goals which the countries intended to achieve. Thus, plans for educational development were just one dimension of total national development. However, it was clear that education had very high priority as indicated by the percentage of each national budget devoted to it. Budget allocations to education typically rose from about 10% before independence to about 20% after independence. There were, of course, country variations. Gambia, for example, still allocated as low

as 9.6% to education whereas Ghana and Nigeria allocated 25% or more.

Special agencies were constituted to deal with aspects of educational development. Examples are the Nigeria Educational Research Council in Nigeria in 1965, the National Curriculum Centre in Ghana in 1965, a Curriculum Development Centre in Monrovia, Liberia, in 1964, and the Science Centre in Nairobi, Kenya, in 1966.

In summary, it is clear that in English-speaking African countries, leaders were convinced that education was the most important factor in speeding up national growth. Political independence without educational independence was unacceptable, and the emerging countries took similar approaches to the task of putting their educational needs and goals in order. To accomplish the task, Africa needed to generate new ideas. The approaches to the generation of new, relevant ideas were similar in the various countries.

The first approach involved setting up educational commissions with wide terms of reference. The exploratory as well as the survey nature of these national commissions revealed the weaknesses in the pre-independence educational system and practice in a number of countries. For the first time, emphasis was placed on correlating the educational system with national aspirations. While education prior to independence trained recipients for positions in the colonial system termed "white collar jobs," emphasis now shifted to training for agricultural and technical jobs. Uganda, for instance, referred to this shift as training "job makers instead of job seekers." Africa is largely an agricultural area with an abundance of raw materials needed in the industrialized parts of the world. To sustain and improve the agriculture of Africa, the emphasis on education encouraged the recipients to "return to the land."

The second approach involved support for large-scale national conferences in an attempt to bring together experts in various fields related to education. The national conferences were used as the contact point between national, as well as international, experts. It is significant to

note that although the focus at this time of national awareness was on indigenous education, former colonial manpower was depended upon to provide the much-needed international component at these conferences. The difference, however, was obvious in that the tone and the pace were dictated by the Africans themselves.

Attendance at international conferences was the third approach. There was a significant shift in the composition of delegations to international conferences from expatriate to indigenous educators, and the content and flavor of papers presented by the Africans became "what we want" rather than "what they think is good for us." Africans also took advantage of international conference platforms to solicit aid directed to meeting their own objectives.

Independence brought opportunity for educated Africans to travel; university professors as well as Ministry officials made educational visits world-wide. They could see for themselves the different philosophies adopted by various industrialized countries to train their nationals in science and technology. These travelled Africans came back to popularize and in some cases to dispel "tales" about education in some parts of the world. For instance, it was shown that American education is not inferior to that of the British, as was believed prior to independence. Japanese technology was not permanently one which produced inferior "made in Japan" goods but was fast developing, expanding, and becoming sophisticated. This fourth approach of scientific awareness by Africans through direct contact opened up a new avenue for rethinking science education in Africa.

The convergence of all those events related to independence and educational planning raised the question: Where should Africa begin? It appeared that a focus on the primary level of education was the logical place, and so the African Primary Science Program received the enthusiastic welcome of educators, politicians, and policymakers as well.

3. Educational Services Incorporated

Long before the Russians launched the first man-made satellite in 1957, Professor Jerrold Zacharias of the Massachusetts Institute of Technology had expressed concern over the small pool of scientists in the United States and the need to increase that pool with able young people who had received thorough grounding in science at the high school level. He voiced his concern to the U.S. government as well as to fellow physicists, notably Francis Friedman and Philip Morrison of M.I.T. (the latter then at Cornell University), and sought to find ways not only to update but also to reform high school physics. The Physical Science Study Committee (PSSC) was established in the middle 1950's and was housed at M.I.T.

The PSSC, operating through the Physics Department at M.I.T., obtained funding from the United States National Science Foundation (a specialized agency of the U.S. government charged with, among other things, the task of improving science education at all levels in the United States) to develop a high school physics course which presented the nature and key concepts of physics. The PSSC's approach to course development involved

workshops where physicists and physics teachers would identify essential fundamental concepts, and design methods and techniques of presentation suitable for high school classrooms. Paramount to the development was trial use of any materials in a cross-section of the nation's classrooms as well as the training of teachers to use an inquiry approach to teaching. This elaborate way of developing a curriculum at the high school level revealed that an informal group in a university setting could not handle adequately the logistics of such a task. Accompanying organizational, operational, and administrative functions demanded a corps of people in addition to scientists and scholars. A special kind of framework was called for and, in response, Educational Services Incorporated (now EDC)* was created in 1958 as an independent non-profit organization initially to house PSSC.

Governed by a prestigious Board of Trustees under the chairmanship of James E. Webb, who was head of the National Aeronautics and Space Administration, EDC functioned as a hub around which curriculum activity in more than one discipline and age level could evolve, and through which funds for the work could be elicited. EDC was marked by flexibility in its operations and by ad hoc decision-making. The persons constituting the membership of the Board were selected to provide credibility for the organization in

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*In 1967, the *Institute for Educational Innovation* merged with ESI to become *Education Development Center, Inc.*, a new corporate entity but in essence only a name change for ESI.

the eyes of government circles and the academic community. The members of the Board represented a variety of disciplines in the social sciences as well as the physical sciences.*

At EDC, the working staff consisted of project development personnel and those responsible for administrative functions of the overall organization. Within the structure of one umbrella agency, it became possible to have curriculum projects in a variety of subjects† at different educational levels, as well as in different countries. As it turned out, the same structure permitted work in educational areas other than curriculum development, for example, institution-building and social services.

The PSSC originators functioned as a Steering Committee distinctly for the support, stimulation, and monitoring of the progress of the physics project. Steering Committees consisted primarily of academicians, with each committee headed by the scholar who was the principal investigator. This pattern of scholar, steering committee, and project personnel carrying out the day-to-day work has persisted to the present day.

The emergence of Education Development Center in 1967 to replace ESI did not change the organizational structure and function. Rather it re-affirmed the efficacy of the concept of an umbrella organization facilitating the work of otherwise independent projects.

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*Over the years, ESI/EDC board members have come from many facets of society: academia, the arts, industry, and education-related agencies and organizations.

†The EDC Social Studies Program (now called School and Society) began curriculum development work in the social sciences in 1962.

The composition of the Board of Trustees broadened the intellectual perspectives of EDC and created access to sources of material, moral, and educational support, while the concept of a project steering committee ensured a continued active linkage of each project to people committed to its development. Membership on the Board of Trustees served to lend credibility and prestige rather than to provide active professional leadership. To some extent this was true also of the Steering Committees, except that personal and professional interests were related to a discrete project.

In the sphere of science education, the EDC organization can be accredited with the revitalization of curriculum development. Prior to PSSC physics in America, school science

> *consisted of a body of knowledge and tried-and-true methodology to which it was considered good for children to be exposed. The content was spelled out and could be learned through reading and memorization. The class was the unit for instruction, the text, the curriculum. Little if any emphasis was placed on practical work or individualized learning. When there was equipment, the teacher used it to demonstrate some scientific principle while the class watched.**

PSSC physics sought to change all of that by emphasizing a variety of features characteristic of all science and by letting children "do" science, i.e., learn by direct participation in all aspects of science learning.

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*Education Development Center, *The Elementary Science Study--A History*, Newton, MA, 1973, p. 8.

As a result of its skillful "action/research" approach in the development of a high school physics course, and the high quality of its leadership and organizational structures, EDC became a reputable center for exploring new and dynamic departures in the teaching of science at the elementary-school level. In 1960 two conferences took place which gave considerable impetus to the idea of science curriculum reform at the elementary level: the Rehovoth conference on the use of science in the advancement of newly-independent African States, and a conference organized by the American Association for the Advancement of Science to explore ways of reforming elementary-school science in the United States. Three key members of the Physical Science Study Committee and two additional scientists seized the opportunity, taking the initiative to review and assess elementary science teaching programs in the Boston area and simultaneously to pursue the interest of Africans in primary school science programs.

By far the most radical approach introduced by EDC in science education was at the elementary school level through the Elementary Science Study. At that level, science was viewed as pre-disciplinary.

> *The focus of the children's attention is on the materials and how to ask questions. . .We want to expose children to science--by working with actual materials and deriving from their own manipulations a feeling of mastery and understanding which can come in no other way. . .As the materials require it, we want the children to measure and to use instruments to measure. . .choose materials which will not only illustrate the basic principles of science, but which will also allow the children to work with it.**

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*Ibid, p. 9.

As at the secondary level, science education development was viewed as team work; a scientist was still an essential member but worked closely with an elementary school teacher. The scientist synthesized, reorganized, and logically arranged the great principles of science and participated in the classroom to check subtle misunderstandings; the teacher was familiar with classroom management and the children's questions. In addition there would be the children, technicians, photographers, stenographic and other auxiliary personnel, all contributing different perspectives and talents.

The process of institutionalizing EDC helped to deliver a strong message: science curriculum development is a long and never-ending process. The emphases and needs may shift, even the subject as well as the levels may change, but the need to review yesterday's assumptions and "truths" will always remain. Hence the creation of an institutional arrangement with sufficient flexibility to meet changing needs.

4. Foreign Aid

In the aftermath of World War II, several agencies were set up in the United States to aid countries in need of rehabilitation.* In 1950,

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*There were significant steps taken by the European Community as well as by the United Nations to assist developing countries, but at this point in the "history" of APSP/SEPA beginnings the sources of funding and technical assistance were American, and are highlighted here.

the U.S. Congress made President Truman's Point IV Program a national policy in the Act for International Development:

> *It is declared to be the policy of the United States to aid the efforts of economically underdeveloped areas, to develop their resources and improve their working and living conditions by encouraging the exchange of technical knowledge and skills and the flow of investment capital.*

In 1961, President Kennedy moved to establish the Agency for International Development which played a major role in Africa, as did the concurrently formed Peace Corps.

Much foreign aid was in the form of bilateral agreements with individual countries, but mechanisms emerged for providing aid on regional and sub-regional levels. This was particularly true in the field of technical assistance, which is better interpreted as a transfer of knowledge including managerial and administrative skills as well as technical content. The evolution of APSP and SEPA is perhaps best seen in the context of technical assistance at a regional level.

A significant factor that is less frequently highlighted in books on foreign aid is the contribution of private foundations like Carnegie Corporation, Ford, and Rockefeller. These organizations are concerned particularly with technical assistance rather than economic aid, and their activities are therefore relevant to the role of APSP and SEPA.

5. Antecedents of APSP

There is a logistic as well as a chronological problem in any attempt to determine the beginnings of the African Primary Science Program. It would be only partly accurate to attribute the beginning of APSP to the planning meeting which took place in Kano, Nigeria, in 1965, or indeed to any one single event. Information gathered from an interview with Professor Jerrold Zacharias of the Massachusetts Institute of Technology revealed that the seeds of APSP had been sown long before the Kano meeting. The real genesis of APSP could be traced back to July 1960 when the first International Conference on Science in the Advancement of New States was held in Rehovoth, Israel.

The Conference, sponsored by the Hebrew University of Jerusalem and the Weizmann Institute of Science, brought together the world's leading scientists, experts in other spheres of human activity, and the statesmen and administrators who made policy in developing countries. The wind of scientific, educational, and technological change which swept through the developed countries in the fifties, and culminated in the launching of the first Russian Sputnik, had an impact on developing countries.

As Abba Eban, chairman of the 1960 Rehovoth Conference, remarked,

> *Two transformations dominate the life of our century--the swift rise of Asian and African peoples to independence, and the headlong progress of science and technology. The aim of the Rehovoth Conference is to create a point of contact between those who represent these two decisive movements of our time--scientific progress and national liberation.*

5.1 The Rehovoth Conference, 1960

The Rehovoth Conference was significant as a catalyst in the formation of an important educational philosophy in Africa.

At the Conference, a meeting took place between two scholars of stature, one an American, Professor Jerrold Zacharias, and the other an African, the late Reverend Solomon Caulker, who was Vice-Principal of Fourah Bay College, Sierra Leone in West Africa. During the Conference, much time was spent discussing such matters as the provision of nuclear reactors for the less-developed nations, an idea which Rev. Caulker persistently challenged while at the same time stressing his belief that the new nations of Africa needed fundamental education at all levels far more than they needed the exotic fruits of modern technology. But he stated what he felt science could do,

> *To all of us has come a whole realization that science through its constantly changing and growing insight, can be brought to bear and to liberate human kind and the human spirit and to make us all stand up with pride and believe we are members of the human race.*

Caulker's position was both acceptable and challenging to Zachar and there was lengthy discussion about the potential of science in third world countries. Zacharias, who was also chairman of the Physical Science Study Committee (PSSC), was optimistic that the techniques adopted and developed in creating a secondary school physics course in the United States had some relevance to the needs of Africa. Both scholars were committed, and determined to continue joint planning when they shook hands and parted.

In our interview with Professor Zacharias, in 1979, he recounted,

> *As I stood in the London airport (on my return from Rehovoth) waiting to catch my flight to the United States, I heard that a plane which took off from Paris some hours back crashed outside the West African city of Dakar. Somehow, my mind went straight to my friend, Solomon, who I was almost certain was on that flight--and indeed he was. There were no survivors in the crash. The Rev. Solomon Caulker had died in that crash.*

Reverend Caulker's ideas lingered in the mind of Zacharias, and he was determined to keep them alive. He felt strongly that "there must be many other Caulkers in Africa." And so, largely through his convictions and efforts, a Steering Committee of scientists and educators was formed to make plans for a conference of leading educators from Africa, the United States, and England. Its purpose would be to discuss Caulker's ideas and determine how modern curriculum development techniques could be applied to African educational needs. The seeds for the emergence of APSP and SEPA had been sown.

Two major conferences, in addition to Rehovoth, were also immediate antecedents to APSP. These events, the Addis Ababa Conference and the Endicott House Study Conference, are therefore discussed in some detail in this Review.

5.2 The Addis Ababa Conference (May 1961)

In the wake of the curriculum innovations of the early 1960's in the United States and in the United Kingdom, Ministers of Education in Africa

held a conference in the Ethiopian capital of Addis Ababa, under the auspices of UNESCO. This conference, the first at the African ministerial level, acknowledged the shortcomings of education in Africa at that time, and considered a philosophy of education that would have relevance to Africa in the future. The participants were in agreement that,

> *. . . the present content of education in Africa is not in line with existing African conditions . . . but is based on a non-African background allowing no room for the African child's intelligence, powers of observation, and creative imagination to develop freely and help him find his bearing in the world . . .*

and recommended that,

> *African educational authorities should revise and reform the content of education in the areas of the curricula, textbooks, and methods, so as to take into account the African environment, child development, cultural heritage, and the demands of technological progress and economic development, especially industrialization.**

The delegates to the Addis Ababa Conference knew they had to grapple with decisions that would influence people's everyday lives for generations to come. Science and technology were accepted as factors which affect the progress of any country, and so it was understandable that the issues discussed at the Addis Ababa Conference included aspects of manpower development in the areas of scientific, technical, and vocational education. Long-range educational planning in Africa was

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*Conference of African States on the Development of Education in Africa, Addis Ababa, 15-25 May 1961. *Final Report*, Paris: UNESCO, 1961.

emphasized at this crucial conference, and both goals and target dates were set which could be included in national development plans. Those attending were unanimous in their decision to set 1980 as the target year for Universal Primary Education (UPE) on the African continent. The deliberations went further than this, however, and mandated that all children would receive the opportunity and benefit of early exposure to education, and that education must be meaningful and relevant to them and to their societies.*

A critical analysis of the Addis Ababa recommendations and those goals set by APSP and SEPA reveal a congruence of purpose in educational aspirations, especially at the primary level. In a way, APSP emerged as a vehicle for translating the wishes of the Ministers of Education into reality. The emphasis placed on the primary cycle of education and the relevance of its content by the African educators during the Endicott House Study Conference in the following month seem to echo, in part, the deliberations at Addis Ababa.

5.3 Africa Summer Study--The Endicott House Conference (June 1961)

Professor Jerrold Zacharias, Chairman of the Steering Committee for the historically significant conference in Dedham, Massachusetts, began

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*Two subsequent regional conferences at the ministerial level in Nairobi (1968) and in Lagos (1976) provided opportunities for attending countries to examine their educational priorities and achievements. Unlike the Addis Ababa conference of 1961, these later conferences were conducted wholly by Africans for Africans and signalled nearly complete independence of educational affairs.

by putting together men and money. With grants of $110,500 from the Ford Foundation and $122,500 from the International Cooperation Administration (ICA), the Steering Committee was ready to face the first task of determining the composition of the conference. Zacharias and his associates in the PSSC network suggested suitable non-African participants. Three people, William O. Brown, Director, African Studies, Boston University; Francis X. Sutton, The Ford Foundation; L. John Lewis, Institute of Education, University of London, who were conversant with the African educational scene, undertook the identification of the Africans who would be participants.

The numerical composition of the participants at the Endicott House Conference is shown in Table 1.

TABLE 1

Attendance at the Endicott House Conference*

Classification of Participants	Number	Percentage
Africans	15	18.99
Non-Africans	37	48.83
Invited Speakers (non-Africans)	12	15.19
Visitors (non-Africans)	15	18.99
TOTAL	79	100.00

African Summer Study, ESI, *Section 1. Organization, Summary, Participants*, September 1, 1961.

The Conference was, in fact, a "study" rather than a conventional conference. According to one of the delegates from Africa, Chief T. T. Solaru, his initial perception of the Conference was one of confusion. He said,

> *We had attended other conferences on education,*
> *but it was a strange meeting here on June 19th.*

And indeed it seemed strange to many African scholars, for it was distinctly different from the usual conference to which participants are encouraged to come with prepared papers, where discussion is limited to the papers that are presented and an agenda is prepared in some detail. And so, when at the opening session, Professor Zacharias stood before the delegates to declare,

> *Well, I brought you here to study African education,*
> *but where we are going I don't know,*

he was dramatizing the true spirit of the meeting; it was to be a study, in the sense of an investigation. The basic concept of a study conference is that a fairly large group of able men, from differing disciplines, are likely to gain new insights into a problem if they are themselves made responsible for defining that problem, and are encouraged to seek solutions by means of discussion and debate. The members of a study are invited in part because of their ability to gain fresh insights into new problems. The proponents of the study conference approach were of the view that much of the stimulus in a study is likely to come from those who are indeed considering the problems for the first time, and who are, therefore, not inhibited by memory of past failures.

As Table 1 shows, only 19% of the conferees were African. How feasible was this if the group was to discuss "African education"? What impact

would the Africans have in a discussion on African education; would their thoughts be drowned in the ideas of 81% non-Africans? How knowledgeable about African education were the invited speakers, all of whom were non-Africans? These and many other questions would surely arise in the minds of anyone taking a cursory look at the list of participants.

Although these exact questions were non-issues at the Conference, there was some allusion to the question of who was to do the job at hand of determining what focus a good science education for the African child should have. Two Nigerian participants, Chief S. O. Awokoya and Chief T. T. Solaru, in the course of their detailed and analytical discussions on the subject of the future of African education, asked "Who is equal to the task"? And Chief Solaru himself answered their question by advising,

> *It means we require all hands on board, all hands, all those who say they want to help us. It doesn't matter from where they come so long as they are men of good will and realize our problems and are experimenting in the way to do it and find the means to do it.*

"All hands on board," he concluded, "should be our motto to produce an integrated and well-planned effort." The team that assembled at Dedham for that historic study conference included dedicated and knowledgeable people who believed in scientific literacy for all. Among them were Professor Jerrold Zacharias, a renowned physicist and Nobel Prize winner; Jerome S. Bruner, a world-famous psychologist; Dr. Henry Kissinger, world accredited social and political scientist; Professor Hezekah Oluwasanmi c Nigeria, an eminent educational innovator who later became vice-chancello

of a new university in Africa; and Dr. Senteza Kajubi of Uganda, a much-travelled African educationist and scholar who also became vice-chancellor [illegible] Africa. These people, along with the others who par- understood the world, including Af[illegible] conference, had proved in their work that they

5.3.1 R[illegible]

Although, in this Review, the Endicott House Study Conference is discussed in the framework of the development of the African Primary Science Program, it is significant to note that the Conference considered a broader spectrum of education than science alone. This is indicated by the various sub-groups formed during the working sessions. There were in fact six groups, each given a mandate to discuss and then to report their findings and recommendations in their areas of specialty. The six sub-groups were:

1. Humanities and Social Studies
2. Language
3. Teacher-Training
4. Research (Proposed International Institute)
5. Mathematics
6. Science

Three groups (4, 5, and 6) are of particular interest to us as they relate to the Review, and will be discussed in more detail in a

subsequent chapter. We include here a summary of the discussions and recommendations for all the groups.*

5.3.1.1 Humanities and Social Studies Group

This group began its work by examining the content of curriculum in the humanities and social sciences in African schools and considering the objectives of humanistic and social science education in general. Lack of teaching materials with an African orientation was noted as a drawback in African schools. It was felt that this would result in the African child lacking sensitivity to his own cultural and social heritage and having limited background for appreciation of differences among cultures. The group made three recommendations:

- creation of materials which focused on Africa
- changes in the educational goals in humanities and the social sciences
- revision of curricular structures to broaden and integrate the teaching of these subjects

5.3.1.2 Language Group

Noting that the language problems in African schools are extremely complex, the group stressed the need to concentrate on teaching the

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*Three concrete programs emerged from the recommendations of the working groups: African Mathematics Program (1963); African Primary Science Program (1965); African Social Studies Programme (1968).

primary language of instruction to be used by pupils, usually English or French. The group was aware that the least-educated teachers often taught at the primary level, which is a time when pupils' language patterns are established. They propos supplementing teachers' efforts with audio teaching aids which would ovide pupils with an appropriate model of spoken English or French. value of incorporating supplemental language instruction into other school subjects, such as science, was also noted, in addition to the need for early reading materials which were particularly relevant to African culture and experience.

5.3.1.3 Teacher Training Group

This group concerned itself with both the pre-service and in-service aspects of teacher education. It is inescapable and also desirable, they maintained, that "Africa will have to train its own people to teach and to teach teachers." They noted the need for training about two million African teachers, if the goal of achieving 100 percent primary school enrollment by 1980 (established at the UNESCO Conference held at Addis Ababa) was to be achieved on schedule. Specific suggestions to meet this goal included a heavy use of media such as television for teacher training. A broad plan was devised for the development of in-service teacher training materials, featuring the integration of teacher training materials with the new classroom curriculum materials.

5.3.1.4 Research Group

Although the relevant document in the Endicott House Report relating to this group was entitled "Proposed International Institute," the group was also known as the "Research-Oriented Group." In its deliberations, the group considered the need for an already planned African-based International Institute for Educational Research. The tentative name given to the proposed institute was "Educational Resources, Africa" (ERA). It was envisioned as a private, non-governmental center where modern educational methods, curricula, and materials could be studied, developed, and made available to tropical African countries.

The specific purposes of ERA would include:

- conducting educational research
- creating instructional materials
- organizing new curricula
- preparing test instruments
- conducting teaching aid workshops
- implementing teacher training
- demonstrating experimental materials in schools
- disseminating useful findings

At a plenary meeting of the conference, the international character [illegible] institute was stressed. Although the cost initially proposed for establishing a functional institute as envisaged was enormous (about a million dollars a year), most of the participants underscored the need for such an institute.

5.3.1.5 Mathematics Group

The mathematics group not only discussed issues but arranged to demonstrate how certain concepts in mathematics could be taught. The group was particularly impressed by a teaching demonstration presented by Professor David Page of the University of Illinois Arithmetic Project. He taught a lesson to 20 local fifth-graders using an inquiry and activity technique which generated high levels of interest, creativity, and achievement among the students. As a result, the mathematics group focused its attention not only on opportunities to improve the content of mathematics instruction in African schools, but also on the need for changes in the goals and techniques of the curriculum to give greater stress to encouraging imagination and initiative among the pupils.

5.3.1.6 Science Group

The science group agreed that there were significant shortcomings in the scope, direction and goals in science curricula in Africa. Suggestions were proposed for implementing changes including:

- structuring science education in a helical pattern to serve both those who were interested in science as a career and those who were not
- using familiar objects as fundamental classroom material
- emphasizing the discovery approach characteristic of the PSSC course in physics
- promoting self-involvement of the student in science instruction

Two specific plans evolved for stimulating efforts in this direction. First, on a short-term basis, the group proposed to seek financing to prepare a series of biology films under the direction of Professors Weston and Walcott of Harvard University plus contributing support to the development of an elementary science curriculum under the direction of Professor Walcott. Second, the group suggested that major curriculum centres be established in Africa and the United States to work with the proposed Educational Resources Africa (ERA) organization in developing a basic African science curriculum and science reading materials in vernacular languages and in investigating science education problems.

6. Activities in Awo-Omama

The ideas generated at both the Addis Ababa Conference and Endicott House Study Conference were tested in a number of African countries while at the same time traditional teaching of science was being critically examined. In Nsukka, Nigeria, Professor Babs A. Fafunwa, who had been a participant at Endicott House, had organized workshops on elementary science, where, as Dean of the Faculty of Education, he combined some of his own ideas with those generated at Endicott. In 1964, Fafunwa sought aid to enable him to execute his plans for elementary school science and, through EDC, received a grant from the Ford Foundation. This made it possible for him to recruit additional staff for his elementary science project. He was fortunate to obtain the services of Mike Savage who had worked on the Elementary Science Study at EDC. For 18 months, Mike was a part of the Nsukka elementary science project, trying out ideas and materials

in the rural environment of Awo-Omama. In an interview recently, Mike had this to say:

> *I was working with Babs on the idea of trying out science materials in a rural environment. I was at that time a member of staff of the Faculty of Education, University of Nigeria, Nsukka, and Awo-Omama (an adjoining community village to Nsukka) was providing me with the research base for the elementary project. . . By the time I finished at Awo-Omama, I was pretty well certain that our approach (using the inquiry method of ESS, employing local concrete materials) to elementary science was viable in African classrooms.*

Important to this Review is the fact that Mike had demonstrated the viability of the ESS materials and approach in an African setting, and also developed additional materials for the teaching of elementary science. From this experience, it became apparent to Fafunwa and Savage that

- science could be taught in an exciting way to elementary school children,
- an open-ended approach to elementary science teaching was possible,
- materials for teaching elementary school science could be derived from the environment of the learner, in this case from the familiar surroundings of the child.

Meanwhile, at the administrative level, plans were underway for meetings to discuss the recommendations made by the science group as an outcome of the Endicott House Conference. The first of these, a meeting in Rome, led to the formal establishment of the African Primary Science Program (APSP).

7. Rome (September 4-5, 1964)

A planning meeting was held in Rome, Italy in September 1964 to make concrete proposals based on the Endicott House Study Conference. The Rome meeting, sponsored by the Ford Foundation, was attended by fourteen participants, ten of whom had taken part in the Endicott House Conference (Table 2).

TABLE 2

Attendance at the Rome Meeting*

Classification of Participants	Number	Percentage
Africans	6	42.86
Non-Africans	8	57.14
TOTAL	14	100.00

The fourteen participants included five administrators, five scientists, three professors of education, and one high school science teacher. The eight Africans at the Rome meeting were from three countries: Ghana, Kenya, and Nigeria. Information about the Fafunwa and Savage exploratory work was provided by the Nigerian participants. In addition, the Kenyan group described the work of the Kenya Science Centre which had been in operation for almost three years. During that period, it had brought about changes in the Kenya Elementary Science curriculum and had developed

*Appendix A of Report, Rome meeting 1964.

science classroom apparatus and material for use with the revised curriculum. The Kenya Science Centre also was involved in training elementary teachers in an effective approach to science teaching.

It was clear from the Rome meeting that enough enthusiasm had been generated to warrant the development in African primary schools of science, based on the pattern and philosophy of EDC's Elementary Science Study. The need was identified for a structure, like the science centres, for coordinating trial-teaching and for the dissemination of the ideas and approaches to elementary science teaching. It also was felt that a mechanism could be found to involve teachers at a considerable distance from the science centres. As well, the Rome Conference discussed the need to reach children of pre-school age with materials of a play nature but of scientific technical significance. It was therefore agreed to call another conference with invitations to representatives from all countries likely to be involved in a primary school science program. Invitations would be issued to people from Ministries of Education, Universities, Institutes of Education, and tutors from Primary-Teacher Training Colleges to meet and decide what direction the primary science curriculum revision should follow. A conference was therefore called for February 21st through the 27th, 1965 in Kano, Nigeria. Materials developed in other countries as well as the materials developed at existing science centres in Africa were to be demonstrated and reviewed.

8. Kano (February 21-27, 1965)

The stated purpose of the one-week long Kano conference was "to plan for possible major changes in the teaching of beginning science in Tropical Africa, primarily for English-speaking Tropical Africa." Of the 67 participants, 33 (see Table 3) were Africans representing nine countries: the then Bechaunaland Protectorate and Swaziland (Botswana, Swaziland), Ghana, Kenya, Liberia, Malawi, Nigeria, Sierra Leone, Tanzania, and Uganda, 34 were non-Africans largely from the United States of America and the United Kingdom (Table 3).

TABLE 3

Participants at the Kano Meeting*

Classification of Participants	Number	Percentage
Africans	33	49.26
Non-Africans	17	25.37
Observers	17	25.37
TOTAL	67	100.00

The Kano Conference took the form of presentations, classroom demonstrations, and discussions. There were five presentations, from Professor Babs Fafunwa (Nigeria) and John Gitau (Kenya) who described the kind of

*ESI Report to AID, April 9, 1965, under Contract No. csd 772.

work that was going on in their science centres at Nsukka and in Nairobi, from Leonard Wastnedge (Nuffield Junior Science Teaching Project, U.K.), Leonard Sealey (Leicestershire Education Department, U.K.), and from Philip Morrison (Cornell University, U.S.A.), all of whom described the educational philosophy of new science programmes. There were also classroom demonstrations by Mike Savage and some elementary school teachers from Kano. (Two weeks before the conference, Mike had gone to Kano from Nsukka and based on his experience in the Awo-Omama schools, he familiarized six African elementary school teachers with a few ESS units.) During the conference, Mike and these teachers held several successful demonstration sessions with local children. Before the plenary meeting, the country representatives had discussions which led to proposals relevant to the successful teaching of science at the elementary stage. Also discussed was who would orchestrate and administrate the program work to be proposed. It was this Conference which decided that EDC's role would be

- to develop and to assist in the development of elementary school science materials,
- to provide the means for setting up science centres--people, materials, etc.,
- to give financial assistance for the reprodution of materials for experimental use,
- to give financial assistance for the training of teachers to use the experimental materials.

Once the deliberations of the Kano Conference had established the concepts of and approach to elementary science to be used in African schools, it was intended that others work out the mechanics of establishing

the African Primary Science Program in a number of the African countries. The Conference did recommend that the best approach would be "to operate Science Workshops during the long vacations (over the years of the program) and to assist in the development of Science Centres in the countries involved." The science workshop activities should include:

- development of guidelines for an elementary science curriculum
- preparation of text materials and laboratory experiments appropriate to the African environment and to African financial and industrial resources
- coordination of the programs being conducted in the participating countries

Administratively, the Kano Conference made definite proposals:

- The activities of the programme would be subject to the advice and ongoing evaluation of a Steering Committee consisting of Africans and of officials from EDC.
- In the initial phases, the Ministry of Education, Training Colleges, and science staffs of the universities in Africa in each country would be heavily involved in decision-making.

As the programme developed, all these groups would continue to be included in varying degrees, but it was emphasized that: "the science programme would have to have the cooperation of Ministry of Education officials."

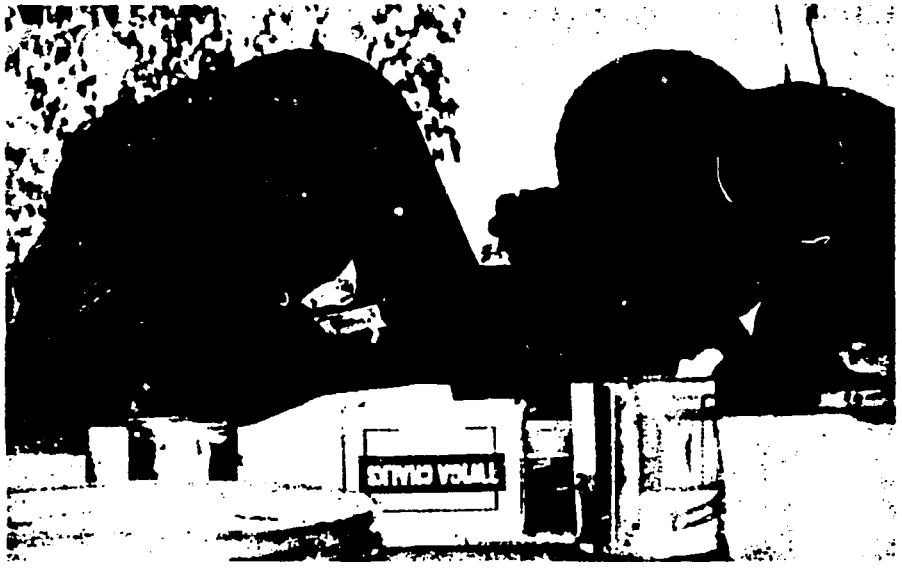
The Kano Conference approved some far-reaching recommendations which have yet to be implemented:

- a controlled experiment to observe results of distributing to children at pre-school age, materials which might help to encourage scientific curiosity;
- the creation of a science park area where large apparatus using sound scientific principles could be available for use by children;
- the supplying to selected secondary schools science clubs of equipment matched to the ability and interests of club members.

The participants said,

> *They (the above measures) would provide meaningful experiences in the utilization of materials, the absence of which is believed to handicap the African child in his studies of the sciences.*

The Kano meeting concluded with renewed faith in a philosophy of primary science education that was child-centered and relevant to the needs of African societies. The conference was significant not only for bringing together representatives of a number of African countries to discuss elementary science but also for the fact that it marked the formal beginning of the African Primary Science Program (APSP) which up to that time was still referred to as the "African Elementary Science Programme."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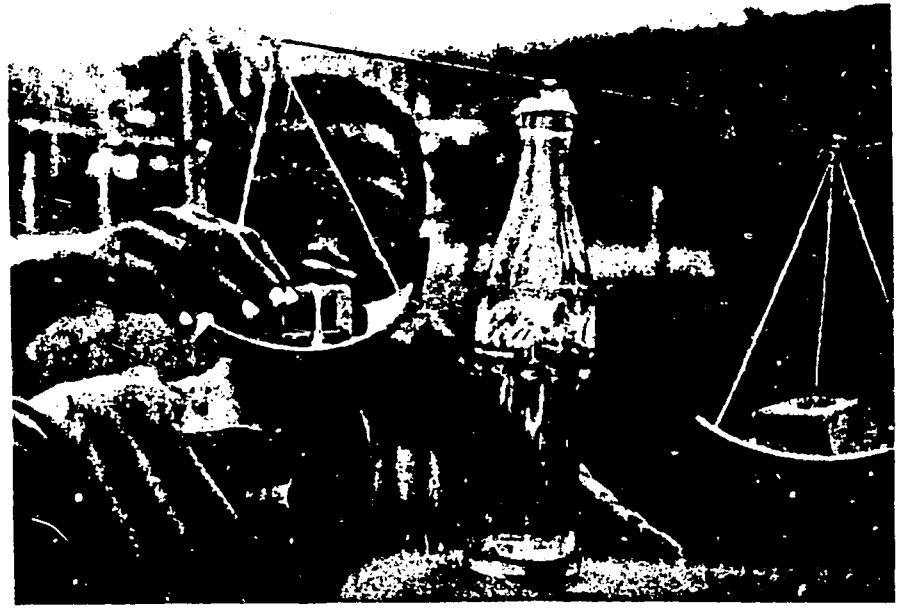

Scientists

Science Educators

Teachers

Children

"Learning by Doing"

III

EMERGENCE OF AN APPROACH

The framework for developing the African Primary Science Program and the materials it intended to produce was to have two integral parts. The science center would be the institutional cornerstone in each participating country. Large international workshops held during long summer vacations would bring together the developers from the science centres, teachers who were using or would use the developing materials, and scientists and educators from African and western countries. The two components did prove to be mutually supportive for defining, testing, and reshaping ideas and materials.

1. The Workshops

1.1 Entebbe (1965)

The first in the series of planned workshops took place in Entebbe, Uganda from July 4 to August 16, 1965.

Chairman of the conference was Professor Jack S. Goldstein of Brandeis University in the United States. An eminent scientist and educator, Dr. Goldstein was the first Chairman of the original APSP Steering, or Advisory, Committee and his interest in and dedication to the work would be sustained throughout the program. As an academic, his example of concern for primary education reinforced a like concern of those African

PREVIOUS PAGE BLANK

academics already interested, and attracted others over the life of APSP and the eventual formation of SEPA.

The range of background and experience of the participants of the workshop--Africans included Ministry of Education officials, primary and secondary school teachers, and university staff members--provided a broad and valuable perspective for the workshop. In all, there were 74 participants (Table 4).

TABLE 4

Participants at the African Science Workshop, Entebbe

Classification of Participants	Number	Percentage
Africans	34	45.95
Non-Africans	19	25.68
Visitors	18	24.32
Others (staff)	3	4.05
TOTAL	74	100.00

The purpose of the workshop was:

- to introduce participants to examples of curriculum revision in Africa, the United Kingdon, and the United States;
- to consider the adaptation of some of these examples for wider use in Africa;

- to prepare elementary science teaching units for experimentation and adaptation by developers in local science centres and by other conference participants;
- to prepare a teacher's guide delineating the teaching approach to be encouraged in presenting the prepared units.

The Entebbe workshop, in a sense, established precedence for a development working-style that was followed by the subsequent workshops in Tanzania (1966) and Ghana (1967).

It was agreed that science units should emphasize the use of locally available materials and the units themselves would be tested in classrooms in more than one country. It was never the design of the program that any group of participants at any workshop "write a final unit" to insert in an existing curriculum, or indeed, to write a whole new curriculum. The essence of the work was the trial of materials with real children in their own school environments, putting into practice the belief of the program that curriculum development was a continuing process.

The atmosphere of the Entebbe workshop allowed flexibility in thinking about content of the units. Rigid scientific or psychological concepts not judged workable with African children were rejected as bases for development of materials. Uppermost in the minds of all the participants was the fact that the focus of the program was on children and how they learn. Both subject matter and concrete materials used must fit the children's needs and their stages of intellectual growth. Thus, the workshop was an occasion for presenting and discussing ideas, outlining several units, and testing and refining those units in local classrooms.

Following the Entebbe meeting, each African participant chose copies of eight of the 22 units produced in draft form. These were to be trial taught in classrooms in the various countries. EDC field staff and their counterparts at the science centres were charged with the responsibility of refining the units further and bringing them to subsequent workshops for discussion of the trial experience.

It is interesting to note that one of the purposes of this first workshop had been to examine examples of curriculum revision in the U.S., and the U.K., and to consider adaptation of some of these to Africa. The result of this consideration was that while approaches used and some subject matter in those examples were adopted, there was no "adaptation." The resultant APSP materials are unique and stand on their own as examples of pure field research and development work done on the African continent. These materials form a base for local revisions, each country being free to choose any part or all of the program for its own syllabus.

1.2 Dar es Salaam (1966)

The six-week summer workshop in Tanzania brought together 56 participants who were again involved in the development of primary science materials. The aims of the 1966 workshop were

- to refine, revise, adapt as necessary, and produce in semi-finished form, science units for use in experimental classes in African elementary schools;
- to begin development work on further science units for elementary schools, including areas not covered in the 1965 Entebbe Workshop;

- to begin preparation of a teacher's guide, which would explain the philosophy behind the new methods of science education, and help teachers handle the new materials in the classrooms;
- to begin planning for primary teacher training in science.

Seventeen units were drafted and, as at Entebbe, each unit was field-tested in at least one local Tanzanian primary school during the workshop. Again, participants returned to their various countries with a sample of units reasonably ready for the African schools. In addition to the unit development, activity began in production of science films illustrating how elementary science was being taught in African classrooms. The primary purpose of these films was teacher training.

1.3 Akosombo (1967)

The 1967 summer workshop in Ghana was attended by many more participants than the previous two at Entebbe and Dar es Salaam. By this time almost all of the science centres, and three sub-centres, had been established. The expatriate and counterpart science educators who manned these centres were at Akosombo. In addition, there were larger contingents of teachers and Ministry of Education officials, and a lesser yet still substantial number of applied scientists.

The aims of this workshop were much the same as those of Dar es Salaam. However, at this point, a quantity of material had gone through the trial teaching and refinement stage and was ready for wider testing. As a result of the workshops, and the work in the science centres, it was decided to

put many of the teaching units in more permanent although not final form. In all, in the years following the Akosombo workshop, 56 teachers' guides, pupils' books, and pupils' readers were produced in quantities large enough (2,000-5,000) for a greater testing sample by countries participating in the program.

Akosombo was the last of the program's large development conferences and further work, including production of several films, took place in schools and at the science centres.

TABLE 5

African Countries Represented at the Three Major Development Workshops

Country	Entebbe	Dar es Salaam	Akosombo
1. Ethiopia			x
2. Ghana	x	x	x
3. Kenya	x	x	x
4. Liberia	x	x	x
5. Lesotho	x	x	x
6. Malawi	x	x	
7. Nigeria	x	x	x
8. Rhodesia	x		
9. Sierra Leone	x	x	x
10. Tanzania	x	x	x
11. Uganda	x	x	x
12. Zambia	x	x	

2. The Science Centres

It was recognized that the most successful way to capitalize on the materials development workshops was to establish science centres in a number of participating countries. The science centres proposed were to be staffed by scientists, science teachers, and an EDC field person, designated as a Science Educator. Most science centres initially were staffed in this way.

The purpose of the science centres would be to:

- test materials developed for each unit;
- trial-teach the units prepared;
- develop new science units and materials;
- conduct training sessions for primary school teachers who would use the new science materials.

Under this plan, feedback from the science centres would prove invaluable in the large workshops, and vice versa. The activities of the centres would be patterned on those of the science centres in Nigeria and Kenya prior to the establishment of APSP.

TABLE 6

Science Centres: Location and Personnel

Country	Location	APSP Science Educators	Local Personnel
Ghana	Primary Science Centre, Ministry of Education, Accra	Stephen D. Manning C.W. Bassett James P. Seawell	O. Bortei-Doku George Laryea Isaac Laryea P.O. Asanbe Wiafe-Anim Oduro Gambrah
Kenya	CRDC, Ministry of Education, Nairobi	M.B.R. Savage William U. Walton William S. Warren Fred Cornall Christopher R. Hale Per Christiansen (Kagumo) Bernard Zubrowski (Siriba)	Edda Gachukia John Mandu Stanley Muka Francis K'Opiyo
Malawi	Science Centre, Domasi Teachers College, Domasi	Richard Kimball Quentin Woomar	Rodney Kumbikano
Nigeria	(1) University of Nigeria, Nsukka (2) Teacher Training College, Abraka (3) College of Education, University of Lagos	M.B.R. Savage William U. Walton C.W. Bassett Akindele Osiyale	Akindele Osiyale Amami Miss Ajetumobi

Note: 1. Largely as a result of the Nigerian civil war, the centres in Nsukka and Abraka ceased to function in 1966.

2. The centre in Lagos was unique in that a Nigerian, Akindele Osiyale, was in fact the APSP Science Educator. In no other centre was an African the official APSP science educator.

TABLE 6

Science Centres: Location and Personnel

(continued)

Country	Location	APSP Science Educators	Local Personnel
Sierra-Leone	Science Curriculum Development Centre, Njala University College, Njala	Robert Francis Hubert Dyasi Walter Drew Dave Magnani (PC) Owain Evans (PC)	Norman Cole (Njala) Victor Johnson (Njala) B.M.E. Davies (Freetown) Becky King (Bo) Carl Fischer (Bo)
Tanzania	(1) Institute of Education, University College, Dar es Salaam (2) Morogoro Teachers College	Eugene Godfredsen Thomas Tilson Joe Elstgeest	M. Banda M.E. Mushi Mary Stephen
Uganda	Science Centre, Institute of Education, Makerere University, Kampala	Douglas Lapp Douglas B. Seager	Dominic Kasirye David Kiyimba J.G. Chakagondua

3. The Situation in African Countries in the Sixties

The ferment which began with independence in African countries gained momentum as these countries progressed through the sixties. In many respects the pattern of educational development was similar from one country to another, but there were variations resulting from their different histories as well as current events. There were several common elements.

i) Immediately following independence most of the countries still looked to their former colonial rulers for capital and personnel requirements. Assistance soon came from other international sources, especially through USAID, UNESCO and the British Council. Some of this came on a bilateral basis, and the African Education Program of EDC was one of the pioneer efforts in regional programming.

ii) There was a dependence on the use of special commissions and committees for initiating change in the educational system.

iii) Because of the need for high level manpower and the drive for equalization of opportunity, major national efforts were directed toward expansion of facilities and increase in school enrollments. Often referred to as *educational renovation*, the drive for change was intended to offer more of the same to more people but distributed differently. Thus, for example, the number of schools and the number of students increased manyfold. A review done by UNESCO for the Lagos Conference of African Ministries of Education (MINEDAF) in January-February 1976, analyzed the quantitative development as compared with the targets set at the Addis

Ababa Conference in 1961. In most countries, although tremendous expansion had taken place, primary school and secondary school total enrollment fell far short of target, as did the reduction in drop-out rate. And, while Addis Ababa had advocated an increase in the ratio of science/arts enrollments in schools and universities, there was in fact a reduction. Similarly, Addis Ababa had advocated an increase of technical vocational institutions in ratio to the general kinds of schools at the secondary level, but instead there was a decrease. Teacher/pupil ratios remained close to target. At the tertiary level, however, most African countries exceeded the Addis Ababa goals not only in terms of percentage enrollment but also in the ratio of students attending universities locally to those attending universities overseas. This was an indication of the demand for high level manpower as quickly as possible.

iv) Even though the Addis Ababa Conference as well as the policy pronouncements of the new governments had drawn attention to the need for new and relevant educational content, very little was done at national levels in the area of curriculum development or even of altering the structure of the educational system. The first efforts at examining the quality of education through the curriculum were through external assistance like EDC's African Education Program of which APSP was a part. Perhaps in response to the overall priorities of the countries themselves, curriculum development and teacher training rated lower than other pressing reforms in terms of financial investments.

v) Experimentation in education as an approach to solving the problem of relevance was essentially an innovation introduced by external intervention and here again EDC's African Education Program and particularly APSP was the pioneer. Other agencies like UNESCO and the British Council also made some contribution in this direction as illustrated by their work in Nigeria and Uganda.

Some specific events in several countries will illustrate the commonalities and the differences in the pursuit of education reform.

3.1 Botswana, Lesotho, and Swaziland

These three countries are very close in terms of colonial history and also have worked collaboratively on educational matters since independence. For several years, they operated a joint university, the University of Botswana, Lesotho and Swaziland, located in Roma, Lesotho. For political as well as economic reasons, the ferment was less vigorous in these countries than in other parts of Africa. Even after independence, the countries depended heavily on foreign expertise in educational planning and policies. Localisation has, however, been a constant goal in terms of high level manpower in these countries. Major education commissions were not set up till the '70s: the National Education Commission in Swaziland (1972-75), the Education Study Commission in Lesotho (1976), and the National Commission on Education in Botswana (1977). Perhaps the most ambitious and comprehensive of the three has been the Botswana Commission whose report entitled *Education for Kagisano* contains about 200 recommen-

dations.

In terms of scholarisation, however, all three countries made tremendous progress in the sixties. Lesotho and Swaziland, in fact, place in the top quarter of all African states in terms of scholarisation, achieving over 35% scholarisation in the age range 6-29 years. Lesotho was involved in APSP work from its inception and, although no APSP science educators were posted there, substantial trials and dissemination of APSP/SEPA materials have gone on in all three countries through the Lesotho contact.

3.2 Ethiopia

Emphasis in Ethiopia in the 1960s was primarily on physical and quantitative expansion to accomplish its goals of increasing available manpower and eradicating illiteracy. World Bank loans were obtained for expansion of secondary schools. The Swedish International Development Agency (SIDA) contributed to the building of elementary schools on a 50-50 basis with the country, and UNICEF contributed to teacher training.

The Haile Selassie I University accelerated its rate of training secondary school teachers; more teacher training institutes and colleges were opened and steps were taken to decentralize the educational system for more effective organisation of the national literacy campaign through provincial education offices. Educational broadcasting, seen as the most practical answer to the national problem of illiteracy, was introduced.

Initial moves were made toward national curriculum development, the formation of various kinds of educational associations, and cooperation with other African countries. Ethiopia had very little contact with APSP until the advent of SEPA in 1970. About the only external input into science education in the sixties was through the British Council which provided one or two expert advisers for periods of two to four years each.

3.3 Gambia

Gambia's priority concern throughout the 1960s was quantitative expansion of education. Concern with relevance and quality of education only assumed major importance in the 1970s.

The Sleight Commission on Education was formed in 1965, the year of Gambia's independence. The Commission recommended a move towards universal primary education in a phased manner: Bathurst (now Banjul), the capital, should attain universal primary education by 1970 while all other areas were to attain this at later dates.*

Major changes in Gambia in the 1970s included:

- expansion of the educational system;

*Two other recommendations made to Gambia by the Sleight Commission were of note:

1. A review of the primary school curriculum;
2. The reorganization of post-primary schools in urban areas, into junior technical schools, and in rural areas, into rural educational schools.

- standardization of educational provision;
- emergence of junior secondary schools;
- introduction of 6-year primary schools.

Gambia did not have contact with APSP until the advent of SEPA. The major external assistance during the 1960s came from UNESCO/UNDP and UNICEF. The former provided financial aid, supplied equipment and books, provided teachers and experts, and assisted in the training of curriculum specialists. UNICEF's contribution was mainly equipment supply.

3.4 Ghana

While Ghana was striving toward universal education, it also appointed review committees to consider improvement of scientific and technological education, e.g. the Kwapong Committee of 1967. The University of Science and Technology was established in Kumasi and the University College of Cape Coast (now University of Cape Coast) was initially designated as a science education institution. These moves were not without their obstacles since political considerations, for example, influenced such decisions as location of schools.

Two events in Ghana during the 1960s are particularly worth noting because they indicate a developing concern for the issue of relevance and quality of education. First, the National Curriculum Centre located in the Ministry of Education, was created in 1965 to produce curriculum materials in general for schools. This was a joint effort of the Ghana

government, the Canadian CIDA and UNICEF. Secondly, a science unit in the Ministry of Education was instituted in 1965 for the specific purpose of promoting and supervising the teaching of science in primary schools. This was a joint effort of the Ghana government and UNICEF.

The existence of these two units in the Ministry of Education provided a favorable atmosphere for the introduction of APSP efforts. It is therefore understandable that Ghana was one of the first countries to which EDC science educators were posted.

3.5 Kenya

Kenya moved rapidly to resolve the major problems of desegregation of schools, production of high level manpower, quantitative expansion of schooling facilities and school enrollment, and the quality and relevance of education.

Beginning in 1964, Kenya produced a series of 5-year development plans. The 1964-1969 plan advocated science education at all levels with emphasis on the training of science teachers and the provision of modern science equipment and facilities. The Ominide Commission in 1964-1965 published its Kenya Education report dealing with, among other things, (a) language policy; (b) curriculum relevance; (c) structure of educational system, science, technical and commercial education; and (d) access to education. The Weir Report (1968) dealt specifically with agricultural education, as did a special FAO study team during the same period. Teacher training for science was instituted at the Kenya Science Teachers College

with a deliberate policy of increasing the ratio of Science and Arts students in higher institutions of learning. Teacher education in all disciplines was also intensified at Kenyatta College and at the faculty of education in Nairobi.

Enrollment in Kenya's primary and secondary schools rose dramatically, but universal education remained an unattained goal. The number of secondary schools rose from 400 in 1966 to 1,029 in 1974. Increasingly, Kenyans took control of the planning of education. Professional teachers' associations became active in the areas of curriculum development and teacher training. Prominent among these were the Kenya National Union of Teachers, Geographical Association of Kenya, Historical Association of Kenya, Kenya Mathematics Association, and Kenya Science Teachers' Association.

International agencies which contributed to the development of education in the 1960s were UNESCO, UNICEF, SIDA, ODM, STEP, the British Council, and USAID.

Significant steps taken by the Kenya government prepared the way for the entry of APSP.

i) In the early 1960s, with the assistance of the Ford Foundation, a science centre was founded in Nairobi, with sub-centres at Nairobi, Kagumo, Siriba, and Kigari.

ii) In the mid-1960s, a science section of the Curriculum Development and Research Centre (CDRC) of the Kenya Institute was established with the aid of CIDA and ODM.

iii) In 1964, a national curriculum centre, designated Kenya Institute of Education (KIE) began to function as a research, teacher training, and curriculum development institution. KIE was a natural home for APSP activities and over the life of the Program, several science educators were posted to the centre by EDC.

3.6 Liberia

The '60s in Liberia were characterized by increased foreign aid and acceleration of training of high-level manpower. UNESCO contributed to the training of curriculum specialists; the World Bank and the British Council supplied equipment.

A national curriculum and materials centre located in the Ministry of Education in Monrovia was created in 1964. The centre had the objectives of (i) evaluation and selection of textbooks; (ii) development and production of instructional materials, and (iii) development of curriculum guides and syllabi.

Participants from Liberia were involved in activities of APSP from its inception in 1965 and, although science educators were never posted there, some trials of APSP ideas were carried out at the Teachers' College of the University of Monrovia.

3.7 Nigeria

In Nigeria, initial concern with the quality and relevance of the educational system and curriculum content was largely in the hands of

professional organisations such as the Science Teachers Association of Nigeria. In 1965, however, the government showed a more decisive interest by setting up the Nigerian Educational Research Council (NERC) which was charged with the task of educational research as well as curriculum development. NERC began preparations for a national curriculum conference which was scheduled for September, 1966. Preparations were, however, suspended because of two military coups in 1966 and the resultant civil war, and it was not until September, 1969, that the curriculum conference was able to convene. Its deliberations became the basis of a nation-wide, all-embracing policy on education, and the inspiration for curriculum development at the national level.

Specifically, in the realm of science education, Nigeria began early in the 1960s to examine its science curriculum at the secondary level. In the summer of 1962, the Ford Foundation in cooperation with several of Nigeria's local ministries of education sponsored an institute for Nigerian teachers. Its purpose was to familiarize teachers with CBA chemistry, PSCC physics and SMSG mathematics, and teams of instructors came from the USA for that purpose. The summer institute was one of the earliest Nigerian contacts with new approaches to curriculum development. It inspired a wave of curriculum projects in the various ministries of education, particularly in the sciences. By the time APSP began work in 1965, most ministries of education in Nigeria had drawn up science curriculum development panels or programmes.

In addition, the work of Babs Fafunwa and Mike Savage at Nsukka was

attracting attention. Their four-week workshop on primary science in 1964, held with funds from the Ford Foundation, produced a report which contained the beginning of several primary school science units. The workshop introduced a collection of university faculty, ministry officials, and primary school teachers to the techniques of experimentation in the development of school curricula for the first time.

The development work of the Nuffield science programmes in Britain had a favorable response in many parts of Africa through a series of summer workshops known as "Ashby Courses." The Science Teachers' Association of Nigeria was also a powerful influence in curriculum development, organizing workshops in cooperation with universities.

Ironically, this series of professional activities in the field of curriculum development had a somewhat negative effect on Nigeria's participation in APSP. By 1965, there were a number of competing programmes. However, Mike Savage, joined by another educator from EDC, continued his work in the schools around Nsukka, under the aegis of APSP. The two were forced to leave at the onset of the 1967 civil war, but the pioneer work of APSP curriculum development had been done in Nigeria.

3.8 Sierra Leone

Sierra Leone pursued rather systematically the goals inspired by Addis Ababa with the recommendations of the Sleight Commission Report of 1962 giving guidance. The development programme in education (1964-70) which resulted was "to improve the system of education in order to promote the

political, social and economic development of the country and at the same time facilitate the transition to a modern economy and society."

Great advances were made in quantitative expansion in the 1960s. Primary school enrollment increased by over 100%. Secondary school enrollment increased by over 400%. Njala University College came into existence in 1964-65, and between 1960 and 1970 university enrollment grew by over 400%. Similar increases were recorded in technical and vocational institutions.

Funding agencies, especially IDA and UNICEF, played a significant role in the provision of these additional educational facilities.

A Science Curriculum Development Centre (SCDC) was established at Njala University College in 1968 with funds from the University, USAID, and EDC (APSP) for the purpose of developing science curriculum materials and organizing in-service training. The creation of SCDC seems to have been inspired by APSP, and provided a convenient entry point for APSP. Science Teachers' Centres were also established in Freetown and Bonthe in 1969. Before the advent of APSP, there was no systematic competitive primary school science programme.

3.9 Tanzania

In Tanzania, the party (TANU) is supreme and has absolute responsibility for national development including educational development. The key document in charting the path of development over the past one-and-one-half

decades is the Arusha Declaration of February 1967. However, even before independence, TANU had wielded great influence in shaping educational policies. Tanzania is the one country among those reviewed which did not set up any commission to study education. It did prepare a series of five-year development programmes starting from 1964-69. There was an interim plan from 1961-63. The planning unit is a tool of the party and its main assignment is to work out details of the implementation of party policies. Besides strong party leadership, there was systematic effort to involve the masses through elaborate public enlightenment programmes and campaigns. The adult education programme of Tanzania is acknowledged to be one of the most successful in Africa.

The 1964-69 plan envisaged expansion of secondary education for the purpose of producing high level manpower. The number of secondary schools increased from 41 in 1961 to 114 in 1970. In subsequent plans, primary education and adult education gained greater priority.

Tanzania, like Kenya, had also inherited the racial system of schooling with its discriminatory practices. Records show, for example, that in 1946, the colonial government's annual expenditures per pupil were

£38.0 for European schools
£4.4 for Asian schools
£1.9 for African schools

One of the first actions of the TANU government after independence was to abolish racial schools. Financial allocation to education remained at

about the same level as in pre-independence years (12%), but the effective distribution per child altered greatly.

One of the policies of government was that Kiswahili become the language of instruction in schools. Thus, when the APSP centre was created (first at the university and later at the Morogoro Teacher Training College), one of its tasks was to translate APSP units into Kiswahili. Tanzania was perhaps the only African country in which APSP units were translated into an indigenous language.

One of the films that best illustrate the APSP/SEPA approach to science (*Let's Find Out*) was made in Morogoro. For reasons not quite clear to the evaluators, however, some discontent with APSP arose and the materials were abandoned in 1971 when a ministry team was appointed to prepare a new science syllabus for the primary schools.

3.10 Uganda

Uganda was primarily concerned with quantitative increases in educational opportunities in the 1960s and was assisted in its endeavours by IDA. The recommendations of the Cattle Commission of 1963 set the pattern for the development. UNESCO, UNDP, and the British Council also assisted in various ways. A secondary school science programme was initiated but there was no primary school science programme until the creation of an APSP science centre in the National Institute of Education in 1969. The fact that the first large APSP workshop was held in Entebbe in 1965 did stimu-

late interest, but there was not a significant follow-up in the first few years.

At about the time of the creation of the APSP Centre, the UNESCO-supported Namutamba Project on Education Integrated with Rural Development was launched by Uganda for an initial period of four years (1968-72). Namutamba was more than a science curriculum project, but science at the primary level formed an important component. A competition for government recognition ensued between that programme and APSP. Eventually, a solution to the dilemma was found. *De facto*, Namutamba absorbed APSP in the 1970s and the APSP approaches were integrated with those of Namutamba through the appointment of David Kiyimba as director of the Namutamba project. He was a Ugandan science educator who had extensive experience with APSP.

4. EDC's Role in APSP Development

Within EDC, the African Primary Science Program had a core staff serving as a mini-secretariat for activities in the field and in the U.S. The APSP office at EDC provided support services, acted as a clearing-house for ideas and resources, and was liaison with the sponsor, AID. The small core staff in the APSP office consisted of co-directors, one for programme, one for administration, an editor, a secretary and, from time to time, an academic advisor. The APSP Steering Committee included Africans, and many of the committee's meetings were held in Africa. Personnel from the U.S. office made periodic visits to the science centres and Ministries of Education in Africa. African educators also visited EDC and, during

the life of the programme, two African visiting scholars spent some months at EDC, contributing to EDC's African education programmes. Toward the end of the programme, three Ghanaian science educators completed eight-month internships at EDC.

Without EDC there would not have been an African science curriculum development project in the early 1960s. A programme would, however, have developed eventually because the weight of intentions of African governments, as well as the efforts of UNESCO and other international agencies, would have precipitated some activity. But EDC's existence and the mutual affinity that had developed early on between Jerrold Zacharias and Solomon Caulker led to accelerated action. In particular, EDC made the following contributions:

i) EDC kept alive Caulker's ideas and procured funds for the innovative and successful 1961 summer study at Endicott House in Dedham, Massachusetts.

ii) EDC mobilized appropriate intellectual resources from three continents, using the academic environment of the Boston/Cambridge area and the goodwill of philanthropic organisations and of the U.S. government towards international cooperation and assistance.

iii) Perhaps in a poignant manner, EDC's leadership believed in humanity and its desire and capacity to develop. Otherwise it is not possible to explain the recognition of African ingenuity at a time when many tended to look for reasons to justify notions of racial superiority.

It also explains EDC's defense of African interests and each country's right to self-determination in education.

iv) The mounting of workshops, meetings, conferences, and exchange programmes for Africans from different countries promoted not merely contact but also international understanding. By interacting directly with Africans on a platform of equality, EDC developed itself into a worthy interpreter of African aspirations to American institutions and of American intentions to Africans, which cemented a bond between Africans and Americans.

v) One role that cannot be overestimated is the facilitation of inter-African cooperation on the educational front. African unity had hitherto been viewed largely in the political sphere, but it was possible by 1968 to perceive it also in science education.

vi) The most obvious useful role played by EDC was in management. Bringing together large numbers of people with different cultural, political, academic, and personal orientations could have precipitated tensions and disagreements. No one could prevent the building up of tensions, but these could be contained by skillful management. The "brokerage" role of EDC, therefore, was not limited to the procurement of funds for projects but extended to individuals acting on behalf of the programme whether it be to settle disputes or to educate government officials about the programme. It was a family.

IV

THE EMERGENCE OF THE SCIENCE EDUCATION PROGRAMME FOR AFRICA

1. Historical Origins of SEPA

Historically, the Science Education Programme for Africa was established in 1970, but the idea for such an organisation and the climate to support it were in existence long before that date. Significant events had occurred earlier at Dedham, Massachusetts, at Awo-Omma and Kano in Nigeria, at Entebbe (Uganda), Dar es Salaam (Tanzania), Akosombo (Ghana), Nairobi (Kenya), Takoradi (Ghana), and at numerous other places in Africa which made it possible for African scientists, educators, teachers, educational administrators, and students to work as partners in science curriculum renewal. At the country level, small groups of professionals sustained interest and activity generated at the large continental workshops and added nuances attuned to their local situations.

But participants of other African conferences, such as that of Ministers of Education, had stated that educational development in their countries by non-African institutions was at variance with the concept of sovereignty. The APSP Steering Committee desired the transfer of the direction and administration of the programme to African hands but was unable to accomplish this due to lack of appropriate mechanisms in Africa. An initial attempt to create such a mechanism was the replacement of the APSP Steering Committee with an Advisory Committee which was wholly

African and would provide counsel to EDC on overall policy, philosophy, and direction of the programme. But this did not resolve the problem of sovereignty. USAID also had sympathy for the Africanization of the programme if a reasonable mechanism could be found for transferring it completely from EDC direction. With all parties in agreement, the need was urgent for an African institution with a permanent identity and a capacity to seek and procure funds for the continuation of programme activities.

The members of the African Advisory Committee met at Takoradi, Ghana, in August/September 1969, in order to discuss the issue but were unable to take bold steps without first consulting with their Ministries of Education. Therefore, the participants at Takoradi agreed to convene a future meeting of representatives of Ministries of Education and certain academic institutions. A crisis arose because no government could be committed to convening such a meeting without prior consultation, and EDC could not convene the meeting without appearing presumptuous. It was to break this impasse that Hubert Dyasi from Njala University College (Sierra Leone) offered his institution and Ministry of Education to act as convenor.

Dyasi returned to Sierra Leone and persuaded the Ministry of Education to serve as host to representatives of the Ministries of Education from several countries. He then organized the Njala University College staff to convene the meeting. EDC became the fiscal agent in the process. Working documents for the meeting were prepared, outlining a proposed organisation that could have some permanence and facilitate continuing cooperation among Africans in the development of their science education

programmes.

Backed by the Ministry of Education of Sierra Leone, the meeting was held in Freetown in February, 1970, under EDC/USAID sponsorship, with APSP/EDC administrators attending as observers. Representatives from nine participating Member States formed a new organisation entitled "Science Education Programme for Africa." An interim executive committee was elected and made plans to meet in Nairobi two months later to consider a constitution, finances, and a programme for the future. The new organisation accepted a broader mandate than continuation of development work in primary science only. There was wide recognition that additional development at secondary and tertiary levels was not only important, but closely interrelated. Dr. Hubert Dyasi was appointed to be the first Executive Secretary for SEPA while continuing his position at Njala University College.

The founding of SEPA created new operational problems. There was now a secretariat in Africa without operating funds, and there was a secretariat at EDC with operating funds but under contract with AID to meet certain obligations such as developing materials in several African countries. The fact that African representatives who had attended the Freetown meeting had left under the impression that EDC field staff and their activities as well as unexpended funds in the EDC/AID contract would be transferred to SEPA complicated the situation since EDC was unable to make the transfer.

The renewal contract agreement between EDC and USAID in 1971 was primarily for implementation of the APSP curricular materials but included

a clause relating to support for an African institution to replace APSP/EDC.

The outline of work contained in the USAID contract afr-791 dated July 1, 1970, states:

> A. *Objective*
>
> *For a period as hereinafter set forth, the Contractor shall provide necessary services for the implementation of an African Primary Science Program. This program will promote curricular reform and new approaches to teaching primary science in five African countries - Sierra Leone, Ghana, Uganda, Kenya, and Tanzania.*
>
> B. *Scope of Work*
>
> *The objective of the program will be accomplished through:*
>
> *1. The development at workshops of materials for tutors to use in their courses in the 151 participating teacher training colleges, the training of the tutors in their use, and assistance to tutors with their in-service training programs for primary teachers.*
>
> *2. Upgrading staff members of curriculum development centers in participating countries through a special training program developed for this purpose; and*
>
> *3. Support to the Science Education Programme for Africa (hereinafter called SEPA), an African-based and directed organization which will ultimately assume complete responsibility for leadership and coordination of African science programs.**

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*USAID Contract afr-791 for the support of the African Primary Science Program 1971-1976. May 28, 1971.

Further resolution was necessary, since the Executive Secretary of SEPA was considered by EDC as its employee while SEPA considered him SEPA's employee. Fortunately, less than three months after its founding, SEPA obtained a direct grant from UNESCO's Division of Science and Technical Education, and within another few months received a grant from Britain's Centre for Educational Development Overseas. From these small grants, SEPA was able to purchase basic office furniture and open its own office; this was significant because it gave SEPA visibility and engendered confidence in the new organisation. The University of Illinois in the United States appointed Dr. Dyasi to its faculty and immediately loaned him to SEPA to serve as Executive Secretary, thus making him financially independent of EDC. At the same time, EDC placed a major project in teacher training under the professional directorship of the SEPA Secretariat. These were critical factors in the evolution of a working relationship between SEPA and EDC, marked by mutual trust and respect.

Two pivotal events occurred in 1972. Three African States, at the Cabinet level, recognized the SEPA Secretariat thereby establishing SEPA as a legitimate entity in the context of international law with powers to enter into legally binding agreements on the basis of SEPA's constitution. Thus SEPA was removed, at least in legal terms, from a position of dependence upon another institution. The second event occurred independently of the first. The Carnegie Corporation of New York in 1972 made a sizable grant of $92,000 to SEPA on the basis of discussions and a proposal submitted by E.A. Yoloye and Hubert Dyasi to set up an educational evaluation programme at the University of Ibadan. Stephen H. Stackpole and Frederic

Mosher of Carnegie represented Carnegie Corporation in the development of the proposal and demonstrated absolute confidence in the young SEPA organisation. The size of the grant was one measure of that confidence, but the real measure was the willingness to entrust fiscal and professional leadership without pre-conditions. The immediate outcome was a direct grant from AID in 1973, larger grants from UNESCO, UNICEF, and the United Nations Environment Program, and the final conclusion of direct agreements with USAID.

From 1971, when EDC successfully urged the inclusion of support for the development of SEPA as a technical assistance institution in the implementation contract, encouragement of SEPA was a consistent APSP thread. By 1973, APSP, for all intents and purposes, had become an institutional development programme, with its major task assisting the formation and early development years of SEPA. Implementation efforts in the five countries, though important in each individual situation, were not perceived as being of as long range significance as a Pan-African organisation which could manage African development of science education.

The cooperation between SEPA and EDC headquarters during 1970-76 did not follow a pre-planned pattern. Hubert Dyasi of SEPA/EDC and Ralph Robins of EDC reached an informal agreement that the SEPA Secretariat would supervise all professional activities in the field while EDC would be responsible for fiscal matters. EDC field staff were made aware of this, and the SEPA Secretariat was involved directly by EDC when reporting to AID and during discussions of future plans. The task was made difficult by its

pioneering nature, but the practice of relying on people rather than on administrative structure and on calculated steps rather than on stringent rules made the difference between success and failure.

2. Programming Development Within SEPA

2.1 Rationale

When SEPA was established in 1970, primary science education development had been in progress for several years. One of the first tasks of SEPA, therefore, was to identify techniques which could enhance networking activities; for example, using science centre personnel in the development of materials for teacher training. Another was creating effective lines of communication with officials in the Ministries of Education in order to engage their attention and interest for support of SEPA at the government level. A third task of signal importance was to develop the SEPA Secretariat's ability to inspire confidence at different levels in educational and scientific communities, among international assistance agencies and foundations, and in government circles.

The educational philosophy of SEPA is child-focussed with science serving as a vehicle. It aims at developing in children the ability to make rational choices so that they can have an impact on their own environment. In efforts to achieve that aim in classroom situations, the role of the teacher becomes one of guide and partner to the child, utilizing appropriate materials.

Paramount to this approach are direct participation by the learner in

all aspects of learning activities as well as a degree of self-evaluation. The implementation of the approach presupposes availability of a pool of knowledge and competent people to make use of the knowledge. SEPA's programming has aimed to train educators to be aware of this resource and employ it in their work. Components are:

- knowledge of the African child and culture,
- knowledge of local environment resources so that learning materials can be drawn from them,
- awareness of competent teachers who welcome a thorough grounding in the approach,
- evaluation practices in tune with the approach and with the direction of African education.

It is intrinsic to SEPA's objectives to offer every young person in each Member State the benefits of a relevant and excellent education, utilizing the accumulated knowledge and techniques of science as a vehicle. The focus is not limited to science but includes the development of the young person through acquisition of skills to enable him/her to make rational decisions about his/her *total* environment. The selection of "science" as a medium was no historical accident but a recognition that "scientific literacy" lay at the base of progress in agricultural, industrial, and medical techniques which have resulted in significant improvements in the quality of life.

2.2 The SEPA Secretariat

The Science Education Programme for Africa was established to provide

African direction and administration of science education at the regional level in Africa. In its eight years of existence it has grown to be a viable and professionally sound organisation commanding the support, recognition, and trust of many African States, several international assistance agencies, relevant U.N. agencies, and numerous professional organisations within and outside of Africa.

The heartbeat of SEPA is its Secretariat. Located in Accra, it was set up to provide an African leadership skilled in the generation of ideas and their translation to imaginative action programmes. Several conferences had concluded that education in Africa could be meaningful only if education development models employed were derived from experiences in and contents of the African physical and cultural environment itself. This focus highlighted a pressing need for thorough and sustained research to develop appropriate models and curriculum materials. The creation of the SEPA Secretariat was an ingenious response to this challenge. It was also concrete evidence of the African States' commitment to collective self-reliance and to the advancement of an African point of view in general education.

2.3 Projects and Programmes

Backed by purposeful leadership at the national level and by insightful support by international organisations, SEPA has undertaken successfully several projects related to various areas of improving science education. These are science teacher/educator training, materials develop-

ment, in-service teacher education, environmental science education, educational evaluation, and science education for out-of-school young Africans. In addition, a small task force works continually on the subject of developmental concept-formation in science and mathematics.

All SEPA projects are characterized by a complete break from traditional science education in which courses consist of scientific laws and endless facts with no selection or system for practical use by students. In SEPA projects, learners participate in systematic investigations employing thought processes that relate to the daily problems they face. In this kind of problem-solving, the learners are mentally and physically active in raising questions, seeking answers, and in improving their understanding of their world.

2.3.1 A *residential science educator training course** was initiated in April, 1972, with the purpose of building a critical mass of manpower trained in the SEPA philosophy and methodology in science education. This manpower would influence in significant ways the development of science education curricula in their respective countries. A number of evaluative reviews, both internal and external, have been made and all point out that African countries are beginning only now to implement universal primary education and that, therefore, the inauguration of the course was timely and its scope should be enlarged. The reviews are also unanimous in their praise of the professional content of the course.

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*See detailed report in Appendix 1.

The course has produced graduates who have for one academic year been absorbed in the integration of content and methodology of the SEPA approach, have learned how to employ them effectively in teaching/learning situations, and who are trained for leadership roles in teacher training-college programmes, teachers' centres, and in curriculum development units in their home countries.

The course is now an integral part of the Faculty of Education at Njala University College (University of Sierra Leone), fulfilling one of the original objectives of the science education department there.

2.3.2 The purpose of the *teacher training materials development project* was to improve prototype science teacher education materials: handbooks, sourcebooks, monographs, background booklets and teaching charts. To achieve the objectives of this project, SEPA deployed African science education professionals and scientists for participation at workshops organized for the purpose.

These publications are crucial to fostering an understanding of the philosophy, psychology, rationale, and content of the SEPA programme. They utilize materials from a variety of sources, including the APSP units, to reflect the integration of new points of view which have emerged in the light of practitioner science educator experiences. Small numbers of these materials were provided to SEPA members for use on a trial basis and have now been refined. The next step is to make large numbers available to African countries.

A subsidiary but essential activity in materials development has been experimentation with a variety of strategies to increase instructional effectiveness of workshops on localizing teacher training material developed at the regional level. A limited number of single-country workshops have been mounted in the past and the time has come to apply those strategies and the experience gained in systematic dissemination activities.

2.3.3 SEPA has carried out specific activities in cooperation with U.N. agencies on the theme of *environmental science education*. In cooperation with African States (through the support of UNICEF, UNESCO, and the Ford Foundation), SEPA organized a workshop in 1974 for selected environmental science teacher educators to:

- highlight innovative teacher training programmes in environmental science education;
- examine existing teacher training curricula in the light of the requirements of an environmentally oriented curriculum of primary schools in Africa;
- provide guidelines for future programming activities in the entire field of environmental science education to save present and future generations from poor health and nutrition due to environmental management;
- draw up a plan for collaborative action among participating countries.

Participants were drawn from fourteen Anglophone African countries. One of the outcomes of the workshop was a detailed statement of objectives of teacher training curricula and of environmental science education in

each country, curriculum guidelines in environmental science for teacher educators, and the use of the environment to develop young people's basic study, social, and technical skills. The workshop was an invaluable reinforcement to the teacher training materials development project.

A similar workshop was held in 1975 for nine Francophone States. The cooperating U.N. agencies were the United Nations Environment Programme, UNICEF, and UNESCO. That workshop so mobilized the interest and commitment of Francophone States that they requested SEPA to open a sub-office in Brazzaville to serve African States in that geographical area.

In 1974, SEPA was invited to assume professional leadership at a workshop on integrated science education for Francophone West African States. The workshop, organized and administered by UNESCO, was a significant step in a growing relationship in programming activities between UNESCO's Division of Science, Technology and Vocational Education, and SEPA, with the latter becoming the implementing agency.

The latest project on the environmental science education theme is a pilot activity carried out by SEPA on a contract with UNESCO for the *development of multi-media materials* for use by first cycle teachers in independent sub-Saharan Africa. The objectives of this activity include the design and development of primary level instructional multi-media "packages" which focus on the environment by utilizing scientifically based principles and social action. Other products will be resource guides for teachers and the evaluation of the materials to establish norms for their utilization and regional transferability. SEPA is using this

activity as a vehicle for the synchronization of curriculum development in the social sciences and in the natural sciences. The project is part of a global network of projects of a joint UNESCO-UNEP programme on environmental education.

2.3.4 Responsible development of education cannot proceed without a built-in component of educational evaluation. In 1972, an educational *evaluation training and research project*,* in cooperation with the University of Ibadan, was established to serve the needs of African countries for people trained in evaluation techniques and instrumentation in evaluation of educational innovation. Graduates of the training courses in educational evaluation would team up with graduates of other SEPA training courses to spearhead the implementation of the SEPA approach.

SEPA took the responsibility of providing fellowships during the early years of the International Centre for Educational Evaluation (ICEE) and used the facility also to undertake contractual evaluation work for UNESCO. Also, under this project, SEPA was able to evaluate two science education programmes. The ICEE now is a constituent department of the Faculty of Education at the University of Ibadan, and will continue to turn out trained manpower imbued with the spirit and philosophy of SEPA.

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*See detailed report in Appendix 2.

2.3.5 Toward the end of 1976, SEPA embarked on a pilot project for the development of an appropriate educational approach focussing on *out-of-school youth and young adults*. The project will extend science education to young people in Africa not reached by the formal education system. The education proposed will be environment-based, incorporating suitable activities from the environment which make use of local structures and conceptualizations and adapting them to present and future environmental requirements. Emphasis will be on activities for youth that will promote health, agriculture, nutrition, and resource conservation.

Through this project, SEPA is evolving a strategy for identifying advantageous points of intervention for participation in community activities in a manner that capitalizes on the strengths of the local community while minimizing the shortcomings. Tentative observations suggest that one of the weakest points in development projects is the difference between a development agency's perceptions of needs, activities, and resources on the one hand and the community's perceptions of these same concerns on the other. This leads not only to the depression of on-going culturally and environmentally appropriate activities but also to a mistrust of the development agency's intervention and, therefore, to the abandonment of its schemes as soon as it withdraws. The history of SEPA itself is an illustration of the value of synchronizing perceptions and of planning and developing jointly with target groups. Such involvement helps later in the communication and sustenance of the development activities as well as in their localization.

Nine pilot studies for finding ways to integrate environmental studies

with an out-of-school training programme are underway in specific communities. Personnel conducting the studies are gathering data on accurate identification and public involvement of key people in the community, adoption of existing community decision-making processes, mobilization of community resources, and wise election of change agents and "animateurs." Data on predominant environmental stresses and on the areas where out-of-school youth might find a livelihood by interaction with the environment are also under study.

More than any other project carried out by SEPA, the out-of-school youth education project teams social science specialists and institutions with natural science and technology specialists in development activity. It is hoped that this integration will foster a continued social science data collection approach in the study of rural technologies and livelihood activities which will in turn be useful for policy-making purposes.

2.3.6 In August, 1978, SEPA assembled a small task force to explore progress made in the application of concepts from developmental psychology in curricula for teacher preparation in Africa. The meeting highlighted the need to:

- *hold periodic dialogue among research psychologists, curriculum specialists, and teacher educators;*
- *provide regular up-to-date bibliography on published and unpublished studies;*
- *identify teacher educators in Africa interested in*

the application of the findings of educational and developmental psychology to curriculum construction;

- *encourage workshops, seminars, conferences, symposia and meetings dealing with the issue of concept development;*

- *translate research findings to language which teacher educators will understand and to encourage research psychologists to participate in the writing of suitable teacher training materials.**

The meeting marked the beginning of the *concept formation project.* The project became formalized in September, 1974, when SEPA, UNESCO, and UNICEF sponsored an African Regional Seminar on the development of science and mathematics concepts in young children in the countries of Africa. Since then, SEPA has organized meetings of an expanded task force to formulate a working model for the future development of the project, carried out a bibliographic survey of on-going and completed research, published a monograph on Piagetian learning theory and SEPA Science, and is publishing a book on the intellectual development of children in Africa which is part of a series entitled, *Essays on the African Child.* The book is devoted to Piagetian theory, research methodologies in child study, development of language and thought, the environment and intellectual development, and implications for teacher education and curriculum development.

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*From a staff paper by Ohuche and Otaala.

This project relates most fundamentally to the SEPA approach which is environment-based and focussed on the child's interaction with that environment. The approach emphasizes learning that is direct, personal, informal, deliberate, and tailored to the child's intellectual, affective, and cultural attributes. For policy-making purposes, the need to understand psychological bases underlying such an approach by the teacher educator, the curriculum developer, and the educational evaluator cannot be overestimated.

3. Characterization of SEPA as an Agency

SEPA derives its integrity from three well-defined sources: 1) provisioning, 2) mode of operation, and 3) characteristics which include, among other things, personality, knowledge, and commitment. Some of these characteristics, namely, knowledge, personality, trust, and confidence contribute to the authority of SEPA. Other sources of authority are derived from the acceptance of SEPA by target communities and the recognition of SEPA by the governing bodies of the countries where it operates. This recognition gives SEPA legitimacy and emphasizes the acceptance of its philosophy. "Partnership" is the style of SEPA operations in terms of the elements in a given community; e.g., broad-based consultations; joint perceptions of needs and diagnosis of problem; and cooperative planning, provisioning, execution of schemes, and evaluation of project activities.

4. Impact of SEPA in African Countries

4.1 Use of APSP Units

There has been an evolutionary process in the use of the APSP units developed in the 1960s. During that period, the materials were used essentially in their original form as supplementary materials for science teaching. In the 1970s, the units had less direct usage. In many countries, for the most part, the activity and discovery-oriented approach of APSP/SEPA teaching has been incorporated into the national science curricula either visibly or obliquely. Evidently, as Africans took greater control of the development of their national curricula, the concern for relevance made it impractical to accept centrally developed materials without modification. While some countries have adapted the units to their local needs, other countries have devised their own. What has been most accepted is the APSP/SEPA approach to working with children.

Country studies reveal that the approach has become an integral part of written syllabi and teaching guides even when APSP or SEPA are not specifically mentioned. The application of APSP/SEPA approaches in the classroom has not yet been documented in all countries, and a detailed study of its extent is needed in the future.

4.2 Manpower Development

Manpower development appears to have been the major area of impact of APSP/SEPA, particularly of SEPA. The SEPA practice of setting up pro-

grammes in existing institutions has been a most effective way of building up national capacities in educational development. Two notable programmes, which enroll students from all participating countries, are the International Centre for Educational Evaluation (ICEE) at Ibadan University in Nigeria and the Science Educators Training Course (SETC) at Njala University College in Sierra Leone. The training of so many people to date has formed a community with like interests and experiences, members of which can communicate fully and easily on matters of educational renovation. Of the eleven people from different African countries who did the research for this Review Report, six are graduates of the ICEE and one had been a visiting scholar at the ICEE.

4.3 Research and Development

Projects in this category are inevitably less visible to the various countries, and consequently, in their reports there is little or no indication that the countries are aware of them. The teacher training materials development work is likely to become very influential if and when its *Handbook of Science Teaching* is properly distributed. Contribution to research in general has a potential for growth in the institutional programmes such as the ICEE and, to some extent, the SETC, but the stability and continuity of the parent institution is essential for research and development to thrive.

5. Visibility of SEPA as an Organisation

All country reports agree that SEPA is well known within a restricted

circle, namely ministry officials, curricula centres, and among those who have benefited from SEPA training programs at ICEE and SETC. SEPA is much less visible beyond these circles, especially to most teachers in the schools.

Attitudes to SEPA in official circles are predominantly favorable, but there are local reservations. In the East African countries, for example, there is a feeling that SEPA programmes are too strongly concentrated in West Africa (Secretariat in Ghana, ICEE in Nigeria, SETC in Sierra Leone). In Ghana, there is a feeling that in spite of the Secretariat being there, SEPA has done little for science programmes in Ghana. Gambia reports an indifferent attitude, largely because of insufficient information about SEPA in official circles. Ethiopia records a favorable attitude, but the Ethiopian revolution has broken what was earlier a very fruitful and effective communication.

In general, it seems that the visibility of SEPA as an organisation is at present low. Visibility, of course, is not to be confused with impact. The only problem is that it is essential for each to reinforce the other for greatest effectiveness.

One other area of impact of SEPA as an organisation is at the level of interaction with international agencies. At this level, both impact and visibility seem to have been achieved in a greater measure than at the country level. For example, UNESCO has constantly involved SEPA in its activities, and organisations like ICASE have had considerable SEPA input.

SEPA, well aware of its problems with visibility, considers correcting

them an urgent responsibility and, as the second volume of this Report will show, has made plans for remedies.

v

REFLECTIVE ANALYSIS

1. Introduction

This portion of the Review is distilled from the mass of information collected during the data gathering stage by two African evaluators. To a large extent, we have "read between the lines" and formed opinions from our reading of documents and from what we were told. As a result, we take responsibility for any conclusions we make and attest that our views do not necessarily represent those of the funding agency nor that of SEPA itself.

The African Primary Science Program was one of the largest and most important educational developments in Africa during the last twenty years. Historically, Africans have been described as people with an insatiable thirst for knowledge; the premium which has been placed on education is exceedingly high. A good education is seen as an enormous investment, hence the byword "Investment in Education," commonly heard in many African countries. Indeed, social as well as economic status in Africa depends to a large extent on how much basic education one has acquired. One would, therefore, expect that a programme such as the African Primary Science Program would be well-received in Africa.

The science element in APSP gave it further attraction for African States, largely because science is considered to be the spring-board to

industrialization and high technology, something which was clearly missing in Africa in the early '50s. African leaders and those responsible for making decisions on educational matters may have been influenced by opinions about science and technology such as those stated by Albert Baez:*

> *Science can root out ignorance, superstition, fear and poverty.*
>
> *Without indigenous science and technology, the natural and human resources of the nations cannot be organized for industrial expansion or national defense.*
>
> *Economic and social development require a climate of popular understanding and acceptance of science.*

Education in most African countries is organized primarily at three levels: primary, secondary and tertiary. Primary education has been regarded as the foundation on which further education is based. If, therefore, a new programme emerges which has potential for changing the African environment, it seems logical to introduce it at the very beginning of the educational ladder. The African Primary Science Program was both logically sound and politically relevant. Africa was ready to accept programmes which influenced not only the political thoughts within the continent but also those that helped to shape the destiny of Africans. We have referred to this optimum time as the *convergence of events*; convergence of several thoughts within and outside Africa. Two events outside Africa which had a

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**Innovation in science education - world-wide*, The Unesco Press, Paris, 1976.

direct influence on the evolution of APSP were the Rehovoth Conference in Israel in 1960, and the Endicott House Summer Conference of 1961. In our interviews with some of the people who played an active part in these conferences we formed some impressions.

In the American environment, the impetus for the Endicott Conference seemed to have come from three directions:

i) the Rehovoth Conference in Israel;

ii) scientists and scholars who had contacts with Africa and Africans;

iii) the experience already acquired in successful science programmes in the United States.

The teaming of academics, who had demonstrated genuine interest in improving the scientific literacy of mankind, and Africans who could articulate their areas of interest in science education was thought to be propitious. Professor Jerrold Zacharias (Zach) did confess that at the time of the conference, the bulk of American scientists knew very little of Africa except what they were able to gather from British educators who had themselves worked in some parts of the continent. While the opinions of educators like Professor Lewis of the London University Institute of Education about African affairs were respected by participants of the Endicott House Conference, the role played by Professor Zacharias was a very special one. Talking to him now, almost twenty years after he first conceived the idea of starting a revolution in science education not only in America but in Africa, one senses a man with a phenomenal memory and very clear vision. In our interview with Frank Sutton of the Ford Foundation

in New York, he described Zach as

> *an incredible and distinguished scientist. Zach has a great capacity to attract very serious and distinguished people to attack a problem not in a routine way but in a characteristically unique way.*

The African Primary Science Program was described by many of the people we interviewed in America as "the brain child of Zacharias." Zacharias was modest enough not to make this claim, but he expressed gratification with the way the programme was conceived, planned, and executed. He had great faith in the African child's capacity to learn science "provided science was presented to him in the proper way." The proper way, according to Zach, is to present the two views of science not separately but at the same time; "problem seeking and problem solving." Using the concrete and familiar objects abundant in the African child's environment as learning materials, the African child could be encouraged to experience and practice science in the way pure scientists work.

2. The APSP Philosophy

The motivating force as well as the philosophy which guided first ESI, and later EDC, was built upon the belief that science is an activity carried out by scientists. As a result, any modifications of the approaches found to be unsuccessful in schools were to be undertaken basically by scientists. Architects of this "scientist-philosophy," notably Professors Zacharias and Goldstein, who were interviewed for this Review, made no pretense about their belief that there was little need for emphasis

on the "art of teaching" beyond the scientific approach of "questioning all things and doing science." Their apathy towards basic training of educationalists in the sciences and in teaching science methods in the Training Schools of Education became obvious as one studied the composition of the group which was to shape this new approach to the teaching as well as the learning of science. (Later in the APSP experience, and most particularly with the advent of SEPA, consideration was given to the "art of teaching" but Zacharias' and Goldstein's contention that the scientific, or inquiry, approach was the key to any field of teaching was never lost sight of.)

The APSP approach was summarized as child-centered, flexible, unstructured, and open-ended. At the time APSP was introduced to Africa, there were other attempts at improving the learning of science, but in almost all cases, these attempts were introduced within the existing trend in the schools.* The APSP approach was a departure from the current structure at the primary level. Science, the architects of the APSP approach maintained, should be taught in the way scientists operate.

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*For instance, in Nairobi, Kenya, in the early '60s, the Ford Foundation sponsored a programme in which a group of science teachers from the Bronx High School of Science in New York worked with Kenya science teachers at the secondary level. Much of the work of this group was governed by what the then existing system dictated, and the improvement of science teaching was seen from the perspective of assisting without disturbing the *status quo*. The Bronx group developed their modern approach to science teaching within the "structured demand and examination system" of the Kenyans.

In our interviews with Professors Goldstein and Zacharias and with Dr. Ralph Robins, an administrator, the strong view of the "scientist's way to science" was supported by all three. No scientist, nor science educator, will doubt the impact which "teaching the way of the scientist" can produce, but the question at that time was in terms of readiness. Was Africa ready for this educational revolution? Did the examination system which conformed to an approved syllabus permit the open-ended approach to science and science teaching? These were problems uppermost in the minds of those who shaped the programme.

In our interviews with African science educators, conference participants, and teachers, we posed the problems raised above. It was significant to note that the Africans had seen these problems as disturbing at first, but said that the problems, once recognized, were tackled. The teachers in whose hands APSP materials were placed were not prepared to teach science, and much less, to teach it in this revolutionary way. The APSP workshops dealt mainly with materials development and appraisal and were not in-service, competency-based workshops. The examination system in most African schools did not change and the new approach posed the problem of how pupils in APSP were to be tested. As a result, a number of the African countries that adopted the programme had to adapt it to their systems and develop syllabi accordingly. It appears that the need to structure the APSP materials was felt to be a necessary departure but that the open-ended approach to science teaching was accepted as a positive way of learning. Thus, we see clearly the distinction between "an approach or philosophy to teaching elementary school science" and

educational programming itself. In fact, the originators of APSP maintained that the "approach" was their concern, but adapting this to any existing system was not. The initiators of APSP never saw it as rejection of their ideas when a country re-structured the material in a way not originally conceived by them. The success of APSP should not be judged solely by how widespread the use of its materials in African schools are *in their original form*; success of the philosophy of APSP in terms of acceptability could be determined in other ways.

For instance, in our interviews with individual African science educators who were actively involved with APSP, we were told that their contact with the APSP philosophy affected their later involvement in science education activities. Professor Babs A. Fafunwa who was one of the African architects of APSP stressed that the now popular innovative Ife University Programme in the use of the mother tongue in teaching at the elementary school level, which he directed in Nigeria, adopted most of its approach to science teaching from APSP. He sees a direct link between APSP ideas and the Ife University Programme, whose materials are now being used in the school system in other Nigerian states. Dr. Akin Osiyale, one of the original local staff of APSP in the University of Lagos College of Education, said that in writing elementary science books now being used in Nigeria, he was heavily influenced by the APSP science teaching philosophy. In Kenya, Mr. Francis K'Opiyo, whose contact with APSP dates back to 1965, is now involved with disseminating the same philosophy in teacher training

workshops and preparation of elementary school teachers for the Kenya Certificate for Primary Education (CPE).

We also feel that the advent of a new programme on the African educational scene underscored the need to modify, if not totally change, the established examination systems in most African countries. While this was certainly not the prime motive of APSP philosophy, and the much-needed revolution in science teaching at the elementary school level is slow in taking shape, yet the impact of the APSP philosophy is obvious in a number of the new and recent educational policies of most English-speaking African countries.

3. Programming and Institution Building

Reference has been made in this Review to the Endicott African Summer Study which took place in 1961. It has been stressed that APSP, to a large extent, owes its birth to that study conference in which a group of scholars from the USA, UK and Africa discussed educational needs for Africa. Today, another idea expressed at that conference has been realized in part by the transformation of APSP into an institution, the Science Education Programme for Africa (SEPA). We feel that those early intentions to create an institution like SEPA have not been given the prominence they deserve.

A resolution tabled at the Summer Conference in 1961 reads as follows:

It is proposed to organize an international institute for educational research, to be established in Africa and conducted jointly with citizens of the African states. Participation in the institution, at all levels, would be individual; that is, there would be no direct government participation as such.

Professor Jerrold Zacharias was Chairman of the session when the issue of an international institute for educational research in Africa was discussed. Specifically, the main objectives and activities of such an institute were:

- conducting of basic research in the sciences related to the process of teaching and learning;
- creation of new educational material and revision of existing material with particular emphasis on investigation into the special curricular needs of Tropical Africa;
- embodiment of these teaching materials (including textbooks, sound recording, apparatus, films, etc.) in experimental and tentative curricula;
- construction of tests for the purposes of selection and evaluation as part of the teaching process, and organisation and conduct of examinations;
- enlistment of teachers in the creation of new materials and teaching aids, with a view to producing a corps of teachers trained in the institute itself and in association with other institutions;
- direct support of teacher training, in the institute itself and in association with other institutions;
- experimental use in schools of material produced by the institute and by other groups;

- organized publication of its findings.

We found this list of eight objectives and activities for the proposed international institute not only impressive but ambitious, and were surprised to note the differing views expressed by participants at the session. The points under most contention were the proposed international character of the institute, and how such an institute would function and be able to accomplish all its goals. Zacharias put forward his views about what was meant by an international organisation.

> *To establish an international organization, therefore, you need to establish the principle. And if you have at least a minimum of two and preferably four to six nations in Africa and a minimum of two countries, let's say the United States and Wales, on the other side you have established its internationality and from then on it can grow and it can grow as fast as is necessary or as fast as is possible.*

Although the definition of a non-governmental international institution was finally accepted by the group during the session, the actual operation of specified tasks generated divergent views. Some people had a problem with what seemed an all-embracing task in production of materials. The material production spelled out, one person observed, seemed to be sufficiently diffused "to degenerate into some kind of vague administrative responsibility that would get to be gadgetry." The need to consider the infra-structural differences in Africa (communication, language, economic potentials, etc.) in setting up an all-embracing African institution was stressed by others. The projected source of funds and operational costs

were discussed and the advantages of establishing an international, non-governmental non-profit private institution were restated and endorsed. But, from the report of this session while debate seemed worthwhile, the discussion ended on this note from the chairman:

> *It seems to me at this point we should wind up not only the day's meeting but the project.*

And thus, the subject was closed and the International Educational Research Institute for Africa exists only in the words of record.

However, the idea of a regional institution persisted even though the African Primary Science Program was essentially a national effort within each participating country and the APSP science educator in each country was responsible to a national institution. Regional versus national effort was always a matter under discussion by funding agencies.

At the time that Professor Zacharias approached the Ford Foundation for support in his efforts to develop an African Primary Science Program, the Foundation had tentatively endorsed a policy which gave preference to support for national rather than regional programmes. Frank Sutton summarized the Foundation's stand when he said:

> *We thought that if we concentrated in one country, the work would also get around but if we concentrated in a regional program, it would, apart from all the technical and political difficulties, seem like spreading thinly.*

Assistance on a regional basis is directed toward development of institutions that foster continued cooperation among the participating coun-

tries. Such institutional development requires considerable effort and resources; for example, it requires formulating a legal basis for the organisation, identifying sources of funding sympathetic to the objectives of the organisation, selecting and training staff indigenous to the region, and identifying a *lingua franca*. But the most important challenge to a regional organisation is the formulation of programmes which will rank high among developmental priorities of cooperating countries. Equally important, too, are the motivating factors leading to the formation of a regional organisation. The onset of political independence in a country usually transforms a country's ideas to "freedom from" what came before, and complete freedom from all domination follows. Thus a regional organisation whose origin and motivating personnel are not intrinsic to the region, immediately makes that organisation suspect; is it another "colonial move?" "do they mean to impose ideas?", etc. On the other hand, when a regional organisation is born out of identified needs and pragmatic purposes by countries within the region, i.e., intrinsic origin, such an organisation is jealously guarded and held in high esteem. Membership in such an organisation is considered a mark of "belonging to."

4. SEPA as a Regional Institution

The years 1960-1970 have been described as the evolutionary and operative years of the African Primary Science Program (APSP). The general acceptance of the objectives of APSP and the cooperation derived from international APSP workshops and conferences gave impetus to the formal inauguration of the Science Education Programme for Africa (SEPA). As

pointed out earlier, APSP derived most of its operating funds from the United States Agency for International Development (USAID) administered largely through the Education Development Center (EDC). Throughout the years of operation of APSP, emphasis was always given to manpower development. Like political independence, both AID and EDC looked forward to the day when the African Primary Science Program would be organized and supported within the African region, thus gaining its financial independence. As a result, the contracts through which funds were provided by AID specified that their support was based on that understanding. The AID evaluation team recommended that AID support to the Secretariat be phased out as contributions by the Member Countries increased. As the Member Countries became more committed to the SEPA approach to improving science education in Africa, and as SEPA membership expanded and external support to the Secretariat was phased out, it was envisaged that SEPA would be able to provide 100% of the Secretariat costs by FY 1979.

In our interviews with AID officers in the Africa Bureau Division, we were impressed by their high regard for and sense of commitment to educational development efforts in the geographic region of Africa. The support which APSP and now SEPA has enjoyed from AID is tremendous. But money alone cannot produce programmes or trained manpower overnight, nor can it create the healthy climate for international understanding in a bilateral programme. Of particular interest is the understanding between AID and SEPA in execution of programmes supported by AID. AID, as a matter of policy, has not taken the role of decision-maker in SEPA programmes. The result is that SEPA pro-

gramming activities have been executed the "SEPA" way. AID has persistently remained in the background while giving the necessary support and in some cases additional funding to programmes executed by SEPA. In particular, we have found that the AID funds have often been the main source of support for the Secretariat of SEPA in Accra. At a time when the Member State contributions have been erratic and, now because of inflation and diversified programme plans, also inadequate, AID support has been a lifeline to the SEPA Secretariat.

At this time, SEPA activities cover programmes in its twelve Member States in the East, West and Southern English-speaking Africa. We have already discussed the SEPA programmes, and in this portion of the Review will discuss the organisational aspect of the SEPA Secretariat.

Perhaps due to lack of sufficient funds and lack of adequate trained manpower, the SEPA Secretariat began with a small indigenous staff. Over the years it has been kept so. Of the original staff of four only the Executive Secretary could be described as a professional in the strict sense. He was the Administrator and at the same time the Programme Manager who monitored the activities of SEPA in the Member States. In the formative years of SEPA, an important and time-consuming task for the Executive Secretary was the solicitation of support from donor agencies. As a result, his time was split between short periods at his desk in the Secretariat and long and arduous trips abroad. The Executive Secretary was simultaneously a technocrat and a public relations officer. The success and failure of SEPA fell on his shoulders and a high degree of diplomacy both in and outside of Africa was called for on his part. In the 1973

Evaluation Report submitted to AID by the American Institutes for Research (AIR), reference was made to the staffing of SEPA:

> *It is the opinion of the evaluation team that the development of SEPA, with strong African leadership from its very early stages, constitutes a model of regional organizational development.*

And so indeed, SEPA grew from strength to strength under the leadership of its first Executive Secretary, Dr. Hubert Dyasi. In the files of donor agencies such as AID, Carnegie, Ford, UNESCO-UNEP, who at one time or other worked with Hubert, glowing tributes were paid to the ingenuity, sense of leadership, and human qualities which the Executive Secretary exhibited. The name Hubert Dyasi came to be synonymous with SEPA.

We talked to Hubert at length and said we admired his vision in initiating and carrying through the many programmes for which SEPA is now known. Hubert insisted that the success of SEPA is due to joint contributions from scholars and administrators in Western countries, scholars from African academic institutions, educational administrators and policy-makers in the various African States, classroom teachers of science in Africa, and the many students with whom he interacted in the SEPA-sponsored science education programmes. Hubert made the point that the growth of SEPA would and should depend on more than one individual, no matter how versatile that individual might be. He sees a great future for SEPA if it can surmount the "teething" problems which plagued the organisation early in its formation. We urged him to outline these problems, and he said there was a major one on which resolutions to other problems rested.

The first major problem of SEPA was, and is today, operating funds. SEPA lacked funds which it could call its own, especially for the formulation and prosecution of its programmes. There is no doubt that if SEPA must depend on donor agencies outside Africa for the major part of its operating costs, it would soon face problems if a recession, a particular political decision, or the like, forced donor agencies to cut back on funds to SEPA; as Hubert puts it, the result would be "disastrous." The solution to this problem, he thinks, would be for Member States in Africa to provide total financial support through regular and increased subscriptions. And SEPA needs to be assured of these incoming funds in a timely way in order to plan ahead. If SEPA is to prosecute all its existing programmes successfully and support them with its own funds, an annual conservative budget of about $500,000 would be needed. At the moment, contributions from the Member States go a long way towards meeting some of these operating costs, but certainly not this projection. The table on the next page shows the source and amount of funds in the SEPA books at the time of this review, with particular reference to the Member States' contribution.

Until complete financial independence is achieved, Hubert feels, SEPA must continue to seek funds from organisations and agencies interested in strenghtening efforts to develop a scientifically literate community in the African region.

In too much dependence on funds from outside agencies we also see the ever-present danger that very soon SEPA will be carrying out programmes that are of interest only to donor agencies. SEPA may unknowingly deviate

Financial Position: SEPA

Position of Members Contribution

20 November 1979

	1978/79		1979/80		
	Contribution paid 1978/79	Balance due 1978/79	Members Contribution 1979/80	Payment 1979/80	Balance 1979/80 up to date
	$	$	$	$	$
Botswana	3,100.00	-	2,500.00	-	2,500.00
Ethiopia	-	16,079.67	-	-	16,079.67
Ghana	12,000.00	-	12,000.00	1,090.90	10,909.10
Gambia	2,528.51	-	2,500.00	-	2,500.00
Kenya	9,217.88	11,748.11	7,500.00	-	19,248.11
Liberia	5,300.00	3,650.00	5,000.00	-	8,650.00
Nigeria	10,570.90	2,044.93	12,000.00	-	14,044.93
Sierra Leone	6,750.00	3,192.36	7,500.00	-	10,692.36
Swaziland	2,500.00	-	2,500.00	-	2,500.00
Uganda	-	15,250.41	7,500.00	-	22,750.41
Zambia	12,294.31	7,294.46	12,000.00	-	19,294.46
	$64,261.60 Cr.	$59,259.94 Dr.	$71,000.00	$1,090.90 Cr.	$129,169.04 Dr.

from its charted course and seek funds which may be tied to other priorities than those of SEPA. This has already occurred, as seen in some of SEPA's recent activities and, in our view, has been weakly defended on the grounds that SEPA philosophy encompasses more than elementary school science and the development of manpower for science curriculum development in Africa. Science, we were told, was only a vehicle for translating the SEPA philosophy. (It is our feeling that SEPA must take an intensive look at its future plans, and it has made a beginning at the Review Conference in Botswana. See Volume II of this report.)

A second problem which faces SEPA is the nature of the administrative setup within the Secretariat. In a memorandum and document 698-0390, titled "Project Paper African Science Education," dated the 18th of May, 1976, which we obtained from AID, we found a reference to and recommendation about a change in the administrative setup in SEPA:

> *To increase the effectiveness of the Secretariat in obtaining external assistance, the AID evaluation team recommended that the position of Executive Secretary be divided into two positions: the Executive Secretary, who would assume administrative and fiscal responsibility and a Program Specialist who would assume program development and management responsibility. AID is providing support in this project to implement this recommendation.*

The recommendation that there be two top positions within SEPA was, in fact, put into effect in 1976. However, we are aware that this practice has not been a total success. Part of the trouble is that of establishing a clear line of authority and hierarchy within the administration. On paper

the executive secretary is expected to be an administrator only, but an executive secretary not involved in the professional aspect of the organisation's programmes is awkward since the programmes constitute the rationale for SEPA's existence.*

5. Viability of a Regional Organisation

The story of SEPA and its success as a regional organisation brings us to the larger issue of the regional organisation's viability in general. The reservations of the Ford Foundation about giving support to a regional organisation as compared with supporting national efforts (see Frank Sutton's statement quoted earlier in this chapter) is one which many funding organisations share. Such reservations are, at least in part, born out of previous disappointing experiences. Within ESI/EDC, there were other African

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*At the Botswana Conference, there was considerable rethinking on the administrative structure of SEPA. (See Volume II of this report.) A more elaborate administrative structure has been proposed including the possibility of field officers or coordinators for different zones of the continent. The post of programme director has been redesignated "assistant director (programmes)" presumably to define the hierarchy more clearly. However, the increase in terms of administrative personnel immediately accentuates the first problem highlighted, namely lack of funds. As of now the secretariat has great difficulties in paying its meager staff. It does seem that in addition to the restructuring of the administration, SEPA would need a vigorous fund raising drive, and to an extent beyond the contributions of member countries. Perhaps it is time for Africa's umbrella political organisation, the Organisation of African Unity (OAU), to take a hand in keeping SEPA alive and active. The recent granting of observer status at OAU to SEPA is a significant first step. Perhaps it is also time that SEPA think seriously about generating funds from its own products.

education programmes which were not as successful as APSP/SEPA. Other regional organisations outside the EDC management, but funded externally, have failed to survive. So many questions remain open to debate: Is a regional organisation viable? Are there things that a regional organisation can do which cannot be better done at a national level? What are the essential factors that determine success or failure of a regional organisation?

5.1 Is a regional organisation viable?

SEPA's success is concrete evidence that a regional organisation is viable. But it is clear from experience that the establishment of such an organisation requires a fairly long gestation period during which sustained effort, patience, flexibility, understanding and sacrifice must interact in complex ways. (We discuss a number of these factors below when we address the third question.) SEPA has experienced major problems, solving a number of them while continuing to grapple with the challenge of establishing financial independence. Even in this area, SEPA has worked in innovative ways and has had an enviable measure of success.

5.2 What can a regional organisation do that cannot be done better nationally?

An organisation such as SEPA has much to contribute by working in a regional framework. One of the most significant contributions of SEPA has been the opening up of *communication*. It has promoted communication among African nations on educational matters in a way that no single African nation could have done. This has been in addition to the kind of

communication carried on at professional conferences. Internally, within Africa, the opportunity for people from various countries to work together in tackling common educational problems has developed a sense of kinship. One could say that a community of people has developed who can communicate educationally, speaking educational language intelligible to one another. In due course, a critical mass of such people is bound to emerge in each country, thus strengthening the process of generating educational change. At a different level, when it has been necessary for other international organisations - UNESCO, UNICEF, UNEP, ICASE, etc. - to communicate with Africa or sometimes even with individual countries in Africa, the existence of SEPA has provided a ready avenue of communication. Over the years, SEPA has built up considerable expertise and knowledge about the African scene. And, being an African organisation, it has commanded greater credibility among African countries than any outside body could have done.

A second contribution is *optimisation of manpower*. Expertise in many skills required for educational programming is scarce in Africa. When scattered expertise can be marshalled to work together on a specific problem either regionally or within one country, it is a powerful force. SEPA has set a model in this technique of optimisation of manpower.

Communication and marshalling of expertise are intangible entities which take a long time to build up. Yet on the African continent where erratic communication and limited expertise are fundamental problems, and where there has been disenchantment with foreign "experts", the enhancing of communication and pooling of expertise are of great significance when it can be seen that these are being done by Africans.

5.3 What are the essential factors that determine success or failure of a regional organisation?

In considering the various factors that determine success or failure, we have identified five for discussion. They are: (1) People, (2) Flexibility, (3) Institutionalisation, (4) Trust, and (5) Humility.

5.3.1 People

In the words of Hubert Dyasi "the practice of relying on people rather than on administrative structures and on calculated steps rather than on clearly laid out rules made the difference between success and failure." That statement encompasses two of our identified factors, namely people and flexibility. We would like to recall in this connection also a comment by Yoloye (1978)* while referring to the core of people in Africa who had had contact with APSP/SEPA.

> *On this core of people rests the hope of generating continual change in the curriculum. It would be erroneous to even estimate the potential of this core in terms of numbers although there is strength in numbers. More important perhaps is the kind of people who form the core. Two imaginative people who have caught the spirit of change may be far more effective than twenty who have simply absorbed the change.*

The "people factor" has manifested itself in many ways in the story of SEPA. Hubert Dyasi is perhaps the greatest illustration of this. In the early years of SEPA, the secretariat was not a physical or administrative structure; it was Hubert's creativity, vision, sensitivity, and

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Op. cit. Yoloye E. A. (editor)

diplomacy which helped to persuade governments to sign the instrument of acceptance of SEPA. At the same time, a critical factor in each country was not so much official processes as the drive and commitment of each country's representative on the SEPA council. And in institutionalising SEPA projects, it was crucial to have one person of sufficient vision and commitment in the institution to accept the responsibility. There had to be a Kamara at Njala to institutionalise SETC. There had to be a Yoloye at Ibadan to institutionalise ICEE.

The reliance on people did not originate with SEPA. The tradition began with the inception of APSP. The greatest asset of both programmes was the ability to identify the kinds of people who had sufficient commitment and motivation to do specific jobs.

5.3.2 Flexibility

The tradition of depending on calculated steps rather than clearly laid out rules is one that also evolved with APSP. One of the things that distinguished APSP from other African education programmes was its truly experimental approach to curriculum development. While other programmes produced their educational materials in hotel conference rooms, APSP workers were out in the classrooms working with real children, testing out ideas, learning about children, and basing their educational materials on field experience. For lack of a better word we have characterised this tradition as flexibility. It is preparedness to modify procedures in the light of hard data and real experience. Ralph Robins summarised this tradition succinctly when he wrote about "changing goals":

*What is frequently not recognised is that experience with the early phases of any innovative programming must necessarily modify what comes later. Our need then is to recognize that this process of goal adjustment is not only natural but a necessity if programmes are to focus realistically on problems in a productive way.**

5.3.3 Institutionalisation

One of the ingenious strategies of SEPA is that of institutionalising its major projects. The two prime examples are the International Centre for Educational Evaluation (ICEE) at the University of Ibadan, Nigeria, and the Science Educators Training Course (SETC) at University College Njala, Sierra Leone. The essence of institutionalisation is persuading a national institution to accept responsibility for the continued existence of a regional programme. Finance for the support of the infrastructure is thus guaranteed as part of the regular annual budget of that institution. By this strategy, one of the basic problems of externally funded regional programmes - that of continuity or permanence after the external funds run out - is solved. Getting a national institution to accept responsibility while maintaining the international or regional character of the programme has proved to be a more reliable way to guarantee permanence than relying on country contributions to support a regional programme.

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*Robins, R. H. *Programming for Change in Science Education*, APSP monograph series, 1970.

5.3.4 Trust

In referring to the confidence in SEPA demonstrated by Stackpole and Mosher of Carnegie Corporation in granting it $92,000 to set up the educational evaluation programme at Ibadan, we said:

> *The size of the grant was one measure of that confidence, but the real measure was the willingness to entrust fiscal and professional leadership without pre-conditions.*

5.3.5 Humility

In discussing the impact of SEPA, we had to distinguish between impact and visibility. SEPA ideas have found their way into the curricula in many African countries but the curricula have not borne the name of SEPA. In most cases, SEPA has not been mentioned even in the preambles. The two major institutionalised SEPA projects, ICEE and SETC bear the names of their universities and not of SEPA, yet they set out to fulfill SEPA ideals and they consistently produce the kind of manpower for educational development in Africa that SEPA wishes to produce. It requires great humility to have one's ideas work without being publicly acknowledged for them. It is like having the victory without the triumph. In our opinion, the victory is the first order of priority. The triumph is of a lower order. In putting its emphasis on effectiveness and efficiency rather than on visibility, we think SEPA set the right priorities. In the long run, the acknowledgement will come even if it is only in terms of historical documentation.

APPENDIX 1

REPORT OF
THE SCIENCE TEACHER EDUCATORS' PROGRAMME
(1975 - 1979)

Project Description

A programme for the professional training of science teacher educators was founded jointly by the Science Education Programme for Africa (SEPA) and the University of Sierra Leone in response to the acute shortage of indigenous professional teacher educators in Africa. The programme is based on the Njala Campus of the University of Sierra Leone and has been in operation since 1975. In its four years of operation it has graduated only a few of these highly needed personnel but all have returned home to satisfy the manpower needs of their countries. Countries that have benefitted by participating in the programme are: The Gambia, Sierra Leone, Liberia, Ghana, Nigeria, Uganda, Kenya, Malawi, Botswana, Lesotho, and Swaziland. A survey conducted by SEPA revealed that a critical mass of persons is needed for each participating country if innovative practices in the training of primary school teachers are to be adopted. Thus the programme hopes many more people will be attending in the future.

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Philosophy and Objectives of the Programme

The programme, as planned and operated in the past three years, views science as an instrument of human and educational change in Africa. Therefore the focus is environmental. We believe that a good lecturer who has the responsibility for training teachers must not only understand content but must understand the characteristics of his students, possess competence in relating with children, and must be made to accept responsibility for his own learning. Graduates of the programme must:

1. have direct experience of their true roles;
2. be able to educate people who will have the following attributes as teachers:

   a) ability to construct units of instructions and teachers' guides,

   b) ability to ask the right questions,

   c) ability to analyse units of instructions,

   d) ability to resolve conflicts between the syllabus on the one hand and broader educational objectives on the other,

   e) ability to work fruitfully with teacher candidates and with children,

   f) sensitivity to the cultural context of the learning situation,

   g) ability to improvise teaching equipment,

   h) knowledge of and ability to apply learning principles,

   i) ability to accept change or innovation,

   j) ability to evaluate and make decisions about the learning situation,

k) ability to make a critical appraisal of one's self and reflect on readings or conversation.

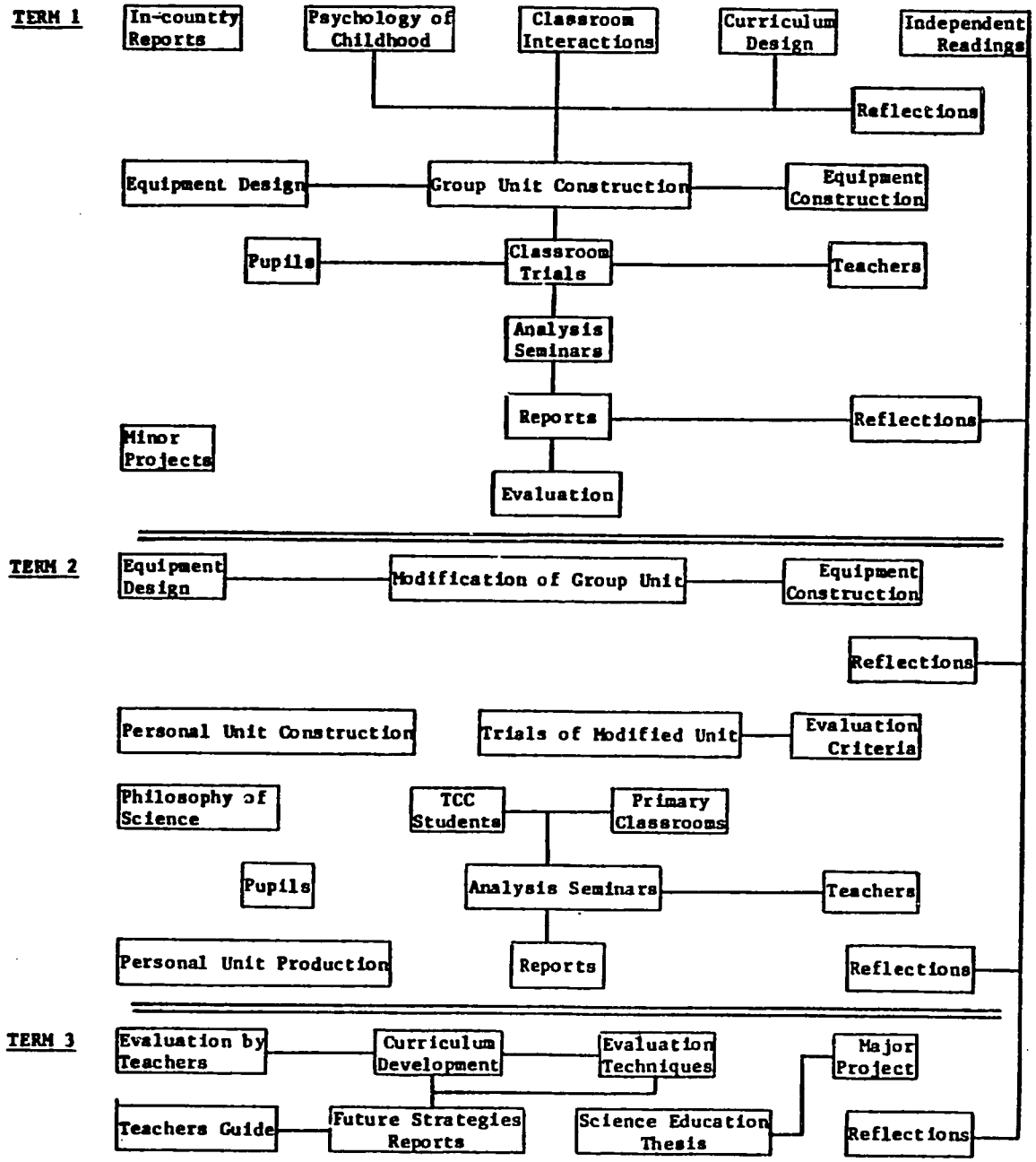
To train the type of teacher educator with the characteristics outlined in these objectives, there was a need to depart radically from existing teacher education models. The programme had to be exploratory, flexible and integrated and thus could not be grafted onto existing models.

The Programme Model of Operation

The programme is a truly original approach to the education of teacher educators. The education of teacher educators, the problem to which this programme addresses itself, has been given little or no consideration in most institutions of higher education. In some countries this problem has been of concern but it has been attacked by training trainers in the same way as training actual classroom teachers. A new approach to the training of trainers of teachers was long overdue. This SEPA programme has therefore made a frontal attack on a basic problem plaguing African educational systems.

The operational chart on p. 148 represents the translation of the designed programme, and its description illustrates procedures followed in executing it.

This operational representation of the programme makes one skeptical about the difference between this and any other conventional programme.


TERM 1
In-country Reports
Psychology of Childhood
Classroom Interactions
Curriculum Design
Independent Readings
Reflections
Equipment Design
Group Unit Construction
Equipment Construction
Pupils
Classroom Trials
Teachers
Analysis Seminars
Reports
Reflections
Minor Projects
Evaluation
TERM 2
Equipment Design
Modification of Group Unit
Equipment Construction
Reflections
Personal Unit Construction
Trials of Modified Unit
Evaluation Criteria
Philosophy of Science
TCC Students
Primary Classrooms
Pupils
Analysis Seminars
Teachers
Personal Unit Production
Reports
Reflections
TERM 3
Evaluation by Teachers
Curriculum Development
Evaluation Techniques
Major Project
Teachers Guide
Future Strategies Reports
Science Education Thesis
Reflections

However, in practice, activities in the programme demonstrate a vigorous pattern of operation quite different from those of the established classroom interactions in other teacher education programmes. The activities integrate courses in and focus on the professional development of the participants in relation to their expected roles. The emphasis is on the acquisition of the competencies described above and thereby make the programme performance-oriented.

Materials, services and resources are cited as aids for the accomplishment of various tasks. The responsibility for tapping these resources rests squarely with the participants. Participants are reminded of the roles of resource people *as* resource people, not lecture-givers. The absence of formalised systematic lectures and the total involvement and responsibility of the learner in his own learning make the programme unique and highly innovative.

All group discussions are conducted through seminars which form the cornerstone of the course. There are two types of seminars. One is intended as an exchange of ideas on experiences encountered through readings or activities undertaken by participants or resource people. These discussions usually generate or highlight problems that become the target, and engage individuals in the search for solutions.

This problem-solving approach used in training at this level is new and would be expected to be used by participants in their jobs.

The other type of seminar is intended to receive reports from participants on their reflections based upon experiences and activities

undertaken. Each student presents a short narrative of an experience that brings into focus the context within which the experience emanated, and abstracts from the narrative an idea which is restructured or appraised to give meaning to the experience. The uniqueness of this exercise makes it a difficult concept for participants to grasp easily. However, once understood, the practice becomes a powerful tool for self-analysis and accommodation of new ideas into the individual's repertoire of thinking.

Reflections have many uses for participants and resource people. They:

1. Help participants and resource people to assess the changes taking place in each individual's thinking as he progresses from stage to stage in the programme.
2. Force participants to be analytical and sensitive to each other's problems.
3. Provide a forum for reopening previously discussed issues that had not become completely crystallised into the thinking of a participant.
4. Help participants to receive feedback from each other and so formulate better thought processes.

Good reflections are characterised by sensitivity, which is the willingness on the part of an individual to expose to the group his innermost feelings about his problems as well as willingness to receive comments from peers. In the three years of the programme, the reflection approach has been found to be an essential strategy in bringing about attitudinal changes.

The seminar approach, with its problem-solving activities, is the basic medium of interaction between participants and resource people. Our

choice of this mode of interaction is predicated on experience that the quality and type of pre-service educational transactions and encounters determines the career style of teacher candidates. If the transactions are characterised by lecturing, so will the new teachers lecture when they become teachers. If, however, the trainers (and subsequent teachers they train) themselves "learn by doing" they are able to impart this way of learning to children.

Effective science teaching demands more than just content mastery. Integrated with this is an understanding of the ingredients that make for good classroom interactions. Many teacher educators recognise the dichotomy between content and method as the pitfall of teacher education programmes, but like the proverbial "weather" everybody talks about it, but nobody does anything. This programme is a bold attempt to confront the issue of dichotomisation in the education of teacher educators.

Our model in the above description suggests the synthesis believed to be necessary in order to professionalise teacher training, and provide appropriate preparation of primary school teachers. We have learned from our years of implementing this programme that career education demands a good balance of career-related ingredients proceeding from the concrete and tangible to the abstract and intangible.

During the implementation of this programme issues have been raised in the form of questions as follows:

- What kinds of educational experiences should teacher educators be exposed to that will equip them with capabilities in contrast to dichotomisation?

- Should they be the kinds of experiences that teacher candidate and teachers are expected to afford pupils in primary classes?
- Should they be experiences that enable them to perceive the world as children perceive it?
- How do we handle the fundamental difference in thought processes and in levels of maturity?
- What will be the conceptual level of the transactions involving the science component?
- How should the experiences relate to the nature of science?

These questions express the major concerns of the programme: their solutions become the basis for modifications in our operations. Practical experiences to which trainees are exposed include a two-tier classroom interaction at the primary and teacher training levels; the actual development of environmentally based instructional units; and the design and construction of teaching equipment.

Program Description

1. Post-graduate Diploma in Science Education.
   a) Admission qualification: Degree in Science and intention to teach in Primary Teacher Training College.
   b) Duration of Course: 9 months.
2. Certificate in Science Education.
   a) Admission qualification:
      i) Completion of Secondary Education or Equivalent.
      ii) Professional Qualification e.g. T.C.
      iii) Three years of primary teacher experience.
   b) Duration of Course: 9 months.

Courses

1st Term

Science Education	-	(Study of Major Problems in Science Education in developing countries)	2 credit hrs.
Curriculum Development	-	(Basic principles of curriculum construction)	3 credit hrs.
Psychology of Learning	-	(Relating with children)	2 credit hrs.
Environmental Approach to Science Teaching			3 credit hrs.
Seminars			2 credit hrs.
			12

2nd Term

Philosophy of Science	-	(Nature of Science)	2 credit hrs.
Educational Psychology	-	(Theory of classroom Interaction)	2 credit hrs.
Educational Psychology	-	(Evaluation of Teaching and Learning)	2 credit hrs.
Advanced Environmental Approach to Science Teaching			3 credit hrs.
Seminars and Independent Study			3 credit hrs.
			12

3rd Term

Inservice Education	- (Techniques of conducting Workshops)	2 credit hrs.
Material Construction	- (Techniques of developing aids for Science Teaching)	3 credit hrs.
Thesis		6 credit hrs.
		11

Total = 35 credit hrs.

COURSE DESCRIPTION

Problems in Science Education

An examination of Science and Science Teaching in developing country. The significance of Science in relation to learning about one's environment and preparing teachers to teach science by utilising pupils background, interests and environment.

Curriculum Development

Study of principles of curriculum development. Examination of available curriculum materials. Construction and utilisation of appropriate materials for the African environment.

Environmental Approach to Science Teaching

General methods of utilising local materials and conditions in teaching science. Problems in the environment associated with pollution of the natural environment and due to increased use of technology. Conservation of the local environment.

Nature of Science

Science as a method of finding out about the environment, a way of doing and learning. Social and educational implications of science in the African context. Science in the African culture.

Educational Psychology

Concept formation in the child. Theory of Classroom Interaction. Evaluation of the Teaching-Learning process.

Inservice Education

Necessity for re-training of teachers. Problems associated with re-training of teachers. Psychology of adult learning. Techniques of conducting Workshops. Human and institutional resources for inservice programming.

Materials Construction

Developing skills in teachers for making equipment using heavy machines and hand tools. Improvisation of tools for school use. Construction of different categories of school apparatus.

Request for Information

Requests for further information regarding these courses should be addressed to:

The Executive Secretary
Science Education Programme for Africa
P. O. Box 9169 Airport
Accra/Ghana

or

The Director
Science Curriculum Development Centre
Njala University College
University of Sierra Leone
Private Mail Bag
Freetown/Sierra Leone

APPENDIX 2

INTERNATIONAL CENTRE FOR EDUCATIONAL EVALUATION (ICEE)

INSTITUTE OF EDUCATION
UNIVERSITY OF IBADAN

A REPORT OF THE FIRST SEVEN YEARS (1971 - 1978)

Preface

This is the first comprehensive report on the International Centre for Educational Evaluation (ICEE) since its inception in 1972. The report covers effectively the period 1972-1979 but it does include the admissions for the 1979-80 Session.

The Science Education Programme for Africa (SEPA) was instrumental in creating the ICEE and thus it is appropriate that a report of the ICEE should be included in the SEPA Review.

E. A. Yoloye

I. HISTORICAL BACKGROUND

The antecedents of the ICEE may be traced back to efforts to evaluate the African Primary Science Program (APSP) -- a curriculum development programme sponsored by the Education Development Center (EDC) from the United States of America from 1965 to 1975. In a report of the evaluation presented by the Coordinator of Evaluation for APSP in November 1971, attention was drawn to the following three major constraints to the evaluation exercise:

(i) non-availability of appropriate evaluation instruments,

(ii) shortage of qualified manpower in the field of educational evaluation,

(iii) inadequate communication.

To combat these problems he recommended:

(a) intensive research,

(b) vigorous training programmes and

(c) a communication network between curriculum workers.

The solution to the first two problems was envisaged in the establishment of a centre for training and research in evaluation that would serve African countries. The urgency of setting up such a Centre was apparent since the newly independent countries of Africa were seriously grappling with the task of evolving new and truly relevant systems of educational development.

Accordingly, informal discussions took place among Dr. Hubert Dyasi, the newly appointed executive Secretary of SEPA (which had succeeded the

APSP); Dr. E. Ayotunde Yoloye who had coordinated the APSP evaluation efforts and Dr. Fritz Mosher of the Carnegie Corporation of New York. With the active encouragement of Dr. Mosher, Dyasi and Yoloye had formal discussions with the officials of Carnegie Corporation in New York in November 1971, specifically Hugh Stackpole and Fritz Mosher. The outcome of the discussion was that SEPA presented a formal proposal to Carnegie for the establishment of a Centre for Educational Evaluation at the University of Ibadan.

In recognition of the considerable planning, testing and experimentation that would need to preceed the establishment of the proposed centre, Carnegie Corporation "granted SEPA $92,000 in early 1972 to enable it to establish a one-year experimental effort at Ibadan, led by Yoloye." (Murphy, 1976)

SEPA made a formal approach to the University of Ibadan and with the cooperation of Professor J. A. Majasan, the then Director of the Institute of Education, the trial year of the Centre was launched in September 1972 as a project of the Institute of Education.

Functions

The functions of the Centre were three

1. The Training of evaluators
2. Research (with emphasis on evaluation techniques and instruments)
3. Contractual evaluation of specific educational projects

The Trial Year

The first two functions were embarked upon in the trial year. Fifteen students from six African countries (Ethiopia, Ghana, Liberia, Nigeria, Kenya and Sierra Leone) were brought to Ibadan for an intensive three-month course in educational evaluation from September to December 1972. Several academic staff of the Institute and the Faculty of Education were also funded to carry out specific research in relevant areas of education. The students were actively involved in the research.

During the year the necessary machinery for securing the endorsement of the University, the National University Council (NUC) and the Federal Government (through the Ministries of Economic Planning, and Education) was set in motion. By early 1973, the full acceptance by all four parties to house the Centre in the University of Ibadan had been obtained. Meanwhile Dyasi had generated widespread interest in the Centre in the SEPA member countries. Mosher paid a visit to the Centre just before the first set of trainees departed for home, to assess the progress of the project. On the bases of this and other assessments as well as the valuable experiences gained during the experimental year a two pronged proposal (by SEPA and University of Ibadan) was presented to Carnegie in March 1973 for the [illegible] $600,000 to establish the Centre as follows:

(a) $400,000 to the University of Ibadan for sta[illegible] research, fellowships to Nigerian trainees, follow up [illegible] and the cost of bringing one distinguished Scholar a year for about

10 weeks to interact with the staff and students of the Centre for a period of three years.

(b) $200,000 to SEPA for fellowships to trainees from outside Nigeria, workshops, and similar follow up activities.

The University of Ibadan in its proposal had indicated that it would assume the basic costs of the Centre after three to five years of its inception when its viability might have been established. Appendix 6 shows the financial contributions which have been made by various bodies to the ICEE.

The Permanent Centre

The Centre was formally established in September 1973 and embarked upon all of its stated three functions. Staff were recruited and equipment was bought and in spite of some teething problems, the Centre took off reasonably smoothly. The one year experimental period had proved most useful.

In 1976 after three years of operation, a report was submitted to the University Development committee on the progress of the Centre. As a result, the University thereafter took over all the basic costs of running the Centre as indicated in the proposal. All through these early years, experimentation continued with all three functions and the programmes underwent modification from year to year. A period of consolidation may however be said to have begun in the 1977/78 session when the programme of training became confined to the three higher degree programmes of M.Ed., M.Phil and Ph.D. As of now, we can regard the Centre as being firmly established, and its influence felt not only in Africa but in various other parts of the world.

II. TRAINING

The training programmes have been of two kinds

(a) The Regular Programmes and (b) Short Courses.

Regular Programmes

The regular programmes have undergone substantial change both in duration and content between 1972 and 1979. During the trial year and the first year of the permanent centre, trainees were brought in only for three months of intensive work at the end of which they were given certificates of satisfactory attendance. It had been envisaged that the Centre would run two kinds of regular courses — a short one of three months and a long one of nine months. By 1974/75 session the short course was abandoned in favour of the nine-month course leading to the *Postgraduate Diploma in Educational Evaluation.* Three main reasons were responsible for this decision:

1. Three months was far too short to impart sufficient depth in evaluation techniques to the kind of trainees available for the course.

2. The trainees would feel happier with a University Diploma which could be recognised by their governments for advancement in their jobs. A Certificate of attendance brought no such recognition.

3. With a three month programme, the trainees were not accepted as regular University students and so could not be accomodated in the student hostels. Accomodation therefore became a major problem and expensive hotel accommodations had to be used.

The nine-month postgraduate Diploma was run for each of three years. Feedback from graduates of the Programme however indicated that they

were often called upon on return home to take on jobs requiring sophisticated research skills for which the Diploma had not adequately prepared them. It was therefore clear that the minimum qualification that would serve the high level needs of the countries would be a Calendar year Masters programme with at least three months devoted to field research. The Centre therefore drew up three programmes which provide for research training and evaluation skills at fairly high levels of sophistication.

1. M.Ed. (12 months)

2. M.Phil (2 academic sessions)

3. Ph.D. (3 academic sessions)

Provision was made in the regulations such that those who had earned the Postgraduate Diploma could return for one year to obtain the M.Phil. So far two such Diploma holders have returned to continue their studies.

Geographical Distribution of Trainees

Trainees have so far come from 17 different Countries, 16 of them in Africa.

Table 1 shows details of the numbers from the various countries.

Sponsorship

Several agencies have sponsored students financially for the regular programmes namely:

(i) Science Education Programme for Africa (SEPA)

(ii) African Mathematics Programme (AMP)

TABLE 1

NUMBER OF ENROLLED – STUDENTS BY COUNTRY AND YEAR

Country	Year								
	'72-73	'73-74	'74-75	'75-76	'76-77	'77-78	'78-79	'79-80	Total
1. Botswana							1		1
2. Cameroun					1	1			2
3. Ethiopia	1							1	2
4. Ghana	2	2	1		2	1	2		10
5. Kenya	3				1	2	1	3	11
6. Lesotho				1			1	1	3
7. Liberia	1	1	2		1				4
8. Malawi					1	2		1	5
9. Nigeria	7	3	3	3	8	3	11	12	50
10. Sierra Leone	1	1	1		1	1	2	1	8
11. Somalia								1	1
12. South Africa					1				1
13. Swaziland				1			1		2
14. Tanzania		1		2	1	2	1	1	8
15. Uganda		2		2	2	2	1		9
16. Zambia			1		2	1		1	4
17. India						1	1	1	3
TOTAL	15	10	8	9	21	16	22	23	124

(iii) Carnegie

(iv) Ford Foundation

(v) The German Foundation for International Development (DSE) on behalf of the African Curriculum Organization (ACO)

(vi) The Anglophone West African Research Consortium (AWARERC) with funds from Ford.

(vii) Commonwealth Fund for Technical Cooperation (CFTC)

(viii) The German Academic Exchange Programme (DAAD)

In addition, in the last three years several students have come on private sponsorship by their parents, or employers. Makerere University, Kampala has sponsored two and Nigerian Ministries of education have sponsored quite a number.

Table 2 shows the number of students sponsored by different organisations. SEPA officially stopped sponsoring any more students with effect from the 1977/78 session on the grounds that ICEE had succeeded in attracting sponsorships from several other sources. (See also Appendix 1)

Table 3 shows the number of enrollments for the various programmes over the eight year period. (Also see Appendix 1)

TABLE 2

FINANCIAL SPONSORSHIP OF STUDENTS

	Year								
	'72-73	'73-74	'74-75	'75-76	'76-77	'77-78	'78-79	'79-80	Total
SEPA	10	5	4	6	3	4	–	–	32
African Math. Programme	5	–	–	–	–	–	–	–	5
Carnegie (through (ICEE)	–	3	3	1	5	1	1	1	15
FORD	–	2	1						3
DAAD								2	2
DSE/ACO					11	7	6	8	32
Makerere University						1			1
AWARERC/FORD							3	1	4
CFTC	–				1		1		2
PRIVATE				2	1	3	11	11	28
TOTAL	15	10	8	9	21	16	22	23	124

TABLE 3

NUMBER OF ENROLLED STUDENTS BY YEAR AND ACADEMIC PROGRAMME

Programme	Year								
	'72-73	'73-74	'74-75	'75-76	'76-77	'77-78	'78-79	'79-80	Total
Certificate of Attendance	15	10	–	–	–	–	–	–	25
Postgraduate Diploma in Educational Evaluation	–	–	8	9	21	–	–	–	38
M.Ed.	–	–	–	–	–	16	20	14	50
M.Phil	–	–	–	–	–	–	1	2	3
Ph.D.	–	–	–	–	–	–	2	6	8
TOTAL	15	10	8	9	21	16	23	22	124

Short Courses

Four major short courses (two regional and two national) have so far been organised.

1. Training course on *Techniques of data collection and analysis for curriculum development and evaluation*, in September 1976.

   This was run jointly with DSE for the African Curriculum Organisation. The duration was six weeks and 35 participants came from 14 African countries.

2. A regional advanced training course on *Educational Evaluation* in July/August 1977.

   This was run jointly with IIEP Paris for ministry nominees from 14 African countries and lasted 4 weeks.

3. A national training workshop for examiners of the Nigerian Joint Admissions and Matriculation Board (JAMB). Over 100 participants attended from all 13 Nigerian Universities. The course lasted one week in March 1979 and dealt with techniques of objective test construction.

4. An international training workshop for examiners of the Royal Society of Health, West Africa, in August 1979. It was attended by over 70 participants from three West African English speaking countries. The workshop dealt with the techniques of constructing and marking essay type tests.

Others

Individual members of staff of the ICEE have also participated in training programmes in other countries e.g.

E. A. Yoloye -- Asian Regional Training Course in Educational Evaluation, Bangkok, Thailand Oct/Nov 1978 (4 weeks)

S. T. Bajah -- Training programmes in

(i) Seychelles
(ii) Papua New Guinea
(iii) Cairo

W. Falayajo -- In Monrovia Liberia on behalf of AWARERC.

III. RESEARCH

Research in the Centre had a modest start with emphasis on individual research by staff and students. Some of the results of these pieces of research have been published in journals. (Appendix 2)

Several pieces are still in progress (Appendix 5). The M.Ed. theses of the students have also constituted some significant research outputs (Appendix 4).

In the last three years however, the ICEE has steadily moved into bigger institutional research largely through its membership of two international bodies.

(i) The International Association for Evaluation of Educational achievement (IEA)

(ii) The International Association for Educational Assessment (IAEA).

The current researches are:

IEA	(i)	Second Mathematics Survey (Now in its third year)
	(ii)	Classroom Environment Study
	(iii)	Item Banking project
IAEA	(i)	Trial of Test administration by Satellite.

Other projects in the area of mastery learning and Teacher Effectiveness are also being organised.

IV. EVALUATION OF PROJECTS

Five major Evaluations of educational projects have been *completed* viz.

1. The Namutamba Project in Uganda
2. The Bendel State Primary Science Project in Nigeria
3. The Teaching of Modern Mathematics in Mauritius
4. The Ife six year primary project in University of Ife Nigeria
5. The Trial of the Unesco Nutrition curriculum (see Appendix 3)

Two major Evaluation projects are currently *in progress*:

1. The Evaluation of the standards of the West African Examinations Council's (WAEC) O- and A-level examinations. (At the request of WAEC)
2. Evaluation of learning in a non-formal learning setting. (Part of an international project of the UNESCO Institute for Education in Hamburg)

Several *requests* for evaluation have been made on which action is expected to start soon, namely:

1. The development of Basic tests in Science and Mathematics. This request was made by UNESCO.
2. Development of Selection Tests for Nursing School Candidates (from Nigerian Nursing Council).
3. Evaluation of Curriculum materials developed by the Comparative Education Studies and Adaptation Centre (CESAC).
4. Evaluation of the Training Programme for Teachers of Health Sciences.

In trying to meet these numerous requests the small staff of the ICEE is stretched to its limits.

Table 4 shows the staffing position of the ICEE for the period 1972/73 to 1979/80.

V. VISITING SCHOLARS

Three distinguished scholars have participated in the ICEE programme as visiting scholars.

TABLE 4

ICEE STAFF BY YEAR

Category	Year							
	'72-73	'73-74	'74-75	'75-76	'76-77	'77-78	'78-79	'79-80
Professor		1	1	1	1	1	1	1
Senior Research Fellow					1	1	1	1
Research Fellow		1	2	2	3	3	3	3
Junior Research Fellow							1	1
Graduate Assistant/ Programme Officer		1	1	1	1			1
Accounts Officer		1	1	1	1	1	1	1
Technologist		1	1	1	1	1	1	1
Secretary IV			1	1	1	1		
Typists		1	2	2	2	2	2	2
Driver		1	1	1	1	1	1	1
Messenger			1	1	1	1	1	1
Total Academic		2	3	3	5	5	6	7
Total Admin. & Tech.		5	8	8	8	7	6	6
Grand Total		7	11	11	13	12	12	13

1. Professor Albert S. Thompson -- Teachers College
Columbia University
New York
1974/75 session

2. Professor Harold Cook -- Teachers College
Columbia University
New York
1975/76 session

3. Dr. K. B. Quansah -- University of Cape Coast
Ghana
1976/77 session

VI. INTERNATIONAL AFFILIATIONS

The ICEE is a member of two international organisations. These are: (i) The IEA and (ii) the IAEA. The Centre has benefitted tremendously from these international contacts particularly in the area of research.

Perhaps the most significant contribution of ICEE in promoting internationalism in educational development is that it was instrumental in the formation of the *African Curriculum Organisation (ACO)* which came into existence in 1976 and now has a membership of 20 countries. The ICEE hosted and had substantial financial input into the planning meeting and the inauguration meeting of the ACO. The Centre acted as coordinating secretariat. Since its inception, the ACO secretariat has, with the consent of the University of Ibadan, been housed in the ICEE.

In turn the ICEE has benefitted from the formation of ACO. In the past three years, the DSE and ACO have sponsored a greater number of students than any other sponsoring body, to the ICEE M.Ed. Courses.

VII. PUBLICATIONS AND DISSEMINATION

A significant step forward in dissemination efforts was taken in 1979 with the publication of the first number of the ICEE newsletter *"Evaluation in Africa."* The newsletter has been favourably received in many quarters. It is hoped that this is only a beginning in the dissemination efforts of ICEE.

VIII. PROBLEMS

Three basic problems have constituted great constraints to the work of the Centre.

(i) Shortage of physical facilities.

(ii) Inadequate accommodation for students.

(iii) Shortage of academic staff.

IX. PROSPECTS

As mentioned earlier, the ICEE may now be said to be in a consolidation phase. Consolidation, however, also involves some expansion. As a result of widespread demand, the ICEE envisages four significant lines of development namely:

1. Expansion of the scope of work beyond just evaluation to embrace other areas of research and curriculum development.
2. Increasing emphasis on institutional research.
3. Increasing emphasis on publications and dissemination.
4. Strengthening the now existing network of evaluators throughout Africa through joint research, joint workshops, and joint training programmes.

X. CONCLUSION

By and large one can be confident that the ICEE has come to stay. It will need continued regional and international support to thrive. We are hopeful that this will be forth-coming.

NOTE

For details of this program, see Appendices 1 through 6 of the separately published report of the ICEE (available from the SEPA secretariat).

Appendix 1: List of Students by Country Sponsorship and Academic Programme

Appendix 2: List of Published Research Articles

Appendix 3: List of Evaluation Reports

Appendix 4: List of M.Ed. Research Projects

Appendix 5: List of Ongoing Research (Grants given by ICEE)

Appendix 6: Financial Contributions

REFERENCES

Murphy E. J. *Creative Philanthropy: Carnegie Corporation and Africa 1953-1973*. New York: Teachers College Press. 1976.

Yoloye E. A. *Evaluation for Innovation: African Primary Science Program Evaluation Report*. Ibadan: Ibadan University Press. 1978.